CRADLE TO CRADLE CERTIFIED®

THE PRODUCT QUALITY STANDARD FOR THE CIRCULAR ECONOMY

A PROGRAM OF

CRADLE TO CRADLE PRODUCTS INNOVATION INSTITUTE

OVERVIEW PREPARED BY

MBDC

08/31/2021

TABLE OF CONTENTS

CRADLE TO CRADLE CERTIFIED® RESOURCES

Standards, guidance and methodologies supporting the Cradle to Cradle Certified® Products Program

MATERIAL HEALTH ASSESSMENT METHODOLOGIES

Material Health methodologies are used to assign assessment ratings to chemicals and materials in a product applying for certification

OTHER ASSESSMENT METHODOLOGIES

Other methodologies required for use in the assessment of products for certification

info@mbdc.com

www.mbdc.com
700 East Jefferson St.
Charlottesville, VA 22902

Last updated August 2021

GET CRADLE TO CRADLE CERTIFIED®

WORK WITH MBDC

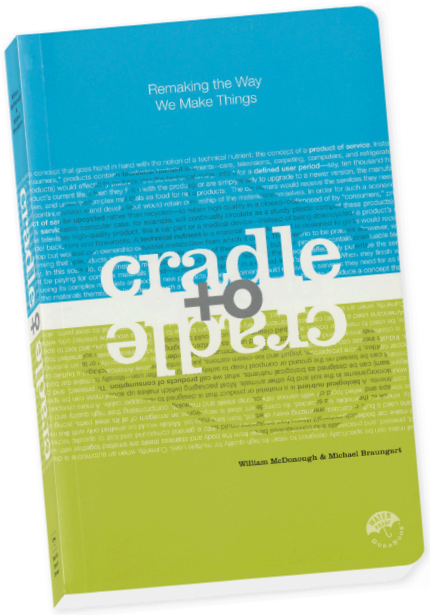
The creators and foremost implementers of the Cradle to Cradle Certified® Products Program

Our goal is a delightfully diverse, safe, healthy and just world, with clean air, water, soil and power – economically, equitably, ecologically and elegantly enjoyed.

[1]This goal statement was created while writing *The Upcycle: Beyond Sustainability—Designing for Abundance*, William McDonough and Michael Braungart, published in 2013 by North Point Press, a division of Farrar, Straus & Giroux.

Remaking the Way We Make Things

In their 2002 book ***Cradle to Cradle: Remaking the Way We Make Things***, architect William McDonough and chemist Michael Braungart presented an integration of design and science that provides enduring benefits for society from safe materials, water and energy in circular economies and eliminates the concept of waste.



Waste Equals Food
Use Current Solar Income
Respect Diversity

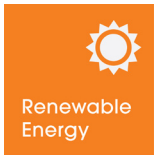
MBDC can help you create
a world of **More Good**

Cradle to Cradle Certified® Products Program

We created Cradle to Cradle Certified® to be the world's most comprehensive product assessment and certification system based on:

MATERIAL HEALTH
safe, healthy, biological and technical nutrients

CIRCULAR ECONOMY: MATERIAL REUTILIZATION
Circular, sharing and shared



RENEWABLE ENERGY & CARBON MANAGEMENT
Clean and renewable

WATER STEWARDSHIP
Clean and available

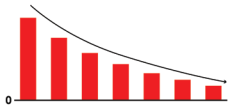
SOCIAL FAIRNESS
Safe, creative and dignified

In 2010, MBDC transferred an exclusive license for the certification program and methodology to the Cradle to Cradle Products Innovation Institute, co-founded by William McDonough and Michael Braungart. The Institute reviews product assessments conducted by assessors such as MBDC, and issues certifications as a third-party, not-for-profit organization.

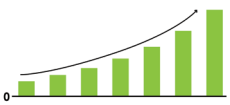
MBDC's Unique Approach to Innovation and Continuous Improvement

Products are often described as **goods**. We design and assess products to make sure they actually are.

The Upcycle Chart
Enables our clients to **1) inventory, 2) assess and then 3) optimize** products, processes and systems with positive intentions and beneficial goals.



Industry can do better than conventional, eco-efficient approaches which seek to reduce or minimize damage and typically portray reducing a negative footprint.



By adding eco-effective approaches and integrating positively defined goals based on Cradle to Cradle® values and principles, we are able to direct innovation in a coherent and positive trajectory.

put the **GOOD** back in **GOODS**

Cradle to Cradle Certified®, created by MBDC, is more than a recognized mark of product quality—it is a process that leads companies to make better products, better companies and better communities. It puts the Good back in Goods!

Read about MBDC's clients who have benefited **economically**, **environmentally** and **socially** with **Cradle to Cradle Certified®**

88% of the products Shaw manufactures are Cradle to Cradle Certified®

A Walk In The Garden
a collaboration with William McDonough

SHAW CONTRACT GROUP

Shaw's "We Want It Back" program results in a 10% savings from storing raw materials on customers' floor for reclamation (perpetual assets).

SHAW CONTRACT GROUP, a Berkshire Hathaway Company, made the groundbreaking decision in 2002 to apply Cradle to Cradle Design™ principles and introduce PVC-free commercial carpet tiles designed to be separated into component materials for carpet-to-carpet recycling. Each tile is labeled with a toll-free number that customers can call to have used tiles picked up for recycling. Shaw worked with McDonough and MBDC to assess the human and environmental health attributes of all ingredients and identify preferred substitutes, as needed.

ACHIEVEMENTS

In 2003, Shaw Industries and MBDC received the inaugural Presidential Green Chemistry Challenge Award from the White House and the U.S. EPA for its EcoWorx® backing.

Currently, nearly 90% of the products Shaw manufactures are Cradle to Cradle Certified® and have undergone a rigorous material health assessment, including residential and commercial carpet, carpet tile and hardwood flooring.

Shaw Industries moved to #1 in the U.S. market share for carpet tile and is now the world's largest carpet company.

Mirra® Chair ©Herman Miller, Inc.

HERMAN MILLER

100% of Herman Miller's electrical energy is from renewable resources.

"Bill McDonough had the drive, vision, and connections to make this protocol a standard across all industries. Also, McDonough was willing to put together resources for the implementation of his vision, therefore ensuring that C2C would be more than just a nice idea on paper. Finally, the 'virtuous closed loops' concept that is behind C2C enabled businesses to move beyond the traditional 'be less bad' to the 'consumption is good' paradigm. C2C is a godsend to business!"

—Mark Schurman, Senior Vice President of Supply Chain Management, Herman Miller

HERMAN MILLER'S dedication to doing more good extends beyond their adoption of Cradle to Cradle Certified® to their "Greenhouse " Factory and Offices in Holland, Michigan designed by William McDonough + Partners. To fully incorporate Cradle to Cradle Design™ into their practices and Design for the Environment guidelines, together we built a customized assessment tool that analyzed materials for their human health and ecological effects, recyclability and design for disassembly.

ACHIEVEMENTS

The first product designed from the beginning to end under the Cradle to Cradle Design protocol was the Mirra chair which - during implementation - led to the training of more than 300 employees. The chair was the first engineered product to use the Cradle to Cradle protocol and received considerable attention from customers who sought out environmentally sustainable products. The resulting protocol, employee engagement and product has led to Herman Miller further expanding their Cradle to Cradle product portfolio and securing brand recognition as a firm deeply involved in sustainability.


CERTIFIED
cradle to cradle
SILVER
Carol's Daughter
Born in Brooklyn. Made with Love.
new
GODDESS STRENGTH
strength & length system
1 Use= 15X Stronger Hair*
FORTIFYING SHAMPOO
FOR WEAK, BREAKAGE-PRONE HAIR
NO Sulfates, Parabens, Artificial Colors
with castor oil, ginger, black cumin seed
11.0 fl oz / 325 ml
Carol's Daughter
orn in Brooklyn. Made with Love.
new
GODDESS STRENGTH
strength & length system
1 Use= 15X Stronger Hair*
FORTIFYING CONDITIONER
FOR WEAK, BREAKAGE-PRONE HAIR
NO Parabens, Petrolatum, Mineral Oil, Artificial Colors
with castor oil, ginger, black cumin seed
11.0 fl oz / 325 ml

L'ORÉAL CAROL'S DAUGHTER

Available on Amazon under its 'Climate Pledge Friendly' badge

"From formulation to packaging and production, we're holding ourselves accountable to our sustainability goals across all of the brands within our portfolio," said Azoulay. "Cradle to Cradle certifications demonstrate our commitment to pushing the boundaries of sustainable product innovation throughout our value chain."

— Danielle Azoulay, Head of CSR and Sustainability, L'Oréal USA

Products are identified as biological nutrients with a strategy in place to attain Gold level

Both the shampoo and conditioner source from **renewable** and **biodegradable ingredients**

The products' manufacturing facility is powered by **100% renewable electricity**

All process chemicals in effluent which are related to the shampoo and conditioner have been **assessed with a strategy in place for optimization**

Completed a **social fairness screen for all tier one suppliers** and a UN Global Compact self assessment of management, human rights, labor, environment and anti-corruption practices


CERTIFIED
cradle to cradle
SILVER
CERTIFIED
cradle to cradle
BRONZE
APEX PLAZA
NET-POSITIVE ENERGY | MASS TIMBER
Designed by William McDonough + Partners
Charlottesville, VA | Under Construction

NORDIC STRUCTURES

First in North America to achieve Cradle to Cradle Certified® Silver and Bronze for Mass Timber products

NORDIC STRUCTURES, achieved the world's first Cradle to Cradle Silver certification for their Nordic X-Lam and Bronze for their Nordic Lam and Lam+. The X-Lam met Gold qualifications in several categories, including Material Reutilization, confirming its circular potential.

William McDonough + Partners facilitated the relationship as part of a commitment to safe, healthy and circular building materials. WM+P's design for HITT Contracting's Co|Lab, the first Mass Timber building in Virginia, utilizes both Nordic Lam and X-Lam panels. Nordic's products were also quickly identified for use in Apex Plaza, which will be the tallest Mass Timber building on the East Coast.

HITT CO|LAB
NET-POSITIVE ENERGY
MASS TIMBER
Falls Church, VA | Completed 2019


CERTIFIED
cradle to cradle
SILVER
HENRY ROSE
HENRY ROSE
HENRY ROSE
HENRY ROSE
HENRY ROSE

HENRY ROSE + IFF

First 100% transparent fine fragrance

"I set out to see if it was possible to develop a line of fine fragrances providing you don't need to sacrifice quality and sophistication for safety. And we did it!" *—Michelle Pfeiffer, Founder, Henry Rose*

"This collaboration between Cradle to Cradle [chemists at MBDC], the Environmental Working Group is unprecedented. Not only have we broken new ground with our product — the first fine fragrance that is 100 percent transparent with its ingredients — but environmentalists and the fragrance industry were able to reach across the aisle to work together towards a common goal: creating a product that is safer for humans and the planet." *—Melina Polly, CEO, Henry Rose*

Fragrance achieved Platinum level due to being free of molecules likely to cause allergic reactions as well as any ingredients on the Cradle to Cradle banned list

Henry Rose is created to **safely biodegrade in natural systems**, while bottles are made from **90% recycled glass**, which is also recyclable, alongside compostable caps

IFF carbon reduction strategy focuses on increasing the amount of renewable energy purchased including working to procure more than **75% of electricity from clean, renewable sources** by 2025

IFF **reduced water use in manufacturing processes by 66%** between 2010 and 2018

Henry Rose **donated a portion of proceeds to farming families** in Haiti as part of a partnership with Heifer International


CERTIFIED
cradle to cradle
BRONZE
intertape polymer group®
ipg
555e

IPG

First certified recyclable carton sealing tape that is repuplable with the corrugate it is applied to

"Achieving the first Cradle to Cradle Certification® for WAT and the Western Michigan University OCC Equivalency certification for our non-reinforced WAT, in each case provide our e-commerce customers evidence that these products are made for a circular economy." *—Greg Yull, President and CEO of IPG*

Material Health — BRONZE

IPG committed to using the Cradle to Cradle Certified® Material Health protocol to assess their products and to **eliminate chemicals of concern**

Circular Economy — BRONZE

Certified water-activated tape can be **recycled and/or use recycled materials** in its production

Renewable Energy — BRONZE

Achieves energy goals by implementing **continuous improvement programs and employee training initiatives** across the entire organization

Water Stewardship — BRONZE

IPG's Manufacturing department was audited to ensure that its **water usage has minimal impact on the environment**

Social Fairness — SILVER

IPG is **accountable to all stakeholders** within the company and the communities where they conduct business


CERTIFIED
cradle to cradle
GOLD

C&A

Real-life example of how rigorously sustainable clothing that can return to nature and can also be accessibly priced.

"What we really need is other brands to go down the same path and to recognize that Cradle to Cradle Certification® is really one of the most well-thought-through, holistic, third-party, peer-reviewed standards for the circular economy."

—Jeffrey Hogue, Global Chief Sustainability Officer, C&A

Achieved Platinum level - the **highest level in the Cradle to Cradle Certified® Products Program**.

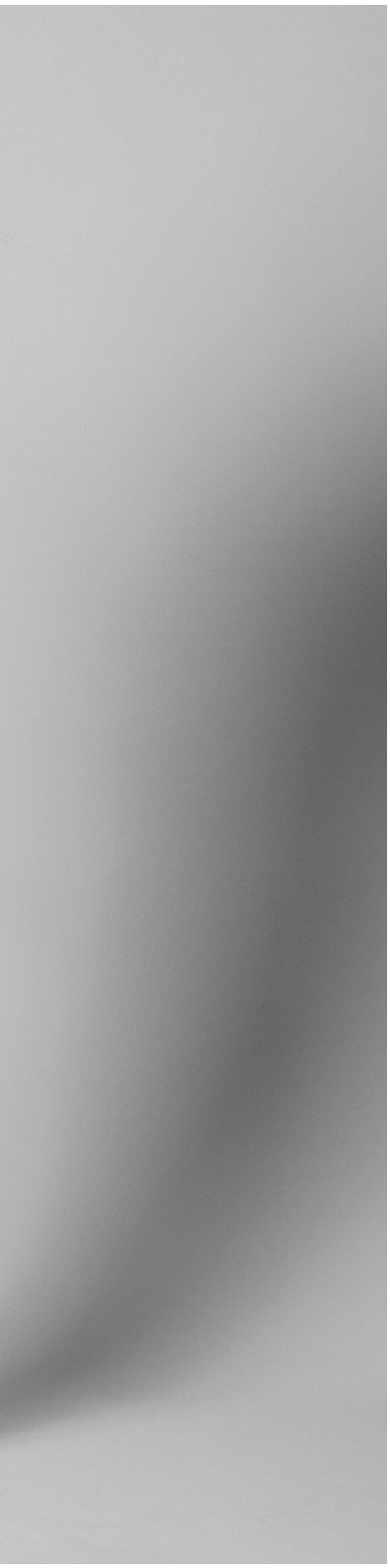
T-shirts are **recyclable** and can be **composted** - returned to healthy soil in about 12 weeks - at the end of their useful lives.

C&A purchased **offsets for 50% of purchased electricity and CO2 emissions** related to the t-shirt production.

All effluent is filtered. The only water imported from the local watershed is for drinking and utility purposes, as well as to compensate for process losses.

Both factories where the t-shirts are produced have impressive and **innovative social fairness initiatives and projects**.

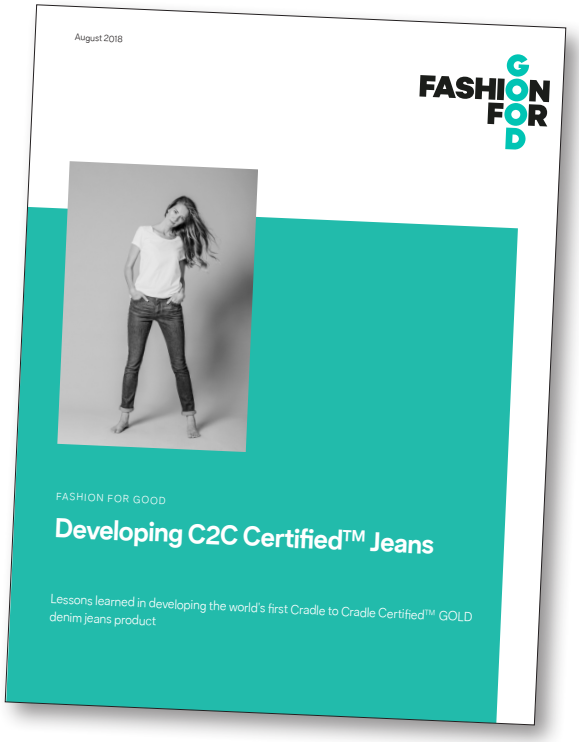

CERTIFIED
cradle to cradle
GOLD
wear the change



C&A

First Cradle to Cradle Certified® Gold jeans.

MBDC worked closely with C&A, their supply chain, Fashion for Good and other assessors – Eco Intelligent Growth (EIG) and EPEA Switzerland – to address challenges in designing such a complex product. The process included evaluating and optimizing the garment for human and environmental health, recyclability and biodegradability, renewable energy use and carbon management, water stewardship and social fairness.



Designed in partnership with Fashion for Good, an open-source initiative co-founded by William McDonough, that supports the transformation of apparel culture toward a circular economy, C&A's new Cradle to Cradle Certified® denim garment release is accompanied by the toolkit *Developing Cradle to Cradle Certified® Jeans*. This toolkit includes concrete solutions on how to approach complex products and projects,such as jeans, which contain multiple technical and biological nutrient components (from thread to zipper) to reach product certification at the Gold level.


HENRY ROSE


change
C&A


ALCOA


Steelcase


L'ORÉAL
REDKEN
REDKEN
extreme
extreme


Shaw


ecovative


HermanMiller


SUNPOWER®

Join this community of innovative companies and become the products of choice for numerous environmentally preferred purchasing programs and consumers

Start on **your path** to **Cradle to Cradle Certified®** with MBDC

MBDC is Where You Start on Your Path to Cradle to Cradle Certified®

MBDC has decades of experience working throughout the supply chain to collect formulations and evaluate product and manufacturing data to meet the requirements. MBDC supports and advises clients throughout the entire process.

1 ENGAGE MBDC TO REVIEW AND ASSESS YOUR BILL OF MATERIALS FOR CERTIFICATION REQUIREMENTS

Conduct initial analysis to determine if it is within the scope of certification

Cross-reference ingredients with the Banned Chemicals List

Determine if there is a commitment to continuous improvement

Conclude if your product meets the eligibility requirements in the Cradle to Cradle Certified® Product Standard

2 MBDC ASSESSES YOUR PRODUCT AGAINST THE PRODUCT STANDARD CRITERIA

Work with you and your supply chain to collect data

Evaluate data against the Product Standard criteria

Partner with you to develop optimization strategies

3 MBDC SUBMITS AN ASSESSMENT SUMMARY REPORT TO THE CRADLE TO CRADLE PRODUCTS INNOVATION INSTITUTE FOR FINAL REVIEW AND CERTIFICATION

The Institute provides independent verification of assessment and issues certificate

4 MBDC WORKS WITH YOU TO CONTINUOUSLY IMPROVE

Every two years, we work with you and your supply chain to gather new data for re-certification

Evaluate data and progress on optimization strategies for continuous improvement

RECOGNITION FOR CRADLE TO CRADLE CERTIFIED®

Selected as a preferred product certification by several of the world's largest retailers.

When brand-name retailers take a stand for safer, sustainable products, industry takes note. By adopting Cradle to Cradle as a third-party, multi-attribute certification and as a design framework, companies are not only empowering customers to make informed choices, but also encouraging their peers to adopt similar values.

SEPTEMBER 23, 2020

Amazon features Cradle to Cradle Certified® as part of their 'Climate Pledge Friendly' badge to make it easier for customers to discover and shop for sustainable products

Jeff Bezos and William McDonough were quoted in Amazon's September 23, 2020 press release:

"Amazon's new program will expand our reach and enable us to empower more brands to deliver safer and more sustainable products for the circular economy." –William McDonough

Amazon, as part of its 'Climate Pledge Friendly," badge, empowers customers to find and purchase products that are Cradle to Cradle Certified® and recognizes the standard as a leading certification for sustainable products.

Through the company's Commitment to Sustainable Chemistry, Walmart encourages the use of Cradle to Cradle Certified® Silver and above products.

Walgreens/Boots Alliance is working to enable consumers to make informed choices by by encouraging suppliers to obtain credible certifications such as Cradle to Cradle Certified®, and to make it easy for consumers to find these more sustainable products.

The Home Depot Eco Options program allows suppliers to use Cradle to Cradle Certified® and the Material Health Certificate from the Cradle to Cradle Products Innovation Institute at an achievement level of Silver or higher in the material health category to qualify for their program.

CRADLE TO CRADLE CERTIFIED®
PRODUCT STANDARD
V4.0

cradle to cradle products innovation institute

CRADLE TO CRADLE CERTIFIED® VERSION4.0

Product Standard

COPYRIGHT

TRADEMARK

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

Table of Contents

Table of Contents

Table of Contents

Foreword

The Cradle to Cradle Products Innovation Institute (C2CPII) is an independent, nonprofit organization dedicated to maximizing the positive impacts of products and materials. As the standard setting and certification body for the Cradle to Cradle Certified® Product Standard, C2CPII works closely with leading organizations worldwide to guide and validate their efforts to apply the principles of material health, product circularity, clean air and climate protection, water and soil stewardship, and social fairness to product design and manufacturing. The standard provides designers, manufacturers, and suppliers with a framework for continually improving what products are made of and how they are made. Cradle to Cradle Certified is a respected mark of products and materials made for the circular economy.

Version 4.0 was released on 16 March 2021.

The effective date of Version 4.0 is 1 July 2021. Products certified to Version 3.1 are required to certify to Version 4.0 by 30 June 2024.

The official language of the Cradle to Cradle Certified Products Program is English and this standard document is to be considered the official language version.

Further information about C2CPII and the Cradle to Cradle Certified Product Standard is available at www.c2ccertified.org.

Inquiries regarding C2CPII and the Cradle to Cradle Certified Product Standard may be directed to info@c2ccertified.org.

Acknowledgements

The Cradle to Cradle Products Innovation Institute (C2CPII) would like to thank the extraordinary group of individuals that contributed their time and expertise to the development of Version 4.0 of the Cradle to Cradle Certified Product Standard. C2CPII developed the new standard through a multi-stakeholder process informed by a diverse group of stakeholders, including technical subject matter experts, leading manufacturers, independent assessors, and other market representatives. C2CPII is especially grateful to current and past members of the C2CPII Standards Steering Committee (formerly Certifications Standard Board), who led the development of the new standard in collaboration with C2CPII staff, as well as the numerous volunteers that served on the Technical Advisory Groups, Stakeholder Advisory Council, and the Cosmetics & Personal Care User Group RSL Task Team. C2CPII is also especially appreciative of the companies that participated in the Version 4.0 Pilot Program, whose leadership and input directly informed the requirements in the final version of the standard.

A complete list of key C2CPII staff contributors and volunteers who served on the C2CPII committees during the development of the Cradle to Cradle Certified® Product Standard Version 4.0 are listed in the Appendix.

The Water & Soil Stewardship and Social Fairness requirement frameworks were developed with financial support from the Laudes Foundation.

1 // Introduction

1.1 History and Background

In 2005, MBDC created the Cradle to Cradle Certified Products Program to acknowledge the high levels of sustainability achieved by its clients in developing products based on Cradle to Cradle® design principles, and to inspire others to optimize their products and "rethink the way they make things." MBDC released Version 1.0 of the Cradle to Cradle Certified Product Standard in 2005 and Version 2.0 in 2008.

In 2010, William McDonough and Dr. Michael Braungart created the Cradle to Cradle Products Innovation Institute (C2CPII), a 501(c)(3) nonprofit organization, to scale Cradle to Cradle certification globally. In 2012, C2CPII took over administration of the Cradle to Cradle Certified Products Program from MBDC and began to independently certify products. Following the release of Version 3.0 of the standard, which was developed by MBDC and launched by C2CPII in January 2013, C2CPII took over development and maintenance of the Cradle to Cradle Certified Product Standard. C2CPII is now established as a fully independent nonprofit organization with ownership of the Cradle to Cradle Certified Products Program and exclusive authority over the development of the standard and the administration of certification. The founders continue to serve as nonvoting, honorary advisors to the C2CPII Standards Steering Committee.

1.2 Standard Development

Since its launch in 2005, the Cradle to Cradle Certified Product Standard has been evolving to address a greater understanding of the environmental and human health impacts of the design, manufacturing, use, reuse, and disposal of materials, advances in best practices and technology, and its application to a wider variety of product and material types. Ongoing improvements to the standard are developed by C2CPII staff, volunteer committees, and external subject matter experts under the direction of the C2CPII Standards Steering Committee, as detailed in the Process for Development of the Cradle to Cradle Certified Product Standard. Updates to the standard requirements and development of new versions of the standard are subject to review and approval by the C2CPII Standards Steering Committee under the supervision of the C2CPII Board of Directors. The development process is based on principles of transparency, openness, and inclusiveness.

The Cradle to Cradle Certified Product Standard will be updated on a regular development cycle. The C2CPII Standards Steering Committee will review the need for standard revisions at least every three years and will make recommendations to the C2CPII Board of Directors on a proposed scope and timeline for updating the standard based on the analysis of certification adoption/achievement data, available science, and market trends. The next review will take place in 2024.

1.3 Cradle to Cradle Certified Product Standard Version 4.0

The vision of C2CPII is a world where safe materials and products are designed and manufactured in a prosperous, circular economy to maximize health and well-being for people and planet. C2CPII's mission is to lead, inspire, and enable all stakeholders across the global economy to create and use innovative products and materials that positively impact people and planet.

1.3.1 Standard Requirement Categories

The standard requirements are based on the Cradle to Cradle® design principles outlined in William McDonough and Michael Braungart's 2002 book, Cradle to Cradle: Remaking the Way We Make Things, and provide guidance in five key categories. These requirement categories and their intended outcomes are listed below.

Material Health – Chemicals and materials used in the product are selected to prioritize the protection of human health and the environment, generating a positive impact on the quality of materials available for future use and cycling.

Product Circularity – Products are intentionally designed for their next use and are actively cycled in their intended cycling pathway(s).

Clean Air & Climate Protection – Product manufacturing results in a positive impact on air quality, the renewable energy supply, and the balance of climate changing greenhouse gases.

Water & Soil Stewardship – Water and soil are treated as precious and shared resources. Watersheds and soil ecosystems are protected, and clean water and healthy soils are available to people and all other organisms.

Social Fairness – Companies are committed to upholding human rights and applying fair and equitable business practices.

1.3.2 Certification Requirements and Levels

The Cradle to Cradle Certified Products Program is based on the concept of continuous improvement and, thus, there are four possible levels of achievement within each of the standard's five key requirement categories: Bronze, Silver, Gold, and Platinum. To reach a desired achievement level within each category, the product must meet all of the requirements for that level, in addition to the requirements at all lower levels.

Certification is awarded to a product when it meets the requirements for the desired achievement level in each of the five key categories (Sections 4-8), as well as the general requirements (Section 3), the packaging requirements (Section 9, if applicable), and the animal welfare requirements (Section 10, if applicable). The product's overall certification level is equal to the lowest level achieved in the five categories (Bronze, Silver, Gold, or Platinum).

The product's certification level is stated on the Cradle to Cradle certificate, and the certification level, along with a scorecard indicating the level achieved in each of the five categories, is stated in the Cradle to Cradle Certified Products Registry on the C2CPII website (www.c2ccertified.org).

Note: Some requirements in the standard address activities that are also subject to regulation by local, state, or federal authorities. However, nothing contained in the Cradle to Cradle Certified Product Standard changes legal regulatory requirements or prescribes how compliance is to be achieved. Demonstration of compliance with certain key regulations is required in some sections of the standard, but this in no way changes the underlying regulatory requirements.

1.3.3 Restrictions to Bronze Level Certification

At the Bronze level, a product is starting out on the path to Cradle to Cradle certification. A company must conduct an inventory of the materials used to make the product, energy use, water and soil stewardship,

and social fairness issues affecting their industry and production region. The company must also define optimization strategies and take initial steps toward the development of circular products and responsible manufacturing practices. The Bronze level of certification is designed to recognize a company's intent to improve the way their product is made, establishing a commitment to ongoing assessment and optimization.

As such, a product may be certified at the Bronze level for a maximum of four years (i.e., two, two-year certification cycles), and must recertify at the Silver level or higher once the second, two-year Bronze certification has expired or it will be delisted from the program. Alternatively, in cases where technical, performance, or market barriers prevent the achievement of the Silver level in any standard category, the product may be recertified at the Bronze level if:

1. The applicant publicly discloses an explanation of the limitation(s) preventing achievement of the Silver level requirements,
2. On-going measurable improvement is achieved (see Section 3.3), and
3. The product meets the Silver achievement level in at least one other category by the end of the fourth year of Bronze level certification (i.e., the expiration date of the second two-year certification).

1.4 Standard Supporting Documents

C2CPII develops and maintains documents to support implementation of the Cradle to Cradle Certified Product Standard, including User Guidance, Material Health assessment methodologies, and other standard reference documents. These documents are meant to educate and provide the necessary information for the certification community to have a robust understanding of the standard. These supporting documents are regularly updated to reflect the improvements made to the standard. All standard supporting documents are available on the C2CPII website at www.c2ccertified.org.

2 // Product Eligibility

2.1 Products Eligible for Certification

The Cradle to Cradle Certified® Products Program applies to products. For certification purposes, a "product" is defined as any physical item that can be routinely and individually purchased from the certification applicant by other entities. This definition includes materials, sub-assemblies, and finished products.

Please see the Cradle to Cradle Certified Products Registry on the C2CPII website for a complete listing of all currently certified products. To determine the eligibility for a product type that is not currently certified, please contact C2CPII before submitting a certification application or beginning a product assessment. C2CPII reserves the right to refuse to certify a product type for which the standard is not currently designed to certify, or is determined to not align with C2C principles in its sole discretion.

For a list of product types that are not eligible for certification, see the Cradle to Cradle Certified Version 4.0 User Guidance.

2.2 Products Not Eligible for the Bronze Achievement Level in Material Health

Children's products, cosmetics, and personal care products are not eligible for certification at the Bronze achievement level in the Material Health category (i.e., they must meet the Silver achievement level requirements or higher in Material Health). The intent is to ensure they do not contain carcinogens, mutagens, or reproductive toxicants (CMRs); persistent, bioaccumulative, and toxic substances (PBTs); very persistent and very bioaccumulative substances (vPvBs); or substances that cause an equivalent level of concern.

2.3 Products Not Eligible for the Bronze or Silver Achievement Level in Product Circularity

Eligible single-use plastic products and plastic packaging products (when certified as a separate product) are not eligible for certification at the Bronze or Silver achievement level in the Product Circularity category (i.e., they must meet the Gold or Platinum achievement level requirements in Product Circularity). The intent is to ensure alignment with the Cradle to Cradle principles for these typically non-circular product types. An exemption is made for plastic packaging that is part of a refill/reuse system (e.g., soap refill pouches), which may be certified at any achievement level in the Product Circularity category.

3 // General Requirements

3.1 Certification Compliance Assurance

Intended Outcome(s)

A compliance assurance system is in place to ensure the certification requirements are met at all times.

Applicable Achievement Level(s)

Bronze

Requirement(s)

A documented certification compliance assurance system is in place.

The certification applicant/holder company must have a documented certification compliance assurance system in place that includes:

1. Designated staff responsible for maintaining the integrity of certified product(s) as defined by the standard.
2. A process for controlling for changes pertinent to the certification and notifying the certification body when relevant changes are planned or otherwise identified. Pertinent changes include, but are not limited to, changes to certified product names or group names, and the list of specific product variations included in or excluded from a certified group.
3. A method of staying informed about and/or controlling for material changes that may occur in the supply chain. One of the following is required:
    a. Suppliers must be required to communicate any proposed changes to the manufacturing process or to intentional product inputs that may alter the chemical composition of the product, or other aspects relevant to certification (e.g., recycled content), to the certification holder. When there are multiple supply chain tiers, suppliers must communicate this requirement to their own suppliers.
    b. All suppliers that provided chemical composition data, or other product relevant data (e.g., amount of recycled content), for the prior certification must be contacted again prior to renewal and asked to provide updated data or to confirm that no relevant changes were made by them or their (sub-)suppliers.
4. Management system best practices including:
    a. A document control process,
    b. Internal self-audits conducted at regular planned intervals (at least once each certification cycle), and
    c. A corrective action process.

3.2 Environmental Policy and Management

Intent

Companies are committed to protecting the environment and are responsibly managing potential environmental impacts.

Requirements Summary

Bronze	Environmental risks are assessed for the final manufacturing stage and for the product.
	An environmental policy based on the environmental risks associated with the final manufacturing stage and the product is in place.
	A strategy is developed for implementing the policy at all final manufacturing stage facilities. At recertification, progress toward achieving the strategy is measured.
	Company executives demonstrate commitment and support for establishing and maintaining a culture for achieving high levels of environmental performance.
Silver	Management systems are in place that support the implementation and oversight of the policy at final manufacturing stage facilities.
Gold	Responsible sourcing management systems are in place that support the implementation and oversight of the environmental policy within the product's supply chain.
Platinum	Environmental objectives are incorporated into relevant employee performance evaluations, and incentives are provided to encourage top management and employees to actively participate in achieving the company's environmental goals.

3.2.1 Assessing Environmental Risks and Opportunities

Intended Outcome(s)

Environmental risks and opportunities relevant to the company and product are examined and understood.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Identify environmental risks and opportunities for all final manufacturing stage facilities and for the certified product.

The risk and opportunity assessment must include:

1. Identification of environmental risks associated with processes occurring at final manufacturing stage facilities, countries in which the final manufacturing stage facilities are located, the product's supply chain, product use, and product end of use.

   The following issues are de facto high-risk in the noted scenarios:

   a. Greenhouse gas emissions and contribution to climate change are high-risk issues for:
      i. Final manufacturing stage facilities with combined total scope 1 and 2 greenhouse gas emissions ≥ 10,000 metric tons CO2e/year.
      ii. Products requiring energy during the use phase (unless the product saves more energy than it uses).
   b. Air pollution is a high-risk issue for:
      i. Final manufacturing stage facilities with on-site combustion power plants (including biomass combustion).
      ii. Final manufacturing stage facilities at which processes commonly known to be air pollutant

intense take place. This includes (but is not limited to): Smelting metals, refining oil, producing cement, using high volumes of organic solvents, and incinerating waste.

c. Water availability is a high-risk issue for:
    i. Final manufacturing stage facilities purchasing and/or withdrawing ≥ 100,000 m3 of freshwater per year when located in medium to high stress location(s) (as defined per the Water & Soil Stewardship requirements).
    ii. Products requiring high volumes of water during the use phase.
d. Water and/or soil quality (i.e., pollution) are high-risk issues for:
    i. Final manufacturing stage facilities with pollutant intense processes (defined per the Water & Soil Stewardship requirements).
    ii. Final manufacturing stage facilities for which stormwater discharge is regulated per the corresponding regional regulatory permitting system. In regions where stormwater is not regulated, any facility within the specific categories of industrial activity that must be covered under the U.S. National Pollutant Discharge Elimination System is de facto high-risk for this issue.
    iii. Products that are primary contributors to microfiber and microplastic pollution (i.e., textile and apparel products made from synthetic fibers that are wet processed and/or that require washing with water during the use phase, tires, and plastic pellets).
e. Waste generation is a high-risk issue for:
    i. Final manufacturing stage facilities for which hazardous waste is regulated per the corresponding regional regulatory permitting system. In regions where hazardous waste is not regulated, any facility producing waste that is listed or characterized as hazardous waste as defined by the European Union's Waste Framework Directive and associated List of Waste or the U.S. Environmental Protection Agency is de facto high-risk for this issue.

2. Identification of best practices employed to address the risks.
3. Information regarding the impact and importance of identified risks.
4. Prioritization of the risks and opportunities identified.

3.2.2 Environmental Policy

Intended Outcome(s)

The company has formally committed to protecting the environment through company policy approved at the executive level.

Applicable Achievement Level(s)

Bronze

Requirement(s)

For the applicant company OR for all final manufacturing stage companies, commit to protecting the environment through company policy.

The policy or policies must:

1. Establish expectations for final manufacturing stage facilities, the product's supply chain, and other relevant stakeholders.
2. Include the company's commitment to address any high-risk environmental issues identified via the risk assessment, including any de facto high-risk issues. (If no high-risk issues were identified, the policy may address environmental protection in a general way.)
3. Define staff responsibilities for implementation.
4. Be formally approved and signed by a duly empowered officer of the applicant company or by the board of directors.

3.2.3 Strategy for Environmental Policy Implementation

Intended Outcome(s)

Environmental performance data are regularly analyzed to ensure manufacturing processes are not having a negative impact on the environment and to measure progress toward environmental performance goals.

Applicable Achievement Level(s)

Bronze

Requirement(s)

For the applicant company OR for all final manufacturing stage companies, develop a strategy for implementing the environmental policy at all final manufacturing stage facilities and report on implementation progress at each recertification.

The strategy must:

1. Address priority risks and opportunities (per Section 3.2.2).
2. Include specific time-bound performance and impact objectives to guide decision-making.
3. Define the scope of implementation.
4. Define the company's human, technical, and material resource allocation for implementation.

For recertification, environmental performance data must be collected and analyzed to measure progress toward achieving environmental targets and objectives, and areas for improvement must be identified. For any identified areas of poor performance, methods of improving outcomes must also be identified and evaluated and the strategy refined accordingly.

3.2.4 Demonstrating Commitment

Intended Outcome(s)

A culture that prioritizes environmental protection is established, promoted, and improved by company leadership.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Demonstrate commitment and support for establishing and maintaining a culture whereby employees and business partners are able to achieve high levels of environmental performance.

The applicant's leadership team (i.e., C-level executive and/or Board of Directors) must demonstrate commitment and support by:

1. Communicating the company's environmental aspirations and strategy for protecting the environment internally and/or externally.
2. Defining a position to actively lead on protecting the environment, oversee implementation of the strategy, and drive continuous improvement efforts.
3. Ensuring there are defined procedures for escalating environmental risks and identified impacts to the executive team.

3.2.5 Environmental Management Systems

Intended Outcome(s)

An environmental performance management system is in place, ensuring that environmental performance of the applicant company and product is improved over time.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: For the final manufacturing stage facility, implement a management system that supports achievement of the environmental policy commitments within facility operations.

Gold level: For the applicant company OR for all final manufacturing stage companies, implement a responsible sourcing management system that supports achievement of the environmental policy commitments within the product's supply chain.

For the Silver level, the management system must include the following elements:

1. Designated staff with environmental compliance responsibilities.
2. Designated oversight function and process.
3. Procedures that support implementation of the environmental policy at all final manufacturing stage facilities.
4. Education for staff with environment-related duties on environmental best practices relevant to the facilities.
5. Procedures to measure and evaluate activities against the environmental policy.
6. Policies and procedures for the prompt implementation of corrective and preventive actions.

For the Gold level, the responsible sourcing management system must include the following elements:

1. Designated staff with responsible sourcing responsibilities.
2. Designated oversight function and process.

3. Procedures to communicate to suppliers the company's environmental policy and any associated sourcing business processes.
4. Supplier contractual requirements for environmental policy compliance and monitoring (e.g., supplier codes of conduct if defined as a contractual term). Contracts must require suppliers to extend environmental compliance expectations to their suppliers.
5. Evaluation of new suppliers prior to the awarding of contracts to determine if the supplier can meet requirements.
6. Policies and procedures for the prompt implementation of corrective and preventive actions.
7. Education for sourcing and/or procurement team(s) on responsible sourcing best practices.
8. Business procedures for identifying and documenting the cause and resolution of environmental issues and/or impacts in the supply chain.

For recertification at the Silver or Gold level, the policy, procedures, practices and/or programs must be reviewed to identify deficiencies and implement changes (if needed) that will lead to improved performance. Remedial activities (if needed) must be underway and seek to identify and address root causes. (Note: This applies to the company-level management system at the Silver level and also to the responsible sourcing management system at the Gold level.)

3.2.6 Environmental Protection Incentives

Intended Outcome(s)

Company management is motivated to take action to protect the environment as relevant to company operations.

Applicable Achievement Level(s)

Platinum

Requirement(s)

For the applicant company OR for all final manufacturing stage companies, incorporate environmental performance results into relevant employee and executive performance evaluations and incentive structures.

The following are required:

1. Performance assessments of any executives or employees with designated environmental responsibilities must include consideration of metrics derived from the environmental policy and strategy.
2. Environmental performance results must be considered in compensation packages / incentive plans for top company executives and management with environmental management or oversight functions (i.e., from C-suite executives to business unit and functional heads).

3.3 Measurable Improvement

Intended Outcome(s)

What a product is made of and how it is made is measurably improved until the product achieves at least the Gold level requirements in all five Cradle to Cradle Certified key categories. While the Gold level reflects high

achievement, reaching the Platinum level in all categories is the ultimate goal.

Applicable Achievement Level(s)

Bronze and Silver

Requirement(s)

At recertification, demonstrate that at least one measurable improvement has been made in at least one of the five program categories since the prior certification.

The measurable improvement required is *in addition to* any actions already required in individual program categories (e.g., progress on strategies and optimization plans).

4 // Material Health Requirements

Category Intent

Chemicals and materials used in the product are selected to prioritize the protection of human health and the environment, generating a positive impact on the quality of materials available for future use and cycling.

Requirements Summary

To achieve a desired level within the category, the requirements at all lower levels must also be met.

Bronze	Product is in compliance with the Restricted Substances List.
	Product does not contain organohalogen substances of special concern, or functionally-related, non-halogenated classes of equivalent concern, above relevant thresholds.
	Product is 100% characterized by generic material.
	Product is ≥ 75% assessed (complete formulation information collected for 100% of materials released directly into the biosphere).
	Strategy developed to phase-out or optimize all x-assessed or grey-rated chemicals.
Silver	Product is ≥ 95% assessed (complete formulation information collected for 100% of materials released directly into the biosphere).
	Product does not contain materials with > 1% carbon-bonded halogens by weight, or recognized PBTs or vPvBs. Product does not contain EU CLP Cat.1 and 2 CMRs or substances causing an equivalent level of concern, or exposure is unlikely or expected to be negligible.
	Product has low VOC emissions (required for products permanently installed in buildings).
	Product complies with VOC content limits (required for liquid and aerosol consumer and construction products).
Gold	100% of homogeneous materials subject to review are assessed (i.e., none have a grey rating due to insufficient data).
	Product is optimized for material health (i.e., all x-assessed chemicals replaced or phased out).
	Strategy developed to either increase the percentage of preferred (A/a and/or B/b assessed) materials and chemicals in the product or optimize the chemistry in the supply chain.
	Product has very low VOC emissions or is inherently non-emitting (required for products permanently installed in buildings).
Platinum	All product relevant process chemicals are assessed (i.e., none have a grey rating due to insufficient data) and no x-assessed chemicals are used.
	> 50% of the product by weight is assessed as A/a or B/b.
	≥ 75% of the product's input materials or chemicals have a C2CPII Material Health Certificate at the Gold or Platinum level or ≥ 50% of the product's input materials or chemicals are Cradle to Cradle Certified at the Gold or Platinum level or equivalent. A strategy is developed to increase percentages over time. OR Environmental health impact hotspot analysis based on life cycle assessment completed, emissions and resource use hotspots that impact human and environmental health are identified, and material health optimization strategy is developed based on the results.

4.1 Restricted Substances List Compliance

Intended Outcome(s)

In alignment with leading regulations that aim to protect human health and the environment, the use of well-known toxic chemicals in the product is avoided.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Comply with the Restricted Substances List (RSL).

The product and its homogeneous materials comply with relevant restrictions on the Restricted Substances List (see *Cradle to Cradle Certified® Restricted Substances List* reference document). Note: The RSL consists of a core list, which is applicable to all material and product types, as well as additional lists that are applicable to specific material and product types. Unless noted otherwise, the lists indicate the maximum allowable concentration of each restricted substance in any homogeneous material subject to review (as defined in Section 4.3) in a certified product.

For textile chemical formulations, the product also complies with the most recent version of the Zero Discharge of Hazardous Chemicals (ZDHC) Manufacturing Restricted Substances List (MRSL) or equivalent.

4.2 Avoidance of Organohalogens and Functionally Related Chemical Classes of Concern

Intended Outcome(s)

Organohalogens, a class of substances associated with toxicity concerns in multiple use-cycle stages, are progressively avoided, beginning with high organohalogen content materials, classes of special concern, and functionally related, non-halogenated classes of equivalent concern (e.g., organophosphate ester flame retardants being used in lieu of halogenated flame retardants).

Applicable Achievement Level(s)

Bronze, Silver, Gold

Requirement(s)

Bronze level: Use materials that are not and do not contain organohalogen substances of special concern, or functionally related, non-halogenated substances of equivalent concern, above relevant thresholds (i.e., per- and polyfluoroalkyl substances (PFASs), halogenated flame retardants (HFRs) and organophosphate ester flame retardants (OPFRs), halogenated polymers, halogenated organic solvents, and other highly halogenated, carbon-based materials). Certain exemptions apply.

Silver level: Use materials in the product that do not contain organohalogen substances in exceedance of 1% by weight. Certain exemptions apply.

Gold level: Use materials in the product that do not contain organohalogen substances above subject to review limits (i.e., 100 ppm or lower if specific concentration limits are defined).

The percentage of organohalogen substances within a homogeneous material is equal to the percentage by weight of all carbon-bonded halogen atoms (Cl, Br, F, and I) within the material.

For the Bronze level, the applicable restrictions for organohalogen substances of special concern are:

1. PFASs: Per- or polyfluoroalkyl substances are defined as fluorinated organic chemicals containing at least one fully fluorinated carbon atom. PFAS-based materials, including fluoropolymers and PFAS-coatings, are not permitted for use (except in exempt materials/parts as noted below). If present as an impurity or minor additive in an otherwise non-fluorinated organic material, carbon-bonded fluorine within PFASs in the material must be < 1,000 ppm of the homogeneous material by weight.
2. HFRs: Halogenated flame retardants are defined as any chlorinated or brominated substance added to a material for the purpose of increasing heat/fire resistance or decreasing flammability. In addition to the restrictions on specific HFRs on the RSL, carbon-bonded chlorine and bromine within any flame retardant in the material (intentionally added or present as an impurity) must be < 1,000 ppm of the homogeneous material by weight (except in exempt materials/parts as noted below).
3. OPFRs: Organophosphate ester flame retardants are defined as any organic esters of phosphoric acid, containing either alkyl chains or aryl groups, that are added to a material for the purpose of increasing heat/fire resistance or decreasing flammability. In addition to the restriction(s) on specific OPFRs on the RSL (e.g., TCEP), OPFR content (intentionally added or present as an impurity) must be < 1,000 ppm of the homogeneous material by weight (except in exempt materials/parts as noted below).
4. Halogenated polymers, halogenated organic solvents, and other highly halogenated, carbon-based materials: Any material containing a sum total of 10% or more of carbon-bonded fluorine, chlorine, and/or bromine by weight is considered a highly halogenated carbon-based material and is thus not permitted for use (except in exempt materials/parts as noted below).

Exemptions

For the Bronze and Silver levels, a homogeneous material may be exempt from meeting this requirement if any of the following conditions are met:

1. It is present at < 1% of the finished product by weight. Materials that are surface coatings applied to foodservice ware or textiles, including apparel, carpets, and furnishings do not qualify for this exemption.
2. It is contained in a part that is < 1% of the finished product by weight.
3. The use of a halogenated organic substance or functionally related chemical of concern in the material is required to meet regulatory requirements (e.g., fire standards). To claim this exemption the following conditions must be met:
    a. alternative methods of meeting the regulatory requirement must not exist, and
    b. the applicant must conduct ongoing research into alternative ways of complying with the regulation without the use of the substance or other x-assessed substance.

Exemptions 1 and 2 may be claimed for homogeneous materials that in sum make up no more than 5% by weight of the finished product. No exemptions may be claimed to meet the Gold level requirement.

4.3 Material and Chemical Inventory

Intended Outcome(s)

An increasing percentage of the product's material and chemical composition is known so that possible risks the materials and chemicals may pose to human health and the environment can be assessed and strategies for using safer chemistry can be developed.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirement(s)

Bronze level: Characterize all homogeneous materials in the product by concentration and generic material type or category/name. In addition, fully define the chemical composition of products that are released directly into the biosphere as part of their intended use (e.g., soaps, paints). For other product types, collect the chemical composition information necessary to assess at least 75% of the product.

Silver level: Fully define the chemical composition of products released directly into the biosphere as part of their intended use (e.g., soaps, paints). For other product types, collect the chemical composition information necessary to assess at least 95% of the product.

Gold level: Fully define the chemical composition of all homogeneous materials within the product.

Platinum level: Fully define the chemical composition of all process chemistry that comes into contact with the product or its material constituents during the final manufacturing stage.

Characterizing Materials in the Product

The concentration of each material as a percentage of the total product weight must be determined.

Fully Defining the Chemical Composition of Materials

Toxicological assessment of a material requires full material disclosure from the supplier(s)/formulator(s) controlling the chemical composition of the material. A homogeneous material is considered fully defined when the chemical names and chemical identifiers are known for all chemicals subject to review. The chemicals subject to review in each homogeneous material are those present at a concentration ≥ 0.01% (100 ppm), with the following exceptions:

1. If a limit below 100 ppm is indicated for a specific substance by the Restricted Substances List, the lower limit applies.
2. If a specific concentration limit (SCL) for any toxicity endpoint of a substance is below 100 ppm as indicated by the Table of Harmonized Entries in Annex VI to the Classification, Labelling, and Packaging of Substances and Mixtures regulation, the lower limit applies.
3. Exemption: A product may contain a maximum of 1% exempt components by weight. The exemption is allowed for minor, commodity type components including sewing thread and solid, preformed fasteners and bearings. Homogeneous materials and substances in these component types may be exempt from review if the following conditions are met:
    a. Metallic components are in compliance with the Restriction of Hazardous Substance (RoHS) directive.

   b. Non-metallic components are in compliance with the Restricted Substances List.
4. In any case where the relevant specialized assessment methodology (e.g., Recycled Content Materials Assessment Methodology, Geological Materials Assessment Methodology, Externally Managed Component Assessment Methodology) allows or requires a different method of defining materials, including different methods and/or limits for determining what chemicals are subject to review, the methods indicated by the relevant methodology document(s) take precedence.

Note: For the Bronze and Silver levels, the percentage assessed is calculated using the methodology in Section 4.4.

Fully Defining Process Chemistry

Process chemistry is considered fully defined when the chemical names and chemical identifiers are known for all process chemicals subject to review.

Process chemicals subject to review are those that are used as an intentional part of any of the processes included in the final manufacturing stage, including:

1. Pure chemical substances.
2. Chemical substances present in mixtures at a concentration ≥ 0.1% (1000 ppm) prior to any dilution at the manufacturing site(s). The exceptions listed above for materials apply (per #1-4 in the sub-section titled Fully Defining the Chemical Composition of Materials, with the default limit as 1000 ppm instead of 100 ppm). Additionally, for textile processing, the limits indicated by the Zero Discharge of Hazardous Chemical (ZDHC) Manufacturing Restricted Substances List (MRSL) take precedence if lower.

4.4 Assessing Chemicals and Materials

Intended Outcome(s)

To encourage continued improvement of material health, an increasing percentage of the product's chemicals and materials are assessed. By the time a product reaches the Gold level, all materials and chemicals subject to review within the product have been assessed as compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirement(s)

Bronze level: Assess at least 75% of the product.

Silver level: Assess at least 95% of the product.

Gold level: Assess 100% of the product.

Platinum level: Assess 100% of the product AND all process chemistry that comes into contact with the product or its material constituents during the final manufacturing stage.

Assessing Chemicals and Materials

Homogeneous materials and chemicals subject to review, including process chemistry subject to review at the

Platinum level, must be assessed according to the Material Health Assessment Methodology and supporting documents. Based on these methods, chemicals subject to review are assigned a, b, c, x, or grey chemical risk ratings and homogeneous materials are assigned A, B, C, X or GREY ratings.

A chemical substance is considered to be assessed when it has been assigned an a, b, c, or x (abc-x) chemical risk rating.

A homogeneous material is considered to be assessed when it has been assigned an A, B, C, or X (ABC-X) assessment rating or is otherwise considered to be assessed based on the specific, relevant methodology (e.g., recycled content assessment methodology, externally managed component methodology).

A material or component that is separately certified and used in another product seeking certification may count as assessed at the same Material Health level and percentage assessed at which it was certified. Materials assessed as A, B, or C may only contain chemicals subject to review that have been assigned a, b, or c chemical risk ratings. Materials assessed as X will contain at least one chemical subject to review that has been assigned an x risk rating, and may also contain chemicals with grey ratings indicating insufficient data for assessment.

Determining Percentage Assessed

The percentage of the product that is assessed must be determined as follows:

1. For each homogeneous material in a product the applicant must either:
    a. Count the entire material as assessed, by weight, if the material has received an A, B, C, or X (ABC-X) assessment rating. Or,
    b. Count the material as partially assessed based on assessed chemicals subject to review in the material. In this case, the percentage assessed for the material is equal to the lower of:
        i. the percentage by weight of all abc-x assessed chemicals within the material, and
        ii. the percentage by number of all abc-x assessed chemicals within the material.
2. For products consisting of a single homogeneous material, the percentage assessed must be calculated as per 1b above (1a is not allowed).
3. For products composed of two or more homogeneous materials, the percentage assessed is calculated as the weighted average of the percentages assessed for each homogeneous material subject to review in the product.

4.5 Material Health Optimization Strategy

Intended Outcome(s)

A strategy is in place for prioritizing the use of materials and chemicals known to be compatible with human and environmental health. Demonstrable progress is made toward achieving the strategy.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirement(s)

Develop a Material Health optimization strategy and demonstrate progress toward achieving the strategy at each recertification.

For the Bronze and Silver levels, the strategy must include a plan for assessing and optimizing or eliminating all X/x assessed and GREY/grey materials and chemicals subject to review. One or more material(s) or chemical(s) must be targeted for specific optimization actions in the near-term (defined as 0-2 years). Optimization work relevant to at least one material or chemical must have been completed during the two-year period between certification and recertification.

For the Gold and Platinum levels, the strategy must focus on:

1. Increasing the percentage of A/a and/or B/b assessed materials and chemicals in the product, or
2. Optimizing chemistry in the supply chain per Section 4.9.

4.6 Using Optimized Materials

Intended Outcome(s)

The product is made from chemicals and materials that have been intentionally selected based on their preferred safety attributes.

- At the Silver level, the product does not contain chemicals classified or listed as carcinogenic, mutagenic, or reproductive toxicants (CMRs), or, if these substances are present, exposure to them is unlikely or expected to be negligible. In addition, the product does not contain persistent, bioaccumulative, and toxic (PBTs) or very persistent and very bioaccumulative (vPvBs) substances. The product also does not contain substances that cause an equivalent level of concern or exposure to them is unlikely or expected to be negligible.
- At the Gold level, chemicals and materials intentionally added to the product are assessed as compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology. Exposure to hazardous chemicals during final manufacture, use, and end-of-use of the product is unlikely or expected to be negligible.
- At the Platinum level, an increased percentage of the product is made from chemicals and materials that are assessed as preferable for human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology. Additionally, process chemicals are assessed as compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology.

Applicable Achievement Level(s)

Silver, Gold, and Platinum

Requirement(s)

Silver level: Use materials in the product that do not contain substances that are:

- Classified or listed as known or suspected to cause cancer, birth defects, genetic damage, reproductive harm (CMRs), or cause an equivalent level of concern, unless exposure to these substances during the product's final manufacturing, use, and end-of-use is unlikely or expected to be negligible, or
- Listed as persistent, bioaccumulative, and toxic (PBTs) or very persistent and very bioaccumulative (vPvBs).

Gold level: Use materials that are assessed as compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology, including only A/a, B/b, and C/c assessed materials and chemicals in the product.

Platinum level: Use materials and process chemicals that are assessed as preferable for human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology, including > 50% A/a and B/b assessed materials and chemicals in the product (see "Determining Percentage Assessed" in Section 4.4), and only A/a, B/b, and C/c assessed process chemistry.

For the Silver level, CMRs are defined as substances that have received a harmonized classification of Category 1 or 2 in one or more of the CMR endpoints as listed within the EU's Classification, Labelling, and Packaging regulation (CLP) Annex VI, or are CMR substances listed on the REACH Candidate list of Substances of Very High Concern (SVHC) for Authorisation (including those on Annex XIV). PBTs, vPvBs, and substances causing an equivalent level of concern are defined per the REACH Candidate list of Substances of Very High Concern (SVHC) for Authorisation (including those on Annex XIV).

Determining Percentage A/a and B/b-assessed for Platinum level

The percentage of the product that is assessed must be determined as follows:

1. For each homogeneous material in a product the applicant must either:
    a. Count the entire material as assessed, by weight, if the material has received an A or B assessment rating. Or,
    b. Count the material as partially assessed based on assessed chemicals subject to review in the material. In this case, the percentage assessed for the material is equal to the lower of:
        i. the percentage by weight of all a or b assessed chemicals within the product, and
        ii. the percentage by number of all a or b assessed chemicals within the product.
2. For products consisting of a single homogeneous material, the percentage A/a- and B/b-assessed must be calculated as per 1b above (1a is not allowed).
3. For products composed of two or more homogeneous materials, the percentage A/a and B/b assessed is calculated as the weighted average of the percentages assessed for each homogeneous material subject to review in the product.

4.7 Volatile Organic Compound (VOC) Emissions

Intended Outcome(s)

Indoor air quality is protected.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Products designed for permanent indoor use comply with leading standards that demonstrate low VOC emissions.

Gold level: Products designed for permanent indoor use comply with leading standards that demonstrate

very low to no VOC emissions.

Products designed for permanent indoor use are products that are installed or placed into a building and remain there (e.g., this includes furniture, but not cleaning products).

To demonstrate fulfilment of this requirement, an applicant must show compliance of the product with the requirements of at least one regional set of best practices for qualifying low VOC emission products. Best practices are defined by the current versions of the leading green building certification systems or standards in a given region (such as BREEAM, DGNB, or LEED). See the *Cradle to Cradle Certified® Volatile Organic Compound Emissions Testing* reference document for a list of recognized standards for the Silver and Gold levels.

Test Report and Laboratory Accreditation Requirements

For the Silver and Gold levels, the following conditions must also be met:

1. Test report or certificate must refer to a test completed/performed no more than two years prior to the date of application, and
2. The analytical laboratory conducting the test must be ISO/IEC 17025 accredited and the accreditation scope must include the applied test method, either explicitly or implicitly within the scope of a flexible ISO/IEC 17025 accreditation for VOC product emission testing.

Exemption

Products made entirely from the following material types are exempt from VOC emissions testing and may be assumed to have low to no VOC emissions:

1. Materials classified as inherently non-emitting sources per the LEED v4 Building Design and Construction EQ Credit Low-Emitting Materials (stone, ceramics, powder-coated metals, plated metals or anodized metals, glass, concrete, clay brick, and unfinished/untreated solid wood) if they do not include integral organic-based surface coatings, binders, or sealants, and
2. Plaster and stucco that have < 1% organic additives.

Note: Unfinished/untreated wood (i.e., wood without organic-based surface coatings, binders, or sealants) can emit VOC and therefore it is not technically non-emitting. However, it is still exempt from this requirement in keeping with LEED v4 Building Design and Construction EQ Credit Low-Emitting Materials.

4.8 Volatile Organic Compound (VOC) Content

Intended Outcome(s)

Outdoor air quality and the health of product installers and users are protected.

Applicable Achievement Level(s)

Silver

Requirement(s)

For liquid, viscous, or aerosol consumer or construction products, limit volatile organic compound (VOC) content to low levels as established by leading standards.

To demonstrate fulfilment of this requirement, an applicant must show compliance of the product with the requirements of at least one regional set of best practices for qualifying low VOC content products. Best practices are defined by the current versions of the leading green building certification systems or standards in a given region (such as BREEAM, DGNB, or LEED). See the *Cradle to Cradle Certified® Volatile Organic Compound Content Limits* reference document for a list of recognized standards and test methods.

The following conditions must also be met:

1. Test reports or certificate (if applicable) must refer to a test performed within two years prior to the date of application, and
2. The analytical laboratory conducting the test (if applicable) must be ISO/IEC 17025 accredited and the accreditation scope must include the applied test method, either explicitly or implicitly within the scope of a flexible ISO/IEC 17025 accreditation for VOC product testing.

Exemptions

Products that are not covered by any of the standards or regulations listed in the *Cradle to Cradle Certified® Volatile Organic Compound Content Limits* reference document are exempt from this requirement.

Water-based consumer products are exempt from this requirement if the only organic substances with vapor pressure ≥ 0.1 mm Hg at 20°C that are subject to review are ethanol, isopropanol, or fragrances and legally mandated denaturants (e.g., 2-butanone for ethanol products).

4.9 Optimizing Chemistry in the Supply Chain

Intended Outcome(s)

The use and emissions of hazardous chemicals in the product's supply chain are reduced or eliminated over time.

Applicable Achievement Level(s)

Platinum

Requirement(s)

Address hazardous chemicals in the product supply chain and develop a strategy to further reduce hazardous chemical use and/or emissions in the supply chain. Demonstrate progress toward achieving reductions at each recertification.

Hazardous chemicals in the product supply chain must be addressed by meeting one of the following:

1. 75% or more of the product's input materials or chemicals have a C2CPII Material Health Certificate OR 50% or more are Cradle to Cradle Certified at the Gold or Platinum level or equivalent (percentage is calculated following the approach described for "Determining Percentage Assessed" in Section 4.4, but summing certified materials and/or chemicals rather than assessed materials and/or chemicals).
2. A cradle to cradle human and environmental health impact hot spot analysis has been performed based on life cycle assessment per ISO 14040, and each of the hot spots identified through this analysis are addressed by the strategy to reduce hazardous chemical use and/or emissions in the

supply chain of the product. The life cycle assessment must be verified by a qualified third party. Depending on how hazardous chemicals in the product supply chain are addressed, the strategy must include one of the following:

1. Steps to increase the percentage of the product's input materials or chemicals that have a C2CPII Material Health Certificate or are Cradle to Cradle Certified at the Gold or Platinum level (or equivalent) over time and also specifically to increase the percentage of inputs that are certified at the Platinum level.
2. Steps to positively impact (i.e., eliminate or reduce use or emissions of hazardous chemicals) for each of the supply chain hotspots identified through the life cycle assessment.

5 // Product Circularity Requirements

Category Intent

Products are intentionally designed for their next use and are actively cycled in their intended cycling pathway(s).

Requirements Summary

To achieve a desired level within the category, the requirements at all lower levels must also be met.

Bronze	Applicant is involved in a circularity education initiative to gain an understanding of relevant cycling infrastructure development.
	Intended cycling pathway(s) for the product and its materials are defined.
	A plan has been created to address challenges with the cycling infrastructure at the end of the product's first use; potential cycling partners have been identified.
	Select product and material types contain cycled and/or renewable content. Alternative: Limitations that prevent achievement of this requirement are publicly reported.
	≥ 50% of materials by weight are compatible with the intended cycling pathway(s) (i.e., recyclable, compostable, or biodegradable).
	Circularity data and cycling instructions are publicly available.
Silver	Partnerships for cycling (recovery and processing) of the product have been initiated. If the product is intended for cycling via municipal systems, materials are compatible with those systems.
	Percentage of cycled and/or renewable content, by weight, is equal to or higher than industry averages and/or is consistent with common practice. Alternative: Limitations that prevent achievement of this requirement are publicly reported.
	≥ 70% of materials by weight are compatible with the intended cycling pathway(s) (i.e., recyclable, compostable, or biodegradable).
	A strategy for improving product circularity is developed including plans for: • Increasing the amount of post-consumer recycled content and/or responsibly sourced renewable material, as relevant to the product type, • Implementing a circular opportunity or innovation, and • Improving the product's design for disassembly (if relevant).

Gold	Percentage of cycled and/or renewable content, by weight, is consistent with values achieved by industry leaders for the product type. Alternative: Limitations that prevent achievement of this requirement are publicly reported.
	≥ 90% of materials by weight are compatible with the intended cycling pathway(s) (i.e., recyclable, compostable, or biodegradable) and support high-value cycling. This means that the materials are of high quality and are likely to retain their value for subsequent use. If relevant, parts containing these materials are designed for easy disassembly.
	The strategy has been implemented including: Increased use of post-consumer and/or responsibly sourced renewable material as relevant to the product type. Alternative: Limitations that prevent increased use are publicly reported. A circular opportunity or innovation that increases product circularity.
	The product is actively cycled (recovered and processed) and/or a program is implemented to increase the cycling rate or quality of the product's materials after use. (Both are required for short-use phase products; one is required for long-use phase products.) For select single-use plastic products, a minimum cycling rate of 50% is achieved.
Platinum	At least two intended cycling pathways are defined for the product and its materials.
	Percentage of cycled and/or renewable content, by weight, has reached the technically feasible maximum.
	≥ 99% of materials by weight are compatible with the intended cycling pathway(s) (i.e., recyclable, compostable, or biodegradable). If relevant, parts containing these materials are designed for easy disassembly.
	The product is actively cycled in an amount consistent with the product's use phase (the shorter the use phase, the higher the minimum percentage required) and a program is implemented to increase the cycling rate or quality of the product's materials after use.
	Cycling rates and quality are monitored over time, and an increase in cumulative cycling rate or quality is demonstrated.

5.1 Circularity Education

Intended Outcome(s)

The applicant has an increased scope of knowledge regarding the circularity potential of their product and has identified opportunities and solutions for overcoming barriers to actively cycling their product via biological and/or technical pathways.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Participate in a circularity education initiative to obtain practical knowledge about developing or improving upon the infrastructure needed for the product to be part of a circular system.

The circularity education initiative must be led by:

1. A company or organization other than the applicant company, and focused on developing the circular economy, or
2. The applicant company, and be a collaborative platform that involves other companies or organizations.

The initiative must:

1. Support learnings toward implementing the company's circularity strategies and cycling infrastructure.
2. Aim to drive progress within an industry or across multiple industries.
3. Ensure that the initiative allows for adequate voice for all participants.

The applicant company must have actively participated in an initiative within the last two years prior to certification or recertification.

5.2 Defining the Product's Technical and/or Biological Cycles

Intended Outcome(s)

The applicant has designated all homogeneous materials in the product as either biological or technical and has identified appropriate cycling pathways for those materials once the product has reached the end of its current use cycle.

Applicable Achievement Level(s)

Bronze and Platinum

Requirement(s)

Bronze level: Designate all homogeneous materials in the product as being intended for technical and/or biological cycles and define the intended cycling pathway(s) for each material. For materials designated for technical cycles, recycling must be one intended cycling pathway.

Platinum level: Define at least two intended cycling pathway(s) for each homogeneous material in the product.

The following homogeneous materials must be designated for the biological cycle:

1. Materials designed to be released directly to the biosphere as part of their intended use or cycling pathway (e.g., liquid cleaning products, soaps, perfume, toilet paper),
2. Biological or biologically derived materials commonly released to the biosphere (e.g., paper), and
3. Coatings, finishes, or liquids applied to materials intended for biological cycles.

For intermediate and wet-applied products, the Bronze level requirements must be applied in the context of at least one relevant finished product or applied substrate example application, respectively.

Exemption

Intermediate and wet-applied products are exempt from the Platinum level requirement.

5.3 Preparing for Active Cycling

Intended Outcome(s)

The applicant has taken demonstrable steps toward addressing any barriers to material recovery and processing in order to actively cycle those materials for their next use.

Applicable Achievement Level(s)

Bronze and Silver

Requirement(s)

Bronze level: Develop a cycling plan to address challenge(s) inhibiting development of the cycling infrastructure for the product at the end of its first use, and identify potential partners that are capable of recovering and processing the product. Report on progress made toward achieving the plan at recertification.

Silver level: Initiate partnerships for recovery and processing of the product according to its intended cycling pathway(s). If the product is intended for cycling via municipal systems, use materials that are compatible with those systems.

For the Bronze level, the cycling plan must include the following:

1. Discrete planned actions and an associated timeline.
2. Identification of potential partners or internal resources for product recovery and processing in accordance with the intended cycling pathway(s) in countries and/or states that cumulatively cover a region accounting for 60% or more of product sales (with one exception per #3 below). Products intended to be cycled via municipal systems or addressed by regional/national product stewardship laws are exempt from this requirement.
3. For intermediate and wet-applied products, the plan must address challenges inhibiting development of the cycling infrastructure for at least one finished product or applied substrate example application, respectively. Identification of potential partners is not required for these product types.
4. For products containing electronic components, the plan must address the recovery and recycling of intentionally used trace elements whose extraction is associated with risks of limited supply (i.e., “scarce elements”).

At recertification, progress must be demonstrated on any planned actions.

For the Silver level, one or more of the following is required in countries and/or states that cumulatively cover a region accounting for 60% or more of product end sales:

1. The applicant company or retail partner has initiated partnership(s) or dedicated internal resources for product recovery and processing. (Initiation of a partnership is defined as the applicant company having an active agreement or contract(s) with entities involved in the recovery and processing of the product for another use cycle.)
2. A product stewardship law or program for the particular product type is in place (e.g., California Carpet Stewardship Law).
3. If intended for cycling via municipal systems, materials are a type that is commonly recycled or

composted via curbside pickup and the material is accepted by municipal recycling programs in the region(s) where the product is sold.

Exemptions

Products with a use phase greater than one year that have been on the market for less than their average use phase are exempt from the Silver level requirement at initial certification.

Intermediate products and liquid formulations are exempt from Silver level requirements in all cases.

5.4 Increasing Demand: Incorporating Cycled and/or Renewable Content

Intended Outcome(s)

Demand for circularly sourced materials is increased as a result of the increased use of cycled or renewable materials in the product, helping to close the loop and advance the circular economy. Negative impacts of virgin material use are also minimized.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirement(s)

Bronze level: For select commonly cycled product and material types, incorporate a minimum percentage of cycled and/or renewable content into the product. Alternatively, publicly disclose an explanation of the limitation(s) preventing achievement of the required minimums.

Silver level: Incorporate a percentage of cycled and/or renewable content into the product equal to or greater than industry averages and/or consistent with common practice. Develop a plan for increasing the use of post-consumer recycled and/or responsibly sourced renewable content, and demonstrate progress toward achieving the plan at recertification. Alternatively, publicly disclose an explanation of the limitation(s) preventing achievement of the required percentage(s).

Gold level: Incorporate a percentage of cycled and/or renewable content into the product that is consistent with industry leaders for the product type. Depending on material type, incorporate either post-consumer recycled or responsibly sourced renewable content. Alternatively, publicly disclose an explanation of the limitation(s) preventing achievement of the required percentage(s).

Platinum level: Incorporate the maximal technically feasible percentage of cycled and/or renewable content into the product.

For the Bronze through Platinum certification levels, the required minimum percentages of cycled and/or renewable content are listed by homogeneous material and application type in the *Cradle to Cradle Certified® Required Percentages of Cycled and Renewable Content by Product and Material Type* reference document. In general, the percentages increase with achievement level, but for products and materials where it is challenging to use cycled materials, the percentage may be zero at one or more levels. The required percentages must be met at the homogeneous material level or the product level as noted below and in the "Instructions for Use" tab in the *Cradle to Cradle Certified® Required Percentages of Cycled and Renewable Content by Product and Material Type* reference document.

The following are required for multi-material products (i.e., products containing more than one homogeneous material), with one exception as noted below:

1. For the Bronze and Silver levels, at least 90% of the homogeneous materials by weight must meet the required minimum percentages of cycled or renewable content.
2. For the Gold and Platinum levels, at least 95% of the homogeneous materials by weight must meet the required minimum percentages of cycled or renewable content.

Exception: For multi-material products where there is only one percentage listed per achievement level, the percentages provided are product-level percentages that may be met in a variety of ways, as long as the finished product overall achieves the required percentage of cycled or renewable content by weight. In these cases, there are no minimum percentages required for individual materials in the product.

For the Bronze, Silver, Gold, and Platinum levels,

1. For cycled content to count toward the required percentages, the amount of cycled content must be verified based on chain of custody documentation (with the exception of steel and aluminum material that can be traced via specification).
2. For biologically derived plastics and liquid formulations to count as renewable, the amount of bio-based content must be determined based on:
    a. Established standards that quantify bio-based content using radiocarbon dating, or
    b. Chain of custody documentation.
3. For biological and biologically derived materials associated with extensive evidence of ecosystem destruction due to land conversion and/or poor management practices (e.g., palm oil, wood, peat) to count as renewable, the material must be certified to a C2CPII-recognized responsible sourcing standard, or an alternative equivalent to certification must be in place, that requires:
    a. Compliance with all applicable laws and regulations of the country in which farming or harvesting operations occur.
    b. Operations that respect land rights and land use rights, and are unlikely to cause displacement of food production.
    c. Planning, monitoring, management, and continuous impact assessment for the farming and/or harvesting of material.
    d. Maintenance, conservation, or enhancement of biodiversity in the forest/vegetation or other ecosystem.
    e. Maintenance or enhancement of the productive function of the forest/vegetation or other ecosystem area and efficient use of harvested materials (e.g., rate of harvest does not exceed rate of regrowth in the long term).
    f. Maintenance or enhancement of the health and vitality of the forest/vegetation or other ecosystem and its protective systems (soil and water).
4. For commonly recycled biological and biologically derived materials, renewable content counts half as much as recycled content toward meeting the required cycled content percentages (e.g., if the percentage of cycled content required is 30%, then 60% renewable content OR 30% recycled content is required). This requirement does not apply to biological fibers used in apparel (i.e., for biological fibers used in apparel, renewable content counts in the same way as recycled content toward meeting the required percentages).

For the Gold and Platinum levels:

1. For any type of biological material to count as renewable, the material must be certified to a C2CPII-recognized responsible sourcing standard, or an alternative equivalent to certification must be in place (see #3 above for required responsible sourcing program elements applicable at the Bronze level and above).
2. For recycled content to count toward the required percentages, at least some of the recycled content must be post-consumer (with specific percentages required for certain material and product types per the *Cradle to Cradle Certified® Required Percentages of Cycled and Renewable Content by Product and Material Type* reference document).

Alternative to Meeting Required Percentages of Cycled and/or Renewable Content: Feasibility Analysis

For the Bronze, Silver, and Gold levels: A feasibility analysis may be applied as an alternative to meeting required percentages of cycled and/or renewable content in any case where an applicant is unable to meet the required percentages, including post-consumer recycled and responsibly sourced content as relevant. This alternative may be used for one or more materials in a product and at any achievement level.

The following are required:

1. An explanation of the limitation(s) preventing the incorporation of the target amount of cycled or renewable content (including post-consumer or responsibly sourced as relevant) and how, based on these limitation(s), the amount of cycled or renewable content currently used represents the maximum that is currently feasible.
2. The explanation must be reported publicly.
3. A strategy for addressing the identified limitation(s) and increasing the amount of cycled and/or renewable content (including post-consumer or responsibly sourced as relevant) over time must be developed. The strategy must include discrete objectives and an associated timeline.
4. For recertification:
    a. The applicant must demonstrate progress toward achieving the objectives.
    b. A description of progress made must be reported publicly.

For single-use plastic products and plastic packaging products (certified as separate products), excluding packaging that is part of a refill/reuse system (e.g., detergent refill pouch), the following two limitations preventing the incorporation of the target amount of cycled or renewable content are accepted:

1. The product or package is used in food contact applications and regulations applicable to the region(s) where the product is sold do not permit the use of recycled content.
2. Product or packaging performance specifications cannot be achieved when using the required percentages of cycled or renewable content.

For all other product types, including plastic packaging that is part of a reuse/refill system, other types of limitations (e.g., cost and availability) are accepted.

5.5 Material Compatibility for Technical and/or Biological Cycles

Intended Outcome(s)

Product materials with the highest capacity for biological and/or technical cycling have been intentionally

selected, increasing the likelihood that such materials will retain their value and move through subsequent cycles of use.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirements

Bronze level: For 50% of the product by weight, incorporate materials that are compatible with the intended cycling pathway(s).

Silver level: For 70% of the product by weight, incorporate materials that are compatible with the intended cycling pathway(s).

Gold level: For 90% of the product by weight, incorporate materials that are compatible with the intended cycling pathway(s) and have high-value technical or biological cycling potential.

Platinum level: For 99% of the product by weight, incorporate materials that are compatible with the intended cycling pathway(s).

For a material to count toward the percentage of materials compatible with the intended cycling pathway(s) the following conditions must be met:

1. Homogeneous materials that need to be separated in order to be cycled must be separable by the entity implementing the intended cycling pathway with given instructions and no additional special knowledge.
2. For products that are installed prior to use (e.g., in a building, a vehicle, or fixed within a sidewalk), it must be possible to extract the product from the installed location.
3. For products and materials intended for technical municipal cycling (i.e., municipal recycling), the product and/or material must be compatible for municipal cycling systems (e.g., painted plastics and plastic laminated paper are not currently compatible for municipal recycling).
4. For solid materials intended for the biological cycle, one of the following conditions must be met:
    a. The material must biodegrade in the intended cycling pathway(s) within the time period and to the extent specified by a C2CPII-recognized compostability or biodegradability standard test.
    b. For paper and biological materials with ≥ 99% unmodified organic material:
        i. The material, at its maximum thickness and/or density, must disintegrate in the intended cycling pathway(s) within the time period and to the extent specified by a C2CPII-recognized compostability or biodegradability standard test, and
        ii. If the intended cycling pathways include composting, a soil sample that is exposed to the material, after disintegration tests have been performed, must pass an ecotoxicity test demonstrating that the exposed soil sample is conducive to plant growth (OECD 208 or equivalent).
    c. For plastic materials, biologically derived materials, and biological materials with < 99% unmodified organic material (including paper that is < 99% cellulose), all of the following conditions must be met:
        i. The material must biodegrade in the intended cycling pathway(s) within the time period and to the extent specified by a C2CPII-recognized compostability standard test.

ii. For any individual organic additives (e.g., pigments, inks, colorants, scents, secondary polymers, glues) present at a concentration of ≥ 1%, the additive must biodegrade in the intended cycling pathway(s) within a specific time period and to the extent specified by:
    1. A C2CPII-recognized biodegradability standard test, or
    2. The available scientific literature and/or research studies.
iii. The material, at its maximum thickness and/or density, must disintegrate in the intended cycling pathway(s) within the time period and to the extent specified by a C2CPII-recognized compostability standard test, and
iv. A soil sample that is exposed to the material, after disintegration tests have been performed, must pass an ecotoxicity test demonstrating that the exposed soil sample is conducive to plant growth (OECD 208 or equivalent).

5. For materials with unavoidable release to the environment during product use (e.g., tires, shoe soles, brake pads), the fraction of material that on average is likely to be released to the environment from the total product over its lifetime may not be counted as compatible with the intended cycling pathway, unless it is biodegradable in the likely environment where release occurs.
6. For wet-applied products that are intended to be applied to materials with likely biological cycling pathways (e.g., paints intended to be applied to wood), one of the following conditions must be met:
    a. The wet-applied product must not typically comprise > 1% by weight of the base material(s) to which it is likely to be applied and the wet-applied product, in combination with the one likely base material, must meet the requirements for solid materials intended for biological cycling (per #4b), OR
    b. The wet-applied product, in combination with one likely base material, must meet the requirements for solid materials intended for biological cycling (per #4c).
7. For wet-applied products that are intended to be applied to materials with likely technical cycling pathways, one of the following conditions must be met:
    a. If the wet-applied material is an ink for printed products, it must pass the qualifications for de-inkability stated in INGEDE Method 11.
    b. If the wet-applied material is an adhesive for printed products, it must pass the qualifications for adhesive separation stated in INGEDE Method 12.
    c. Evidence must be provided that the wet-applied material will not adversely affect the reprocessing value of the material to which it has been applied.
8. For products that are liquid formulations (excluding wet-applied products), individual substances within the formulation, or the formulation as a whole may be evaluated when determining the percentage compatible for the biological cycle.
    a. When evaluating based on individual substance(s), the following conditions apply:
        i. For organic chemicals and surfactants to count toward the percentage compatible, the substance must biodegrade in the intended cycling pathway(s) within the time period and extent specified by a C2CPII-recognized biodegradability standard test. In addition,
            1. Organic chemicals with a log K_{oc} < 4.5 must meet the OECD definition for ultimate biodegradability (aerobic), and
            2. Organic chemicals with a log K_{oc} ≥ 1.5 must meet the OECD definition of anaerobic biodegradability.

ii. For inorganic chemicals, benign minerals may be counted toward the percentage compatible.
iii. Water weight is excluded from the calculation.

b. When evaluating the formulation as a whole, if one of the following requirements have been met the product counts as 100% compatible for the biological cycle:
i. The formulation has demonstrated ready biodegradability in both anaerobic and aerobic conditions as demonstrated by a C2CPII-recognized biodegradability standard test. (The formulation may also contain benign mineral nutrients.)
ii. For consumable consumer products (e.g., shampoo, detergents), the material must biodegrade in the intended cycling pathway(s) within the time period and to the extent specified by a C2CPII-recognized biodegradability standard test.

For the Gold level: The use of materials with high-value cycling potential (i.e., high-quality material as defined in #1-2 below) is required.

1. For a material to count toward the required percentage (90%) of materials compatible with the intended cycling pathway(s), the following conditions must be met:
   a. Materials intended for technical cycles and solid materials intended for biological cycles:
      i. Must not contain additives or features that are likely to result in low-value (i.e., low-quality) reprocessed material, and
      ii. Must be able to substitute for virgin material without loss of essential product function or material durability, contain at least 80% renewable or post-consumer recycled content, or have at least two plausible next uses.
   b. Solid materials intended for biological cycles must be certified by a C2CPII-recognized compostability program.
2. Select liquid formulations (e.g., soaps, cleaning products, lubricants) must meet minimum percent ready biodegradability and/or anaerobic biodegradability requirements per C2CPII-recognized standards; testing may be required. (Note: > 90% biodegradation of organic substances is required in some cases.)
3. For plastic beverage containers, plastic caps and lids must remain attached to the container during the product's intended use.

Analytical laboratories conducting required tests must be accredited or certified for the specific analysis per ISO 17025, DIN CERTCO approved, or equivalent.

5.6 Circularity Data and Cycling Instructions

Intended Outcome(s)

Circularity information for proper end-of-use handling of the product is publicly available, increasing the likelihood that the product's materials will be actively recovered and processed for a next cycle of use.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Make data to support cycling of the product in its intended pathway(s) and instructions for how to cycle the

product publicly available.

The applicant must make data to support cycling of the product in its intended pathway(s) publicly available. The data may be reported via the Cradle to Cradle Certified® Circularity Data Report (see *Cradle to Cradle Certified® Circularity Data Report* reference document) or a C2CPII-recognized circularity reporting standard.

When applicable, the applicant must make instructions for how to cycle the product publicly available. The instructions must include how to identify the materials for cycling, any required product maintenance, and how to recover, reprocess, or recycle the product (see Cycling Instructions section in the *Cradle to Cradle Certified® Circularity Data Report* reference document).

5.7 Circular Design Opportunities and Innovation

Intended Outcome(s)

The product is designed in a way that creates more end-of-use cycling opportunities.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Develop a plan for implementing a circular design opportunity or innovation that increases product circularity; demonstrate progress toward achieving the plan at recertification.

Gold level: Implement a circular design opportunity or innovation.

For the Gold level, circular design opportunities and innovations receiving credit are those that are commonly known and/or can be demonstrated to contribute to one or more of the following:

1. Increased end-of-use cycling
2. Greater engagement with users for end-of-use cycling
3. Prolonged use of the product
4. Decreased need to extract and produce virgin materials

For intermediate and wet-applied products, the applicant company must communicate how to implement the circular design opportunity to finished product manufacturer(s) or the customers of the wet-applied material, respectively.

5.8 Product Designed for Disassembly

Intended Outcome(s)

The product may be easily disassembled into discrete materials compatible for its intended cycling pathway(s) making it more likely that a large percentage of the materials in the product will be cycled.

Applicable Achievement Level(s)

Silver, Gold, and Platinum

Requirement(s)

Silver level: For products with multiple materials requiring separation for cycling in the intended pathway, develop a plan for increasing the ease of product disassembly into discrete materials for intended cycling pathway(s).

Gold level: For products with multiple materials requiring separation for cycling in the intended pathway, and for 90% of materials by weight, intentionally design the product for ease of disassembly.

Platinum level: For products with multiple materials requiring separation for cycling in the intended pathway, and for 99% of materials by weight, intentionally design the product for ease of disassembly.

For the Silver level, the plan for increasing the ease of product disassembly must include at least one of the design or communication elements required at the Gold level.

For the Gold and Platinum levels, the following design and communications elements define "ease of disassembly" and are required as applicable for ≥ 90% (for Gold) and ≥ 99% (for Platinum) of materials by weight:

1. The product includes at least one design feature that improves the ease of disassembly compared to a commonly or previously used alternative product.
2. Processes that result in the loss of specific materials in the product in order to recover other materials (e.g., burning plastics to recover metals) must be avoided.
3. If disassembly operations are conducted by an entity other than the applicant company, comprehensive disassembly instructions must be publicly available and accessible to the party(ies) involved in disassembly.
4. If disassembly operations are conducted by the general public, components must be separable using common tools (e.g., hammer, screwdriver, pliers) with minimal technical experience and instruction.
5. For products with ≥ 30 homogeneous materials and/or if disassembly is performed by an entity other than the product user, the disassembly process:
    a. Must be at least semi-automated (e.g., for electronics), or
    b. Can occur in a reliably consistent manner with clear instructions (e.g., via a Standard Operating Procedure, or another standardized process for training those who are disassembling the product).

For the Platinum level, the design and communications elements above are required as applicable for ≥ 99% of materials by weight.

Exemption

Liquid products, intermediate products, and products that do not require separation for the intended cycling pathway, including multi-material products that are cycled either intact or into a new hybrid material, are exempt from the requirements in this section.

5.9 Active Cycling

Intended Outcome(s)

The product's materials are actively being recovered and processed for their next use via the intended cycles

and/or the product manufacturer is demonstrably invested in a program that will lead to higher product and material cycling rates and/or a higher quality of materials available for cycling.

Applicable Achievement Level(s)

Gold and Platinum

Requirement(s)

Gold level:

For select single-use plastic products and single-use plastic packaging (when certified as a separate product), actively cycle ≥ 50% of the product's materials and implement a program to increase the cycling rate or quality of the product for its next use.

For other short-use phase products, actively cycle at least some (> 0%) of the product's materials and implement a program to increase the cycling rate or quality of the product for its next use.

For long-use phase products, actively cycle at least some (> 0%) of the product's materials or implement a program to increase the cycling rate or quality of the product for its next use.

Platinum level:

For long-use phase products, actively cycle the product's materials and implement a program to increase the cycling rate or quality of the product for its next use.

Monitor cycling rates and quality over time, and demonstrate an increase in either cumulative cycling rate or quality.

Actively cycle a minimum percentage of the product's materials based on the duration of the product's use phase.

Active cycling includes both recovery and processing of the product's materials for their next use.

Requirements for a material or product to be considered high quality or have high value cycling potential are provided in Section 5.5 for the Gold level.

The 'select' single-use plastic products and single-use plastic packaging required to achieve ≥ 50% active cycling at the Gold level are eligible product and packaging types that are subject to extended producer responsibility regulations and/or regulatory measures intended to reduce use. This includes: Beverage cups including covers and lids, beverage bottles, take-out or immediate consumption food containers, packets and wrappers made from flexible materials used to contain food that is intended for immediate consumption, wet wipes, and balloons. Exception: If the plastic material within the product is made from responsibly sourced renewable material and it is demonstrated to readily biodegrade in all relevant environmental compartments where there is potential for release and disposition (e.g., soil, freshwater including wetlands, marine water including surface and deep water conditions), the active cycling rate for other short-use phase products may be applied (> 0%).

For the Platinum level:

1. If demonstrating an increase in cumulative cycling rate, the increase must be via one or more intended cycling pathway(s).
2. The minimum required percentage of actively cycled product is a function of the product's use phase duration or the average use phase duration for the product type (the shorter the use phase,

the higher the minimum percentage required). This minimum required percentage is calculated as follows:

$\frac{100}{2+L}$ where L is the product use phase time (in years) or the average use phase time for the product type (in years). If using the use phase time for the product, lifetime warranties may not be used for its derivation.

Exemptions

Long-use phase products that have been on the market for a time period less than the product's average use phase are exempt from the Platinum level requirement.

Intermediate products and liquid formulations are exempt from all requirements in this section.

6 // Clean Air & Climate Protection Requirements

Category Intent

Product manufacturing results in a positive impact on air quality, the renewable energy supply, and the balance of climate changing greenhouse gases.

Requirements Summary

To achieve a desired level within the category, the requirements at all lower levels must also be met.

Bronze	Final manufacturing facilities comply with air emissions regulations or guidelines - i.e., permits, international guidelines, or industry best practice.
	Annual electricity use and greenhouse gas emissions associated with the final manufacturing stage of the product have been quantified.
	A strategy for increasing use and/or procurement of renewable electricity and addressing greenhouse gas emissions has been developed. The strategy includes near and mid-term targets.
	5% target(s)* for procuring or producing renewable electricity and/or addressing greenhouse gas emissions have been achieved. Applicable to final manufacturing stage electricity and emissions only.
	Products that use energy during the use phase (e.g., appliances) or that greatly impact the energy efficiency of buildings (e.g., windows, insulation), are certified using a C2CPII-recognized energy efficiency standard or similar, if available.
	Greenhouse gas emissions data for the applicant company, for all final manufacturing stage facilities, or for the final manufacturing stage of the product are made available to stakeholders.
Silver	For construction products and building materials used to construct primary building elements, the embodied emissions associated with the product from cradle to gate or through end of use have been quantified.
	The renewable electricity and greenhouse gas reduction strategy includes long-term target(s) in addition to the near and mid-term targets.
	20% target(s)* for procuring or producing renewable electricity and/or addressing greenhouse gas emissions have been achieved. Applicable to final manufacturing stage electricity and emissions only. Alternative: 25% of the embodied emissions associated with the product from cradle to gate or through end of use are offset or otherwise addressed (e.g., through projects with suppliers, product redesign, savings during the use phase). Note: This is required at the Gold level in all cases.

Gold	For all product types, the embodied emissions associated with the product from cradle to gate or through end of use have been quantified.
	For construction products and building materials used to construct primary building elements, a third-party critical review of the quantification of embodied greenhouse gas emissions is conducted, and an Environmental Product Declaration produced. For other product types, third-party verification or an internal review is conducted.
	50% target(s)* for procuring or producing renewable electricity and/or addressing greenhouse gas emissions have been achieved. Applicable to final manufacturing stage electricity and emissions only. 50% of the renewable electricity (25% of total electricity used) is either produced on site or procured through long-term power purchase agreements supporting new renewable electricity installations. Alternative: Renewable electricity procurement matches 100% of electricity used at final manufacturing facilities.
	Embodied greenhouse gas emissions data are made available to stakeholders.
	Blowing agents used in the manufacture of the product's foam materials (any foam > 1% of product by weight) have low to no global warming potential and no ozone depletion potential.
	25% of the embodied emissions associated with the product from cradle to gate or through end of use are offset or otherwise addressed (e.g., through projects with suppliers, product redesign, savings during the use phase).
Platinum	For all product types, a third-party critical review of the quantification of embodied greenhouse gas emissions associated with the product from resource extraction through end of use is conducted, and an Environmental Product Declaration produced.
	> 100% of electricity is renewably sourced. The electricity is produced on site or procured through long-term power purchase agreements supporting new renewable electricity installations. For other on-site energy demands (if any), eligible sources of bioenergy are used. > 100% of any remaining greenhouse gas emissions are offset. Applicable to final manufacturing stage electricity and emissions only.
	100% of the embodied emissions associated with the product from cradle to gate or through end of use are offset or otherwise addressed (e.g., through projects with suppliers, product redesign, savings during the use phase).

*Depending on the achievement level, the "targets" may apply to renewable electricity procurement or on-site production and use, performance improvements (emissions intensity reductions), absolute emissions reductions, use of eligible bioenergy sources, purchase of carbon offsets, and/or financial donations or investments.

6.1 Air Emissions Compliance

Intended Outcome(s)

The final manufacturing stage facilities where the product is manufactured are in compliance with regulatory and/or industry best practice air emissions limitations.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Final manufacturing stage facilities comply with air emissions regulations or guidelines.

Facilities must comply with the corresponding regional regulatory (if any), international, or industry best practice air emissions guidelines.

Compliance with all applicable laws and regulations, including compliance with regional regulatory air emissions limitations, is required as a baseline. For final manufacturing stage facilities meeting this requirement based on regulatory compliance, the parameters addressed in the permit must also be consistent with leading regulations, international guidelines, or industry best practice. Leading regulations are defined as those that include a functioning mechanism through which ambient air quality-based limits are set (i.e., assessment of the existing ambient air quality is used to inform and set the permitted limits with the goal of maintaining high quality standards).

6.2 Quantifying Electricity Use and Greenhouse Gas Emissions

Intended Outcome(s)

Electricity use and greenhouse gas emissions associated with final manufacturing and the product's embodied greenhouse gas emissions have been quantified and verified, creating a baseline against which reductions can be measured, and helping to identify areas for improvement.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirement(s)

Bronze level: Quantify annual electricity use and greenhouse gas emissions associated with the final manufacturing stage of the product.

Silver level: For construction products and building materials used to construct primary building elements (i.e., products for which life cycle assessment is common practice), quantify the embodied greenhouse gas emissions associated with the product from resource extraction through final manufacturing or end of use.

Gold level: For construction products and building materials used to construct primary building elements (i.e., products for which life cycle assessment is common practice), conduct a third-party critical review and produce an Environmental Product Declaration (EPD). For other product types, quantify the embodied greenhouse gas emissions associated with the product from resource extraction through final manufacturing or end of use and, if self-reported, conduct an internal review.

Platinum level: For all product types, conduct a third-party critical review of the quantification of embodied greenhouse gas emissions associated with the product from resource extraction through end of use and produce an Environmental Product Declaration (EPD).

For the Bronze level:

1. Report electricity in terms of kWh or equivalent and the resulting greenhouse gas emissions in terms of CO_2e.
2. Report greenhouse gas emissions from all other sources (e.g., direct emissions from burning fuels, including biofuels) in terms of CO_2e.

The methods employed must follow a recognized greenhouse gas accounting methodology (i.e., the Greenhouse Gas Protocol or others listed by CDP).

For the Silver, Gold, and Platinum levels, the methods employed to quantify embodied emissions must follow ISO 14040 and ISO 14044 (Environmental management – Life cycle assessment –Principles and framework and – Requirements and guidelines) or other standards or guidance based on ISO 14040 and ISO 14044 (e.g., the Greenhouse Gas Protocol Product Life Cycle and Accounting Standard). If available, product category rules must be followed.

For the Gold and Platinum levels, Environmental Product Declarations (EPDs) must conform to ISO 14025 and EN 15804 or ISO 21930.

Primary building elements are defined as:

1. The structural frame, including beams, columns, and slabs,
2. External walls, cladding, and insulation,
3. Floors and ceilings,
4. External walls,
5. Internal walls,
6. Windows,
7. Roofs, and
8. Foundations and substructures.

For product types where a third-party critical review is not required at the Gold level (i.e., all products except construction products and building materials), if embodied emissions were quantified by a qualified third party, an internal review is not required. If embodied emissions were quantified by the applicant company (i.e., self-reported), third-party verification may be requested by C2CPII should the application audit surface concerns about whether the data are complete or accurate.

6.3 Clean Air & Climate Protection Strategy

Intended Outcome(s)

A clean air and climate protection strategy that includes targets aligned with international climate science and goals is established, providing a pathway for increasing the amount of renewable energy used to manufacture the product and reducing or offsetting greenhouse gas emissions during the product manufacturing process.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirements

Develop a Clean Air & Climate Protection strategy and report on progress made toward achieving the strategy

at each recertification.

The strategy must include the following:

1. Quantitative targets for increasing renewable electricity use and/or procurement and addressing greenhouse gas emissions (as applicable by achievement level below).
    a. For the Bronze, Silver, and Gold level, near-term (0-2 years) and mid-term (2-20 years) targets must be set.
    b. For the Silver and Gold levels, long-term (2050 or before; > 20 years) targets must also be set.
    c. For the Gold level, the long-term targets must be to achieve > 100% renewable and/or a better than carbon neutral final manufacturing stage for the product. Alternatively, the long-term targets must be science-based (see Definitions section).
    d. For the Platinum level, the timeline for meeting the selected target(s) may be determined by the applicant.
2. Proposed activities and method(s) for reaching each target and the rationale for selecting the specific targets, including how the targets are considered to be sufficiently ambitious. Base year(s) and target year(s) must be indicated. Note: Methods that receive credit are further described in Section 6.4 Using Renewable Electricity and Addressing Greenhouse Gas Emissions in Final Manufacturing and in 6.10 Addressing Embodied Greenhouse Gas Emissions.
3. A report of progress made toward meeting the targets that were set at the last certification renewal (not applicable for initial certification).
4. For the Bronze, Silver, and Gold levels, the estimated cost of moving to the next achievement level in the Clean Air Renewable Energy & Climate Protection category via one or more of the methods described in Section 6.4.

Scope

1. For the Bronze, Silver, and Gold levels, product attributable electricity use and greenhouse gas emissions associated with the final manufacturing stage of the product must be within the scope of the strategy.
2. For construction products and building materials used to construct primary building elements at the Silver level, and for all products at the Gold and Platinum levels, the strategy must take into account the product's (or products') embodied greenhouse gas emissions.

6.4 Using Renewable Electricity and Addressing Greenhouse Gas Emissions in Final Manufacturing

Intended Outcome(s)

Depending on achievement level and methods used, applicants are:

- Employing efficiency and conservation measures to reduce energy use and greenhouse gas emissions,
- Signaling demand for renewable energy,
- Supporting carbon offset projects that go beyond business as usual,
- Avoiding the use of fuels that may contribute to reduced food security, conversion of forested and

other natural areas to cropland, and/or cause a near-term increase in atmospheric carbon dioxide,
- Producing renewable electricity in excess and releasing it to the grid for all to use, and/or
- Positively impacting the balance of climate changing greenhouse gases attributable to the final manufacturing stage of the product (i.e., more are offset than are generated).

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirements

Bronze level: For the final manufacturing stage of the product, procure or produce renewable electricity and/or address greenhouse gas emissions, achieving 5% target(s)* for electricity and other greenhouse gas emissions sources.

Silver level: For the final manufacturing stage of the product, procure or produce renewable electricity and/or address greenhouse gas emissions, achieving 20% target(s)* for electricity and other greenhouse gas emissions sources. Alternatively, meet the embodied emissions target (25%) required for all products at the Gold level.

Gold level: For the final manufacturing stage of the product, procure or produce renewable electricity and/or address greenhouse gas emissions, achieving 50% target(s)* for electricity and other greenhouse gas emissions sources.

Platinum level: For the final manufacturing stage of the product, procure or produce renewable electricity and/or address greenhouse gas emissions, achieving > 100% target(s)* for electricity and other greenhouse gas emissions sources.

*The target(s) may be met via a variety of methods. Depending on the achievement level, these include renewable electricity procurement, on-site renewable electricity production and use, performance improvements (i.e., greenhouse gas intensity reduction), absolute emissions reductions, use of eligible bioenergy sources, purchase of carbon offsets, and/or financial donations and investments. See the Renewable Electricity and Greenhouse Gas Emissions Targets section below for more information.

Renewable Electricity and Greenhouse Gas Emissions Targets

There are separate targets applicable to (1) electricity, including purchased electricity and on-site renewable electricity, and (2) greenhouse gas emissions from other scope 1 and 2 sources. One or more of the methods listed below may be applied toward achieving the targets. For example, if the renewable electricity target for a given achievement level has been partially met, then one or more of the other listed methods may be used to achieve the remainder of the target. See the supplementary sub-sections below for additional requirements pertaining to the accepted methods. The targets below apply to the final manufacturing stage of the product unless otherwise noted.

For the Bronze level:

1. For electricity (including purchased electricity resulting in scope 2 emissions and on-site renewable electricity):
    a. Procure or produce renewable electricity to match 5% of the electricity used (Note: Renewable

electricity that is part of a utility's default offer receives credit only if there is no voluntary renewable electricity market in the applicable market region),

b. Provide financial support to a climate-relevant public policy initiative (must be valued at 2x the cost of purchasing renewable electricity attribute certificates or other voluntary purchase matching 5% of the electricity used),
c. Purchase carbon offsets to compensate for 5% of the resulting greenhouse gas emissions, or
d. Improve performance by 5% (i.e., reduce electricity use intensity and/or the associated greenhouse gas emissions intensity by 5%).

2. For all other greenhouse gas emissions sources (including all scope 1/direct and other scope 2/indirect emissions):
    a. Use eligible sources of bioenergy, achieving the bioenergy credit for 5% of total greenhouse gas emissions,
    b. Purchase carbon offsets to compensate for 5% of the resulting greenhouse gas emissions,
    c. Invest in on-site emissions reductions projects (must be of an equivalent value to carbon offsets compensating for 5% of emissions), or
    d. Improve performance by 5% (i.e., reduce greenhouse gas emissions intensity by 5%).

For the Silver level:

1. For electricity (including purchased electricity resulting in scope 2 emissions and on-site renewable electricity):
    a. Procure or produce renewable electricity to match 20% of the electricity used (Note: Renewable electricity that is part of a utility's default offer receives credit only if there is no voluntary renewable electricity market in the applicable market region),
    b. Purchase carbon offsets to compensate for 20% of the resulting greenhouse gas emissions,
    c. Provide financial support (valued at 2x the cost of renewable electricity attribute certificates or other voluntary purchase option matching 20% of the electricity used) to a climate-relevant public policy initiative,
    d. Improve performance by 20% (i.e., reduce electricity use intensity and/or greenhouse gas emissions intensity by 20%) and reduce absolute emissions per science-based targets, or
    e. Improve performance by up to 10% and meet the remainder of the 20% target via the other accepted method(s).
2. For all other greenhouse gas emissions sources (including all scope 1/direct and other scope 2/indirect emissions):
    a. Use eligible sources of bioenergy, achieving the bioenergy credit for 20% of total greenhouse gas emissions,
    b. Purchase carbon offsets to compensate for 20% of greenhouse gas emissions,
    c. Invest in on-site emissions reductions projects, for example, purchase more energy efficient equipment (must be of an equivalent value to carbon offsets compensating for 20% of emissions),
    d. Improve performance by 20% (i.e., reduce greenhouse gas emissions intensity by 20%) and reduce absolute emissions per science-based targets, or
    e. Improve performance by up to 10% and meet the remainder of the 20% target via the other accepted method(s).

Alternative to #1 and #2: Achieve the embodied emissions target required at the Gold level (see Section 6.8 Addressing Embodied Greenhouse Gas Emissions for further detail).

For the Gold level,

1. For electricity (including purchased electricity resulting in scope 2 emissions and on-site renewable electricity):
    a. Procure or produce renewable electricity to match 50% of the electricity used, producing at least half of the 50% (i.e., 25% of the total electricity used) on site and/or procuring half through long-term power purchase agreements (PPAs) supporting new renewable electricity installations (Note: Renewable electricity that is part of a utility's default offer receives credit for the other 25% only if there is no voluntary renewable electricity market in the applicable market region),
    b. Procure renewable electricity to match 100% of the electricity used at all final manufacturing stage facilities (Note: This is a facility level requirement rather than a final manufacturing stage requirement),
    c. Purchase carbon offsets to compensate for 50% of the resulting greenhouse gas emissions,
    d. Provide financial support (valued at 2x the cost of renewable electricity attribute certificates or other voluntary purchase option matching 25% of the electricity used) to a climate-relevant public policy initiative and meet the remainder of the 50% target (25%) via the other accepted method(s) (Note: This option may not be used as an alternative to achieving the on-site or PPA requirements), or
    e. Improve performance by up to 12.5% (i.e., reduce electricity use intensity and/or the associated greenhouse gas emissions intensity by 12.5%) and meet the remainder of the 50% target via the other accepted method(s).
2. For all other greenhouse gas emissions sources (including all scope 1/direct and other scope 2/indirect emissions):
    a. Use eligible sources of bioenergy, achieving the bioenergy credit for 50% of total greenhouse gas emissions,
    b. Purchase carbon offsets to compensate for 50% of greenhouse gas emissions, or
    c. Improve performance by up to 12.5% (i.e., reduce greenhouse gas emissions intensity by 12.5%) and meet the remainder of the 50% target via other accepted method(s).

For the Platinum level:

1. Procure or produce > 100% of the electricity used, producing the electricity on site and/or procuring through long-term power purchase agreements supporting new renewable electricity installations,
2. Use eligible sources of bioenergy for other on-site energy demands (if any) (Note: Other energy sources (e.g., hydrogen) will be considered on a case-by-case basis), and
3. Purchase carbon offsets to compensate for > 100% of greenhouse gas emissions from non-energy sources and/or from bioenergy receiving partial credit (if any).

Note: The Platinum level goal is to fully electrify, use renewable electricity for total energy demand, and to use carbon offsets only to address any emissions from non-energy sources. However, if the physical infrastructure and/or the political situation do not allow for this, exceptions may be made on a case-by-case basis, allowing for the use of carbon offsets to address greenhouse gas emissions resulting from purchased electricity and/or burning of fuels on site.

Meeting the Renewable Electricity Targets

For the Bronze and Silver levels and for half (i.e., 50%) of the Gold level target (or for 100% of the Gold target if using the 100% renewable electricity procurement alternative per the sub-section titled Renewable Electricity and Greenhouse Gas Emissions Targets above):

1. Renewable electricity may be:
    a. Produced on site,
    b. Procured from a utility or other provider (e.g., through a utility's optional green power offering, or through direct power purchase agreements), and/or
    c. Procured via unbundled renewable energy attribute certificates that support new (≤15 years) renewable electricity installations (e.g., Renewable Energy Certificates (RECs) or Guarantees of Origin (GOs)). Note: "Unbundled" refers to renewable energy attributes that are sold separately from the renewable electricity itself.
2. The electricity must be from one or more of the following sources:
    a. Solar,
    b. Wind,
    c. Geothermal,
    d. Non-impoundment hydropower, or hydropower certified to a C2CPII-recognized renewable (hydro) electricity standard, or
    e. Eligible biofuels (see Accounting for Bioenergy and Applying the Bioenergy Credit section below).

Other renewable sources (e.g., wave and tidal energy) will be evaluated on a case-by-case basis.

3. Renewable electricity (as defined in #2a-e) that is part of a utility's default offer may receive credit toward achieving the renewable electricity targets only if there is no voluntary renewable electricity market in the applicable market region. (Note: An alternative option, including for cases where there is a voluntary renewable electricity market, is to convert the amount of purchased electricity to greenhouse gas emissions and to meet the offset target instead – which does give credit for using renewable electricity present on the grid through that electricity's effect on the emissions rate. See section titled Meeting the Carbon Offset Targets below for further information).
4. Double counting of renewable energy attributes must not occur.
    a. Renewable energy attribute certificates must be retained by the applicant or canceled on the applicant's behalf in all cases.
    b. If procuring unbundled renewable energy attribute certificates outside of a regulated tracking system that controls for double counting, a qualified third party must verify that double counting has not occurred.
5. The generation or consumption of the renewable electricity may not be used to meet any regulatory requirements. Note: In regions with a cap and trade program and where a legal framework and process exists for reducing the cap to support emissions reductions claims associated with voluntary renewable electricity purchases, participation in the process to reduce the cap is required (e.g., for voluntary renewable energy attribute certificates generated in U.S. states with a cap and trade program and voluntary renewable energy set aside accounts, an appropriate amount of allowances must also be retired).

For the remaining half (i.e., 50%) of the Gold target (unless using the 100% renewable electricity procurement alternative per the sub-section above titled Renewable Electricity and Offset Targets) and for the Platinum level target:

1. The renewable electricity must be:
    a. Produced and consumed on site to the extent feasible, and/or
    b. Procured through long-term (≥ 15 years) power purchase agreements that support new (≤15 years) renewable electricity installations (Note: Virtual power purchase agreements are accepted. Other procurement options meeting the intent of the requirement will be considered on a case-by-case basis.)
2. The electricity must be from one or more of the following sources:
    a. Solar,
    b. Wind,
    c. Geothermal,
    d. Non-impoundment hydropower, or hydropower certified to a C2CPII-recognized renewable (hydro) electricity standard, or
    e. Eligible biofuels (see Accounting for Bioenergy and Applying the Bioenergy Credit section below).

    Other renewable sources (e.g., wave and tidal energy) will be evaluated on a case-by-case basis.
3. Power purchase agreements must support renewable electricity generation that occurs:
    a. In the same grid region as the applicant's facility(ies), or
    b. In a grid region with higher emissions rates than the region where the applicant's facility(ies) are located.
4. Double counting of renewable energy attributes and/or use for regulatory compliance must not occur (per #4 and #5 of the preceding section).

Meeting the Carbon Offset Targets

Carbon offsets may be used to address both direct and indirect greenhouse gas emissions. For example, this includes emissions produced on site from burning fuels and emissions resulting from the generation of purchased electricity or steam off site.

Exception: Carbon offsets may not be used to address emissions attributable to purchased electricity in countries where the nuclear power share is > 10%.

To claim and apply carbon offsets toward the offset target(s), the following conditions must be met:

1. Offsets must be sourced from projects certified to a C2CPII-recognized offset project certification program that aims to ensure that:
    a. The associated greenhouse gas reductions or removals are additional, accurately estimated, permanent, and not double counted.
    b. Offset projects operate in compliance with local laws.
2. The offsets must be purchased voluntarily (and not for compliance purposes).
3. If using carbon offsets to address emissions attributable to the use of purchased electricity (i.e., scope 2 emissions): Emissions attributable to the purchased electricity must be calculated using residual emissions factors if available, or grid average emissions factors if not.

Accounting for Bioenergy and Achieving the Bioenergy Credit

If bioenergy is produced on site (including use of biofuels), the greenhouse gas emissions attributable to the bioenergy must be added to the total CO_2e subject to the offset targets.

If the bioenergy is produced from eligible fuels, the bioenergy credit may also be subtracted from the amount of offsets required to reach a given target. The bioenergy credit = (the carbon dioxide combustion emissions of the eligible biofuel) x (the bioenergy credit multiplier for the eligible fuel source type). In addition to receiving the bioenergy emissions credit for the use of eligible biofuels, electric bioenergy produced on site from these fuels may also be counted toward the renewable electricity target.

Eligible fuels are solid, liquid, or gaseous forms of fuel sourced from organic and renewable materials that would otherwise be categorized as waste as defined by the most recent version of the Green-e® Renewable Energy Standard for Canada and the United States.

The bioenergy credit multipliers by eligible fuel source type are as follows (see the Definitions section for a description of the approach used to define these multipliers):

1. Agricultural crop residue that is unmerchantable as food and other similar rapidly renewable waste material: 0.63
2. Animal and other organic waste (e.g., food scraps), landfill gas, and wastewater methane: 1
3. Woody waste: 0.57

To receive the bioenergy credit, the applicant must retain all rights to the environmental attributes associated with the bioenergy. Emissions reductions attributes may not be sold, registered, or claimed by others.

Bioenergy must be produced on site and any biofuels must be used directly to receive the bioenergy credit with the following exception: For the Bronze and Silver levels, “green-gas” certificates may be employed to compensate for natural gas obtained through the standard gas grid. New (≤15 years) biogas installations within the same market region must be supported. Carbon offsets supporting bioenergy installations receive credit as described above in the section titled Meeting the Carbon Offset Targets.

Achieving the Performance Improvement Credit

The renewable electricity and/or greenhouse gas emissions targets may be reduced when performance improvement(s) resulting from energy conservation and efficiency projects have been demonstrated and verified by a qualified third party. The performance improvement credit may be applied to (1) purchased electricity in terms of kWh or equivalent and direct emissions separately, or (2) combined scope 1 and 2 emissions. In general, the renewable electricity and offset targets may be reduced by one percentage point for each percent of normalized performance improvement achieved, within the following limits:

1. For Bronze level: The 5% renewable electricity and/or greenhouse gas emissions targets may be reduced by up to five percentage points (100% of the targets). If performance improvement(s) of 5% has been achieved, renewable electricity, carbon offsets, and/or other methods of achieving the targets are not required.
2. For Silver level: The 20% renewable electricity and/or greenhouse gas emissions targets may be reduced by up to 10 percentage points (50% of the targets). If the maximum performance improvement credit of 10% has been achieved, only 10% of electricity must be renewably sourced and only 10% of greenhouse gas emissions must be offset or addressed via the other allowable methods. Alternative: If, for the applicant company, absolute emissions reductions are achieved

in line with the Science Based Targets Initiative's (SBTI) well below 2°C or 1.5°C scenarios, the 20% renewable electricity and/or offset targets may be reduced by up to 20 percentage points (100% of the targets). Targets must be verified by SBTI and absolute reductions in line with the targets must be realized over the prior certification period. In this case, if performance improvement(s) of 20% or more has been achieved, renewable electricity, carbon offsets and/or other methods of achieving the targets are not required.

3. For Gold level: The 50% renewable electricity and/or greenhouse gas emissions targets may be reduced by up to 12.5 percentage points (25% of the targets). If the maximum performance improvement credit of 12.5% has been achieved, only 37.5% of electricity must be renewably sourced and only 37.5% of greenhouse gas emissions must be offset or addressed via the other allowable methods.
4. The performance improvement credit may not be used toward fulfillment of the Platinum level targets.

The performance improvement credit may be applied when all of the following conditions are met:

1. Performance improvement is achieved at a facility that is part of the product's final manufacturing stage.
2. The product is allocated a share of overall facility energy use and emissions proportional to its share in the facility's overall production. (This is required prior to determining the amount of carbon offsets and/or renewable electricity necessary to meet the remainder of the target(s)).
3. Performance improvements are determined using a baseline year of no more than 10 years prior to certification or recertification (as applicable).
4. Performance improvements from baseline to reporting year must be determined and normalized per an approved method and verified by a qualified third party with expertise in energy performance measurement and verification.
    a. The International Performance Measurement and Verification Protocol (IPMVP), Method C (i.e., the whole facility method), or similar methods based on ISO 50015 and ISO 50047, are accepted.
5. The verifier must report performance improvement(s) in the appropriate quantities depending on how the remainder of the targets will be met as follows:
    a. Performance improvement must be reported separately for electricity and all other greenhouse gas emissions sources (required if meeting renewable electricity and greenhouse gas emissions targets separately); or,
    b. Total performance improvement for all energy sources combined must be converted to and reported as percentage of CO_2e savings achieved (i.e., avoided emissions).
6. The reporting year for the performance improvement verification report must be within one year of the certification issue date. Verification must be repeated upon each recertification.
7. The applicant must retain all rights to the environmental attributes associated with the performance improvement.

6.5 Energy Efficiency During Product Use

Intended Outcome(s)

Manufacturers are incentivized to make energy efficient products and product users are able to identify and select products that perform efficiently.

Applicable Achievement Level(s)

Bronze

Requirement(s)

For products that use energy during the use phase (e.g., appliances) or that greatly impact the energy efficiency of buildings (e.g., windows, insulation), obtain a certification and/or label using a C2CPII-recognized energy efficiency standard, labeling program, or similar, if available.

C2CPII-recognized efficiency standards and labels must allow users to identify products with above-average performance (e.g., EU Energy Label and EnergyStar in the U.S.).

Certification or labeling is required if a relevant certification or label is available in the region(s) where the product is sold.

6.6 Transparency

Intended Outcome(s)

Greenhouse gas emissions data are available to stakeholders, demonstrating the manufacturer's commitment to protecting the climate.

Applicable Achievement Level(s)

Bronze and Gold

Requirement(s)

Bronze level: Make greenhouse gas emissions data for the applicant company, all final manufacturing stage facilities, or the final manufacturing stage of the product available to stakeholders.

Gold level: Make embodied greenhouse gas emissions data for the product available to stakeholders. For construction products and building materials used to construct primary building elements (i.e., product types for which life cycle assessment is common practice), make an Environmental Product Declaration available.

For the Bronze level, scope 1 and scope 2 emissions must be reported separately.

6.7 Using Blowing Agents with Low or No Global Warming Potential

Intended Outcome(s)

Blowing agents used in the product's manufacturing and supply chain do not contribute to climate change or depletion of the ozone layer.

Applicable Achievement Level(s)
Gold

Requirement(s)
For blowing agents used to manufacture foam materials, use blowing agents with low to no global warming potential (GWP) and no ozone depletion potential (ODP).

Blowing agents with a RED or GREY hazard rating in the Climatic Relevance endpoint (as defined by the C2CPII Material Health Assessment Methodology) must not be used. This is required regardless of whether or not the blowing agent remains within the final product and regardless of whether the blowing agent is used during the final manufacturing stage or in the supply chain.

Exemption
Blowing agents used to manufacture foam materials if the foam material makes up < 1% of the product by weight.

6.8 Addressing Embodied Greenhouse Gas Emissions

Intended Outcome(s)
Offsetting or reducing embodied GHG emissions has demonstrably decreased the proportion of climate-changing greenhouse gases attributable to manufacturing of the product.

Applicable Achievement Level(s)
Gold and Platinum

Requirement(s)
Gold level: Offset or otherwise address 25% of embodied greenhouse gas emissions attributable to the product from resource extraction through final manufacturing or through end of use.

Platinum level: Offset or otherwise address 100% of embodied greenhouse gas emissions attributable to the product from resource extraction through final manufacturing or through end of use.

At a minimum, a cradle to gate scope including emissions attributable to the final manufacturing stage must be employed.

Embodied greenhouse gas emissions may be addressed through a variety of methods, including but not limited to, the purchase of carbon offsets, projects with suppliers, product redesign, and savings during the use phase.

Reduction in embodied greenhouse gas emissions per functional unit receives credit when compared to a baseline of no more than 10 years prior to certification or recertification (as applicable).

Above average performance (lower embodied emissions per functional unit) receives credit when compared to an industry-wide third-party verified benchmark, if available. An industry-wide generic EPD published in the past five years may be used as the benchmark. Otherwise, the performance of a sample of similar products

may be used for comparison.

Qualified third-party verification of the percentage addressed is required if meeting the targets through methods other than offset purchase.

7 // Water & Soil Stewardship Requirements

Category Intent

Water and soil are treated as precious and shared resources. Watersheds and soil ecosystems are protected, and clean water and healthy soils are available to people and all other organisms.

Requirements Summary

To achieve a desired level within the category, the requirements at all lower levels must also be met.

Bronze	Local and product relevant water and soil issues are characterized. (Required for final manufacturing stage facilities and select tier 1 suppliers of key materials.)
	Final manufacturing facilities comply with water quality regulations or guidelines (i.e., permits, international guidelines, or industry best practice).
	Product relevant chemicals entering effluent or sludge comply with the relevant restrictions on the Core Restricted Substances List (RSL). (Required for final manufacturing stage.)
	Water use at final manufacturing stage facilities is quantified.
	Adequate drinking water, sanitation, and hygiene are provided (final manufacturing stage facilities only).
	A strategy for achieving the Silver level water and soil conservation requirements has been developed. For facilities using high volumes of water in stressed locations, the strategy includes water use reduction targets. Progress is reported at recertification.
Silver	Manufacturing facilities of tier 1 suppliers comply with water quality regulations or guidelines (i.e., compliance with permits, international guidelines, or industry best practice). (Required for tier 1 suppliers of key materials associated with pollutant intense processes.)
	The Bronze level water and soil conservation strategy has been implemented including: At least one conservation technology or best practice at facilities expected to have the greatest water- or soil-related impacts. (Required for final manufacturing facilities with high volume processes in stressed locations and facilities with pollutant intense processes.) One additional action to conserve water and/or soil either at final manufacturing facilities or in the supply chain. (Required when there are any facilities with high volume or pollutant intense processes and/or in stressed locations, or key materials in scope.)
	Product relevant process chemicals entering effluent and sludge are defined and assessed.
	Product relevant effluent and sludge does not contain recognized PBTs, vPvBs, or EU CLP Cat.1 and 2 CMRs, or substances causing an equivalent level of concern, or exposure via effluent and sludge is unlikely or expected to be negligible. (Required for final manufacturing stage.)
	Water use data are made available to stakeholders.
	A strategy for achieving the Gold level water and soil conservation requirements has been developed. Progress is reported at recertification.

Gold	The Silver level water and soil conservation strategy has been implemented including: Conservation technologies and best practices at facilities expected to have the greatest water- and/or soil-related impacts. (Required for all final manufacturing facilities with high volume or pollutant intense processes and/or in stressed locations.) Actions to conserve water and/or soil in the supply chain, including the use of certified materials, working as part of multi-stakeholder group(s), and/or working directly with suppliers to implement water and soil stewardship requirements and address the processes of concern. (Required for key materials in scope.)
	Product relevant chemicals in effluent and sludge are assessed and optimized (i.e., none are x-assessed or grey-rated). (Required for the final manufacturing stage and for key materials where pollutant intense processes occur at tier 1, or at any tier for leather, metal finishing, pulp/paper and textiles.)
	A positive impact project that addresses local and/or product relevant water and/or soil issues has been implemented.
Platinum	Water quality data are made available to stakeholders.
	Impact of positive impact project demonstrated.
	For final manufacturing stage facilities: A comprehensive effluent and sludge quality management system has been established, and Effluent and sludge produced as a result of all manufacturing processes used at the facility are optimized.

7.1 Characterizing Local and Product Relevant Water & Soil Issues

Intended Outcome(s)

Through the assessment and understanding of water- and soil-related impacts attributable to the product, including local water availability and quality issues relevant to the product's manufacturing facilities, opportunities to address the impacts are identified.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Characterize local and product relevant water and soil issues.

For all final manufacturing stage facilities:

1. Determine the basin/catchment/watershed name.
2. Identify risks to water quantity (including baseline water stress) and water quality, and risk of unimproved or no access to drinking water and sanitation as defined by the most recent version of the World Resources Institute Aqueduct database or equivalent.

3. If a catchment level plan is available, obtain, review, and determine how the plan is relevant to the site. This must include a determination of whether a groundwater abstraction cap (i.e., a regulatory limit on total withdrawals) based on water resource availability has been set, and if so, the cap's relevance to the site.
4. Describe effluent and sludge treatment process(es).
5. If third-party treatment facilities are employed, identify the provider(s) and describe any issues with their ability to adequately treat effluent received from the facility.
6. Identify any known issues with source and/or receiving water contamination (e.g., due to the use of reclaimed water) or high concentrations of naturally occurring hazardous substances.
7. Describe any known issues with soil contamination, erosion, or other types of degradation at the site.
8. Determine if the facility is potentially impacting any sensitive ecosystems, protected areas, or similar.

For the product: Identify the use cycle stage(s) (also commonly referred to as "life cycle" stages) responsible for the majority of water quantity and quality related impacts. Describe the impacts of concern.

For facilities of tier 1 suppliers using high volume or pollutant intense processes to produce key materials that make up ≥ 25% of the product by weight or by cost, or for all tier 1 suppliers:

1. Determine the basin/catchment/watershed name.
2. Identify risks to water quantity (including baseline water stress) and water quality, and risk of unimproved or no access to drinking water and sanitation as defined by the most recent version of the World Resources Institute Aqueduct database or equivalent.

Key Materials

A key material is defined as a material that is typically produced using a high-volume water use process or a pollutant intense process (see *Cradle to Cradle Certified® Water & Soil Stewardship – Key Materials* reference document for the list of applicable materials and processes).

The key materials in scope for the Water & Soil Stewardship requirements must be determined at the generic material level (e.g., if several aluminum parts are used, the total weight of aluminum applies). If there are no key materials present at ≥ 25% when aggregated by generic material type, but the sum of all key materials is ≥ 25%, the requirements for key materials must be applied to the key materials representing the highest weight or cost fractions of the product until < 25% of the product includes key materials to which the requirements have not been applied. If the 25% threshold is met when using only weight or only cost, then the metric that results in meeting the 25% threshold must be used.

Alternative: Water and soil conservation (quantity and quality) impact hot spots, identified based on conducting a life cycle assessment per ISO 14040, may be used instead of key materials that make up ≥ 25% of the product by weight or by cost for all Water & Soil Stewardship requirements applying to key materials. The assessment must be verified by a qualified third party.

7.2 Effluent Quality Compliance

Intended Outcome(s)

Final manufacturing stage and select supplier facilities are in compliance with regulatory and/or industry best practice effluent limitations.

Applicable Achievement Level(s)

Bronze and Silver

Requirement(s)

Bronze level: For the final manufacturing stage, treat effluent (either on or off site) prior to discharge to the environment and adhere to effluent quality regulations or guidelines.

Silver level: For select tier 1 supplier facilities, treat effluent (either on or off site) prior to discharge to the environment and adhere to effluent quality regulations or guidelines.

Facilities discharging effluent directly to surface or groundwater must comply with the corresponding regional regulatory (if any), international, or industry best practice effluent quality guidelines for direct discharge. (Note: Facilities discharging via a sewer system that does not route to an effluent treatment facility with at least secondary treatment capabilities or equivalent are discharging directly to surface or groundwater for the purposes of this requirement.)

Bronze level

For final manufacturing stage facilities meeting this requirement based on regulatory compliance, the parameters addressed in the permit must also be consistent with leading regulations, international guidelines, or industry best practice. Leading regulations are defined as those that include a functioning mechanism through which water quality-based limits are set.

Final manufacturing stage facilities discharging process effluent to an off-site, independently operated effluent treatment facility (e.g., publicly owned treatment works, central effluent treatment plant, or wastewater treatment plant) with at least secondary treatment must:

1. Comply with required pretreatment limits, if any, and
2. Demonstrate that the treatment facility is treating the effluent received to quality standards in line with the corresponding regional regulatory (if any) or international guidelines.
   OR
   Comply with regional regulatory (if any), international, or industry best practice effluent quality guidelines for direct discharge.

Silver level

Select tier 1 supplier facilities discharging process effluent to an off-site, independently operated effluent treatment facility (e.g., publicly owned treatment works, central effluent treatment plant, or wastewater treatment plant) with at least secondary treatment must comply with required pretreatment limits, if any.

The “select” tier 1 supplier facilities in scope are those using pollutant intense processes to produce key materials (per the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials* reference document) that make up ≥ 25% of the product by weight or by cost.

Effluent testing

When effluent must be tested for verification purposes, sampling and testing must be conducted according to the methods specified by regulatory permits, the off-site, independently operated effluent treatment facility, and/or other guidelines as relevant. The analytical laboratory conducting the tests must be accredited or certified for the specific analysis per ISO 17025, NALEP, or equivalent.

7.3 Quantifying Water Use

Intended Outcome(s)

Water withdrawals, discharge, and consumption at facilities manufacturing the product(s) are quantified, creating a baseline against which reductions can be measured, and helping to identify areas for improvement.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Quantify annual water withdrawals, discharge, and consumption for all final manufacturing stage facilities.

Data must be collected on the following and the data sources indicated:

1. Withdrawals by source and water type,
2. Discharges by receiving body/destination,
3. Capacity of on-site treatment equipment,
4. Consumption by source,
5. Total amount and percentage of water recycled and reused.
6. Facilities that withdraw or purchase ≥ 100,000 m^3 of water per year are considered as having high-volume processes.

7.4 Providing Drinking Water, Sanitation, and Hygiene

Intended Outcome(s)

Access to drinking water, sanitation, and hygiene is treated as a basic requirement at the facilities where the product is manufactured.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Provide potable drinking water, adequate sanitation, and hygiene to all workers at all final manufacturing stage facilities.

The following conditions must be met:

1. Potable water must be dispensed using a clean and accessible method.
2. An adequate number of toilets per employee must be provided as required by local regulations or international guidelines if local regulations do not exist. The applicant must ensure that sewered and/or portable toilets:
    a. Provide privacy at all times (i.e., may be locked from the inside).
    b. Are separate for each gender. Alternatively, toilet facilities will not be occupied by more than one employee at a time, can be locked from the inside, and contain at least one toilet.
    c. If portable toilets are provided, they must be vented and equipped with lighting.

   d. Are accessible to all employees including disabled people and people with reduced mobility wherever current employees require such accommodations.
3. Handwashing facilities must be located at or adjacent to each toilet facility and must be equipped with one of the following:
   a. Running water and soap.
   b. Waterless skin-cleansing agents capable of disinfecting the skin or neutralizing the contaminants to which the employee may be exposed.
4. A sanitary method of drying hands after washing must be provided.
5. The applicant must establish and implement a maintenance and cleaning schedule with the goal of ensuring that each toilet and handwashing area is maintained in a clean, sanitary, and serviceable condition (including provision of toilet paper or other hygienic option).
6. Reasonable access to drinking water, sanitation, and hygiene facilities must be provided (i.e., either freely accessible at any time as needed by employees or, at a minimum, readily available upon request).

7.5 Water & Soil Stewardship Strategy

Intended Outcome(s)

A water and soil stewardship strategy is developed, providing an actionable pathway toward operating in a manner that protects water and soil resources.

Applicable Achievement Level(s)

Bronze and Silver

Requirement(s)

Bronze level: Develop a strategy for achieving the Silver level water and soil conservation requirements and report on progress made toward achieving the strategy at each recertification.

Silver level: Develop a strategy for achieving the Gold level water and soil conservation requirements and report on progress made toward achieving the strategy at each recertification.

For the Bronze level, the strategy must be designed with the aim of eventually achieving the Silver level as described in Section 7.6 Water and Soil Conservation.

For final manufacturing stage facilities with high volume processes that are also in medium to high stress locations, the strategy must also include quantitative water use reduction targets, informed by the Quantifying Water Use requirements (Section 7.3), including:

1. Near-term (defined as 0-2 years) and mid-term (defined as 2-20 years) targets.
2. Proposed activities and method(s) for reaching each target.
3. Base year(s) and target year(s) must be indicated.
4. A report of progress made toward meeting the targets that were set at the last certification including percent reductions in use and increases in percent recycling achieved (not applicable for initial certification).

For the Silver level, the strategy must be designed with the aim of eventually achieving the Gold level as described in Section 7.6 Water and Soil Conservation.

All strategies must include specific goal(s) and associated timelines for implementation.

7.6 Water & Soil Conservation

Intended Outcome(s)

Conservation technologies and best practices are increasingly being implemented to reduce water use and/or improve effluent and/or soil quality where there are known issues.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Implement at least one conservation technology or best practice at all final manufacturing stage facilities with high volume processes in stressed locations and/or with pollutant intense processes, and take at least one additional action to conserve water and/or soil at final manufacturing stage facilities or in the supply chain.

Gold level:

1. Implement conservation technologies or best practices at all final manufacturing stage facilities with high volume or pollutant intense processes, and/or in stressed locations.
2. For key materials that make up ≥ 25% of the product by weight or by cost, take action to conserve water and/or soil in the supply chain.

Silver Level

For final manufacturing stage facilities with high volume processes in medium to high stress locations, at least one technology or best practice leading to water use reductions must be implemented, and

For final manufacturing stage facilities with pollutant intense processes, at least one technology or best practice leading to improved effluent quality must be implemented, and

One of the Gold level requirements must also be implemented for at least one final manufacturing stage facility or for one key material that makes up ≥ 25% of the product by weight or by cost. (Required unless there are no final manufacturing stage facilities or key materials in scope for the Gold level requirements.)

High-volume and pollutant intense processes by material type are listed in the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials* reference document. Stress level is defined using the baseline water stress metric first referenced in Section 7.1. Other methods of identifying stress level may be considered on a case-by-case basis.

Gold Level

For final manufacturing stage facilities with high volume processes in medium to high stress locations, technologies or best practices leading to the maximum feasible water use reductions must be implemented, and

For final manufacturing stage facilities with high volume processes in low stress locations, at least one

technology or best practice leading to water use reductions must be implemented, and

For final manufacturing stage facilities in high stress locations without high volume processes, at least one technology or best practice leading to water use reductions must be implemented, and

For final manufacturing stage facilities with pollutant intense processes, technologies or best practices leading to the maximum feasible improvement in effluent quality must be implemented.

For key materials that make up ≥ 25% of the product by weight or by cost:

1. For forest and agricultural raw materials (excluding untraceable commodity type agriculturally derived material, e.g., ethanol):
    a. The material must be certified to a C2CPII-recognized standard that addresses the processes of concern (per the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials* reference document) or an equivalent alternative to certification must be in place.
    b. Alternatively, for the Gold level (i.e., not an option for the Platinum level), the following are required:
        i. An explanation of the limitation(s) preventing the incorporation of the required percentage(s) of certified material and how, based on these limitation(s), the amount of certified material currently used represents the maximum that is currently feasible.
        ii. The explanation must be reported publicly.
        iii. A strategy for addressing the identified limitation(s) and increasing the amount of certified material over time must be developed. The strategy must include discrete objectives and an associated timeline.
        iv. For recertification:
            1. The applicant must demonstrate progress toward achieving the objectives.
            2. A description of progress made must be reported publicly.
2. For other material types:
    a. A C2CPII-recognized certification or alternative that addresses the processes of concern must be in place (the alternative described in 1b above may be applied), or
    b. The applicant must be actively involved with a multi-stakeholder group working to address the processes of concern, or
    c. The applicant must work directly with suppliers of key materials to implement the Water and Soil Stewardship requirements (per the Alternative for Key Materials section below).

Alternative for Key Materials: Working with Suppliers to Implement Water and Soil Stewardship Requirements

The following receives credit as an alternative to using certified materials, implementing alternatives, or working with a multi-stakeholder working group to address water- and soil-related issues of concern:

For the Gold level, suppliers of key materials must fulfill the following requirements:

1. Local and Product Relevant Water and Soil Issues must be characterized (per Section 7.1).
2. For supplier facilities producing key materials associated with high volume processes and located in medium to high stress locations: At least one technology or best practice leading to water use reductions must be implemented.

3. For supplier facilities producing key materials associated with pollutant intense processes:
    a. The Effluent Quality Compliance requirements must be fulfilled (per Section 7.2), and
    b. At least one technology or best practice leading to improved water and/or soil quality must be implemented.

7.7 Assessing and Optimizing Product Relevant Chemicals in Effluent and Sludge

Intended Outcome(s)

Chemicals entering receiving waters and soils as a result of product manufacturing have been intentionally selected based on their preferred safety attributes.

- At the Bronze level, in alignment with leading regulations that aim to protect human health and the environment, the release of well-known toxic chemicals is avoided.
- At the Silver level, chemicals classified as carcinogenic, mutagenic, or reproductive toxicants (CMRs) are not used, or, if these substances are present, exposure to them is unlikely or expected to be negligible. In addition, persistent, bioaccumulative, and toxic (PBTs) or very persistent and very bioaccumulative (vPvBs) substances are not used. The product also does not contain substances that cause an equivalent level of concern or exposure to them is unlikely or expected to be negligible.
- At the Gold level, chemicals used are compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology. Exposure to hazardous chemicals via product relevant effluent and sludge is unlikely or expected to be negligible.

Applicable Achievement Level(s)

Bronze, Silver, and Gold

Requirement(s)

Bronze level: All product relevant chemicals entering effluent or sludge during the final manufacturing stage comply with the relevant restrictions on the Core Restricted Substances List (RSL).

Silver level:

Define and assess product relevant process chemicals entering effluent or sludge during the final manufacturing stage and develop a strategy for optimization.

- Ensure that any product relevant chemicals (including product relevant process chemicals) released with effluent or sludge during the final manufacturing stage:
    - Are not classified or listed as known or suspected to cause cancer, birth defects, genetic damage, reproductive harm (CMRs), or cause an equivalent level of concern, or, if these substances are released, that exposure is unlikely or expected to be negligible, and
    - Are not listed as persistent, bioaccumulative, and toxic (PBTs), very persistent and very bioaccumulative (vPvBs).

Gold level:

- Define and assess all product relevant chemicals entering effluent or sludge during the final manufacturing stage and at select supplier facilities.
- Ensure that any product relevant chemicals released with effluent or sludge during the final manufacturing stage or at select supplier facilities are compatible with human and environmental

health according to the Cradle to Cradle Certified Material Health Assessment Methodology, allowing only a, b, and c assessed chemicals within effluent and sludge.

For the Bronze level,

1. Product relevant chemicals are defined as intentional product inputs and process chemicals (including single chemicals and chemical mixtures, as well as known contaminants) used to manufacture the product. (Note: Process chemicals are further defined in the Definitions section).
2. All product relevant chemicals that enter or potentially enter the effluent are in scope.
3. If applicable, restriction thresholds apply to the chemical mixtures as received from the supplier.

For the Silver level,

1. For process chemical formulations, all substances present at 1000 ppm (0.1%) or above within the formulation are subject to review. Substances may be grey-rated due to missing toxicity information and otherwise must have received an abc-x rating.
2. CMRs are defined as substances that have received a harmonized classification of Category 1 or 2 in one or more of the CMR endpoints as listed within the EU's Classification, Labelling and Packaging regulation (CLP) Annex VI, or are CMR substances listed on the REACH Candidate list of Substances of Very High Concern (SVHC) for Authorisation (including those on Annex XIV). PBTs, vPvBs, and substances causing an equivalent level of concern are defined per the REACH Candidate list of Substances of Very High Concern (SVHC) for Authorisation (including those on Annex XIV).

For the Gold level, the "select" suppliers in scope are those meeting both of the following conditions:

1. Tier 1 suppliers to the final manufacturing stage and suppliers that carry out pollutant intense processes associated with the following material types regardless of tier: leather, metal finishes, pulp and paper, and textiles, and
2. Suppliers that produce key materials using pollutant intense processes for materials that make up ≥ 25% of the product by weight or by cost.

7.8 Transparency

Intended Outcome(s)

Water use and effluent quality data for final manufacturing stage facilities are available to stakeholders, demonstrating the manufacturer's commitment to water stewardship.

Applicable Achievement Level(s)

Silver and Platinum

Requirement(s)

Silver level: Make water use data for final manufacturing stage facilities available to stakeholders.

Platinum level: Make effluent quality data for the final manufacturing stage facilities available to stakeholders.

The data must include:

1. For the Silver and Platinum levels, withdrawals by source and stress level, consumption, and

discharge by level of treatment and destination.

2. For the Platinum level, effluent quality test reports as required for verification of the Effluent Quality Compliance requirements (see Section 7.2).

7.9 Positive Impact Project

Intended Outcome(s)

Water and/or soil quality, water quantity, or the health of aquatic and/or soil ecosystems within the catchment(s) where the manufacturer, employees, customers, and/or suppliers are located is improved through initiation or participation in a collaborative project.

Applicable Achievement Level(s)

Gold and Platinum

Requirement(s)

Gold level: Implement a project that will positively impact local and/or product relevant water or soil issues.

Platinum level: Demonstrate the impact of the positive impact project using quantitative metric(s).

The project must:

1. Reach beyond the final manufacturing stage facility and into the value chain and/or local community and aim to positively impact aquatic and/or soil ecosystems, local communities, water and/or soil quality and/or water quantity within the catchment(s) where the manufacturer, employees, customers, and/or suppliers are located.
2. Include direct involvement by company employees and/or senior management.
3. Address one or more of the issues identified in the Characterize Local and Product Relevant Water and Soil Issues requirement (Section 7.1) or otherwise be material to the applicant company.

7.10 Optimizing Effluent and Sludge Quality at the Facility Level

Intended Outcome(s)

Effluent and sludge at final manufacturing facilities are managed with the aim of protecting local water quality and ecosystem health.

Applicable Achievement Level(s)

Platinum

Requirement(s)

For the final manufacturing stage facilities:

- Establish a comprehensive effluent and sludge quality management system, and
- Optimize the effluent and sludge produced as a result of all manufacturing processes used at the facility.

The following are in scope:

1. Effluent and sludge produced as a result of all manufacturing processes at the facility.
2. Non-manufacturing effluent and sludge (e.g., from water used in toilets, kitchen areas) unless treated by an off-site, independently operated effluent treatment facility.
3. All chemicals with potential to enter effluent and sludge including, but not limited to:
    a. process chemicals,
    b. intentional product inputs,
    c. chemicals used to treat and clean cooling systems,
    d. chemicals used to treat the effluent, and
    e. custodial/cleaning chemicals used in the manufacturing area.

Managing Effluent and Sludge Quality

The comprehensive effluent quality management system must:

1. Be informed by an understanding of:
    a. The hazardous substances (defined as substances with RED hazard(s) per the Material Health Assessment Methodology) used intentionally and unintentionally by the facility and the industry. This must be determined based on a comprehensive review of safety data sheets and the relevant literature on chemicals of known and emerging concern, both regulated and non-regulated. (Note: This is different from the chemical inventory required for materials and products in the Material Health category.)
    b. Local and catchment level water quality issues that are relevant to the facility, surrounding ecosystem, and community, including the quality of source and receiving waters, and the health of receiving ecosystems, determined per the Characterize Local and Product Relevant Water Issues requirement (Section 7.1) and communication with non-governmental organizations (NGOs) working on local water issues and/or local water authorities.
2. Include comprehensive methods for avoiding the intentional and unintentional use, and subsequent introduction, of hazardous substances to the environment via effluent and sludge. The methods must address all chemicals in scope and may include but are not limited to:
    a. Use of third-party certified and optimized input formulations and materials,
    b. Analytical testing of purchased formulations to screen for hazardous contaminants, and
    c. Adherence to industry best practice manufacturing restricted substances lists.
3. Include qualified third-party verification that processes and procedures for on-site treatment facility operation (if any) and water quality management are in place and functioning.
4. Monitor conventional water quality parameters (e.g., pH, total suspended solids, biochemical oxygen demand), and for the release of hazardous substances relevant to the industry and facility. The following are required:
    a. Effluent as it leaves the facility must be tested for all substances of concern identified per the required research (per #1).
    b. Best practices must be used to collect samples.
    c. Testing must be conducted at least two times per year.
    d. Laboratories conducting the tests must be ISO 17025 accredited.

Optimizing Effluent and Sludge Quality

1. For conventional water quality parameters, facility(ies) releasing effluent directly to surface or groundwater (defined in Section 7.2) must comply with the more stringent of the limitations indicated by either their permits or as follows:
    a. pH: 6-9
    b. Biological Oxygen Demand (BOD): 25 mg/L
    c. Chemical Oxygen Demand (COD): 100 mg/L
    d. Total Suspended Solids (TSS): 30 mg/L
    e. Ammonia (as N): 10 mg/L
    f. Total nitrogen: 10 mg/L
    g. Total phosphorus: 2.0 mg/L
    h. Temperature: < 3 °C increase
    i. Color: 7 m^{-1} (436 nm; yellow) 5 m^{-1} (525 nm; red) 3 m^{-1} (620 nm; blue)
    j. Oil and grease: 10 mg/L
    k. Coliform: 400 bacteria/100 ml

    Applicants who would be required to comply with effluent limits more stringent than what is indicated by their permits may alternatively publicly disclose an explanation of the conditions and/or trade-offs preventing the facility from meeting the more stringent limits.

    These effluent limits are the most stringent of those listed for multi-brand consortia or for the benchmark countries (if not included in multi-brand consortia list) per Zero Discharge of Hazardous Chemicals Programme, Textile Industry Wastewater Discharge Quality Standards Literature Review REV1, 2015. https://www.roadmaptozero.com/fileadmin/pdf/WastewaterQualityGuidelineLitReview.pdf

2. Hazardous substances identified per the required research (per the Effluent and Sludge Quality Management section #1) must not be x-assessed in effluent or sludge (per the Material Health Assessment Methodology section on assessment of effluent and sludge).

Receiving water is defined as the ultimate receiving water in the case of off-site, independently operated effluent treatment facilities.

8 // Social Fairness Requirements

Category Intent

Companies are committed to upholding human rights and applying fair and equitable business practices.

Requirements Summary

To achieve a desired level within the category, the requirements at all lower levels must also be met.

Bronze	Human rights risks are assessed for the applicant company, final manufacturing stage, and direct suppliers to the final manufacturing stage (tier 1). Progress is made on assessing risks beyond tier 1 (i.e., tier 2 and beyond).
	A human rights policy based on international human rights standards and an understanding of the company's risk areas is in place.
	A strategy for implementing the human rights policy is developed. At recertification, progress toward achieving the strategy is measured.
	For the applicant company and final manufacturing stage facilities, performance against the human rights policy is measured and corrective actions for select issues (e.g., child labor, forced labor) are complete. Corrective actions are planned for any other poor performance issues and, at recertification, progress is demonstrated.
	Company executives demonstrate commitment and support for establishing, promoting, maintaining, and improving a culture of social fairness.
Silver	Social audit performance data are requested from tier 1 suppliers in high-risk locations. At recertification, progress is made on supply chain data collection and corrective actions, if needed. Corrective actions for select issues (e.g., child labor, forced labor) are complete.
	Management systems support the implementation and oversight of the human rights policy within company operations.
	A grievance mechanism permits company employees and other stakeholders to obtain redress for negative human rights impacts.
	The company has implemented a positive social impact project that measurably improves the lives of employees, the local community, or a social aspect of the value chain.
	The company uses open and transparent governance and reporting, making information on how human rights risks are managed and adverse impacts are addressed publicly available.

Gold	Human rights risks are assessed for the product's components and raw materials (regardless of tier).
	Materials associated with high risk of child or forced labor or support of conflict are certified to a C2CPII-recognized certification program or an equivalent alternative is in place. If a certification program is not available, a traceability exercise is conducted upon recertification.
	Responsible sourcing management systems support the implementation and oversight of the policy within the product's supply chain.
	A grievance mechanism permits contract manufacturer employees and other stakeholders to obtain redress for negative human rights impacts.
	An assessment has been conducted to determine the impact of the positive impact project using quantitative metric(s). Measurable progress is demonstrated at recertification.
	The company incorporates stakeholder engagement and feedback into human rights risk management. Stakeholder feedback informs strategy and operations.
Platinum	The company is collaborating to develop and scale solutions to an intractable social issue within the value chain of the product.
	The company fosters a diverse, inclusive, and engaged work environment in which social fairness operates as a core part of recruitment, training, remuneration, performance evaluation, and incentive structures.

8.1 Assessing Risks and Opportunities

Intended Outcome(s)

Opportunities for improvement are identified and understood as a result of an assessment of human rights risks.

Applicable Achievement Level(s)

Bronze and Gold

Requirement(s)

Bronze level:

- Assess human rights risks and identify opportunities for improvement for the applicant company, including all final manufacturing stage facilities, and tier 1 suppliers. (Note: Tier 1 suppliers are defined as suppliers to the final manufacturing stage, including in cases where the applicant is using contract manufacturing.)
- Demonstrate ongoing efforts to improve visibility and assess risks within the certified product's supply chain (i.e., beyond tier 1).

Gold level: Assess human rights risks and identify opportunities for improvement associated with the product's components and raw materials (regardless of supply chain tier).

For the Bronze level, the risk and opportunity assessment must include:

1. A company level risk assessment based on conducting desk research, at a minimum, to identify:

   a. Known and likely human rights risks associated with the applicant company's own operations, final manufacturing stage facilities, the product's supply chain, product cycling, relevant communities, potentially affected groups, and other relevant stakeholders.
   b. Well-known risks associated with the applicant's industry/sector and country(ies) of operation.
2. A tier 1 supplier risk assessment based on knowledge of supplier industry/sector and locations to identify high-risk supplier facilities including those in:
   a. Industries/sectors associated with a high risk of human rights violations or other negative human rights impacts.
   b. Locations that are reputed to have conflict, corruption, widespread human rights violations, and/or weak governance.
   c. De facto high-risk locations, defined as countries that fall below the 65% percentile when taking an average of the six World Bank Worldwide Governance Indicators.
3. Identification of human rights due diligence best practices to address the risks.
4. Information regarding the impact and importance of identified risks as defined by affected stakeholders, including employees of the applicant company.
5. Prioritization of the risks and opportunities for improvement identified. At a minimum, the following must be prioritized:
   a. Well-known industry risks,
   b. Human rights violations, and
   c. Issues where the applicant has substantial leverage to make improvements.
6. Testing the results of the assessment with internal audience(s) to validate the outcome.

Ongoing efforts to improve visibility and assess risks within the product's supply chain based on increasing knowledge of tier 2 (and eventually beyond tier 2) supplier industry/sector(s) and location(s) as described in #2 above for tier 1 must be demonstrated. If new risks are identified, #3-6 above also apply. For supplier locations that have not yet been identified, if there is a chance that the location is high risk, then it must be considered de facto high risk until shown otherwise. Identification of the locations of these potentially high-risk suppliers must be prioritized.

For the Gold level, high-risk components and raw materials must be identified, including the following de facto high-risk items:

1. Materials and components from source countries where there is reason to believe that child labor or forced labor is involved, and
2. Tin, tantalum, tungsten, and gold from conflict-affected and high-risk areas.
3. If new risks are identified, #3-6 above also apply.

8.2 Human Rights Policy

Intended Outcome(s)

The applicant is formally committed to respecting and upholding human rights as defined by international standards.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Commit to respect human rights, as enshrined in municipal law and internationally recognized human rights standards, through company policy.

The policy must:

1. Establish human rights expectations for the applicant company, the supply chain, communities, potentially affected groups, and other relevant stakeholders.
2. Include the company's commitment to support the following (Note: These are the expectations that must be established and are referred to as "required policy elements" in other sections of the standard):
    a. Elimination of discrimination with respect to employment and occupation including, but not limited to, ethnicity-, race- and gender-based discrimination,
    b. Elimination of harassment and abuse,
    c. Elimination of all forms of forced or compulsory labor, or activities that are known to lead to forced labor (e.g., human trafficking),
    d. The abolition of child labor and adequate protections for workers above the legal working age and below age 18,
    e. Prevention of excessive working hours,
    f. Freedom of association and collective bargaining,
    g. Safe and healthy work, including:
        i. Access to water, sanitation, and hygiene (WASH),
        ii. Emergency preparation and response,
        iii. Hazardous materials handling procedures,
        iv. Management systems that address health and safety risks, and
        v. Appropriate building construction, electrical, and fire safety,
    h. Provision of the legal minimum wage and all legally mandated benefits including employer contributions for social security benefits and services,
    i. Aspirations for the provision of a living wage that covers the necessities for life as defined in its local context (e.g., food, water, housing, health care, education, clothing, transportation, child care, discretionary income),
    j. Fair and ethical business practices, including anti-corruption/bribery. (Note: In practice, this may be part of a human rights policy or, more commonly, a separate company policy or code.),
    k. Additional priority issues identified in the risk assessment (per Section 8.1), if any.
3. Be formally approved and signed by a duly empowered officer of the applicant company or by the board of directors.

The policy must be guided by the eight Fundamental Conventions of the International Labor Organization and the United Nations Guiding Principles on Business and Human Rights, as well as the International Bill of Human Rights. Where national law and these international human rights standards differ, the applicant must follow the higher standard; where they are in conflict, the applicant must seek to respect internationally recognized human rights to the greatest extent possible.

8.3 Monitor and Verify Performance

Intended Outcome(s)

Performance on upholding human rights is monitored and verified, ensuring that corrective actions are taken when poor performance is identified and increasing the level of assurance that risks to human rights are addressed.

Applicable Achievement Level(s)

Bronze, Silver, and Gold

Requirement(s)

Bronze level: For the applicant company and final manufacturing stage facilities, measure performance against the human rights policy and confirm the completion of corrective actions associated with issues of high concern including child labor, forced labor, corruption/bribery, and immediate threats to life and safety. For any other poor performance issues, plan corrective actions and, at recertification, demonstrate progress on addressing the issues.

Silver level: Request data measuring performance against the human rights policy from all high-risk tier 1 suppliers. At recertification, demonstrate continued efforts to obtain performance data and evidence of tracking corrective actions that may be necessary at tier 1 supplier locations.

Gold level: For components and raw materials associated with high risk of child labor, forced labor, or support of conflict, specify or certify to a C2CPII-recognized certification (if available) or equivalent that includes performance requirements aligned with the human rights policy.

For the Bronze level:

1. Performance data must be generated and verified by a qualified party.
2. If identified, the following issues of high concern must be resolved prior to certification or recertification
    a. Child labor,
    b. Forced labor,
    c. Corruption/bribery,
    d. Unauthorized subcontracting,
    e. Missing or deficient permits (i.e., business license, building permit, and environmental permit(s) if required by local regulations),
    f. Any immediate threat to life or safety (e.g., poor fire safety, structural safety hazard), and
    g. Denial of access to the facility, workers, or files.

For the Silver level:

1. Social audit performance data must be requested from all high-risk tier 1 suppliers providing components and materials that are subject to review (as defined in Material Health Section 4.3), including all de facto high-risk suppliers (as defined in Section 8.1).
2. If data are outdated or not available, the applicant must arrange for a social audit to be conducted.
3. Audits must be performed by qualified personnel with a social audit credential and no conflicts of interest related to the supplier.

4. Data must be generated within the past 24 months.
5. If identified, the following issues of high concern must be resolved prior to certification or recertification,
    a. Child labor,
    b. Forced labor,
    c. Corruption/bribery,
    d. Unauthorized subcontracting,
    e. Missing or deficient permits (i.e., business license, building permit, and environmental permit(s) if required by local regulations),
    f. Any immediate threat to life or safety (e.g., poor fire safety, structural safety hazard), and
    g. Denial of access to the facility, workers, or files.
6. Corrective actions must be planned or ongoing for any other poor performance issues identified. At recertification, the applicant must demonstrate progress on:
    a. Encouraging suppliers to complete corrective actions,
    b. Tracking whether timelines are adhered to, and
    c. Taking steps to suspend or terminate relationships with suppliers that fail to make progress on remediation.
7. At recertification, progress must be demonstrated on requesting social audit data from additional high-risk suppliers, if any, identified through the supplier risk assessment. For suppliers that continually fail to provide data, the applicant must take remedial actions (i.e., steps to suspend or terminate the relationship) after a maximum of two years.

For the Gold level:

1. A C2CPII-recognized certification or an equivalent alternative to certification is required for all de facto high-risk components and raw materials subject to review (as defined for Material Health), if a C2CPII-recognized certification exists and certified material is available.
2. At recertification, if a C2CPII-recognized certification does not exist, or certified material is not available, and the applicant has not been able to institute an alternative, the applicant must:
    a. Undertake a traceability exercise with the goal of tracking the material from the direct supplier through all stages of processing to initial production or extraction,
    b. Establish how to mitigate the negative human rights impacts, and
    c. Participate in a stakeholder initiative actively working to address the issues.

8.4 Strategy for Policy Implementation

Intended Outcome(s)

A framework for monitoring and measuring progress toward achievement of social performance targets and for identifying areas for improvement is established.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Bronze level: Develop a strategy for implementing the human rights policy and report on implementation progress at each recertification.

The strategy must:

1. Address priority risks and opportunities (per Section 8.1).
2. Include specific time-bound performance and impact objectives to guide decision making.
3. Define the scope of implementation.
4. Define the company's human, technical, and material resource allocation for implementation.

For recertification, performance data must be collected and analyzed to measure progress toward achieving social targets and objectives, and identify areas for improvement. For any areas of poor performance identified, methods of improving outcomes must be identified and evaluated, and the strategy refined accordingly.

8.5 Demonstrating Commitment

Intended Outcome(s)

A culture of social fairness that prioritizes human rights and the application of responsible business practices to all stakeholders is established, promoted, and improved by company leadership.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Demonstrate commitment and support for establishing and maintaining a culture whereby employees and business partners are able to achieve high levels of social performance.

The applicant's leadership team (i.e., C-level executive and/or Board of Directors) must demonstrate commitment and support by:

1. Communicating the company's social aspirations and values, strategy for upholding human rights, and significance of respect for human rights to the success of the company internally and/or externally.
2. Defining a position to actively lead on human rights, oversee implementation of the strategy, and drive continuous improvement efforts.
3. Ensuring there are defined procedures for escalating human rights risks and identified impacts to the executive team.

8.6 Management Systems

Intended Outcome(s)

A management system for people and procedures is in place, ensuring that necessary corrective actions are taken, actions are effective, and that performance on protecting human rights is ultimately improved.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Implement a management system that supports achievement of the human rights policy commitments within company operations.

Gold level: Implement a responsible sourcing management system that supports achievement of the human rights policy commitments within the product's supply chain.

For the Silver level, the management system must include the following elements:

1. Designated staff with social compliance responsibilities.
2. Designated oversight function and process.
3. Business procedures that support implementation of the human rights policy within the company's workplace and across corporate functions and different levels of management.
4. Education for staff with social-related duties on human rights principles.
5. Internal communication and employee involvement.
6. Procedures to measure and evaluate workplace activities against the human rights policy.
7. Policies and procedures for the prompt implementation of corrective and preventive actions within the company's workforce.

For the Gold level, the responsible sourcing management system must include the following elements:

1. Designated staff with ethical sourcing responsibilities.
2. Designated oversight function and process.
3. Procedures to communicate to suppliers the company's human rights policy and any associated ethical sourcing business processes.
4. Supplier contractual requirements for human rights policy compliance and monitoring (e.g., supplier codes of conduct if defined as a contractual term). Contracts must require suppliers to extend social compliance expectations to their suppliers.
5. Evaluation of new suppliers prior to the awarding of contracts to determine if the supplier can meet requirements.
6. Policies and procedures for the prompt implementation of corrective and preventive actions.
7. Education for sourcing and/or procurement team(s) on responsible sourcing and/or human rights principles.
8. Business procedures for identifying and documenting the cause and resolution of human rights issues and/or impacts in the supply chain that arise as a result of audits/reviews or concerns raised by employees or other third parties.

For recertification at the Silver or Gold level, the policy, procedures, practices and/or programs must be reviewed to identify deficiencies and implement changes (if needed) that will lead to improved performance. Remedial activities (if needed) must be underway and seek to identify and address root causes. (Note: This applies to the company-level management system at the Silver level and also to the responsible sourcing management system at the Gold level.)

8.7 Grievance Mechanisms

Intended Outcome(s)

A mechanism is in place by which employees, customers, suppliers, and other stakeholders may safely report negative effects of business activities and operations and other social fairness concerns to the company in order to obtain redress for those impacts.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Provide a grievance mechanism that permits company employees and other stakeholders to obtain redress for negative human rights impacts. For any contract final manufacturing stage facilities, request that a grievance mechanism be made available.

Gold level: For contract final manufacturing stage facilities, ensure that a grievance mechanism is available that permits employees and other stakeholders to obtain redress for negative human rights impacts.

For the Silver and Gold levels, the applicant company must have a grievance mechanism for company employees and other stakeholders that:

1. Is supported by a non-retaliation policy.
2. Is capable of addressing the risks and potential adverse impacts on people.
3. Addresses concerns promptly, using an understandable and transparent process based on local best practices that is readily accessible by any affected stakeholder.
4. Provides feedback to those concerned, without their risking retribution.
5. Includes informing direct employees about the mechanism at the time of hire.
6. Does not impede or preclude access to judicial or administrative remedies that might be available under law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.
7. Includes written records and periodic reviews to identify and make necessary improvements.

For the Gold level, the grievance mechanism may be provided by the contract manufacturer or by the applicant.

8.8 Positive Impact Project

Intended Outcome(s)

Positive impact on a social issue of significant importance to the company and/or value chain of the product.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Implement a positive impact project that measurably improves the lives of employees, the local community, or a social aspect within the value chain of the product.

Gold level: Conduct an assessment to determine the impact of the positive impact project using quantitative metric(s).

For the Silver level, the following are required:

1. The applicant must invest in a social impact project that involves issues or opportunities that were identified in the risk assessment process (per Section 8.1) or that are otherwise material to the company.
2. The project goal(s) must be supported by one or more key performance indicators that are tracked before, during, and after the project.
3. Project selection must incorporate employee input.

For the Gold level, an impact assessment must be performed based on the defined key performance indicator(s). For recertification, measurable progress must be demonstrated.

8.9 Transparency and Stakeholder Engagement

Intended Outcome(s)

The applicant company is held accountable for any negative human rights impacts, encouraging ever improving performance.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Use open and transparent governance and reporting, making information on how human rights risks are managed and adverse impacts are addressed publicly available.

Gold level: Incorporate stakeholder engagement and feedback into human rights risk management, using it to shape company strategy and operations.

For the Silver level, the applicant must make the following information publicly available:

1. The human rights policy, objectives, and progress toward achieving objectives (i.e., activities and outcomes),
2. A description of adverse impacts on human rights and how they are addressed, and
3. Sourcing information including number of suppliers by geographic location. Required for the final manufacturing stage, direct suppliers to the final manufacturing stage, and suppliers of high-risk components and raw materials (when such information becomes available or at a minimum for the Gold level when identified as required per Section 8.1).

For the Gold level, the applicant must have a robust process for accepting or soliciting, and responding to, stakeholder feedback. Input from stakeholders must be regularly obtained and used to shape the strategy for implementing the human rights policy, management systems, and related operations.

8.10 Collaborating to Solve Social Issues

Intended Outcome(s)

Industry-wide progress is made toward solving social issues that are widely recognized as being difficult and complex.

Applicable Achievement Level(s)

Platinum

Requirement(s)

Collaborate to develop and scale solutions to an intractable social issue within the value chain of the product.

Collaboration must be with a multi-stakeholder program or consortium working on a common goal to comprehensively address a social issue. The applicant must actively participate for the full certification period. The initiative selected must:

1. Support implementation of the company's social strategy and policy.
2. Aim to drive progress within an industry or across multiple industries.
3. Ensure that ground rules for the partnership allow for adequate voice for all participants.
4. Include ongoing assessment of partnership impact.

8.11 Fostering a Culture of Social Fairness

Intended Outcome(s)

Socially fair business practices in its governance and management approach are applied by the applicant company. This is reflected by a diverse, inclusive, and engaged workforce and through training, remuneration, and payment of a living wage.

Applicable Achievement Level(s)

Platinum

Requirement(s)

Foster a diverse, inclusive, and engaged work environment in which social fairness operates as a core part of recruitment, training, remuneration, performance evaluation, and incentive structures.

The following are required:

1. Hiring and promotion processes must be evaluated and amended, if needed, to promote inclusivity and equal opportunity.
2. Access to training on key social issues (i.e., those included in the policy or identified per the risk assessment) must be provided to all executives and employees.
3. Awareness training on diversity and inclusion, gender equality, and anti-discrimination must be provided to all staff.
4. Social performance indicators must include ethnicity-, race-, sex- and age-disaggregated data on hiring, compensation, promotion, demotion, training and mentoring for employees of all levels.

Exception: If applicable local laws do not permit collection of all or a portion of the required data, the pertinent portion of the requirement is waived.

5. Data must be evaluated for pay equity, including a comparison of the average wages by ethnicity, race, and gender for work of equal value, and the ratio of the compensation of the CEO or equivalent to the median and average wage of a full-time worker. The exception noted in #4 applies.
6. Pay equity data must be published externally and made publicly accessible. An explanation of differences that may be realized or quantified over time must be included. The exception noted in #4 applies.
7. Data on violence in the workplace, including gender-based violence, must be documented where it has occurred.
8. Performance assessments of any executives or employees with designated social responsibilities must include consideration of criteria or metrics derived from the human rights policy and strategy.
    a. Social performance results must be considered in compensation packages / incentive plans for top company executives and management with social management or oversight functions (i.e., from C-level executives to business unit and functional heads).
9. Diversity and equal opportunity employment must be included in the organization's social strategy and implementation. The company must:
    a. Conduct an evaluation to understand why differences in representation by ethnicity, race, and gender exist in the boardroom, the workplace, and the first tier of the supply chain.
    b. Develop and implement a plan for remedying any differences that are or may be attributable to unequal opportunity.
    c. Investigate, encourage, and promote equal opportunities for women and racial, ethnic, religious, or economically disadvantaged minorities into supervisory and management roles in the workplace, particularly if they are under-represented in such roles.
10. Employees must be paid a living wage. This is defined as being paid sufficiently for a standard workweek (i.e., not including overtime) to afford a decent standard of living for their families, inclusive of: food, water, housing, education, health care, transportation, clothing, and other essential needs including savings for unexpected events and some disposable income.
11. Program(s) must be implemented to regularly engage employees (including other workers on the premises or under the supervision of the company) on the company's social vision and goals, and to identify actions that will help the company to achieve them.

9 // Packaging for Certified Products

The requirements in this section apply to the packaging of a product seeking certification. At a minimum, the packaging for a product seeking certification is subject to the requirements listed in this section.

Alternatively, packaging may be:

1. Certified as a separate product –– In this case, the product must meet all standard requirements, the same as other products. Note that standard Sections 2.3 and 5 include requirements specific to single-use plastic packaging when certified as a separate product.
2. Assessed separately from the product in the Material Health and Product Circularity categories only –– In this case, the achievement levels for these two categories are assigned to the packaging separately, and are separately stated on the product's certificate and in the Cradle to Cradle Certified Product Registry. If this option is selected, the packaging is not certified in its own right and is not subject to the Clean Air & Climate Protection, Water & Soil Stewardship, or Social Fairness requirements.

Intended Outcome(s)

Product packaging meets high product circularity standards at the entry level of certification, ensuring alignment with the Cradle to Cradle principles for these typically non-circular product types.

Applicable Achievement Level(s)

Bronze

Requirement(s)

For product packaging, design the packaging for cycling, incorporate cycled content, and ensure access to cycling.

The following are required:

1. The primary packaging materials for formulated consumer products that are fast-moving consumer goods, including cosmetics, personal care, and household and industrial/institutional cleaning products, and for any product, packaging materials that are intended to be used with the product or for the application or dispensing of the product (e.g., mascara brush, lipstick tube, or other types of applicators, paper towel or toilet paper cores, tape dispenser, glue stick), must comply with:
    a. The RSL (Section 4.1),
    b. The restriction on organohalogens and functionally related chemicals of concern (Section 4.2), AND two of the following from c, d, e, and f below:
    c. The sum of post-consumer cycled and renewable content must be ≥ 20% or equal to the percentage of cycled and renewable content required for the Silver level per Section 5.4 Increasing Demand.
    d. 90% of the packaging materials by weight meet all cycling requirements below or meet the Silver and Gold level requirements, respectively, in Sections 5.2 Preparing for Active Cycling and 5.5 Material Compatibility for Technical and/or Biological Cycles:
        i. The packaging must be compatible for municipal cycling systems,

ii. Plastic materials must be a type that is commonly recycled or composted via curbside pickup (i.e., PET, HDPE, PP, bioplastics) and the material must be accepted by municipal recycling programs in the region(s) where the product is sold,
iii. Materials that are intended for composting must be fully compostable per a C2CPII-recognized compostability standard consistent with the intended cycling pathway(s), and
iv. Materials that are commonly recyclable (e.g., paper, steel, aluminum) must not contain additives or features that are likely to result in low-value (i.e., low-quality) reprocessed material. Additives that may be present in the recycled content used are out of scope for this determination. Exemption: Glass is exempt from this requirement.

e. The packaging is reusable/refillable, is part of a refill system (e.g., refill pouches), and/or the packaging has a product-specific take-back program.
f. The applicant has demonstrated efforts to reduce the amount or weight of the packaging materials for the certified product or has met the Gold level requirements in Section 5.7 Circular Design Opportunities and Innovation.

2. Any other packaging materials contained in one sales unit as it is offered to the end user or consumer at the point of purchase and not added exclusively for shipping (e.g., a toothpaste box, outer box containing individually wrapped product units), must comply with:
   a. The restriction on organohalogens and functionally related chemicals of concern (Section 4.2), AND one of the following from b, c, d, and e below:
   b. The sum of post-consumer cycled and renewable content must be ≥ 20% or equal to the percentage of cycled and renewable content required for the Silver level per Section 5.4 Increasing Demand.
   c. 90% of the packaging materials by weight meet all cycling requirements below or meet the Silver and Gold level requirements, respectively, in Sections 5.2 Preparing for Active Cycling and 5.5 Material Compatibility for Technical and/or Biological Cycles:
      i. The packaging must be compatible for municipal cycling systems,
      ii. Plastic materials must be a type that is commonly recycled or composted via curbside pickup (i.e., PET, HDPE, PP, bioplastics) and the material must be accepted by municipal recycling programs in the region(s) where the product is sold,
      iii. Materials that are intended for composting must be fully compostable per a C2CPII-recognized compostability standard consistent with the intended cycling pathway(s), and
      iv. Materials that are commonly recyclable (e.g., paper, steel, aluminum) must not contain additives or features that are likely to result in low-value (i.e., low-quality) reprocessed material. Additives that may be present in the recycled content used are out of scope for this determination. Exemption: Glass is exempt from this requirement.
   d. The packaging is reusable/refillable, is part of a refill system (e.g., refill pouches), and/or the packaging has a product-specific take-back program.
   e. The applicant has demonstrated efforts to reduce the amount or weight of the packaging materials for the certified product or has met the Gold level requirements in Section 5.7 Circular Design Opportunities and Innovation.

The following materials are not subject to the packaging requirements:

1. Materials used exclusively for shipping the product, such as a box, pallet, or shrink/plastic wrap, that

are not the primary packaging materials that contain, envelop, or hold the product.

2. Packaging materials for products that are sold exclusively as material inputs for other products (rather than being sold to the general public).

10 // Animal Welfare Requirements

Several animal material types may not be used in certified products (see eligibility restrictions in the User Guidance). The requirements in this section apply to animal materials and substances derived from animal materials that are eligible for certification. The eligible materials and substances to which the requirements in this section apply are:

1. By-products of meat production and fishing (e.g., leather, sheepskin, down, fish skin - excluding fur), or
2. Material sourced from animals that do not have to be killed or live-plucked in order to harvest the material (e.g., sheep's wool).

For substances derived from by-products (e.g., substances derived from fat, skin, bone): The requirements in this section apply only if these substances are inextricably tied to the product's core functionality (e.g., products made entirely from gelatin, collagen, chondroitin, squid ink, or tallow, and products containing these substances, if tied to core functionality).

Note: These requirements do not apply to material from invertebrates for which clear evidence of sentience does not exist.

Intended Outcome(s)

The welfare of the animals is protected during all production phases when material from animals is used in a certified product.

Applicable Achievement Level(s)

Bronze and Silver

Requirement(s)

Bronze level: For products containing animal material, commit to protecting animal welfare through company policy. Develop a strategy and plan for implementing a mechanism that aims to ensure adherence to the policy and demonstrate progress toward implementing the policy and mechanism.

Silver level: Use materials and substances certified to a C2CPII-recognized animal welfare certification program, or equivalent alternative.

For the Bronze level, the applicant must have a policy in place that forbids animal abuse at all facilities where the animals are raised and/or slaughtered (including any facilities in the supply chain), and during transport. The policy must:

1. Address the five freedoms:
    a. Freedom from hunger and thirst
    b. Freedom from discomfort
    c. Freedom from pain, injury, and disease
    d. Freedom to express normal behavior
    e. Freedom from fear and distress
2. Prohibit specific practices of high concern for the animal-derived material type in question (e.g., mulesing of sheep).

3. Include provisions to immediately address cases where it becomes known that animal abuse is occurring (e.g., a provision to immediately cease doing business with affected suppliers until the issue is resolved).

The planned mechanism for implementing the policy must include:

1. Regular on-site surveillance of all relevant facilities by individuals knowledgeable of animal health and welfare issues to verify implementation of the policy.
2. A method of tracking material from farm to certified product in any case where the farm is not the final manufacturing stage.

For the Silver level:

1. The animal welfare certification or alternative must address all required points of the policy (per the Bronze level requirements) and include regular site surveillance of all relevant facilities by third-party auditors knowledgeable of animal health and welfare issues. Regular site surveillance is defined as at least one on-site audit every two years including an allowance for conducting unannounced audits.
2. If using an equivalent alternative to certification, qualified third-party auditors without a conflict of interest (i.e., no other paid services provided to the applicant) must verify equivalency and policy implementation.

11 // Private Label Product Requirements

A private label product is a product that is identical in every way to another product that is currently Cradle to Cradle Certified (i.e., the parent product), except for brand name and packaging.

Companies applying for a private label product certification must meet the following requirements:

1. Complete and sign a Private Label Verification Form stating that the product is identical to the certified parent product,
2. If necessary for the achievement level in the Product Circularity category met by the parent product, make a connection to the original equipment manufacturer's or parent product company's take-back program(s) or other cycling initiatives in order for the product to be cycled as intended, and
3. Unless meeting all standard requirements per the option below, disclose that the certification is a private label certification. (C2CPII will indicate which certifications are private label product certifications on the Cradle to Cradle Certified Product Registry and on Cradle to Cradle Certified certificates.)

All other program requirements will have been met by the parent product company rather than by the private label company.

If a company does not wish to disclose that the product has a private label certification, the product and company must meet all standard requirements (although the majority will have already been met by the manufacturer and parent company). This will include:

- The company-level Social Fairness requirements, and
- The company-level Environmental Policy and Management requirements unless already met by the final manufacturing stage.

For further information about private label certifications, see the Policy for Certification of Private Label Products within the Cradle to Cradle Certified® Certification Scheme.

12 // Definitions

Anaerobic digestion – The process by which microorganisms biologically decompose material into carbon dioxide, methane, water, inorganic compounds, and/or biomass in an anaerobic environment (absence of oxygen), within a limited time period.

Baseline water stress – Measures the ratio of total water withdrawals to available renewable surface and groundwater supplies. Water withdrawals include domestic, industrial, irrigation, and livestock consumptive and non-consumptive uses. Available renewable water supplies include the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users. - WRI Aqueduct, 2019

Benign minerals – Inorganic salts that contain cations and anions that are considered compatible with or beneficial to biological life processes.

Biodegradable material – A material that can undergo near-complete biological decomposition into carbon dioxide, water, inorganic compounds, and biomass in a natural medium (soil, water, or anaerobic environments) within a limited time period, thereby efficiently returning nutrients from the material back to the earth.

Bioenergy credit multiplier – A unitless factor used to calculate the bioenergy credit. The bioenergy credit multiplier is equal to: [1- (adjusted Biogenic Assessment Factor for the eligible fuel)].

Biogenic assessment factor – A unitless factor that represents the net atmospheric biogenic CO2 contribution associated with using a biogenic feedstock at a stationary source, taking into consideration biogenic landscape and process attributes associated with feedstock production, processing, and use at a stationary source, relative to the amount of biogenic feedstock consumed. This term represents a ratio of the net biogenic carbon cycle effects from all stages of the growth, harvest/collection, processing, and use of a biogenic feedstock relative to the carbon content of biogenic feedstock used at the point of assessment and resulting in stack emissions at a stationary source. [Reference: U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Atmospheric Programs, Climate Change Division. Framework for Assessing Biogenic CO2 Emissions from Stationary Sources, November 2014] BAFs modeled using future anticipated baselines developed for fuels most similar to those eligible for credit per the standard were selected. The BAFs were adjusted up by 10% as a conservative approach, or in the case of landfill gas and similar, set to zero rather than giving a credit greater than the carbon dioxide emissions produced.

Biological cycle – The cycle by which materials or parts are released to, and ideally reprocessed in, the environment via composting, biodegradation, nutrient extraction, or other biological metabolic pathways.

Biologically derived material – A material that is a biological material or that was originally derived from a biological material through one or multiple chemical transformations.

Biological material – A material that is extracted from a plant or animal source without significant chemical processing.

Chemical substance (or "substance") – Matter of constant composition best characterized by the entities (molecules, formula units, atoms) it is composed of. Physical properties such as density, refractive index, electric conductivity, melting point, etc., characterize the chemical substance.

Child labor – Work that deprives children of their childhood, their potential, and their dignity, and that is

harmful to physical and mental development. A child is anyone under the age of 18. The minimum working age is 15 years, or statutory school-leaving age, whichever is higher. This age can vary by country. Key References: United Nations Convention on the Rights of the Child, International Labor Organization (ILO) Convention 138 – Minimum Age, ILO Convention 182 – Worst Forms of Child Labor.

Collective bargaining – All negotiations which take place between an employer, a group of employers or one or more employers' organizations, on the one hand, and one or more workers' organizations, on the other, for: (a) determining working conditions and terms of employment; and/or (b) regulating relations between employers and workers; and/or (c) regulating relations between employers or their organizations and a workers' organization or workers' organizations. Key References: International Labor Organization (ILO) Convention 98 – Right to Organize and Collective Bargaining, ILO, ILO C154 - Collective Bargaining Convention.

Component ("Part") – A single functional grouping of contents. A part is an optional categorization to identify a portion of a product that is used modularly. A part will still be comprised of one or more homogeneous materials.

Compostable material – Characteristic of a product, packaging, or associated component that allows it to biodegrade, generating a relatively homogeneous and stable humus-like substance within a limited time period.

Cycling – The processing of material, parts, or whole products toward a new use cycle via a technical or biological cycling pathway that includes at least one of the following: reuse, remanufacturing, refurbishing, recycling, nutrient extraction/anaerobic digestion, composting, or biodegradation.

Cycled content – Material or parts that have been reclaimed, recycled, salvaged, or otherwise captured from a pre-consumer or post-use phase of a previous cycle.

Cycling pathway – A specific method, system, or other means of processing a material at the end of its use phase. Examples include: municipal recycling, home composting, aerobic biodegradation in wastewater (i.e., at municipal treatment plant), take-back and repair/remanufacture by the manufacturer.

Destructive disassembly operations – Disassembly processes that deal with the partial or complete destruction of obstructing components. In these cases, components or irreversible fasteners (e.g., welds) are destroyed using destructive tools such as a hammer, crowbar, or grinder.

Direct discharge – Effluent is discharged to surface or groundwater instead of to an externally owned and operated wastewater/effluent treatment facility.

Discrimination – Unequal treatment, directly or indirectly, on various grounds including race, ethnicity, sex, language, religion, political or other opinion, national or social origin, property, and birth or other status (such as sexual orientation or health status, for example, having HIV/AIDS). Key References: Universal Declaration of Human Rights – Article 2, 7, 23, International Labor Organization (IL) Convention 111 – Discrimination, International Convention on the Elimination of All Forms of Racial Discrimination, International Convention on the Elimination of All Forms of Discrimination against Women.

Diversity – The inclusion of different types of people (such as people of different races or cultures) in a group or organization.

Excessive working hours – Maximum working hours of 8 hours per day, or 48 hours per week. Overtime is the number of hours worked beyond the maximum allowed by week, and international standards limit this to

60 hours per week. Rest days are a continuous period of at least 24 hours each week. National laws can vary from international standards. Key References: International Labor Organization (ILO) Convention 1 – Hours of Work (Industry), ILO Convention 30 – Hours of Work (Commerce, Offices), ILO Convention 116 – Reduction of Hours of Work, ILO Convention 14 – Weekly Rest.

Fast-moving consumer goods – Non-durable consumer products that are purchased frequently, consumed rapidly, and sold quickly at a relatively low cost. Examples include household goods such as cosmetics, personal care, cleaning products, and office supplies.

Final manufacturing stage – The processes that constitute the final manufacturing stage are defined by industry category in the Cradle to Cradle Certified® Methodology for Applying the Final Manufacturing Stage Requirements.

Final manufacturing stage facility – A facility at which final manufacturing stage processes occur. Final manufacturing stage processes are defined in the Cradle to Cradle Certified® Methodology for Applying the Final Manufacturing Stage Requirements.

Forced labor – Situations in which persons are coerced to work through the use of violence or intimidation, or by more subtle means such as accumulated debt, retention of identity papers, or threats of denunciation to immigration authorities. Key References: International Labor Organization (ILO) Convention 29 – Forced Labor and ILO Convention 105 – Abolition of Forced Labor.

Formulated consumer product – A product whose function is determined primarily by its chemical composition (rather than shape, surface, or physical design). Typically, it is a single homogeneous chemical mixture such as a liquid, gel, paste, cream, powder, tablet, or bar.

Freedom of association – The fundamental human right of peaceful assembly and association, including the right to form and to join (or not join) trade unions and other organizations for the protection of their interests. Key References: United Nations Declaration on Human Rights, Articles 20 and 23, International Labor Organization (ILO) Convention 87 – Freedom of Association and the Protection of the Right to Organize, ILO Convention 98 – Right to Organize and Collective Bargaining.

Generic material type – The general class a homogeneous material belongs to. The generic material type is the common term that would be used to describe a material in commerce. Examples of generic material types include: aluminum, polyethylene, steel, cotton, and medium-density fiberboard.

Harassment and abuse – Includes, but is not limited to, violence, corporal punishment, harsh or degrading treatment, sexual or physical harassment, mental, physical, verbal, or sexual abuse. Key References: Universal Declaration of Human Rights, International Covenant on Civil and Political Rights, Declaration on the Protection of all Persons from Being Subjected to Torture and Other Cruel, Inhumane or Degrading Treatment or Punishment, International Labor Organization (ILO) Convention 190 – Violence and Harassment.

High-value cycling – The cycling of high-quality materials as defined by the Gold level requirements for "high-value cycling potential" in Section 5.5.

Homogeneous material (or "material") – A material of uniform composition throughout that cannot be mechanically disjointed, in principle, into different materials. Coatings and finishes such as plating, powder coats, enamels, etc., are considered unique homogeneous materials (see *Cradle to Cradle Certified Methodology for Defining Homogeneous Materials* for details).

Inclusion – The act or practice of including and accommodating people who have historically been excluded.

Intended cycling pathway – See "Cycling pathway."

Intermediate product – A product sold exclusively as an input to be used in another product and not sold to the general public.

Key material – A material that is typically manufactured using a pollutant intense or high-volume water use process (see the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials* reference document).

Living wage – The remuneration received for a standard workweek by a worker in a particular place sufficient to afford a decent standard of living for the worker and her or his family. Elements of a decent standard of living include food, water, housing, education, health care, transportation, clothing, and other essential needs including provision for unexpected events. Key References: Global Living Wage Coalition, Anker Methodology.

Long-use phase product – A product with a use phase time that is typically greater than 1 year.

Material – See "Homogeneous material."

Minimum wage – The compensation to be paid to an employee or worker, based on wage levels of individual countries. Nearly all countries have a national body that determines minimum wages nationally, or for sectors or occupations. In most jurisdictions, overtime must be paid at a premium. Wages and premiums vary by country. Key References: International Labor Organization (ILO) Convention 26 - Minimum Wage, ILO Convention 131 - Minimum Wage Calculation, ILO Convention 100 – Equal Remuneration.

Nutrient extraction – Applying biomass conversion processes and equipment to produce low-volume but high-value chemical products.

Rare and endangered species – Any species listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) appendices [Reference: https://www.cites.org/eng/app/index.php] and/or in the International Union for Conservation of Nature (IUCN) Red List as Near Threatened, Vulnerable, or Endangered. [http://www.iucnredlist.org/]

Performance improvement – In the context of energy conservation and efficiency projects, this term refers to the percentage change in energy consumption from a baseline period to a reporting period. Depending on the methodology employed, one or both of these values will be adjusted (i.e., normalized) to account for differences in production, weather, etc., between the baseline and reporting period. This adjustment allows for a comparison of two consumption amounts that correspond to consistent conditions. Note that performance improvements do not necessarily correspond with or lead to total energy use reductions, particularly if production has greatly increased.

Pharmaceutical – A compound manufactured for use as a medicinal drug. This includes any substance or combination of substances presented as having properties for treating or preventing disease; or any substance or combination of substances that may be used in or administered to human beings and/or animals either with a view to restoring, correcting, or modifying physiological functions by exerting a pharmacological, immunological, or metabolic action, or to making a medical diagnosis.

Post-consumer cycled content – Material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose.

Pre-consumer cycled content – Material or parts diverted from the waste stream during a manufacturing process. Material or parts such as rework, regrind, or scrap that are generated in a process and are capable of

being reclaimed within the same process that generated it are excluded.

Primary packaging materials – The materials that physically contain, envelop, or hold the certified product, and typically come into direct contact with the product. Any materials or components that are attached to the materials that physically contain, envelop, or hold the certified product (such as inks, adhesives, labels, nozzles, pumps, and caps) are also considered to be part of the primary packaging.

Process chemical – Any substance that comes into direct contact with the product or any of its material constituents during any of the processes that constitute the final manufacturing stage of the product. It is used as an intentional part of any of these processes to fulfill a specific function or achieve a specific effect in the product or any of its material constituents. Within this definition, process chemicals are limited to pure chemical substances and chemical substances present in a mixture at a concentration of 1,000 ppm or above. Mixtures include liquids, sprays, gases, aerosols, solids, etc. The concentration threshold applies to process mixtures directly as received by the supplier and prior to any dilution that may take place at the manufacturing site. This definition does not include maintenance agents for machinery, effluent, or wastewater treatment chemicals, chemicals used in steam boilers, or cleaning agents used for the production area, offices, and/or lavatories. Distilled water, tap water, and ambient air in their unaltered state are excluded from the assessment.

Product – A physical item that can be routinely and individually purchased from the applicant by other entities. A product is composed of one or more components, homogeneous materials, and/or chemical substances. A product may function as a component or material in another product.

Product use phase time – The typical time of use of a product starting at the point the product is received by the user or customer, and ending at the time the product is cycled (this includes refurbishment, remanufacturing, reuse, and recycling, but not repair).

Rapidly renewable – Material derived from a natural resource (agriculture or animal-derived) that has a maximum 10-year regeneration cycle. (Note: This term is used in the Renewable Energy & Climate category while the term “renewable” is used in the Product Circularity category.)

Recycled content – proportion of pre-consumer or post-consumer materials, by mass, of recycled material in a product or packaging.

Recycling – The process by which a material, after serving its intended function, is processed into a new material via mechanical or chemical transformation and then added to a new material formulation in a different context.

Refillable – A characteristic of a product or packaging that can be filled with the same or similar product more than once, in its original form and without additional processing except for specified requirements such as cleaning or washing. Programs must exist to facilitate refilling and reuse to support a refillable claim.

Refurbishing – The process of returning a product to good working condition by replacing or repairing major components that are faulty or close to failure, and making cosmetic changes to update the appearance of a product, such as cleaning, changing fabric, painting, or refinishing.

Remanufacturing – The process of disassembly and recovery at the subassembly or component level. Functioning, reusable parts are taken out of a used product and rebuilt into a new one. This process includes quality assurance and potential enhancements or changes to the components.

Renewable content – Material derived from a living, natural resource (agriculture, aquaculture, or animal-derived) that can be continually replenished. Material must be legally harvested, as defined by exporting and receiving country. If the material is wood, or another material associated with extensive evidence of ecosystem destruction due to land conversion and/or poor management practices, to count as renewable the material must be certified by a C2CPII-recognized program as responsibly sourced. If the material is a biologically derived plastic or liquid formulation, material only counts as renewable if its bio-based content has been quantified using radiocarbon dating and through chain of custody documentation showing derivation from natural resources.

Responsibly sourced renewable content – Material that is certified by a C2CPII-recognized standard that verifies sustainable, environmentally friendly forest or vegetation management. These recognized standards have criteria that address: 1) Compliance with all applicable laws and regulations of the country in which farming or harvesting operations occur, 2) Operations that respect land rights and land use rights, and are unlikely to cause displacement of food production, 3) Planning, monitoring, management, and continuous impact assessment for the farming and/or harvesting of material, 4) Maintenance, conservation, or enhancement of biodiversity in the forest/vegetation or other ecosystem, 5) Maintenance or enhancement of the productive function of the forest/vegetation or other ecosystem area and efficient use of harvested materials (e.g., rate of harvest does not exceed rate of regrowth in the long term), 6) Maintenance or enhancement of the health and vitality of the forest/vegetation or other ecosystem and its protective systems (soil and water).

Reusable – Characteristic of a product or packaging that has been designed to be used in more than one use cycle for the same purpose for which it was originally conceived.

Separable – The ability of removing one homogeneous material from another one it is physically attached to.

Science-based targets – Targets adopted by companies to reduce greenhouse gas (GHG) emissions that are aligned with the level of decarbonization required to keep global temperature increase below 2 degrees Celsius compared to pre-industrial temperatures, as described in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5). [Reference: sciencebasedtargets.org, accessed 26 September 2018]

Scope 1 emissions – Emissions from operations that are owned or controlled by the reporting (i.e., applicant) company.

Scope 2 emissions – Indirect emissions from the generation of purchased or acquired electricity, steam, heat, or cooling consumed by the reporting (i.e., applicant) company.

Short-use phase product – A product with a use phase time that is typically less than 1 year.

Single-use plastic product – Any disposable plastic product, made wholly or partially from plastic, that is designed to be used only once (i.e., is not reusable or refillable) Note: This definition includes biodegradable plastics.

Stakeholder – An individual who may affect or be affected by an organization's activities. An affected stakeholder in the context of the Social Fairness requirements is an individual whose human rights have been affected by an enterprise's operations, products, or services.

Substance – See "Chemical substance."

Supply chain – A set of organizations linked by flow(s) of products, services, finances, or information from a source to a customer.

Technical cycle – The cycle by which a product's materials or parts are reprocessed for a new product use cycle via recycling, repair, refurbishment, remanufacturing, or reuse.

Tier 1 supplier – For the purposes of Cradle to Cradle certification, this term refers to direct suppliers to the final manufacturing stage of the product. For cases where the applicant company uses contract manufacturing, tier 1 suppliers are the suppliers of the contract manufacturer.

Value chain – Interlinked value-adding activities that convert inputs into outputs which, in turn, add to the bottom line and help create competitive advantage. A value chain typically consists of inbound distribution or logistics, manufacturing operations, outbound distribution or logistics, marketing and selling, and after-sales service. These activities are supported by purchasing or procurement, research and development, human resource development, and corporate infrastructure (Reference: Businessdictionary.com and https://www.ifm.eng.cam.ac.uk/research/dstools/value-chain-/).

13 // Appendix – Key Contributors

Key C2CPII Staff Contributors

Esther Julier
Justin Bours, PhD
Matteo Kausch, PhD
Susan Klosterhaus, PhD

Standards Steering Committee (formerly Certifications Standard Board)

Susan Klosterhaus, PhD (chair)
Jay Bolus
Rudi Daelmans
Anette Hastrup
Peter Karsch
Angela Nahikian
Christoph Semisch, PhD
Peter Vissers
Ryan Williams, PhD
Cedric Wintraecken
Sean Ansett
Mary Davidge
Maureen Gorsen
Jeffrey Hogue
Paul Murray
Haixiang Qian
Troy Virgo
Howard Williams
Gabe Wing

Prof. Dr. Michael Braungart, Honorary Advisor
William McDonough, Honorary Advisor

Material Health Technical Advisory Group

Matteo Kausch, PhD (chair)
Nyree Bekarian Mack
Dwayne Fuhlhage
Christina Krebs
Clare Perkins
Jonathan Smieja, PhD
Patrick Van Sprang
Larry Weiss, MD
Lauren Zulli
Jay Bolus (co-chair)
James Ewell
Lauren Heine, PhD
Tom Lent
Priya Premchandran
Homer Swei, PhD
Troy Virgo
Margaret Whittaker, PhD

Product Circularity Technical Advisory Group

Matteo Kausch, PhD (chair)
Haixiang Qian (co-chair)
Rachel Berman
Huantian Cao
Jennifer Gilbert
Thomas Hill
Ana Maria Leal
Justin Bours, PhD (former chair)
Kellie Ballew
Feliks Bezati, PhD
Andrew Collins
Annette Hastrup
Frieke Heens
Soko Made

Kendra Martz
Ronald Sherga
Dorien van der Weele
Cristina Sendra
Wes Sullens

Clean Air & Climate Protection Technical Advisory Group

Esther Julier (chair)
Woodrow Clark II, PhD
Max DuBuisson
Todd Jones
Jo Hwa Li
Claire Mattelet
Gert-Jan Vroege
Peter Karsch (co-chair)
Kevin de Cuba
Thorsten Grantner
Ozge Kaplan
Kathleen Loftus
Barbara Toole O'Neil
Frances Yang

Water & Soil Stewardship Technical Advisory Group

Esther Julier (chair)
Bill Ayling
Amanda Cattermole
Lynda Grose
Albin Kaelin
James Richardson
Annette Hastrup (co-chair)
Josiah Cain
Linda Greer, PhD
Eric Harrington
Raj Rajan
Shawn Sahbari

Social Fairness Technical Advisory Group

Esther Julier (chair)
Catherine Benoit Norris
Sarah Krasley
Dan Osusky
Sean Ansett (co-chair)
Zheng Hu
Steven Oates
Kristen Plume

Stakeholder Advisory Council

Tammy Ayers
Julie Brown
Baptiste Carriere-Pradal
Ignasi Cubiñá
Jeff Frost
Jean Hansen
Paul Murray
Dan Schibel
Mariska van Dalen
Donna Westerman
Gabe Wing
Melissa Baker
Pascal Brun
Jo Chidley
Rudi Daelmans
Timothy Glaz
Alison Kinn-Bennett
Jeffrey Prins
Wes Sullens
Dorien van der Weele
Howard Williams
Owen Zachariasse

Cosmetics & Personal Care User Group, RSL Task Team

Monica Becker (lead)
Hans Steisslinger, PhD
Antonio Quinones-Rivera, PhD
Homer Swei, PhD

CRADLE TO CRADLE CERTIFIED®
PRODUCT STANDARD
V3.1

CRADLE TO CRADLE CERTIFIED™

PRODUCT STANDARD

VERSION 3.1

COPYRIGHT

TRADEMARK

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

THE *CRADLE TO CRADLE CERTIFIED* STANDARD REVISION HISTORY

REVISION	SECTION	TYPE OF CHANGE	DATE	AUTHORIZED BY
3.0	Initial Release		11/2012	MBDC & C2CPII
3.1	3	The cyclability assessment has been removed from the Material Health Assessment Methodology.	12/2014	C2CPII Certification Standards Board
3.1	4	The requirement that only A, B, and C assessed materials may count as recyclable or compostable in the Material Reutilization Score has been removed (i.e., X and GREY assessed materials may now count as recyclable or compostable when calculating the Material Reutilization Score).	12/2014	C2CPII Certification Standards Board
3.1	all	The information from both the Cradle to Cradle Certified Product Standard, Version 3.0 and its associated guidance document, Supplemental Guidance for the Cradle to Cradle Certified Product Standard, Version 3.0, has been consolidated into this document. Tables and passages that contained information that was available elsewhere in a more accessible or up-to-date form have been removed. The original intent has been further clarified; inconsistencies and typos that were contained in Version 3.0 have been corrected throughout.	1/2016	C2CPII
3.1	3	Information previously covered in both the Cradle to Cradle Certified Product Standard, Version 3.0 and Cradle to Cradle Certified™ Material Health Assessment Methodology, Version 3.0 has been removed so that it is only present in the Assessment Methodology document.	1/2016	C2CPII
3.1	3.3, Table 4	Removed reference to commercial products with regard to PTFE	6/2018	C2CPII

FOREWORD

Document Purpose
This version of the Cradle to Cradle Certified™ Product Standard (Version 3.1) represents a minor revision of Version 3.0.

In December 2014 the Cradle to Cradle Products Innovation Institute's Certification Standards Board approved the development of version 3.1 of the Cradle to Cradle Certified Product Standard. The main purpose of developing version 3.1 was to remove the overlap in the Material Health and Material Reutilization categories that was introduced in version 3.0 of the standard. These requirements were added to version 3.0 to discourage the re-use of materials that contain harmful substances; however, in practice this resulted in unforeseen problems that ran counter to the intent of the standard and the continuous improvement goal of Cradle to Cradle in general. The Institute and the Certification Standards Board felt it was important to address these issues immediately in a revised version of the standard. Further, a number of minor modifications were made to reduce redundancy and enhance clarity of the standard (see '*The Cradle to Cradle Certified Standard Revision History'* above).

The Cradle to Cradle Products Innovation Institute (C2CPII)
The Cradle to Cradle Products Innovation Institute administers the Cradle to Cradle Certified Products Program. The Certification Standards Board, using the Cradle to Cradle framework, is responsible for reviewing and approving revisions and/or amendments to the Cradle to Cradle Certified Product Standard and ensuring continuous improvement of products based upon five categories: material health, material reutilization, renewable energy and carbon management, water stewardship, and social fairness. Products that meet the criteria of this rating system will receive the Cradle to Cradle Certified certification mark for one of five levels. (http://c2ccertified.org)

MBDC, LLC
MBDC originated the Cradle to Cradle design framework and has 20 years of experience helping clients go beyond minimizing harm and move towards creating a wholly positive impact on the planet. MBDC partners with innovative clients within various sectors and industries to spur creativity, differentiate their brands and recognize their market leadership, attract and retain customers, enhance competitive advantage, and reduce long-term risks. MBDC leads companies towards sustainable growth by helping clients optimize corporate strategy, communications, operations, supply chains, and product designs. MBDC is an Accredited Assessment Body in the Cradle to Cradle Certified Products Program. (http://mbdc.com)

Environmental Protection Encouragement Agency, GmbH
Founded by Professor Dr. Michael Braungart in 1987, the Environmental Protection Encouragement Agency (EPEA) Internationale Umweltforschung GmbH works with clients worldwide to apply the Cradle to Cradle methodology to the design of new processes, products, and services. Materials are applied with respect for their intrinsic value and their useful afterlife in recycled or even "upcycled" products, which have value and technological sophistication that may be higher than that of their original use. EPEA is an Accredited Assessment Body in the Cradle to Cradle Certified Products Program. (http://epea-hamburg.org)

Together, we take on the challenge of scientifically evaluating and innovatively designing products according to a unique design practice.

SUPPORTING DOCUMENTS

The following documents are to be used in conjunction with the Cradle to Cradle Certified Product Standard:

- *Cradle to Cradle Certified™ Material Health Assessment Methodology, Version 3.1 or Cradle to Cradle Certified™ Material Health Assessment Methodology, Version 3.0* and *Supplemental Guidance for the Cradle to Cradle Certified™ Material Health Assessment Methodology, Version 3.0.*
- *Cradle to Cradle Certified Policies and Procedures.*

All supporting documents can be downloaded from the Cradle to Cradle Products Innovation Institute website (http://c2ccertified.org).

1 INTRODUCTION TO CRADLE TO CRADLE®

Cradle to Cradle was developed by William McDonough and Michael Braungart, two pioneers merging intentional design, chemistry, and products for industry. Originally used loosely as a term with different meanings as contraindication to "cradle to grave,"[1] Cradle to Cradle is a beneficial design approach integrating multiple attributes: safe materials, continuous reclamation and re-use of materials, clean water, renewable energy, and social fairness.

William McDonough began his career as an architect in New York pioneering approaches to building design and concepts—such as "*a building like a tree, a city like a forest*"—which became foundational to the green building movement. His projects included building the first green office in New York for the Environmental Defense Fund in 1984, design of a solar-powered daycare center operated by children (1989), and a strategy for carbon balance and offset that garnered front-page coverage in the *Wall Street Journal* three years before the 1992 Rio Earth Summit. He was a founding member of the American Institute of Architects Committee on the Environment (COTE) and a charter member of the United States Green Building Council (USGBC).

Michael Braungart formed the Environmental Protection and Encouragement Agency (EPEA) Internationale Umweltforschung GmbH[2] in 1987, and soon afterward launched the Intelligent Products System (IPS), which defined materials as nutrients with the unique characterization that such materials could be continually reused in biological and technical cycles. The IPS was based on the European precautionary principle and brought a new perspective: that materials can be seen as key parts of technical and biological metabolisms.

McDonough and Braungart met in 1991 and began to share ideas. Together they merged the concept of materials as nutrients within biological and technical cycles with the concept of intentional design. This would later become the Cradle to Cradle design framework, which is the practical approach to product design in which all materials are biological and technical nutrients with coherent use periods and reverse logistics, renewable power, safe water, and social fairness.

In 1991, William McDonough was commissioned by the City of Hannover, Germany, at the suggestion of Dr. Michael Braungart, to craft sustainable design principles for Expo 2000, The World's Fair. *The Hannover Principles: Design for Sustainability*[3] were received and honored by Jaime Lerner, mayor of Curitiba, at the World Urban Forum of the Rio Earth Summit (UNCED) in 1992. They were delivered as a gift from the state of Lower Saxony by McDonough, who attended as the Official Representative for Architecture and City Planning for the International Union of Architects and the American Institute of Architects (dual role). In 1995, McDonough and Braungart co-founded McDonough Braungart Design Chemistry, LLC (MBDC).[4]

The Atlantic magazine published an article by McDonough and Braungart entitled "The Next Industrial Revolution"[5] in October 1998. This article chronicled the rise of "*eco-efficiency*" (doing more with less) as the main environmental strategy of many leading businesses and introduced the idea of "*eco-effectiveness*" to determine the right thing to do before doing it efficiently. In this article the terms

"downcycling" and *"upcycling"* were used to show how, by design, we can return product materials with improved, rather than degraded, quality over time.

By 2001 several case studies on the integration of the Cradle to Cradle design principles in product design by leading businesses were made available in video and DVD form by Earthome Productions.[6] Included in this compilation were stories from Designtex (Steelcase), Herman Miller, Ford, and Nike. In 2002, the book *Cradle to Cradle: Remaking The Way We Make Things* was published.[7]

MBDC launched the Cradle to Cradle Certified™ Program[8] in October 2005. As the program grew worldwide, the desire for an independent certification body was identified to bring the program into the public sphere. In August 2010 an exclusive, worldwide license was granted to the Cradle to Cradle Products Innovation Institute[9] as a third party not-for-profit organization to manage the certification program.

Cradle to Cradle® and C2C® and are registered marks of MBDC, LLC.

Certified Cradle to Cradle™ and Cradle to Cradle Certified™ are registered marks of MBDC, LLC used under license by the Cradle to Cradle Products Innovation Institute.

1.1 WHAT IS CRADLE TO CRADLE® DESIGN?

The Cradle to Cradle design principles provide a positive agenda for continuous innovation around the economic, environmental, and social issues of human design and use of products and services. Specifically, the purpose of the product certification program is to improve the way we make, use, and re-use things recognizing two metabolisms, the *biological metabolism* and the *technical metabolism*, with a goal to leave a beneficial footprint for human society and the environment.

The aim is to set a positive course for product and process design and development in a way that will allow natural and technical systems, products, and processes to support the diverse living population on earth. Cradle to Cradle design mirrors the healthy, regenerative productivity of nature, and considers materials as assets, not liabilities.

Management theorist Peter Drucker has said that it is a manager's job to do something the right way—to be efficient—but it is an executive's job to do the right thing—to be effective. To date, global efforts by businesses have been focused on becoming more efficient and reducing the (bad) environmental "footprint" by optimizing existing systems, which may be wrong designs. Cradle to Cradle design is about choosing the right thing to do and then doing that thing the right way to achieve positive outcomes. In other words, to become *"more good,"* not just *"less bad."*

For example, while it makes sense to slow down the use of fossil fuels, this is not the goal. Cradle to Cradle is a continuous improvement process design tool that starts with the positive or beneficial end in mind and executes efficiently towards achieving this goal. In this example the Cradle to Cradle goal is a move to renewable energy sources.

Long-Term Goals, Short-Term Actions, and Transitions

We start by defining long-term Cradle to Cradle goals and then develop transitional strategies to achieve them. In the short term, we can make successive design-based decisions that will move us to a more sustaining condition. The short-term actions for product development start with complete identification of the materials and chemicals that make up the product and process in order to assess them for human and ecological impacts.

In the medium term the goal is for designs that are positive or beneficial in terms of cost, performance, aesthetics, material health, and material (re)utilization potential with continuous use and reuse periods. Additionally, moving renewable energy forward in a cost-effective way, celebrating clean water as a human right, and honoring social systems are part of the holistic Cradle to Cradle approach.

The long-term goals can be wholly positive and intended to support 10 billion people and other species. For example, McDonough and Braungart's long-term goal is:

> "*Our goal is a delightfully diverse, safe, healthy and just world, with clean air, water, soil and power - economically, equitably, ecologically and elegantly enjoyed.*"

Cradle to Cradle provides a unique frame of thinking that is based on the precautionary principle and trust in the product supply chain. This is not a framework based on guilt or intended as an opportunity for taking legal actions. Rather it is the basis for building up a support system.

We work with humility and recognize that checking single chemicals in materials and products does not give the complete picture and that there may be unintended consequences, but it is a good start. In focusing attention on chemicals it is not our intention to promote more animal testing. If a chemical bio-accumulates we would rather see alternatives substituted.

The question becomes one of design intention and we can ask, "What type of products do we want to see?" Chemists become designers and designers become chemists. As humans, we accept the limitations of our knowledge and we will make mistakes, but these mistakes need to be reversible by future generations.

The product certification program is a QUALITY statement using QUANTITY indicators. Each level represents a higher quality indicator using multiple attributes. Today the program is primarily oriented from a Western cultural perspective. Longer term, the program is expected to evolve and quality indicators respecting and celebrating cultural diversity are anticipated.

1.2 THE CRADLE TO CRADLE® PRINCIPLES

In nature, there is no concept of waste. Everything is effectively food for another organism or system. Materials are reutilized in safe cycles. There are no persistent, bio-accumulative materials that can lead to irreversible changes. The earth accrues biota grown from the energy of the sun. We celebrate the diversity of people and of species. We become native to place, celebrating abundance and honoring every child that is born. In short, the design of goods and provision of services can be achieved with three principles in mind:

1. Eliminate the Concept of Waste

- Nutrients become nutrients again. All materials are seen as potential nutrients in one of two cycles – technical and biological cycles.
- Design materials and products that are effectively "food" for other systems. This means designing materials and products to be used over and over in either technical or biological systems.
- Design materials and products that are safe. Design materials and products whose nutrient management system leaves a beneficial legacy economically, environmentally, and equitably.
- Create and participate in systems to collect and recover the value of these materials and products. This is especially important for the effective management of scarce materials.
- Clean water is vital for humans and all other organisms. Manage influent and effluent water streams responsibly, and consider local impacts of water use to promote healthy watersheds and ecosystems.
- Carbon dioxide (CO_2) should be sequestered in soil. Our current practice where carbon dioxide ends up in the oceans and in the atmosphere is a mismanagement of a material.

2. Use Renewable Energy

- The quality of energy matters. Energy from renewable sources is paramount to effective design.
- Aligning with Green-e's list of eligible sources, renewable energy sources are solar, wind, hydropower, biomass (when not in competition with food supplies), geothermal, and hydrogen fuel cells.

3. Celebrate Diversity

- Use social fairness to guide a company's operations and stakeholder relationships.
- Encourage staff participation in creative design and research projects to enhance your Cradle to Cradle story.
- Technological diversity is key for innovation; explore different options in looking for creative solutions.
- Support local biodiversity to help your local ecosystem flourish; strive to have a beneficial social, cultural, and ecological footprint.

Under the Cradle to Cradle design approach, products that result in materials flowing into the biosphere (either from the product contents or the packaging) are considered to be "products of consumption." Materials that are recovered after use can be considered to be "products of service." (Note: some materials such as paper or bio-plastics are products of consumption as they ultimately return to the biosphere after a number of post-use cycles.)

1.3 COMPLEMENTARY METABOLISMS

The Cradle to Cradle Certified™ Program focuses on the characteristics of sustainable materials, products, and systems. As a result, this method places a major emphasis on the human and ecological health impacts of a product's ingredients at the chemical level, as well as on the ability of that product to be truly recycled or safely composted. The quality of energy used to create a product, water quantity and quality, and social fairness also are essential Cradle to Cradle characteristics and focus areas in this certification process.

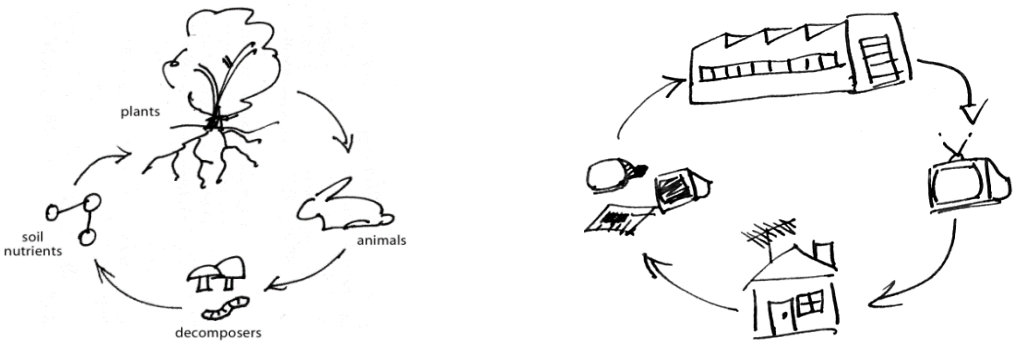
Cradle to Cradle design draws on knowledge from the fields of environmental chemistry and material flows management (broadly termed Industrial Ecology), and the fields of industrial and architectural design. It includes the *Intelligent Product System* (IPS) pioneered by chemist Dr. Michael Braungart in 1986.

Cradle to Cradle is an innovative approach that models human industry on the processes of nature's *biological nutrient metabolism* integrated with an equally effective *technical nutrient metabolism*, in which the materials of human industry safely and productively flow within the two metabolisms in a fully characterized and fully assessed way. Products that are designed as services are made from materials that cycle in the technical metabolism at the end of their use cycle. Consumption products, those that naturally end up in the environment (biological cycle) during or post-use, are made from materials that are inherently safe for the biosphere.

Nature's metabolism runs on renewable energy and returns all materials safely in cycles for reuse. Everything can be considered a nutrient with future value. All of our man-made designs exist in this metabolism and many products will result in the nutrients connecting with, and flowing directly into, this system during and after use. These materials need to meet a standard for "biological nutrients" with the highest level of safety designed in.

Products that have achieved positive design milestones along the continuum of improvement are shown to be suitable for cycling perpetually on Earth, using ingredients that are safe and beneficial – either to biodegrade naturally and restore the soil, or to be fully recycled into high-quality materials for subsequent product generations, again and again. This allows a company to eliminate the concept of waste and recover value, rather than creating a future of solid waste liability. Cradle to Cradle design turns contingent liabilities into assets.

Figure 1 Depiction of Biological and Technological Nutrient Cycles



Biological Nutrients Technical Nutrients

1.3.1 Effective Material Cycles

Products of Consumption

A product of consumption is a material or product that is typically changed biologically, chemically, or physically during use and therefore enters the biosphere either by nature or by human intention. As a result, products of consumption should consist of biological nutrient materials.

Biological cycle materials and products need to be designed for safe combustion without the need for filters. Biological cycle products such as paper or bio-plastics may go through a series of technical cycles (e.g., recycling) before finally going safely into biological systems (e.g., composting or incineration for energy recovery).

A biological nutrient product is usable by defined living organisms to carry on life processes such as growth, cell division, synthesis of carbohydrates, energy management, and other complex functions. Any material emanating from a product of consumption that comes into intentional or likely unintentional and uncontrolled contact with biological systems is assessed for its capacity to support their metabolism. Metabolic pathways consist of oxidation, catabolism (degradation, decrease in complexity), and anabolism (construction, increase in complexity), both occurring generally in a coupled manner. The classification of products as biological nutrients (or source of nutrients) depends on the biological systems with which they interact. These systems can be more or less complex along the following organizational hierarchy:

- Organisms (nutrients for predators).
- Organic macromolecules and combinations thereof (nutrients for fungi, microorganisms, vegetarian animals; oral, dermal or olfactory nutrients).
- Minerals (nutrients for autotrophic plants).

For example, a detergent that is comprised of readily biodegradable materials could be designed such that the material or its breakdown products provide nutrition for living systems. Products like tires and brake shoes that abrade in use are also products of consumption, but have yet to be designed with biological nutrient materials.

Products of Service

A product of service is a material or product designed to provide a service to the user without conveying ownership of the materials. Products of service are ideally comprised of technical nutrients that are recovered at the end-of-use phase.

Technical nutrients (TNs) are products or materials that "feed" technical systems. While they may or may not be suitable to return to air, soil, or water, technical nutrients are never consumed but instead are catabolized (deconstructed) and anabolized (constructed) according to the following hierarchy:

- (Dismantle and) reuse.
- (Dismantle and) physical transformation (e.g., plastic remolding).
- (Dismantle and) chemical transformation (e.g., plastic depolymerization, pyrolysis, gasification).

Technical nutrients can therefore be managed with service contracts or leasing models so that users benefit from the product service without owning the materials. In the case of scarce materials, it is especially important to use them in products of service so that they remain available over the long term as useful materials.

Externally Managed Components (EMCs)

An EMC is a sub-assembly, component, or material within a product that is exempt from the general requirement of full characterization to the 100 ppm level because it is managed in a technical nutrient cycle as part of a supplier or manufacturer commercialized nutrient management program.

To be considered an EMC, the sub-assembly, component, or material within a product must meet the following criteria:

1. The supplier of the EMC has provided the applicant with a guarantee for take back and appropriate nutrient management. The supplier may designate a third party or parties for implementation.
2. The supplier has signed a declaration that chemicals in the EMC will not negatively impact humans or the natural environment during the intended and unintended but highly likely use of the product for which the EMC is a component. This guarantee may be provided if the EMC is Cradle to Cradle Certified (Gold level or higher), or other appropriate evidence.
3. The EMC has undergone testing by an accredited analytical laboratory to ensure that harmful substances are not being emitted from the EMC above the chemicals' analytical detection limits. Off-gas testing is required for all EMCs (See Section 3.9 for more information on volatile organic compounds [VOCs] emission testing). Migration and leaching testing may be required depending on the type of EMC.

Note that EMCs are not exempt from banned list declarations. Also note that if during use of the product for which the EMC is a component a user is exposed to any part or chemical within the component, or if any part or chemical within the component is released to the environment, the component is not considered an EMC and will be assessed and inventoried like the other materials in the product.

EMCs were introduced in version 3.0 of the Cradle to Cradle Certified Product Standard as a way to include product components that do not need to be assessed the same way as the rest of a product because they are managed as a whole by the supplier or a third party. The EMC concept was invented by the founders of the Cradle to Cradle® framework to encourage manufacturers to design complex components that are completely managed after their use phase. As of the release date of version 3.0 of this Standard, an EMC had not yet been included in a Cradle to Cradle Certified product. Examples of potential EMCs are a pneumatic cylinder in an office chair, the motherboard in a computer, the electric motor inside an automated window shade product, and a solar panel.

2 OVERVIEW OF THE STANDARD

2.1 PRODUCT SCOPE

This certification program applies to materials, sub-assemblies, and finished products. Materials and sub-assemblies can be considered "products" for certification purposes.

This program does not address performance measures associated with any products that qualify for the Cradle to Cradle Certified™ Products Program. Product compliance with all applicable laws and regulations is assumed. Some rules in the program address activities that are also subject to regulation by local, state, or federal authorities. However, nothing contained herein changes legal regulatory requirements or prescribes how compliance is to be achieved. Documentation of compliance with certain key regulations may be included in some sections of the Standard, but this in no way changes the underlying regulatory requirements.

There are a number of product attributes that may exclude a manufacturer from seeking certification. The following list depicts some cases and issues that are out of the scope of this program. The purpose of this list is to create a threshold to prevent unreasonable products from entering the system and to protect the positive values around products, as well as their usefulness. The scope of the program does not include the following:

- The presence of any chemicals from the Cradle to Cradle Certified "Banned List" (See Appendix for lists).
- Processes in and of themselves.
- Food, beverages, pharmaceuticals, or fuels and other products intended for combustion during use.
- Buildings, countries, cities.
- Products from rare or endangered species (e.g., ivory).
- Products with ethical issues (e.g., weapons, tobacco, electric chair, etc.).
- Products leading to or including animal abuse.
- Products with apparent safety concerns related to physical and chemical characteristics.
- Products from companies involved in rain forest damage, child labor, blood metals, or blood diamonds.
- Applicant involved in terror support or racism/discrimination.
- Nuclear power and/or products used to produce nuclear power.
- Products that may be contrary to the intent of the Cradle to Cradle principles.

Product Packaging

Packaging material may be certified as a separate product or may be considered part of a product and thus included in the product certification. However, though it is encouraged, the packaging material is not required to be included in the product assessment. If the packaging material was included in the

assessment, the achievement level assigned to the packaging is provided on the product's certificate and in the entry in the Product Registry (http://c2ccertified.org/products/registry). If the certificate and the entry in the Product Registry do not address packaging, then the packaging is not included in the certification. Note that when packaging materials are included in the assessment, only the requirements in the Material Health and Material Reutilization categories are addressed.

Though not required to be included in the product assessment, materials in the product's primary packaging are subject to the same banned list requirements as the materials in the product and thus may not contain chemicals on the banned lists (see definition of 'primary packaging' below). Signed declarations stating that banned list chemicals have not been intentionally added at concentrations >0.1% (>1000 ppm) must be obtained for each homogeneous material used in the primary packaging, including inks, adhesives, and any materials used to label the package. Banned list declarations may be obtained from the supplier, the product manufacturer, or the assessor (see Section 3.3 of this document for more information). For primary packaging made from recycled materials, analytical testing for banned list chemicals may be required if all of the material ingredients cannot be defined with current information.

Primary packaging refers to the container that envelops a liquid, gel, paste, or powder and is intended to be kept with the product during its use or up until the moment of application (e.g., surface cleaner spray bottle, paint can, dishwasher powder box, nail polish bottle, wet-wipe pouch/packet/tub). Any materials that are intended to be removed prior to the product's use are not considered primary packaging (e.g. pallet, shrink wrap, carton). All materials meeting this definition are considered part of the primary packaging, including inks, adhesives and any materials used to label the package. Primary packaging is not in scope for products that are sold exclusively as material inputs for other products (rather than being sold to the general public).

2.2 STANDARD CATEGORIES AND THEIR SCOPE

Products seeking to be Cradle to Cradle Certified™ are evaluated against criteria in the following five categories:

Material Health – The ultimate goal is for all products to be manufactured using only those materials that have been optimized and do not contain any X or Grey assessed materials/chemicals. As such, products are able to achieve increasingly higher levels of certification as the percentage of assessed and optimized materials in the finished product increases.

The boundaries of review are drawn at the product leaving the direct production facility. The process chemicals associated with the production of certain inputs are included, where applicable (e.g., textiles, plated parts, paper, foam).

Material Reutilization – A key component of Cradle to Cradle design is the concept of technical nutrients and biological nutrients flowing perpetually in their respective metabolisms. Products are evaluated for their nutrient potential and nutrient actualization, as well as the role the manufacturer plays in material/nutrient recovery.

The intention of this category is to provide a quantitative measure of a product's design for recyclability and/or compostability. The larger the percentage of a product and/or its components that remain in a technical and/or biological metabolism, the better the score for this category.

Renewable Energy and Carbon Management – Cradle to Cradle products are manufactured in a way that positively impacts our energy supply, ecosystem balance, community, and ultimately strives to keep carbon in soil and earth vegetation where it belongs.

The intention of this category is to provide a quantitative measure of the percentage of renewably generated energy that is utilized in the manufacture of the product. Purchased electricity and direct on-site emissions associated with the final manufacturing stage of the product, as well as embodied energy associated with the product from Cradle to Gate, are considered, depending on the level of certification.

Water Stewardship – Water is a scarce and valuable resource. Product manufacturers are evaluated against their understanding of (and responsibility for) water withdrawals, consumption, and releases within the local ecology, and are rewarded for innovation in the areas of conservation and quality of discharge.

The intention of this category is to provide a quantitative and qualitative measure of water usage and water effluent related directly to the manufacture of the certified product.

Social Fairness – Cradle to Cradle product manufacturers strive to ensure that progress is made towards sustaining business operations that protect the value chain and contribute to all stakeholder interests, including employees, customers, community members, and the environment.

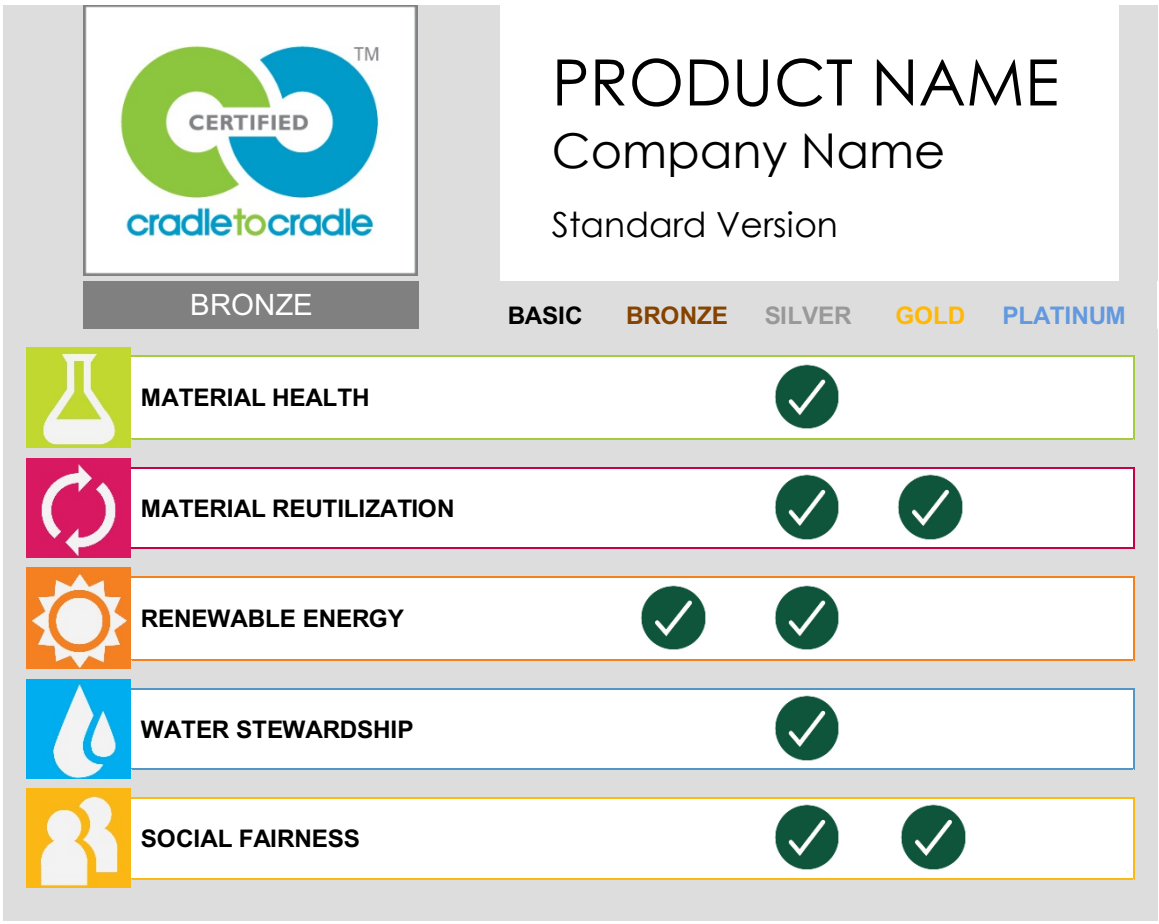
The intention of this category is to provide a qualitative measure of the impact a product's manufacture has on people and communities, and it includes some measures of general environmental impacts. Requirements apply to the facility or facilities where the final product is manufactured unless otherwise noted.

2.3 CERTIFICATION LEVELS

Because this program is not based on the binary, pass/fail model, but instead incorporates the concept of continuous improvement, the certification results are split into a **5-Level System of Basic, Bronze, Silver, Gold, and Platinum**. The minimum level of achievement in any of the five categories ultimately determines the final certification level.

When products qualify for certification, the manufacturer will receive a certificate and a scorecard that can be used to educate consumers on the level of achievement attained in all five categories. In addition, the product and its related certification level and scorecard will be listed on the Cradle to Cradle Products Innovation Institute's website (http://c2ccertified.org). An example scorecard is shown in Table 1.

Table 1 Example Product Scorecard



Publication of Product Scorecard

Publication of the product scorecard on the Certified Products Registry or in a company's marketing material is encouraged, but not required. Manufacturers can opt out of having their full scorecard published on the Certified Products Registry along with their overall level of certification.

Basic Level Is A Provisional Certification

At the Basic level, a product is just starting out on the path to certification. A company must conduct a rudimentary inventory of materials used to make the product, energy use, water stewardship, and social fairness issues affecting their industry and production region. The Basic level of certification has been designed to recognize a company's intent to improve the way their product is made, establishing a commitment to ongoing assessment and optimization.

As such, the Version 3.1 Basic level certification is a 'provisional' certification. A product may be certified only once at this level, and must re-certify at a higher level once the two year certification has expired or be delisted from the program. In addition, products certified at the Basic level under Version 3.1 may not use the certification mark on their product, but may refer to it in web and print marketing materials.

2.4 SUMMARY OF STANDARD REQUIREMENTS

Table 2 lists the Standard requirements for each of the five categories by certification level.

Table 2 Cradle to Cradle Certified™ Product Standard, Version 3.1

1. MATERIAL HEALTH	Basic	Bronze	Silver	Gold	Platinum
No Banned List chemicals are present above thresholds.	●	●	●	●	●
Materials defined as biological or technical nutrients.	●	●	●	●	●
100% "characterized" (i.e., all generic materials listed).	●	●	●	●	●
Strategy developed to optimize all remaining x-assessed chemicals.		●	●	●	●
At least 75% assessed by weight (Complete formulation information collected for 100% of BN materials that are released directly into the biosphere as a part of their intended use).		●	●	●	●
At least 95% assessed by weight (Complete formulation information collected for 100% of BN materials that are released directly into the biosphere as a part of their intended use).			●	●	●
Assessed materials do not contain carcinogenic, mutagenic, or reproductively toxic (CMR) chemicals in a form that may result in plausible exposure.			●	●	●
100% assessed by weight.				●	●
Formulation optimized (i.e., all x-assessed chemicals replaced or phased out).				●	●
Meets Cradle to Cradle VOC emission standards where relevant.				●	●
All process chemicals assessed and no x-assessed chemicals present.					●
2. MATERIAL REUTILIZATION	**Basic**	**Bronze**	**Silver**	**Gold**	**Platinum**
Defined the appropriate cycle (i.e., technical or biological) for the product.	●	●	●	●	●
Designed or manufactured for the technical or biological cycle and has a material (re)utilization score ≥ 35.		●	●	●	●
Designed or manufactured for the technical or biological cycle and has a material (re)utilization score ≥ 50.			●	●	●
Designed or manufactured for the technical or biological cycle and has a material (re)utilization score ≥ 65.				●	●

Well-defined nutrient management strategy (including scope, timeline, and budget) for developing the logistics and recovery systems for this class of product or material.				●	●
Designed or manufactured for the technical or biological cycle and has a material (re)utilization score of 100.					●
The product is actively being recovered and cycled in a technical or biological metabolism.					●
3. RENEWABLE ENERGY AND CARBON MANAGEMENT	**Basic**	**Bronze**	**Silver**	**Gold**	**Platinum**
Purchased electricity and direct on-site emissions associated with the final manufacturing stage of the product are quantified.	●	●	●	●	●
A renewable energy use and carbon management strategy is developed.		●	●	●	●
For the final manufacturing stage of the product, 5% of purchased electricity is renewably sourced or offset with renewable energy projects, and 5% of direct on-site emissions are offset.			●	●	●
For the final manufacturing stage of the product, 50% of purchased electricity is renewably sourced or offset with renewable energy projects, and 50% of direct on-site emissions are offset.				●	●
For the final manufacturing stage of the product, >100% of purchased electricity is renewably sourced or offset with renewable energy projects, and >100% of direct on-site emissions are offset.					●
The embodied energy associated with the product from Cradle to Gate is characterized and quantified, and a strategy to optimize is developed.					●
≥ 5% of the embodied energy associated with the product from Cradle to Gate is covered by offsets or otherwise addressed (e.g., through projects with suppliers, product re-design, savings during the use phase, etc.).					●
4. WATER STEWARDSHIP	**Basic**	**Bronze**	**Silver**	**Gold**	**Platinum**

The manufacturer has not received a significant violation of their discharge permit related to their product within the last two years.	●	●	●	●	●
Local- and business-specific water-related issues are characterized (e.g., the manufacturer will determine if water scarcity is an issue and/or if sensitive ecosystems are at risk due to direct operations).	●	●	●	●	●
A statement of water stewardship intentions describing what action is being taken for mitigating identified problems and concerns is provided.	●	●	●	●	●
A facility-wide water audit is completed.		●	●	●	●
Product-related process chemicals in effluent are characterized and assessed (required for facilities with product-relevant effluent). OR Supply chain-relevant water issues for at least 20% of Tier 1 suppliers are characterized and a positive impact strategy is developed (required for facilities with no product-relevant effluent).			●	●	●
Product-related process chemicals in effluent are optimized (effluents identified as problematic are kept flowing in systems of nutrient recovery; effluents leaving facility do not contain chemicals assessed as problematic) (required for facilities with product-relevant effluent). OR Demonstrated progress against the strategy developed for the Silver-level requirements (required for facilities with no product-relevant effluent).				●	●
All water leaving the manufacturing facility meets drinking water quality standards.					●

5. SOCIAL FAIRNESS	Basic	Bronze	Silver	Gold	Platinum
A streamlined self-audit is conducted to assess protection of fundamental human rights.	●	●	●	●	●
Management procedures aiming to address any identified issues have been provided.	●	●	●	●	●
A full social responsibility self-audit is complete and a positive impact strategy is developed (based on UN Global Compact Tool or B-Corp).		●	●	●	●
Material-specific and/or issue-related audit or certification relevant to a minimum of 25% of the product material by weight is complete (FSC Certified, Fair Trade, etc.). OR Supply chain-relevant social issues are fully investigated and a positive impact strategy is developed. OR The company is actively conducting an innovative social project that positively impacts employees' lives, the local community, global community, or social aspects of the product's supply chain or recycling/reuse.			●	●	●
Two of the Silver-level requirements are complete.				●	●
All three Silver-level requirements are complete.					●
A facility-level audit is completed by a third party against an internationally recognized social responsibility program (e.g., SA8000 standard or B-Corp).					●

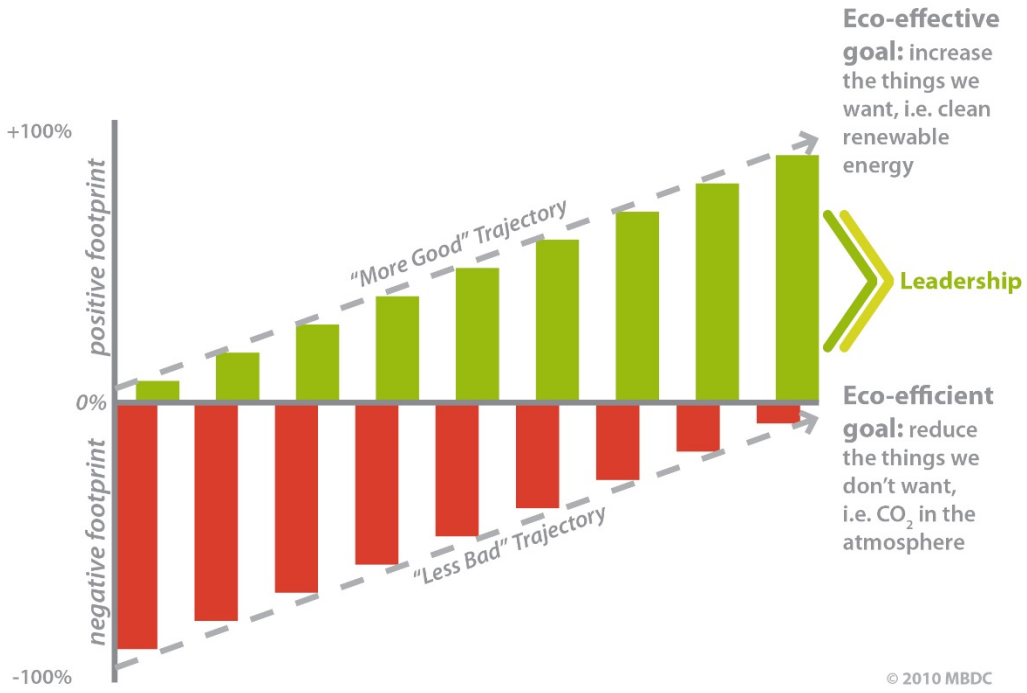
2.5 CONTINUOUS IMPROVEMENT AND OPTIMIZATION

It is expected that certification holders will make a good faith effort toward optimization in all five categories. Program conformance requires that all applicants outline their intention for the eventual phase-out/replacement of problematic substances (i.e., those materials or chemicals with X ratings) as

part of certification. The plan constructed is meant to lay the foundation for prioritizing the phase-out of problematic product inputs in order to move along the Cradle to Cradle® continuum. The Accredited Assessor will help gauge whether significant progress has been made on the optimization of x-assessed substances to maintain or improve the certification level.

The continuous improvement chart shown in
Figure 2 clearly shows how the goal is not "zero" but instead to combine the progressive reduction of "bad" with the increase in "good" to reach a beneficial Cradle to Cradle goal.

Figure 2 Continuous Improvement Chart



2.6 CERTIFICATION MARKS

Companies receiving certification will have the opportunity to license the Cradle to Cradle Certified™ Marks. This Mark signifies to the global marketplace that the company has chosen a positive path toward using chemicals, materials, and processes for production that are healthy and fit in perpetual use cycles.

The Certification Mark(s) may only be used under license and in direct association with the certified product or that product's marketing materials. The Certification Mark(s) depicted below may be printed on the product with the exception of products certified at the Basic level. Because product certification at the Basic level is a two-year provisional certification, the Certification Mark for Basic may not be used on the products. In general, the certification mark may not be used as a general-purpose mark associated with the company and its products. A style guide is available to demonstrate correct usage.

Figure 3 Cradle to Cradle Certified™ Marks

2.7 CERTIFICATION CYCLE AND RECERTIFICATION REQUIREMENT

Each product certification is valid for two years under Version 3.1 of the Standard. Certification holders must renew each certification prior to its expiration date to maintain Cradle to Cradle Certified™ product status. As part of the recertification process, certification holders must work with an accredited assessor to submit an updated assessment summary, which reports a good faith effort towards continually improving the product in accordance with Cradle to Cradle principles.

3 MATERIAL HEALTH

Safe and Healthy Materials

The review for Material Health generates material assessment ratings based on the hazards of chemicals in products and their relative routes of exposure during the intended (and highly likely unintended) use and end-of-use product phases. The ultimate goal is for all products to be manufactured using only those materials that have been optimized and do not contain any X or Grey assessed materials. As such, products are able to achieve increasingly higher levels of certification as the percentage of optimized materials in the finished product increases.

Table 3 lists each requirement within the Material Health category. To achieve a given level, the requirements at all lower levels are to be met as well. The sections that follow provide interpretation and suggested methods for achievement.

Table 3 Material Health Requirements

LEVEL	ACHIEVEMENT
BASIC	The product is 100% characterized by its generic materials (e.g., aluminum, polyethylene, steel, etc.) and/or product categories and names (e.g., coatings). The appropriate metabolism (i.e., technical nutrient (TN) or biological nutrient (BN) is identified for the product and its materials and/or chemicals. The materials subject to review in the product do not contain any Banned List chemicals above allowable thresholds based on supplier declarations.
BRONZE	The product is at least 75% assessed (by weight) using ABC-X ratings. Externally Managed Components (EMCs) are considered assessed and contribute to the overall percentage of the product that has been assessed. Complete formulation information needs to have been collected for 100% of BN materials that are released directly into the biosphere as a part of their intended use (e.g., cosmetics, personal care, soaps, detergents, paint, etc.). A phase-out or optimization strategy has been developed for those materials with an X rating.
SILVER	The product has been at least 95% assessed (by weight) using ABC-X ratings. Externally Managed Components (EMCs) are considered assessed and contribute to the overall percentage of the product that has been assessed. Complete formulation information needs to have been collected for 100% of BN materials that are released directly into the biosphere as a part of their intended use (e.g., cosmetics, personal care, soaps, detergents, paint, etc.). The product does not contain substances known or suspected to cause cancer, birth defects, genetic damage, or reproductive harm (CMRs) in a form that may result in plausible exposure.
GOLD	The product has been 100% assessed (by weight) using ABC ratings. All EMCs are considered assessed as non-X.

	The product contains no X assessed materials (optimization strategy is not required). Product meets Cradle to Cradle VOC emissions standards where relevant
PLATINUM	All process chemicals have been assessed and none have been assessed as x.

3.1 GENERIC MATERIAL TYPE AND INPUTS SUBJECT TO REVIEW

Standard Requirement

The product is 100% characterized by its generic materials (e.g., aluminum, polyethylene, steel, etc.) and/or product categories and names (e.g., coatings).

Applicable Levels of Certification

This requirement applies to all levels of certification (Basic, Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to identify the generic materials used in the product and list them in a Bill of Materials. The Bill of Materials will be used at higher levels of certification to guide the identification of the chemicals present in those materials that will be assessed for their potential to impact human and environmental health. The intent of this requirement is also to assist a manufacturer with understanding all of the materials that are present in the product that may be subject to review.

Methods

Use a Bill of Materials to record the information below. The Bill of Materials should include the following column headings: part number, part description, number of parts per product, generic material, part weight, total weight (all parts), and percent of total weight. Some of these may not be relevant depending on product configuration.

Trade names and grades for purchased materials (exact material specification), color of polymers, finish type information, supplier name, location, and contact information are additional columns that will be useful if the applicant is applying at certification levels above Basic and/or if an assessor will be assisting with data collection from the supply chain.

1. List all homogeneous materials that are present in the product by generic material type and/or product categories and names within the Bill of Materials. Parts and components of assemblies and sub-assemblies of non-homogeneous (i.e., heterogeneous) materials are to be broken down to the homogeneous material level.
    a. Homogeneous materials are defined as materials of uniform composition throughout that cannot be mechanically disjointed, in principle, into different materials. Examples of homogeneous materials are polypropylene, steel, shampoo, glass cleaner, nylon yarn, finish, and coating.
    b. Examples of non-homogeneous materials are powder-coated steel, a printed bottle label, plywood, laminate, and chair casters.

Material safety data sheets (MSDSs) may be useful in completing this first step of characterizing the breakdown of the product; however, it will likely be necessary to consult with material suppliers. ***It cannot be assumed that MSDSs contain complete materials information even at a generic level.***

2. Weigh each material and record the weights in the Bill of Materials. When more than one of a single product input is used, remember to multiply the weight of a single material by the total number of items used in the product.

3. Determine the materials subject to review. First, weigh the entire product. Divide the weight of each material in the product by the total product weight to calculate the percentage of total weight for each material. All homogeneous materials present at ≥0.01% (≥100 ppm) are subject to review, with the following exceptions: finishes (coatings, plating, paints), blowing agents, textile auxiliaries, paper bleaching agents, and plating chemistry are subject to review at any concentration level when the part these are relevant to is itself present at ≥0.01% in the product. For example, a blowing agent used to manufacture foam that is present at <0.01% within the overall product does not need to be reviewed. The blowing agent does need to be reviewed for foam present at ≥0.01%, even if the blowing agent itself is present at levels below 0.01%.

Required Documentation

Ideally, separate Bills of Material will be provided for each product configuration under review. This may, however, be very difficult in the case of complex product systems. A single Bill of Materials can only be used for a product or group of products that share all of the same materials (or chemicals) in the same concentrations, with the exception of material (or chemical) components that can be substituted into the product (or Bill of Materials) without substantially changing the concentrations of each material (or chemical) in the product (e.g., a chair in different color styles or patterns, or soap in different fragrances; not an office set that includes a cabinet that is 95% "Alloy A" and a desk that is 10% "Alloy A"). For multiple products featuring various concentrations of materials (or chemicals), each product configuration is required to be reported.

3.2 IDENTIFYING APPROPRIATE METABOLISM(S)

Standard Requirement

The appropriate metabolism (i.e., biological or technical) has been identified for the product and its material components.

Applicable Levels of Certification

This requirement applies to all levels of certification (Basic, Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to identify the intended nutrient cycle (i.e., biological or technical) for the product and its components, which can then be used to guide the development and implementation of an appropriate nutrient management strategy required for higher levels of certification.

Methods

For each homogeneous material subject to review, as determined according to the process described in Section 3.1, identify in the Bill of Materials whether it is part of a technical or biological nutrient cycle. It may be that a material still needs to be designed for the most appropriate metabolism; the goal at this

stage is to simply define what is appropriate. The following definitions and examples will aid in categorizing each material as well as the overall product.

Technical Nutrients (TNs)

- Materials or products that are capable of "feeding" technical systems: they may be dismantled and reused, or physically or chemically transformed, but are not consumed (i.e., materials that do not enter the biosphere).
- Materials or products that generally cannot be processed by biological systems.
- Materials or products that are items used as Products of Service. A Product of Service is a material or product designed to provide a service to the user without conveying ownership of the materials.
- Metals and plastics are examples of TNs. Bio-plastics, although they are from the biosphere, may be designed as TNs (i.e., kept in technical cycles).
- Externally Managed Components (EMCs) are a type of TN defined in Section 1.3.1.3.

Biological Nutrients (BNs)

- Materials or products that are usable by living organisms to carry on life processes.
- Materials or products that are items used as Products of Consumption, which are typically changed biologically, chemically, or physically during use and therefore enter the biosphere either by nature or human intention. Such products should be designed for the biological system and thus are categorized and evaluated as biological nutrients. For example, brake pads, which abrade into the environment upon use, should ideally be designed for the biological cycle and will be reviewed with that intention in mind.
- Cleaning products, cosmetics, personal care products, and paper are examples of BNs.

Note that the classification as TN or BN will determine which Banned List applies to the product, and will be considered in the material health assessment.

Required Documentation

Clearly identify in the Bill of Materials whether each material is part of a technical or biological nutrient cycle. This may be accomplished by adding a column in the Bill of Materials.

3.3 DETERMINING ABSENCE OF BANNED LIST CHEMICALS

Standard Requirement

The materials subject to review in the product do not contain any Banned List chemicals above the allowable thresholds based on supplier declarations.

Applicable Levels of Certification

This requirement applies to all levels of certification (Basic, Bronze, Silver, Gold, and Platinum). However, in cases where an applicant is applying for levels above Basic, full material disclosures (as described in Section 3.4) may be used in place of Banned List declarations.

Intent

The intent of this requirement is to ensure, to the extent possible, that chemicals considered harmful to humans or the environment are not intentionally added to materials in the certified products above a designated threshold. By requiring suppliers to submit declarations, the onus for confirming absence of Banned List chemicals is placed on the supplier to give them some responsibility for understanding the chemical composition of their materials and removing an additional obligation from manufacturers to test for all Banned List chemicals.

Methods

1. Refer to the Banned Lists of Chemicals for the Cradle to Cradle Certified™ Products Program (Appendix). Note there are two banned lists, one for technical nutrient (TN) materials and one for biological nutrient (BN) materials. See Table 4 for a guide to determine where Banned List chemicals are often used, and where to expect and look for their presence.
2. For each homogeneous material identified in the product, gather supplier declarations stating that Banned List chemicals have not been *intentionally added* above the allowable threshold (generally 1000 ppm, with the exceptions noted below). An *intentionally added* substance is a substance that has been added to the material for a specific purpose. A substance is also considered to be intentionally added to a material if a manufacturer chooses to use a material coming from a source that is likely to contain the substance. 'Intentionally added' also means 'known to contain.' Also note the following:
    a. The concentration of the banned chemical within each homogeneous material, and not the concentration of each banned chemical within the overall product, is the basis for this review.
    b. Exceptions to the TN Banned List and the 1000 ppm allowable threshold are as follows:
        i. Lead, PTFE, and PAHs are substances that are on the Biological Nutrients Banned List but not the Technical Nutrients Banned List. While these substances can be used in some materials as technical nutrients where exposure is not expected to occur (e.g., lead in aluminum, PAHs in carbon black), they are harmful chemicals and should not be present in materials that may result in exposure to humans and the environment. The following therefore applies:
            a. When present above 1000 ppm, lead, PTFE, and PAHs are also banned for use in TN materials where direct exposure to humans or the environment is highly likely to occur. Examples of these materials include paints, coatings, and finishes that are used on the surface of products such as toys or other children's products and jewelry.
            b. PTFE is banned in TNs if it is the primary component of the product. PTFE is considered a primary component when it represents more than 50% of the product (not material) by weight.
        ii. The thresholds for metals in BN materials are 2 ppm for cadmium, 90 ppm for lead, 100 ppm for chromium, 1 ppm for mercury, and 10 ppm for arsenic. With the exception of the lead threshold, these are the lowest soil screening values (SVs) among those of eleven European countries whose SVs are compared in Armiento et al. (2011) [www.tandfonline.com/doi/abs/10.1080/02757540.2010.534085]. The lead threshold is based on the legal threshold for paint in the US (90 ppm), which is lower than the lowest SV for the metal [www.cpsc.gov].

c. EMCs are not exempt from Banned List declarations.

d. Banned list declarations are also required for each homogeneous material used in the product's primary packaging (if any), including inks, adhesives, and any materials used to label the package (see Section 2.1 of this document for more information).

e. Analytical testing for Banned List chemicals is not accepted in lieu of supplier declarations, but is required in the following situations:

   i. To ensure absence of Banned List chemicals from recycled content when full data cannot or will not be gathered. See section 3.3.1 for further information.

Required Documentation

A signed statement from each supplier must be obtained and submitted to the assessor to verify that the product or material does not contain banned chemicals. Product manufacturers or the assessor may also sign these declarations if they have detailed knowledge of the material's chemical constituents. A supplier may submit a Banned List declaration that broadly covers all inputs provided to a manufacturer. At a minimum, these statements must:

1. Clearly identify the supplier and the material by product identification number, trade name, and/or grade as appropriate.
2. Include the full listing of Banned List chemicals (ensure that the correct list is used depending on whether each item has been categorized as a BN or TN).
3. Include the statement that such chemicals have not been intentionally added at >0.1% (lower levels apply for BN).

A convenient way to track whether materials contain Banned List chemicals and/or whether signed supplier declarations have been received for the inputs is to add a column to the Bill of Materials where comments can be included to that effect.

Table 4 Major Uses and Primary Human Health and Environmental Issues Associated with Banned List Chemicals

Banned List Category	Major Uses and Contamination Concerns	Primary Issues
Metals: Lead, cadmium, chromium VI, mercury	Intentional inputs to some metal alloys, inks, colorants and stains. Lead and cadmium are used in batteries. Chromium VI may be used as a wood preservative, in leather tanning, and as a metal coating. Mercury is used in fluorescent bulbs and other specialty applications. These metals are contaminants found in many materials including polymers, paper, metals, glass, paint and coatings, etc.	Lead: potent neurotoxin, possible carcinogen (IARC). Cadmium and chromium VI: carcinogenic to humans (IARC). Mercury: potent neurotoxin, highly toxic to the respiratory system and kidneys.
Metals: Arsenic	Alloying agent and/or impurity of copper, brass and bronze, wood preservative (chromated copper arsenate).	Carcinogenic to humans (IARC).

Banned List Category	Major Uses and Contamination Concerns	Primary Issues
Flame Retardants	Additive to polymers used in electronics, appliances, and automotive applications, carpet, furniture foam, upholstery, and textiles.	Environmental persistence, bioaccumulation, endocrine disruption, liver and neurodevelopmental toxicity. TDCP/TDCPP: Known carcinogen (CA Prop 65).
Phthalates	Used as plasticizers (to increase softness and flexibility) in PVC and other polymers, inks, and adhesives, personal care products such as nail polish and hair gels, and medical devices. May be found as contaminants in recycled polymers and paper at low levels.	Endocrine disruption, reproductive development toxicity.
Halogenated Polymers	PVC is widely used in a variety of products from packaging to construction. It is somewhat common for PET to be contaminated with PVC due to similar specific gravity. A common use of PVDC is in films (e.g., Saran Wrap). CPVC (chlorinated polyvinyl chloride) is used to manufacture pipes. Polychloroprene (neoprene) is used to manufacture wet suits, laptop sleeves, iPod holders, gaskets and hoses. Polytetrafluoroethylene (PTFE) is used in a wide range of products where low friction and/or scratch resistance is required, including cookware, inks, paints, coatings, textiles, etc.	Production and release of potent toxins including dioxins, furans, and hydrogen chloride upon combustion. Vinyl chloride monomer is carcinogenic to humans (IARC). Chloroprene monomer is possibly carcinogenic to humans (IARC) and a known carcinogen (CA Prop. 65). PFOA, used during manufacture of PTFE, may be released when PTFE is heated to high temperatures. (Also see below for more information; PFOA is also on the Banned List). PTFE is associated with pulmonary edema upon inhalation of fumes when heated to high temperatures. Additives such as phthalates used widely in halogenated polymers are also problematic.

Banned List Category	Major Uses and Contamination Concerns	Primary Issues
Chlorinated Hydrocarbons	The chlorinated hydrocarbons on the Banned List are primarily used as pesticides (insecticides, fungicides); some are banned for use in the U.S., EU, and other countries. Secondary uses of some compounds are solvents for waxes, gums, resins, tars, rubbers, oils, asphalts, dyes and intermediates. Hexachlorobenzene is used in the manufacture of synthetic rubber and as a plasticizing agent in PVC. SCCPs are used in lubricants, plasticizers, flame retardants. (Note: It is currently unlikely to find these as intentional inputs to consumer products.)	Toxicity concerns vary depending on the chemical and include carcinogenicity, reproductive toxicity, endocrine disruption, persistence, bioaccumulation, and aquatic toxicity at low concentrations.
Polycyclic aromatic hydrocarbons (PAHs)	PAHs are present in fossil fuels (coal, mineral oil, etc.). They are produced during incomplete combustion of organic materials and released in vehicle, factory, and other exhausts. PAHs are also found in a variety of consumer products as contaminants due to the use of extender oils and carbon black. PAHs may be found in soft polymers (rubber and elastomers) and black hard polymers.	Some are known carcinogens, mutagens, and reproductive toxins.
Pentachlorophenol (PCP)	Fungicide banned for use in the U.S. except as a wood preservative for telephone poles, pilings, and other heavy-duty applications. PCP may be used as a cotton and leather preservative. It is no longer produced in the EU and is banned in some countries.	Known carcinogen (CA Prop 65).
Octylphenol, Octylphenol ethoxylates; Nonylphenol, Nonylphenol ethoxylates	Surfactants and wetting agents used in cleaning products, paints, inks, adhesives, pesticides, textiles, and paper processing. Canada and the EU have restricted the use of NPEs.	Persistent in the aquatic environment, moderately bioaccumulative, extremely toxic to aquatic organisms, endocrine disruption.

Banned List Category	Major Uses and Contamination Concerns	Primary Issues
Triorganotin compounds (-butyl, -octyl, -phenyl)	Fungicides and bactericides that may be used in textile, leather, pulp and paper manufacturing. In this context they are primarily of concern due to their effects on aquatic organisms, as they may be released with process water. May also be used as PVC stabilizers, wood preservatives, and pesticide treatment for textiles and carpet. Use is restricted in the EU, U.S., and other countries.	Highly toxic to aquatic organisms, endocrine disruption
Perfluorooctane-sulfonate (PFOS), Perfluorooctanoic acid (PFOA)	PFOS: May be used as a stain repellent for textiles and carpet (phased out in U.S. and EU), mist suppressant in chromium VI metal plating process, fire fighting foam, photo-imaging, paper coating (repels oil and water) PFOA: Used in the production of PTFE and other fluoropolymers; PTFE may degrade to PFOA.	Persistent, bioaccumulative, present at low levels in the human body; PFOS and PFOA have been associated with a variety of toxic effects in mammals, including developmental toxicity and liver toxicity; human health effects are not fully understood.

3.3.1 Recycled Content

It may be necessary to test materials containing recycled content for Banned List chemicals. Analytical testing is required for certain material types and sources in cases where full ingredient data cannot or will not be gathered and where there are concerns about possible contamination. The intent of this requirement is to ensure the use of safe materials in recycling streams. The assessor, in consultation with the manufacturer, is responsible for determining whether a material is likely to contain Banned List chemicals based on its source, and requiring analytical testing when the presence of Banned List chemicals above the designated threshold is a concern.

Table 5 can be used as a reference for examples of materials with known issues with regard to Banned List chemicals.

Note that for metals, testing will generally not be necessary. Identification of the specific alloy grade being used will allow determination of the full chemical composition of the metal alloy down to 0.01%. Potentially useful references for looking up metal composition based on grade include www.matweb.com, www.efunda.com, and www.copper.org.

Table 5 Examples of Materials with Known Issues with Regard to Banned List Chemicals and Suggested Analytical Methods

Banned List Category	Recycled Material Types to Test	Method (suggested)
Metals: chromium VI, mercury	All materials.	Chromium VI: ICP/MS or ICP/AES (ICP/OES) with detection limits in the low ppm range. Note that if ashing digestion techniques are required, mercury, arsenic, and tin may volatilize from the sample, increasing detection limits, though an acceptable detection limit should still be attainable. If total chromium in the material is greater than that allowed for the desired certification level, then further testing will be required to determine the amount of hexavalent chromium present using alkaline digestion techniques (most cases). XRF testing methods are allowed for glass. Mercury: ICP or CVAA/direct mercury analysis with detection limits in the low ppm range.
Metals: lead, cadmium	All materials identified as biological nutrients, or in technical nutrients with no guaranteed management plan.	Same as above for chromium VI.
Metals: arsenic	Copper, brass, bronze, recycled wood where full data cannot be gathered.	Same as above for chromium VI.
Halogenated Flame Retardants (refers only to those on the Banned List)	Polymers sourced from electronic, appliance, and automotive sources, recycled carpet, upholstery foam, and textiles.	GC/MS; Detection limit <0.1% for Basic level and the Banned List chemicals; Detection limit <0.01% (100 ppm) for Bronze level and above. If flame retardants are not expected to be present (unlikely for these material types): oxygen bomb combustion sample preparation followed by ion chromatography with detection limits in the low ppm range (25 ppm max, ~5ppm or less preferred) may be used. This is a screen for all halogens including inorganic so will cover the halogenated polymer test as well. Request that bromine, chlorine, and fluorine be reported separately.

Banned List Category	Recycled Material Types to Test	Method (suggested)
Phthalates: DEHP, BBP, DBP	Flexible polymers other than PET, HDPE, and PP from standard post-consumer recycling streams. (Franz et al. (2004) found phthalate contamination in recycled PET in the 0.05-0.5 ppm range. Vinggaard et al. (2000) found the maximum concentration of phthalates in paper to be 28 ppm for DBP).	CPSC-CH-C1001-09.3 Standard Operating Procedure for Determination of Phthalates (or more recent version). GC/MS; detection limit <0.1% (1000ppm).
Halogenated Polymers: PVC, PVDC, CPVC, Polychloroprene, PTFE	All polymers	If flame retardants or other halogens are not expected to be present, this method is recommended: oxygen bomb combustion sample preparation followed by ion chromatography with detection limits in low ppm range (25 ppm max, ~5ppm or less preferred). This is a screen for all halogens including inorganic. Request that bromine, chlorine, and fluorine be reported separately. If flame retardants or other halogens are expected to be present: GC/MS; detection limit <0.1% for Basic level and the Banned List chemicals; detection limit <0.01% (100 ppm) for Bronze level and above. (Complete this test and the oxygen bomb screening test if applying above the Basic level and hoping to achieve an X or grey assessment for recycled content). Other common halogen sources that are not on the Banned List of chemicals: chlorinated pigments, additional flame retardants, UV stabilizers, and biocides. If these are expected to be present, it is recommended to use GC/MS methods to test for specific chemicals on the Banned List.

Banned List Category	Recycled Material Types to Test	Method (suggested)
Chlorinated Hydrocarbons (refers only to those on the Banned List)	Testing is not required unless applying at the Gold level.	The VOC testing required at the Gold level covers this requirement. Single materials will not need to be tested; instead the entire product is tested. See VOC Emissions Testing (Section 3.9).
Polycyclic aromatic hydrocarbons (PAHs)	Testing is not required.	Not applicable.
Pentachlorophenol (PCP)	Recycled wood from heavy-duty applications such as utility poles, railroad ties, etc., cotton and leather.	GC/ECD; (See Becker, Buge and Win. Determination of PCP I waste wood – method comparison by a collaborative trial. Chemosphere 47 (2002): 1001-1006). Detection limit <0.1% for Basic level and the Banned List chemicals; Detection limit <0.01% (100 ppm) for Bronze level and above.
Octylphenol, Octylphenol ethoxylates; Nonylphenol, Nonylphenol ethoxylates	Recycled textiles, reclaimed fibers, recycled leather.	LC/MS; detection limit <0.1% (1000 ppm).
Triorganotin compounds (-butyl, -octyl, -phenyl)	Recycled wood, carpet, textiles.	GC/MS; detection limit <0.1% (1000 ppm).
Perfluorooctanesulfonate (PFOS) Perfluorooctanoic acid (PFOA)	Recycled textiles, reclaimed fiber.	LC/MS; detection <0.1% (1000 ppm).

Testing Intervals

Testing of recycled content to ensure absence of banned substances is required when complete data cannot be obtained. At a minimum, testing is required at the time of the initial certification and again at each subsequent re-application.

An exception to this requirement is for materials containing recycled content for which a C or better material assessment is desirable (so that they may contribute to the percentage assessed to Gold certified products). In these cases, testing is required on a semi-annual basis (every six months). These semi-annual test results must be provided to the assessor immediately after testing is completed. If any test shows problematic chemicals present above the required thresholds, the material will no longer be assessed as C or better. This will affect the overall certification level immediately (i.e., demotion from Gold). For this reason it is recommended that only consistent and relatively clean material streams be used, especially in the case of Gold certified products. Note that testing is usually not required for steel, aluminum, and other metals.

Selecting a Testing Laboratory and Analytical Method

Laboratories conducting the analytical testing of recycled content must be certified to ISO 17025 and experienced in materials analysis. There are many laboratories that specialize in testing environmental samples (e.g., air, water, and soil); however, these labs may not have expertise in extracting and analyzing contaminants from other material types. It is recommended that applicants work with their assessor to select an appropriate laboratory to conduct the analyses.

Table 5 lists appropriate testing methods for common material types and contaminants. It may, however, be necessary to determine appropriate methods on a case-by-case basis. In addition, different laboratories may use somewhat different methods based on equipment availability and expertise. Some laboratories may also use proprietary sample preparation methods that they will not fully disclose. Instrumentation may include ICP/MS, ICP/AES, GC/MS, GC/ECD, or LC/LMS, among others. The appropriate method is dependent on the contaminant of interest, material type, and analytical laboratory. In some cases X-ray fluorescence (XRF) methods may be used (i.e., for glass elemental analysis). In speaking with and selecting a laboratory, it must be ensured that:

1. Detection limits are low enough.
    a. If applying only at the Basic level, detection limits of <1000 ppm for each contaminant are acceptable in most cases. Exceptions to this are metals in biological nutrients.
    b. If applying for levels above Basic, detection limits of <100 ppm are needed for the metals (lead, cadmium, mercury, chromium VI), flame retardants, and halogenated polymers (see Section 3.4.2). A detection limit of <100 ppm is sufficient for any other contaminant(s) that will be tested.
    c. Generally, detection limits of much less than 1000 ppm will be achievable.
2. Sample preparation and contaminant extraction methods are appropriate. Generally, solvent extractions will be necessary. Environmental laboratories experienced in testing air, water, and soil samples may use U.S. Environmental Protection Agency (EPA) standardized methods; however, such methods may not be appropriate for extraction of contaminants from materials such as polymers.

Required Testing Documentation

Test reports including contaminants tested for, detection limits, description of material sample(s) tested, test method(s), laboratory certification information, and laboratory contact information must be submitted to the assessor.

RoHS directive testing reports may be submitted to ensure conformance with the Banned List for metals (mercury, chromium VI) and some flame retardants (RoHS does not cover TBBPA or TDCP). RoHS compliance statements fully cover the Basic-level requirements for these contaminants.

To determine that metals and halogens are present at <100 ppm, as required at the Bronze level and above for assessing recycled content, full RoHS test reports including detection limits and contaminant concentrations should be provided (compliance statements alone are not sufficient). If detection limits are <100 ppm, the RoHS test report applies.

CONEG compliance statements (relevant to packaging in the U.S.) apply for lead, cadmium, chromium VI, and mercury testing for paper and other packaging materials with recycled content.

3.4 COLLECTION OF MATERIAL COMPOSITION DATA

Standard Requirement

Material ingredient data must be collected to generate ABC-X assessments for each material in a product.

Applicable Levels of Certification

This requirement applies to the Bronze level of certification and above (Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to assist a manufacturer with understanding the chemicals that are present in the product so that they may be assessed for their potential to adversely impact human or environmental health.

Methods

1. Sign necessary confidentiality agreements with suppliers and sub-suppliers, if necessary. Confidentiality is a major concern for many manufacturers so it will often be necessary to sign confidentiality agreements assuring that ingredient data will be held as confidential. Three-way agreements may be necessary in cases where a consultant is gathering data and sending it on to an assessor.
2. Collect data for each homogeneous material subject to review (as determined in Section 3.1) until the desired percentage of the materials in the product have been assessed. It will often be necessary to collect data from multiple sequential tiers of a supply chain to identify all chemicals subject to review in each homogeneous material. The chemicals subject to review in each material are those present at a concentration ≥ 0.01% (≥ 100 ppm), and those subject to review at any concentration (see f. and g. below). Chemicals subject to review are limited to intentionally added inputs (see Section 3.1 for definition of intentionally added). Request the following information at each tier as necessary to identify all chemicals subject to review in each homogeneous material:
    a. Name of each chemical or specific manufacturer trade name and grade in the case of purchased chemicals or chemical mixtures.
    b. Unique CAS for all raw chemicals.
    c. Concentration or concentration range (e.g., 0-1%, 1-5%, etc.) of each chemical or chemical mixture (note the concentrations must add to 100% or a statement from the supplier that all ingredients are present is required).
    d. The function each chemical or chemical mixture serves within the material or product (i.e., resin, main polymer, catalyst, antioxidant, UV stabilizer, pigment, impurity, etc.; note this information is useful to have when conducting assessments but is not required).
    e. Percent recycled content, if any, including indication of type (post-consumer or post-industrial).
    f. The concentrations of lead, mercury, hexavalent chromium, cadmium, pigments, dyes and other colorants, phthalates, halogenated organics, and scarce elements or substances specified in the *Material Health Assessment Methodology* document (i.e., indium, gold, diamond, etc.) when present at any concentration.

g. Process chemicals used that are metal plating agents (i.e., hexavalent chromium), textile auxiliaries (i.e., textile process chemicals), blowing agents, and paper bleaching agents. These process chemicals are subject to review even if they are not expected or known to be present in the finished product. Note that for paper, manufacturers may not know if process chemicals remain in the final product at ≥100ppm. If they are unsure, it is required that they provide data on process chemicals as well. Octylphenol, octylphenol ethoxylates, nonylphenol, nonylphenol ethoxylates, and triorganotin compounds (-butyl, -octyl, -phenyl) are Banned List chemicals that may be used in textile, paper, and pulp processing. Evaluation and optimization of process chemicals will extend into all product-relevant processes at the Platinum level.

3. Identify all chemicals present at 0.01% or greater in the material (or at any concentration for the exceptions listed in 2.f. and 2.g. above) if the goal is for a material to receive an A, B, or C assessment. If it has become clear that a material will be X assessed before the full chemical composition has been obtained, it is allowable to have incomplete data such as those reported on an MSDS. In such cases, a supplier declaration stating that no Banned List chemicals are present must be obtained.

There are analytical testing and other requirements for EMCs and materials containing recycled content, but analytical testing is generally not required for identifying chemicals subject to review. See Sections 3.4.1 and 3.4.2 for further information on EMCs and materials containing recycled content.

4. Common follow-up questions relevant to conducting assessments once data have been provided are:
   a. For polymers, what are the residual monomer concentrations (in cases where monomers are x assessed)?
   b. Have petroleum distillates been severely hydro-treated?
   c. In cases where chemical concentrations have been provided, what is the final concentration of that chemical in the product? Note that some chemicals that were added or used during the manufacturing process may not be present in the final product.

The applicant is required to provide the information to answer these common follow-up questions.

For polymers, the residual monomer concentrations must be reported in cases where the monomers are 'x' assessed or on the Banned Lists (e.g., PFOA and PFOS concentrations must be reported for materials containing PTFE). Analytical testing to determine the monomer concentration in the material is required if the monomer concentration cannot be obtained from existing information.

Knowing what ingredients to expect in different material types is helpful in determining whether accurate information has been provided. See Table 6 for guidance.

Table 6 Typical Ingredients in Common Materials

MATERIAL TYPE	DESCRIPTION	TYPICAL INGREDIENTS
Adhesives	Glues, tapes, binders, etc.	Resins, fillers, antioxidants, catalysts, film backers, preservatives, solvents, tackifiers, defoamers, etc.

Adhesives – Formaldehyde-based Binders	Melamine-Formaldehyde (MF), Phenol-Formaldehyde (PF), Urea-Formaldehyde (UF), Wet Strength, M-UF, P-UF, Non-Scavenged UF, etc.	Base resin, residuals, etc.
Fabric	Natural or synthetic fibers, yarn, etc. Woven and non-woven textiles.	Base fiber, dyes and/or pigments, recycled content, auxiliaries, flame retardants, residual pesticides or preservatives.
Fasteners (metal)	Screws, bolts, washers, rivets, etc.	Base metal alloy, recycled content, coatings or paint, trace contamination, waxes, lubricants/plating/finishes.
Finishes	Most metal (structural and fasteners) will have a finish: Zinc oxide, oil, chrome, etc.	Hexavalent chromium finishes, cadmium plating, etc.
Polyurethane Foam	Cushions, padding, insulation, etc.	Polyol and isocyanate, blowing agent, catalyst, additives, colorants, flame retardants, etc.
Glass, Fiberglass, Clay	Tempered glass, fiberglass.	Glass, colorants, recycled content, trace heavy metal contamination, other additives for fiberglass reinforcements such as sizing and coatings.
Inks, Dyes, Colorants, Pigments	Paper inks, fabric dyes, plastics and paint colorants, printing inks for paper, fabric, labels, etc.	Colorants, biocides, solvents, polymers, minerals, fillers, resins, etc.
Laminates	High-pressure or low-pressure decorative laminate.	Adhesive, kraft paper, wetting agents, resins, residuals from resins, abrasion additives, decorative paper, backers, etc.
Metal (not fasteners)	Table legs, arms, etc. Steel, aluminum, etc.	Base metal alloy, recycled content, coatings or paint, trace contamination.
Paints	Coatings on a variety of substrates.	Colorants, biocides, solvents, polymers, minerals, fillers, waxes, resins, etc.
Paper and Pulp	Labels, packaging, envelopes, etc.	Pulp, paper, biocides, inks, bleaching agents, residual process chemicals, recycled content, trace contamination, aluminum sulfate, etc.
Polymers	Including copolymers, nylon, ABS, polypropylene,	Base resins, colorants, catalysts, fillers, recycled content, trace contamination,

	polyethylene, PET, PU, PC, acetals, PVC, etc	flame retardants, additives such as UV stabilizers, antioxidants, recycled content, trace, residual monomers (common problematic monomers: styrene, butadiene, acrylonitrile, bisphenol A, etc.).
Wood, Natural Fibers (treated or untreated)	Plywood, particleboard, veneers, oriented strand board, solid wood, jute fiber, etc.	Base material, adhesives, preservatives, flame retardants, etc.

Required Documentation

A Bill of Substances for each homogeneous material that includes the information listed above is required. Note that "Exact Material Specification" is required for this stage.

It is recommended to also obtain a signed statement from the manufacturer indicating that, to the best of their knowledge, all chemicals that are present at 0.01% or greater in the material have been provided (or to any level for the exceptions listed above) in the Bill of Material.

3.4.1 Externally Managed Components (EMCs)

The following information must be collected from the applicant or applicant's supplier if a sub-assembly is to be defined as an EMC (see Section 1.3.1.3 for definition and more information on EMCs):

1. The supplier of the EMC has provided the applicant with a guarantee for take back and appropriate nutrient management. The supplier may designate a third party or parties for implementation.
2. The supplier has signed a declaration that chemicals in the EMC will not negatively impact humans or the natural environment during the intended and unintended but highly likely use of the product for which the EMC is a component. This guarantee may be provided if the EMC is Cradle to Cradle Certified™ (Gold level or higher), or other appropriate evidence.
3. The EMC has undergone testing by an accredited analytical laboratory to insure that harmful substances are not being emitted from the EMC above the chemical's analytical detection limits. Off-gas testing is required for all indoor-use EMCs (See Section 3.9 for more information on VOCs emission testing). Migration and leaching testing may be required depending on the type of EMC.

If the above are completed, the general requirement for full chemical compositional identification and assessment of the EMC will not apply.

The intent of these requirements is for the supplier to indicate, to the best of their knowledge, that the sub-assembly is a sealed component that is manufactured in a way that prohibits the migration of chemicals and materials from the component. If, during use of the product for which the EMC is a component, a user is exposed to any part or chemical within the component, or if any part or chemical within the component is released to the environment, the component is not considered an EMC and will be assessed and inventoried like the other materials in the product.

It is recognized that it is not possible to know with absolute certainty that chemicals and materials in the EMC will not negatively impact humans or the natural environment during all the possible use and

re-use scenarios. The overall intent is to allow for the use of product components that do not need to be assessed the same way as the rest of a product because they are managed as a whole by the supplier or a third party. The EMC concept was invented by the founders of the Cradle to Cradle® framework to encourage manufacturers to design complex components that are completely managed after their use phase. Examples of potential EMCs are a pneumatic cylinder in an office chair, the motherboard in a computer, the electric motor inside an automated window shade product, and a solar panel.

Required Documentation

The following documents must be submitted to the assessor:

1. A signed statement from the manufacturer guaranteeing take back and appropriate nutrient management of the EMCs, including a full description of the take back program and how the product or material will be returned.
2. A signed declaration that chemicals in the EMC will not negatively impact humans or the natural environment, as detailed above (this guarantee may be provided if the assembly/part is Cradle to Cradle Certified (Gold level or higher), or other appropriate evidence).
3. Test results, including a description of the test methods used and laboratory contact information.

3.4.2 Recycled Content

The information below will aid in the collection of chemical ingredient data from the applicant or applicant's supplier if the product contains recycled content.

1. **Recycled content from a single stream source** -- In cases where recycled content is coming from a single stream source, it may be possible to gather ingredient data from the original manufacturer as described above for other homogeneous material types. For example, a single stream, post-industrial recycled material source may be made up of one or two materials of known trade name and grade. In this case, analytical testing is not required, assuming the actual material formulation has been obtained.
2. **Recycled content from an undefined source --** In many cases, it is not possible to obtain sufficient ingredient data on materials containing recycled content from undefined sources (the majority of post-consumer recycled materials are undefined) to ensure that Banned List chemicals are not present above allowable thresholds, determine whether toxic metals and organohalogens are present at ≤100 ppm, and to complete an A, B, C, or X material assessment. This may be done through a combination of analytical testing and ingredient disclosures as follows:
    a. Metals: Metals are some of the most highly recyclable and recycled materials known. Steel mills, aluminum plants, and other facilities that recycle metal alloys perform analytical tests for the purpose of identifying and tightly controlling the elemental composition of the alloys being manufactured using recycled scrap. Therefore, the ingredient composition for metal alloys can usually be found in publicly available sources (e.g., AISI, JIS, Aluminum Association) or in the mill certificate provided by the metal supplier[1].

[1] The user must have the specific alloy number for the metal before being able to identify its composition (i.e. AISI 1020 Steel; JIS G 3101 Steel; 6061 Aluminum).

If possible, obtain the alloy grade and look up standard composition in the available databases or obtain the mill certificate with full composition information. Identifying the specific alloy grade being used will allow determination of the full chemical composition of the metal alloy down to the 100ppm (0.01%) level. The following websites are potentially useful references for looking up metal composition: www.matweb.com, www.efunda.com, and www.copper.org.

Alternatively, analytical testing can be used to obtain the full chemical composition down to 0.01% and then conduct the material assessment. Analytical methods with detection limits that are ≤100ppm (0.01%) for lead, mercury, cadmium, and chromium VI must be used. Analytical testing for lead is required in cases where available alloy composition data for recycled cast aluminum does not report the lead concentration.

b. Glass: Glass is also one of the most recyclable materials today. Similar to recycled metals, a series of simple and inexpensive analytical tests can be performed to identify the full elemental composition of the inorganic material.

   If possible, obtain an ingredient disclosure from the supplier to identify the full elemental composition of the glass material. If a disclosure cannot be obtained, conduct analytical testing with detection limits that are ≤100ppm (0.01%) to obtain the full chemical composition down to 0.01% and then generate the material assessment. XRF methods may be used for elemental analysis of glass.

c. Paper and Natural Cellulosic Fibers: Recycled paper and other natural fibers compose one of the largest recycled material pools by weight worldwide. In some cases, paper composition information can be obtained from the paper mill(s). Alternatively, analytical testing must be conducted.

   Identify chemicals that are present in the material at concentrations ≥100 ppm and pulp bleaching agents at any concentration (it is required that pulp suppliers disclose the type of bleaching process used). Data are to cover final product composition as opposed to input composition, if possible. In addition to pulp bleaching agents, a number of different process chemicals (e.g., de-inkers, sizing agents) may be used in the recycling of paper and natural fiber materials to make them suitable for manufactured products in their next use phase, and these must be considered. If it is unclear whether or not process chemicals remain in the final product, it is recommended to gather data on process chemicals as well. Analytical testing for metals (excluding arsenic) is required for the assessment of paper containing recycled content.

   To be eligible to earn an A, B, or C material assessment rating, the ingredients remaining on the finished paper must be fully identified and assessed. The assessor must then evaluate all ingredients that compose ≥0.01% of the finished paper product using the Cradle to Cradle Certified Material Health Assessment Methodology. For untreated post-consumer recycled paper, if the recycled paper remains in an untreated state (i.e., raw recycled paper), then it might not be possible to determine the full composition by weight for all ingredients. In these cases, a material assessment cannot be performed and the material will earn a GREY assessment and is added to prioritized optimization plan.

d. Polymers: Plastics are an integral part of everyday life and are seen as valuable technical nutrients that need to be kept in closed-loop material flows rather than burned for energy or dumped in landfills. There are usually significant challenges in obtaining the full composition of a post-consumer recycled plastic due to contamination, varying grades of resin from different manufacturers, various product labels, and content residues. However, when a material comes

from just one or two known sources, it may be possible to go back to the original manufacturer to gather full chemical ingredient data, as for virgin materials.

Polymers must be from relatively consistent recycling streams in order to receive an A, B, or C material assessment. If an A, B, or C assessment is of interest:

i. Define the recycling stream. For example, is the material sourced only from clear PET bottles, milk jugs, battery casings, etc.? How has the material been separated from other types of plastic? Discuss separation techniques with the material provider(s) and document any known contamination issues.

ii. In addition to testing for the presence of Banned List chemicals above the allowable thresholds, testing for other contaminants may be required depending on discussions with material providers and knowledge of the specific material types. The goal is to determine if any chemicals that would result in an X assessment are present at ≥100 ppm. For example, in the case of recycled PET, antimony testing may be required as it is expected to be present. In these cases, testing regimens will need to be developed on a case-by-case basis. If total halogen concentrations are greater than 100 ppm based on a screening test, it will be necessary to identify the specific halogen compound or compounds present in the product to determine whether any one organohalogen compound is present at a concentration of 100 ppm or greater. Note that the total halogen test will also detect inorganic halides such as chloride salts, which are typically not problematic.

3. Materials subject to analytical testing are those containing recycled content from undefined sources (i.e., most post-consumer sources) for which full chemical ingredient data cannot be gathered and/or contamination is suspected. At a minimum, testing is to be done as described in Section 3.3.1 to determine the absence of Banned List chemicals above the allowable thresholds.

4. Note that it may not be possible to gather full chemical ingredient data on materials that contain recycled content from undefined sources. Recycled content that has passed testing for Banned List chemicals (see Section 3.3.1), but for which full ingredient data cannot be gathered or adequately determined (i.e., for polymers from inconsistent streams), will not count toward the total percentage assessed (it is considered "un-assessed" or GREY). This will be a common situation for post-consumer recycled plastics from variable and mixed streams and paper that has not been re-pulped but only shredded for reuse.

Required Documentation

See Section 3.3.1 for required documentation.

3.5 MATERIAL ASSESSMENTS

Standard Requirement

Materials in a product must be assessed using the ABC-X rating system. The required percentage of the product that is assessed is dependent on the certification level.

Applicable Levels of Certification

This requirement applies to the Bronze level of certification and above (Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to assist the manufacturer with understanding the potential for the chemicals in their product to adversely impact human or environmental health (chemical hazard profiling), and whether or not the materials in the product support Cradle to Cradle® material health objectives. The intent is also to give designers a tool to evaluate and profile the hazards associated with a chemical by which they can make educated and informed decisions when creating products.

Methods

See the document entitled *Cradle to Cradle Certified™ Material Health Assessment Methodology, Version 3.1* (available for download on the Cradle to Cradle Products Innovation Institute website at www.c2ccertified.org).

Required Documentation

A column in the Bill of Materials can be used to list and track assessment ratings for each homogeneous material. At a minimum, this level of information must be reported to the Cradle to Cradle Products Innovation Institute. Assessment ratings for each chemical ingredient in each homogeneous material may or may not be reported, although each assessor will be required to track this information for each project and for auditing purposes.

3.6 DETERMINING PERCENTAGE ASSESSED

Standard Requirement

Materials in a product must be assessed using the ABC-X rating system. The following percentage of materials in the product that are assessed is required for each certification level:

Bronze level	TNs and BNs are at least 75% assessed as A, B, C, or X. Complete formulation information needs to have been collected for 100% of BN materials that are released directly into the biosphere as a part of their intended use (e.g., cosmetics, personal care, soaps, detergents, paint, etc.).
Silver level	TNs and BNs are at least 95% assessed as A, B, C, or X. Complete formulation information needs to have been collected for 100% of BN materials that are released directly into the biosphere as a part of their intended use (e.g., cosmetics, personal care, soaps, detergents, paint, etc.).
Gold level	TNs and BNs are 100% assessed as A, B, or C.

Applicable Levels of Certification

This requirement applies to the Bronze level of certification and above (Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to encourage manufacturers to identify the extent to which the materials in their product may adversely impact human or environmental health by increasing the percentage of materials that are assessed with each higher level of certification.

Methods

1. In order for a homogeneous material subject to review to be counted as "assessed," the following must be true:

    a. For materials assessed as A, B, or C, all chemicals subject to review have been identified and none of those chemicals were assigned an 'x' or 'grey' single chemical risk rating. This refers to chemical substances as present in the homogeneous materials of the finished product. For example, if the manufacturer mixes a base resin with a color masterbatch during production, the resin and masterbatch together are a single homogeneous material for the purpose of the assessment and this is where the 100ppm threshold is applied. If any substance subject to review in this homogeneous material receives a single chemical risk rating of 'x', the entire homogeneous material will be x-assessed, regardless of whether the substance was an ingredient of the base resin or the masterbatch. See Section 3.4 for more information on chemicals subject to review in each material.

    b. The concentrations of the following chemical ingredients in the material have been collected, regardless of their concentration in the material:

        i. Lead, mercury, hexavalent chromium, cadmium, pigments, dyes and other colorants, phthalates, halogenated organics, and scarce elements (i.e., elements such as indium and gold).

        ii. Process chemicals: metal plating agents (i.e., hexavalent chromium), textile auxiliaries, blowing agents, and paper bleaching agents.

    c. Analytical testing has been completed and thresholds have been met where relevant for EMCs and materials containing recycled content. See guidance in Section 3.4 for further information.

    d. The material has received an A, B, C, or X assessment, or it is defined as an EMC (Section 3.4.1).

2. The total percentage of materials in the product assessed equals the sum of the individual percentages by weight of each homogeneous material that meet the requirements listed above, with one exception as follows. In the case that the finished product is a single-material product, then the percentages for each input product/mixture and/or chemical are used in determining the percentage of the product assessed. For this purpose, a product is considered a single-material product if it is composed of:
    - a single homogeneous material, or
    - a single homogeneous material that is at least 95% of the final product by weight and 5% or less of other materials that are either a coating, finish, print, paint, ink, other surface treatment, film, or interlayer.

Note that the percentage assessed required for each certification level corresponds to the percentage of materials, not the chemicals, assessed by weight in the product. This is because:

- Only chemicals ≥100ppm in the material (plus exceptions noted above), and not all chemicals in the material, are subject to review. It is possible that a small percentage of the material contains chemicals that have not been identified and assessed.
- X-assessed materials may have one or more ingredients that have not been identified. The identification process may have been discontinued once a problematic ingredient was identified in the material.

Note also that in cases where the finished product is a single-material product, the percentages for each assessed chemical substance by weight are used in determining the percentage of the product assessed.

A material may be identified as GREY if the supplier refuses to provide the complete formulation, or expert judgment by the assessor concludes a substance has been omitted from the material formulation. A material may also be identified as GREY if certain hazard data are not available for one or more chemicals in the material (for more information on the chemical risk assessment process see the *Cradle to Cradle Certified*™ *Material Health Assessment Methodology, Version 3.1).* Because there is not enough information to render an assessment, chemicals or materials assigned a GREY rating do not count toward the percentage assessed. Once the missing information is obtained, a GREY material may become an A, B, C, or X assessed material and count toward the percentage assessed.

In order for a material to count towards the percentage assessed at the Silver level, one of the following is required to ensure carcinogens, mutagens, or reproductive toxins (CMRs) are not present in those materials:

- All of the chemicals subject to review in the material have been identified (i.e., no GREY ingredients) and none received a single chemical risk score of 'x' as a result of being a CMR, OR
- In cases where an X-assessed material may have one or more ingredients that have not been identified (i.e., GREY ingredients), the material supplier or other party with knowledge of the chemical composition of the material has signed a declaration stating that CMRs are not present in the material.

Required Documentation

It is recommended that a column(s) in the Bill of Materials be used to tabulate and calculate the total percentage of the product that has been assessed.

3.7 MATERIAL OPTIMIZATION STRATEGY

Standard Requirement

A phase-out or optimization strategy has been developed for those materials with an X rating.

Applicable Levels of Certification

This requirement applies to the Bronze and Silver levels of certification. (By definition, Gold- and Platinum-level products will not contain any x-assessed substances and therefore will not need a material optimization plan.)

Intent

The intent of this requirement is to encourage the manufacturer to develop a plan for phasing out the use of all chemicals or materials in their product that may adversely impact human or environmental health and advance along the continuous improvement pathway to higher levels of product certification.

Methods

1. Each applicant will receive a certification report from their consultant or assessor. This report will include assessment comments, indicating as much as possible what the issues are with a given material. The report will also contain a recommendations section that may provide some guidance on which materials are most feasible to work on in the near term. Some consultants / assessors will also track optimization opportunities in the Bill of Materials. These documents are the starting point

for developing an optimization plan. The following information will be needed to construct the optimization strategy:

   a. Assessment results (A, B, C, X, or Grey) and description/comments.

   b. Initial optimization recommendations and next steps.

   c. Indication of how difficult it will be to optimize each material.

2. All X (problematic) and Grey (data missing) materials are to be included in the optimization plan. The exception is for materials assessed as Grey only because of recycled content, which is difficult to define. These may be excluded from the plan.

3. Generally, optimization will be done through current suppliers.

   a. The first step in most cases will be to approach the suppliers to inquire if they would be willing to work on optimizing the materials that are purchased from them.

   b. When contacting suppliers, discuss with them the assessment results. Suppliers may also contact the consultants / assessors for further detail if needed, as much of their ingredient information is confidential and cannot be provided.

4. Include a plan timeline.

   a. It is recommended to divide the timeline into near-term optimization (next 1-2 years) and longer-term optimization (> 2 years).

   b. Focus near-term optimization on materials that are most feasible to optimize.

   c. It is acceptable to select only one or two materials to work on in the near term.

5. Include a plan budget.

   a. It is understood that this will be a rough estimate.

   b. Changes to materials may result in increased, decreased, or no change to a material's cost. Indicate what change in cost is expected, if possible.

   c. Any time needed to test potential new materials and staff time to work with suppliers on optimization may also be included in the budget, if significant.

6. **It is required that some optimization progress be made prior to each successive re-application.** Note, however, that X assessed items are allowed at the Basic to Silver levels of certification (excluding carcinogens, mutagens, and reproductive toxins at Silver). Complete phase-out of at least one X assessed item is preferable; however, it may not always be possible to fully substitute materials prior to re-application. Acceptable progress includes:

   a. Work has been done towards the goal of fully characterizing materials previously assessed as Grey (i.e., new material ingredient information has been gathered).

   b. Research has been completed and documented regarding possible alternative materials, including performance issues, costs, etc.

   c. Performance testing has been completed on alternative materials.

7. For products that do not contain any X or Grey assessed materials, it is required that progress be made in other program categories (i.e., Material Reutilization, Renewable Energy and Carbon Management, Water Stewardship, or Social Fairness). See Section 8 (Continuous Improvement and Optimization) for further information.

Required Documentation

A complete strategy or plan addressing all items listed above for each X or Grey assessed material is required. This information may be provided in the form of a table, or as part of the original Bill of Material, with the following column headings: component, assessment, optimization recommendation (from consultants or assessors), opportunity (feasibility or difficulty), action plan including timeline (near term or long term), budget or cost, and progress (for reporting progress at re-application).

3.8 DETERMINING ABSENCE OF CMR SUBSTANCES

Standard Requirement

The product does not contain substances known or suspected to cause cancer, birth defects, genetic damage, or reproductive harm (CMRs) in a form that may result in plausible exposure during the product scenarios evaluated.

Applicable Levels of Certification

This requirement applies to the Silver level of certification and above (Silver, Gold, and Platinum).

Intent

The intent of this requirement is to prevent the use of chemicals that have been identified as CMRs in materials or products. These chemicals are considered to be particularly harmful to humans and wildlife.

Methods

The chemical hazard profiles are used to generate A, B, C, or X assessments and verify that any X assessed materials do not contain a chemical with a single chemical risk score of 'x' as a result of being a carcinogen, mutagen, or reproductive toxicant (CMR).

This requirement shall be interpreted to mean that the 95% or more of the materials in the product that have been assessed as A, B, C, or X do not contain known or suspected CMRs in a form that will result in plausible exposure to humans or the environment during the product scenarios evaluated. Because the A, B, C, X material health assessment methodology incorporates both hazard and exposure considerations, materials containing known or suspected CMRs may receive a C assessment, and thus be allowed for use in a Silver-certified product, if the assessor determined that relevant exposure to those CMRs is not plausible. If the assessor determined that plausible exposure to the CMR may occur as a result of its use in the material, the material receives an X assessment and is not permitted for use in a Silver-certified product. Further details of the material health assessment methodology are available in a separate document (*Cradle to Cradle Certified™ Material Health Assessment Methodology, Version 3.1*).

Note that all chemicals, including CMRs, are treated equally in the material health assessment methodology. Generally, the chemicals that are present at concentrations below 100 ppm in each homogeneous material are not subject to review, and the homogeneous materials that are present at concentrations below 100 ppm in a product are not subject to review either. Thus it is possible that CMRs are present in a certified product if they are below the concentration subject to review or are present in a material that is not subject to review. However, if a CMR is in a material, or is one of the chemical types that are subject to review at *any* concentration in the product, it is subject to review (see Section 3.4 for a complete list). When a material assessment is completed, the assessor will report back to the consultant and/or applicant regarding which materials contain these chemicals.

Required Documentation

Chemical hazard profiles are generally not fully documented with reports provided to applicants due to confidentiality reasons. In order to track and verify the presence or absence of CMRs for each homogeneous material, it is suggested that a column be added to the standard Bill of Materials.

3.9 VOLATILE ORGANIC COMPOUND (VOC) EMISSIONS TESTING

Standard Requirement

A product designed for indoor use, or one that could potentially impact indoor air quality, meets Cradle to Cradle Certified™ VOC emissions standards.

Applicable Levels of Certification

This requirement applies to the Gold level of certification and above (Gold and Platinum) and EMCs at all certification levels.

Intent

The intent of this requirement is to ensure that VOCs are not being emitted from products used indoors or products that impact the concentration of VOCs in the indoor environment.

Methods

Indoor-use products are those with intended or likely unintended use scenarios in interior spaces (i.e., inside a building).

Due to the short duration of exposure, consumable indoor products fully designed as biological nutrients (e.g., detergents, personal care products, toilet paper) are not subject to the VOC emissions testing requirement. Furthermore, VOC tests are not required for products that are sold exclusively as material inputs for other products (rather than being sold to the general public).

The VOCs with established Chronic Reference Exposure Levels (CRELs) listed in the California Department of Public Health's (CDPH) Standard Method v1.1-2010 must be included in emissions testing. CREL values are continuously updated by the California Office of Environmental Health Hazard Assessment (see http://oehha.ca.gov/air/allrels.html). If the assessor has reason to believe other problematic substances may be present in the product (e.g., radioactive substances in granite), these may also be required for testing. Although 4-Phenylcyclohexene is not listed in the CDPH Standard Method v1.1-2010 as of the time of this writing, it must also be included in emissions testing of any carpet or flooring product seeking to fulfill this requirement.

To demonstrate compliance with emissions standards, a product must comply with the following requirements:

1. One of the following test methods to quantify emissions has been used:
    a. ASTM D5116 for small chamber or equivalent.
    b. EU standard.
    c. ASTM D6670 for large chamber or equivalent EU standard.

d. ANSI/BIFMA M7.1 for office furniture or equivalent EU standard.

e. ISO 16000 series for VOCs

2. One of the following loading scenarios to quantify emissions has been used:

a. ANSI/BIFMA M7.1 for office furniture.

b. California Department of Health Services section 01350 for all other products.

3. Emissions results

a. VOCs that are considered known carcinogens, endocrine disruptors, mutagens, reproductive toxins, or teratogens are below detection limits (detection limits must be < 9.0 µg/m^3 for formaldehyde and < 2µg/m^3 for all other chemicals).

b. TVOC must be < 0.5 mg/m^3.

c. Individual VOCs that would receive an x assessment must be < (0.01) x [the lower of the TLV or MAK value].

d. The time point used is 7 days for VOCs and IVOCs.

e. The analytical laboratory used must be ISO 17025 accredited.

These thresholds were designed to reflect those required in the California Department of Public Health's Standard Method v1.1-2010.

Required Documentation

Testing reports, including a description of the samples tested, the analytical methods used, the method detection limits, and laboratory contact information must be submitted to the assessor.

3.10 PROCESS CHEMICALS

Standard Requirement

All process chemicals used during the final manufacturing stage of the product are assessed and none are assessed with an x rating (no GREYs).

Applicable Levels of Certification

This requirement applies to the Platinum level of certification only.

Intent

The intent of this requirement is to ensure that chemicals used in the product manufacturing process do not adversely impact human or environmental health.

Methods

All process chemicals used during the final manufacturing stage of the product are subject to review.

A process chemical is defined as any substance that comes into direct contact with the product or any of its material constituents during any of processes that constitute the final manufacturing stage of the product. It is used as an intentional part of any of these processes to fulfill a specific function or achieve a specific effect in the product or any of its material constituents. Within this definition, process

chemicals are limited to pure chemical substances and chemical substances present in a mixture at a concentration of 1,000 ppm or above. Mixtures include liquids, sprays, gases, aerosols, solids, etc. The concentration threshold applies to process mixtures directly as received by the supplier and prior to any dilution that may take place at the manufacturing site(s). This definition does not include maintenance agents for machinery, effluent or wastewater treatment chemicals, chemicals used in steam boilers, or cleaning agents used for the production area, offices, and/or lavatories. Distilled water, tap water, and ambient air in their chemically unaltered state are excluded from the assessment.

The same methodology is applied in assessing process chemicals as for product inputs, although different exposure scenarios will be important to consider. The single chemical risk rating (as a, b, c, or x) must be reported for each process chemical identified. The single chemical risk rating considers the chemical's hazards and exposure via any relevant exposure scenarios determined by the assessor. Note that the assessment must be conducted using the final reacted form of the parent chemical resulting in exposure. For example, if the exposure is via effluent, the assessment must be conducted on the primary hydrolyzed or reacted form of the parent chemical that would appear in the effluent. See the *Material Health Assessment Methodology* document for further details on how the single chemical risk score is determined.

Required Documentation

If applying for the Platinum level in the Material Health category, a list of all process chemicals in the Bill of Materials is required. Indicate under the "generic material" that it is a process chemical. Also report the single chemical risk rating (a, b, c, or x) for each chemical.

4 MATERIAL REUTILIZATION

Eliminate the Concept of "Waste"

A significant focus of Cradle to Cradle® as a product design framework is to promote the creation of an optimized materials economy that eliminates the concept of "waste." This category of the program is intended to create incentives for industry to eliminate the concept of "waste" by designing products with materials that may be perpetually cycled to retain their value. The Program challenges companies to take more responsibility for creating the infrastructure and systems necessary for recovering and recycling materials as the nutrients necessary to fuel our global economies. There are many opportunities for companies to use products as part of the services they offer their customers.

Table 7 lists each requirement within the Material Reutilization category. To achieve a given level, the requirements at all lower levels are to be met as well. The sections that follow provide interpretation and suggested methods for achievement.

Table 7 Material Reutilization Requirements

LEVEL	ACHIEVEMENT
BASIC	Each generic material in the product is clearly defined as an intended part of a biological or technical cycle (this is covered by the Material Health requirement at Basic level; see Material Health guidance in Section 3.2).
BRONZE	The product has a Material Reutilization Score that is ≥ 35.
SILVER	The product has a Material Reutilization Score that is ≥ 50.
GOLD	The product has a Material Reutilization Score that is ≥ 65. The manufacturer has completed a "nutrient management" strategy for the product including scope, timeline, and budget.
PLATINUM	The product has a Material Reutilization Score of 100. The product is actively being recovered and cycled in a technical or biological metabolism.

4.1 MATERIAL REUTILIZATION SCORE

Standard Requirement

The following Material Reutilization Score is required for each certification level:

Bronze level: ≥ 35
Silver level: ≥ 50
Gold level: ≥ 65
Platinum level: 100

Applicable Levels of Certification

This requirement applies to the Bronze level of certification and above (Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to increase the material reutilization potential of a product determined by using the Material Reutilization Scoring method described below.

Methods

1. For each homogeneous material subject to review (as determined according to the process described in Section 3.1), indicate the recyclable, biodegradable (including compostable), rapidly renewable, and recycled content as percentages. Note that it is not required to have reutilization data for all homogeneous materials subject to review. It is recommended to first gather data on higher weight inputs. Depending on the certification level of interest, gathering data on all homogeneous materials may not be necessary in order to achieve the required reutilization score. Note also that although it is highly recommended, it is not required that recyclable, biodegradable (including compostable), and recycled content be verified by outside sources in order to receive credit.

    a. Recyclable material: A recyclable material is a material that can be recycled at least once after its initial use phase somewhere in the world, at least at the pilot scale, in the intended end-of-use scenario the applicant aspires to, independent of current feasibility and implementation. It does not matter whether the product is likely to be recycled in this way based on current infrastructure and/or the regions in which the product is distributed. (Note: The plan to realize the intended end-of-use scenario is due at the Gold level, and implementation needs to be demonstrated for the Platinum level). The entire material needs be recyclable in order to be counted as recyclable in the Material Reutilization score.

    The material must also be separable under normal recycling conditions, commonly separated in practice by the consumer in order for recycling to occur (e.g., just because it's possible to strip a coating from a material does not mean that the user would commonly do this in practice in order to recycle the material), and/or separated by the manufacturer or contracted third party as part of an active product recovery/take back program. The separability requirement applies only in cases where separation would be necessary in order for recycling to occur. The portion of an EMC that is recyclable once take back has occurred applies.

    Renewably sourced materials that are incinerated to produce energy ('waste to energy') may be counted as recyclable (e.g., polyethylene made from sugar cane) in the Material Reutilization score if the assessor determines that incineration of the material does not lead to problematic by-products (i.e., scrubber technology has been demonstrated to efficiently remove the problematic by-products).

    Note that each homogeneous material counts either as fully recyclable (i.e. with all of its mass) or not. A homogeneous material cannot be partially recyclable. This extends also to single-homogenous material products, which will either be 0 or 100% recyclable. Conversely, biodegradability may be assessed on an individual chemical substance basis for liquid, gel, powder, or paste products.

    b. Biodegradable chemical or material: The OECD defines the appropriate testing methods for determining ready and inherent biodegradability. The entire material needs be biodegradable in order to be counted as biodegradable in the Material Reutilization score. If making biodegradability claims for materials that are not commonly known to be biodegradable, testing should be done according to these, or comparable, methods. Biodegradability of the material must be considered under the conditions of the material's intended end-of-use scenario.

c. Compostable material: A compostable material is a material capable of undergoing biological decomposition in a compost site as part of an available program, such that the material is not visually distinguishable and breaks down into carbon dioxide, water, inorganic compounds, and biomass at a rate consistent with known compostable materials. If making claims on the compostable nature of materials that are not commonly known to be compostable, testing is required according to the appropriate ASTM, ISO, CEN, or DIN standard (e.g., ASTM D6400-04 for plastics). The entire material needs be compostable and be separable from other materials in the product in order for that material to count as compostable in the Material Reutilization score.

   Renewably sourced materials that are incinerated to produce energy ('waste to energy') may be counted as compostable (e.g., wood) in the Material Reutilization score if the assessor determines that incineration of the material does not lead to problematic by-products (i.e., scrubber technology has been demonstrated to efficiently remove the problematic by-products).

d. Recycled material (combined percentage of post- and pre- consumer recycled materials).

   ii. Post-consumer recycled material is a material that has been collected for recycling after consumer use.

   iii. Pre-consumer recycled material is a material that has been collected for recycling prior to consumer use, comes from sources outside of the applicant manufacturer's facility, and has been modified before being suitable for recycling back into a manufacturing process. Waste materials directly incorporated back into the manufacturing process within the applicant facility do not apply.

d. Rapidly renewable material: A rapidly renewable material is a material that is grown and harvested in cycles of less than 10 years. FSC certified wood and wood products may also be counted as rapidly renewable, even if they are grown and harvested in cycles of more than 10 years.

2. In the case of steel parts, if it is not possible to determine the actual percentage of recycled content, the industry-wide average may be used. For other material types where it is not possible to determine recycled content, zero recycled content should be assumed. The following are the industry averages obtained from the Steel Recycling Institute (www.recycle-steel.org; 2010 data) for the basic oxygen furnace method (BOF) and electric arc furnace method (EAF). If the method is unknown, use the lowest value.

   a. BOF: 33.6%

   b. EAF: 89.9%

3. Sum the individual percentages of recyclable and biodegradable (including compostable) materials. This sum equals "% of the product considered recyclable or biodegradable/compostable" in the formula below.

4. Multiply the individual percentages (as proportions; e.g., 50%=0.5) of recycled and rapidly renewable content present within each homogeneous material by the percentage of those materials within the overall product and sum the results. This sum equals "% recycled or rapidly renewable content in the product" in the formula below.

5. Calculate the Material Reutilization Score as follows with percentages entered as proportions:

$$\frac{\left[\begin{matrix}\%\ recycled\ or\ rapidly\ renewable \\ product\ content\end{matrix}\right] + 2\left[\begin{matrix}\%\ of\ product\ recyclable \\ or\ biodegradable/compostable\end{matrix}\right]}{3} \times 100$$

Example: Product X contains 80% recyclable materials and 40% recycled materials

$$\text{Material Reutilization Score} = \frac{[(0.40) * 1] + [(0.80) * 2]}{3} \quad X\ 100 \quad = \quad 67$$

Special Considerations for Calculating the MR Score for Products Containing Water

With the exception of paints (see next section), water weight must be excluded from the product weight when calculating the Material Reutilization score. This means that water does not count as recyclable, biodegradable/compostable, rapidly renewable, or as recycled input, but that it also does not contribute to the denominator when determining the weight fractions of other chemical substances and inputs that do count as recyclable, biodegradable/compostable, rapidly renewable, or as recycled input.

Special Considerations for Calculating the MR Score for Paint and other Wet-Applied Products

How to Calculate Percent Cyclable

General purpose and wall paints and other wet-applied products must be regarded as Biological Nutrients, and are thus assessed based on their safety when released into the biosphere (by erosion, washing, leaching, burning, or similar processes) and their biodegradability. Because such products are formulated, single-material products, the percent biodegradable is not based on the percent of biodegradable homogeneous materials (as for multiple-material products). Instead, the '% biodegradable content' for the MR score is based on the individual product ingredients and must be calculated in the following manner:

1. Sum the percent weight of all substances that are biodegradable in their pure form, as per the relevant OECD (or comparable) tests and definitions.
2. Add the percent weight of water in the product and the percent weight of benign minerals commonly found in surface soils and sediments. Benign minerals are defined as those having a single chemical risk rating of a, b, or c (not x or GREY). Minerals commonly found in soils or sediments are limited to Al-, Ca-, Fe-, Mg-, Mn-, Na-, K-, or Zn-containing silicates, oxides, carbonates, or phosphates that can be commercially derived without chemical alteration from surface soil or sediments (no more than 2 m below the land surface or sea level). If the applicant feels that a non– Al-, Ca-, Fe-, Mg-, Mn-, Na-, K-, or Zn-containing silicate, oxide, carbonate, or phosphate should be counted as a benign soil/sediment mineral, they must submit a request to amend this guidance to the C2CPII.
3. The resulting percentage is used as the % cyclable ('recyclable/biodegradable') content to compute the MR score.

How to Calculate % Rapidly Renewable/Recycled Content

To derive the '% rapidly renewable content' of the product, water weight is excluded (e.g., if the paint is 15% rapidly renewable inputs by weight and 20% water by weight, the % rapidly renewable content used to derive the MR score would be 15% / (100%-20%) = 18.75%).

Required Documentation

For tracking and reporting of recyclable, biodegradable (including compostable), recycled, and rapidly renewable content, it is recommended that additional columns be added to the original Bill of Materials used to report and define homogeneous materials, as described in Section 3.1.

4.2 NUTRIENT MANAGEMENT STRATEGY

Standard Requirement

The company has completed development of a "nutrient management" strategy for the product, including scope, timeline, and budget.

Applicable Levels of Certification

This requirement applies to the Gold level of certification and above (Gold and Platinum).

Intent

The intent of this requirement is to challenge manufacturers to take more responsibility for creating the infrastructure and systems necessary for recovering and recycling materials as the nutrients necessary to fuel our global economies.

Methods

A nutrient management strategy is defined as a process for actively recovering or cycling the technological or biological nutrients in the product in a technical or biological metabolism. Nutrient management strategies will likely be very unique to each product. See Section 4.3 for examples of nutrient management methods.

The following must be addressed in the plan for development of a "nutrient management" strategy:

1. Commencement date of program.
2. Method of recovering, reusing, recycling, or composting individual materials within the product and the product overall.
3. Method of informing customers regarding disassembly of product, if needed.
4. Method of informing customers and the public about the program and access to recycling or other options.
5. Budget allocated to execution of the plan.
6. Initial and future targets and timeline for number of units or volume of materials to be collected and recycled or composted.
7. Recovery and recycling rate data, if available (for municipal recycling, provide average rates).

a. Partners in program (i.e., who will be recycling or composting).

b. Target end-markets for recycled goods.

c. Estimated market value of goods pre-recycling.

Required Documentation

A strategy outline and narrative addressing the points listed above are required.

4.3 NUTRIENT CYCLING

Standard Requirement

The product is actively being recovered and cycled in a technical or biological metabolism.

Applicable Levels of Certification

This requirement applies to the Platinum level of certification only.

Intent

The intent of this requirement is to ensure that manufacturers are actively recovering and recycling the product and thus working towards the goal of eliminating the concept of waste.

Methods

1. Methods of recovering and recycling products that qualify include:

   a. Company-sponsored collection program: The manufacturer has ownership of, and is in direct control of, creating the infrastructure for the recovery and recycling or industrial composting of the product.

   b. Municipal recycling: The product has been designed to be recycled using the municipal recycling systems. One hundred percent of the product's materials can be separated and recycled within municipal systems. Within the U.S. and where not otherwise clearly defined by regulations, the Federal Trade Commission's (FTC) definitions of "recyclable" apply (see FTC GreenGuide). The average recycling rates and references below for the material type(s) must be reported.

   c. Retail-sponsored collection program: A retail organization is partnering with one or more original equipment manufacturers to collect and recycle or compost selected products (e.g., recycling of electronic products through retail outlets).

   d. Manufacturing association-sponsored collection program: The original equipment manufacturers organize a program to collect and recycle or compost selected products.

2. Collect data on the recovery and recyclability or compostability rate at which the materials are managed based on percent of volume of units sold. It should be shown that recovery rates are balanced with use and installation timelines. For example, an architectural installation made of aluminum may be on a building well over 50 years old, but the company has not yet experienced any "recovery" due to the long timeline. Since aluminum is one of the most highly recycled materials, this case is exempt from meeting positive recovery rates. In most cases, however, at least some recovery and recycling must be occurring in order to meet this requirement.

3. Conduct compostability testing for materials that are not generally known to be compostable, if applicable. See Terms and Definitions for the definition of "compostable" and applicable testing standards.

Required Documentation

A description of the product stewardship program used to collect and recycle the product after its first use-phase must be provided. The description must address the points listed above for developing a strategy as required at the Gold level, in addition to the recovery and recyclability or compostability rate in the program. For compostable products, cite the relevant standard and provide test results.

5 RENEWABLE ENERGY AND CARBON MANAGEMENT

Eco-effective energy production

Cradle to Cradle® envisions a future in which industry and commerce positively impact the energy supply, ecosystem balance, and community. This is a future powered by current solar income and built on circular material flows. The Renewable Energy and Carbon Management category is a combination of these core principles of Cradle to Cradle design: *produce and use renewable energy* and *eliminate the concept of waste.* Renewable energy displaces energy produced from fossil fuels, which emit carbon. Changing the quantity and quality of energy used affects the balance of carbon in the atmosphere and ultimately the climate. Ideally, emissions are simply eliminated, and renewable energy is produced in excess to be supplied to local communities. When emissions do occur, they are managed as biological nutrients and balanced with an equivalent uptake by natural systems. If we are to reach the ultimate goal of net positive impact, it is critical to accurately measure energy use and emissions. By obtaining these measurements, we can identify and carry out effective plans for transitioning to renewable energy use, and achieving a balance of carbon in the atmosphere and as food for building healthy soil.

Table 8 lists each unique requirement within the Renewable Energy and Carbon Management category. To achieve a given level, the requirements at all lower levels are to be met as well. The following sections provide interpretation and suggested methods for achievement.

Table 8 Renewable Energy and Carbon Management Requirements

LEVEL	ACHIEVEMENT
BASIC	Annual electricity use and greenhouse gas emissions associated with the final manufacturing stage of the product are quantified.
BRONZE	A renewable electricity use and carbon management strategy is developed.
SILVER	For the final manufacturing stage of the product, 5% of electricity is renewably sourced or offset with renewable electricity projects, and 5% of GHG emissions are offset.
GOLD	For the final manufacturing stage of the product, 50% of electricity is renewably sourced or offset with renewable electricity projects, and 50% of GHG emissions are offset.
PLATINUM	For the final manufacturing stage of the product, >100% of electricity is renewably sourced or offset with renewable electricity projects, and >100% of GHG emissions are offset. The embodied energy associated with the product from Cradle to Gate is characterized and quantified, and a strategy to optimize is developed. At re-application, progress on the optimization plan is demonstrated. ≥ 5% of the embodied energy associated with the product from Cradle to Gate is covered by offsets or otherwise addressed (e.g., through projects with suppliers, product re-design, savings during the use phase, etc.).

5.1 QUANTIFYING ELECTRICITY USE AND EMISSIONS

Standard Requirement

Annual electricity use and greenhouse gas (GHG) emissions associated with the final manufacturing stage of the product are quantified.

Applicable Levels of Certification

This requirement applies to the Basic level of certification and above (Basic, Bronze, Silver, Gold, and Platinum). Annual electricity use and GHG emissions associated with the final manufacturing stage of the product must be re-calculated at re-certification.

Intent

The intent of this requirement is to assist manufacturers with understanding their baseline electricity use and GHG emissions.

Methods

1. Conduct a facility-level audit of electricity use and GHG emissions for all facilities involved in final manufacturing stage processes as follows:

    a. The electricity use and GHG emissions calculations must pertain to the final manufacturing stage of the product only, rather than to all of the product-relevant processes at the facility. The intent of this is to establish an even playing field for manufacturers with varying levels of vertical integration and to measure electricity used for similar processes. Processes that are considered to represent the final manufacturing stage by product category can be found in the Final Manufacturing Stage Guidance document, which is subject to periodic review based on assessor and applicant feedback. Please contact certification@c2ccertified.org if your product category is not represented or if you have comments regarding the listed processes.

    b. Calculate the amount of electricity used, including the percent on-site renewables and the percent renewables purchased from the grid and/or compliant renewable energy certificate (REC) sources. Note that if heat is purchased directly from a utility, include it in the calculations for GHG emissions (see next section). Also note that overhead operations, including facility air conditioning and lighting, may be considered non-attributable (see the Greenhouse Gas (GHG) Protocol Product Standard for detail). Even so, if it is not possible to separate these from the total, they may be included. Electricity use must be reported in terms of kilowatt hours (kWh).

    c. Calculate total carbon equivalent emissions from GHG emissions associated with the final manufacturing stage of the product. The GHG emissions in scope for this requirement are those that are (1) emitted directly during the product's final manufacture or on-site treatment of process wastes or (2) associated with purchased heat. GHG emissions associated with electricity generated off-site are out of scope. Be sure to include all on-site fuel uses such as gasoline for transport vehicles, propane, etc. when attributable to the product. If transport vehicles are used during the final manufacturing stage of the product, whether owned by the company or not, the emissions from the fuel used for the vehicles must be included in the total emissions calculation. Also be sure to include any relevant product-attributable, non-electricity-related emissions, such as methane from water treatment ponds, fugitive emissions from refrigerants, and/or carbon dioxide from cement production. Select a widely recognized method and guidance when calculating emissions. Appropriate references include GHG Protocol Product Standard and the

Intergovernmental Panel on Climate Change (IPCC). GHG emissions must be reported in terms of carbon dioxide equivalents (tCO_2e).

d. Allocate electricity and GHG emissions to the applicant product(s) (see definition of product-attributable processes in Chapter 7 of the GHG Protocol -- Product Life Cycle Accounting and Reporting Standard[1]). Select the most appropriate method for the product(s) under review. For example, if products are of similar weight across SKUs, a weight allocation is appropriate.

e. An applicant must work with their accredited assessment body to obtain the appropriate template for quantifying the product-allocated electricity use and emissions.

2. In addition to the requirements and questions described above and below, the following questions will help in evaluating whether all relevant GHG emissions sources have been accounted for and aid in making judgments about data accuracy:

   a. Have fugitive emissions been accounted for? These are emissions due to storage leaks or machinery leaks. In the case of refrigerants, this may be accounted for based on the amount of recharge required.

   b. Does the company own any vehicles that are directly relevant to product manufacture or transport? For transport using company-owned vehicles, if driving distances were employed in estimating emissions (as opposed to actual fuel use), was actual driving distance available, or was distance estimated based on straight line or shortest route distances? How does this estimate compare with actual distance?

   c. Does the company conduct on-site wastewater treatment relevant to the product? Has this been accounted for?

   d. Are other process-relevant GHG emissions of concern (e.g., in cement manufacture)?

   e. What reference sources have been used in selecting the emissions factors?

Required Documentation

Record the information listed below for each facility at which the product undergoes final manufacturing (see above for more information on determining the final manufacturing stage/processes).

1. Facility name.
2. Country and region.
3. Utility name.
4. Renewable electricity purchased (delivered) through utility. Note: This is not the same as the average utility or regional grid mix. The applicant may only claim renewable electricity that is delivered to them through renewable energy pricing programs, or assurance that claims to the use of renewable electricity in the utility mix may be made by customers of the utility.
5. Total amount of electricity required for the final manufacturing stage of the product in terms of kWh.
6. Total amount of GHG emissions generated for the final manufacturing stage of the product in terms of tCO_2e.
7. Total amount of renewable electricity generated on site for the final manufacturing stage of the product in terms of kWh.
8. Date range of data (calendar or fiscal year are acceptable).

9. Data source (e.g., utility bills and receipts; if other data source, please describe).
10. Indicate the GHGs that are included in this inventory. Note that carbon dioxide is to be included at a minimum. The widely used GHG Protocol stationary combustion tool also includes methane and nitrous oxide in totals.
11. Indicate and describe the method used to allocate electricity use and GHG emissions to the production of the applicant product (e.g., percentage of total production weight or volume).
12. Indicate and describe the method used to allocate electricity use and GHG emissions to the final manufacturing stage of the product.
13. Indicate guidance and/or tools used (e.g., GHG Protocol, Stationary Combustion Tool, etc.).
14. Supporting documents such as Excel worksheets from the GHG Protocol and electricity use bills may be provided and/or requested as well. These will allow the assessor to evaluate data quality and completeness.

5.2 RENEWABLE ELECTRICITY AND CARBON MANAGEMENT STRATEGY

Standard Requirement

A renewable electricity use and carbon management strategy is developed.

Applicable Levels of Certification

This requirement applies to the Bronze level of certification and above (Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to challenge manufacturers to develop a strategy that not only increases renewable electricity use and reduces GHG emissions, but also achieves the ultimate goal of using > 100% renewable electricity and closing the carbon cycle for the final manufacturing stages of the product.

Methods

1. The strategy must cover facility-level electricity use and GHG emissions for at least the final manufacturing stage of the product.
2. The following should be included in a renewable electricity and carbon management strategy:
    a. Methods that are and/or will be employed to use renewable electricity and manage GHG emissions, including a description of whether the focus is on installation of renewables, absolute reductions (i.e., improved energy efficiency measures), and/or intensity initiatives (e.g., efficiency improvements defined as reductions in emissions normalized by total production), or carbon sequestration projects.
    b. Quantitative targets and timeline, including dates that individual initiatives went or will go into effect.
    c. Progress made to date and what change in absolute emissions can be attributed to integration of renewables or efficiency improvements. If no progress has been made, explain why.
    d. Budget allocated to execution of the plan.

Required Documentation

A strategy outline and narrative addressing the points listed above are required.

5.3 USING RENEWABLE ELECTRICITY AND ADDRESSING GREENHOUSE GAS EMISSIONS

Standard Requirement

A percentage of the electricity is renewably sourced or offset with renewable energy projects, and the same percentage of GHG emissions are offset. This requirement applies only to the electricity use and GHG emissions associated with the final manufacturing stage of the product.

The following percentages are required for each certification level:

Silver level:	5%
Gold level:	50%
Platinum level:	> 100%

Applicable Levels of Certification

This requirement applies to the Silver level of certification and above (Silver, Gold, and Platinum).

Intent

The intent of this requirement is to encourage manufacturers to participate in the demand for renewable electricity with the goal of producing > 100% renewable electricity for a product. With only a baseline investment in renewable electricity, subsequent energy efficiency measures may increase the percentage of overall renewable electricity use, thereby incentivizing efficiency as a path to effectiveness. The intent of the following methods is to designate appropriate strategies for making valid claims to renewable electricity generation, and appropriately managing GHG emissions.

Methods

Using Renewable Electricity

1. Calculate the annual electricity use associated with the final manufacturing stage of the product based on data from the previous year. If there is reason to expect that electricity consumption will be much higher in the subsequent year or for new products, different methods will have to be applied. For example, if it is known that there will be a significant increase in production volume for an existing product, the allocated electricity consumption and production volume estimates should be employed to estimate the total amount of electricity required for the coming year. Estimates for new products may be based on allocated electricity consumption estimates for existing products of similar type.
2. Note that renewable electricity that is already a standard part of the grid mix does not count toward this requirement unless the applicant is participating in a voluntary green pricing program or the applicant has verified that their utility is delivering renewable electricity that may be claimed by the utility customer without being double-counted elsewhere in the system. Renewable electricity used as part of direct power purchase agreements (PPAs) with renewable energy producers may count toward the requirement as long as the purchased energy is derived from a source among those eligible (solar, wind, hydropower, biomass (when not in competition with food supplies), geothermal, and hydrogen fuel cells) and the associated attributes of renewable-based generation are also

transferred as part of the purchase agreement and not claimed or counted elsewhere (i.e., sold to a third party in the form of RECs).

3. *On-Site Renewables:* Calculate the percentage of on-site renewable electricity generation as a proportion of the overall electricity attributed to the final manufacturing stage of the product based on data from the previous year. To meet the renewable electricity use requirement for a particular level, the remaining percentage of renewable electricity must be compensated for by the purchase of RECs or offsets.

4. *Unbundled Renewable Energy Certificates (RECs)*: If purchasing unbundled RECs to compensate for the percent of renewable electricity required, the RECs must be from voluntary programs (as opposed to compliance programs). In the U.S., Green-e RECs must be purchased. Outside the U.S., the use of equivalent, verified RECs is appropriate. It is important to ensure that RECs are not double-counted and the applicant has valid claim to the use of the renewable electricity attribute provided.

5. *Offsets supporting Renewable Energy*: Registered carbon offsets that support renewable energy projects may be used in place of RECs for electricity; however, in this case the electricity needs to be converted to metric tons CO_2 equivalents (tCO_2e) using the utility or regional grid electricity mix (this is referred to as the 'Alternative Energy Inventory' in the templates). Renewable electricity in a grid or regional mix will result in lower emissions overall, so that the amounts of offsets are less than if electricity was produced from fossil fuel sources.

    a. NUCLEAR POWER: When using carbon offsets in place of RECs for electricity to meet the renewable electricity requirement ('Alternative Energy Inventory'), the emissions value that the required offset amount is based on needs to be adjusted for the share of nuclear power in the electricity mix. For all electrical sources, calculate the amount of CO_2e attributed to nuclear power by using the average CO_2 emissions from coal. This is done because compared to energy from other fossil fuels, nuclear power is responsible for very low to zero greenhouse gas emissions, particularly when the supply chain is not considered. However, nuclear power is not a renewable source of electricity and the low CO_2 emissions would be an undue advantage to any manufacturer purchasing offsets for this requirement. As the environmental and human costs of nuclear energy are immeasurably high, an adjustment is made to the total GHG emissions prior to offset purchase. (Note: In most cases the conversion of electricity produced from nuclear energy to emissions is not necessary because this electricity may be treated like other non-renewable electricity sources and compensated for via the purchase of RECs.)

        i. Using data from the World Nuclear Association (http://world-nuclear.org), calculate the nuclear multiplier based on the country where each final manufacturing facility is located with the following formula: (Percent of Nuclear*891 grams CO_2e/kWh)/(1,000,000 g/ton). Be sure to enter the percentage as a proportion (e.g., 10%=0.1). The assumed emissions rate for electricity produced from coal is 891 g/kWh (value is from http://world-nuclear.org). The following website lists the most recent values for the percentage of nuclear shares of electricity generation: http://world-nuclear.org/info/Facts-and-Figures/Nuclear-generation-by-country/. Multiply the total *product-allocated* electricity by the nuclear multiplier and add this to the total *product-allocated* CO_2e, making sure all units are in metric tons. The Excel-based worksheet made available to assessors by the Cradle to Cradle Products Innovation Institute for the collection of Energy and emissions data includes up-to-date nuclear values and the formula for adjusting emissions associated with electricity when conducting the Alternative Energy Inventory.

ii. Optional: It is allowable to use more local electricity mix information than national grid data. The formula remains unchanged in this case: (Percent of Nuclear*891 grams CO_2e/kWh)/(1,000,000 g/ton).

iii. Multiply total metric tons CO_2e, including nuclear carbon conversion, by the desired offset percentage to determine the amount of offsets that should be purchased.

6. For electrical sources, the carbon offset project types listed below (as defined by CDM methodologies) are recommended. Carbon credits generated by hydropower projects will ideally be offset using the Gold Standard to provide assurance that the environmental and community impacts have been accounted for and will be continually monitored.

   a. AM0019: Renewable energy projects replacing part of the electricity production of one single fossil fuel-fired power plant that stands alone or supplies to a grid, excluding biomass projects.

   b. AM0026: Methodology for zero-emissions grid-connected electricity generation from renewable sources in Chile or in countries with merit order-based dispatch grid.

   c. AM0052: Increased electricity generation from existing hydropower stations through decision support system optimization.

   d. AM0072: Fossil fuel displacement by geothermal resources for space heating.

   e. AMS-I.A.: Electricity generation by the user.

   f. AMS-I.B.: Mechanical energy for the user with or without electrical energy.

   g. AMS-I.C.: Thermal energy production with or without electricity.

   h. AMS-I.D.: Grid-connected renewable electricity generation.

   i. AMS-I.F.: Renewable electricity generation for captive use and mini-grid.

   j. ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources.

Addressing GHG Emissions

For emissions originating from non-electrical resources (e.g., on-site natural gas, propane for forklifts, process emissions), projects supporting the sequestration of carbon into forests or soil or other carbon offset strategies are accepted. RECs are not appropriate for these emission types.

1. Calculate the annual GHG emissions associated with the final manufacturing stage of the product based on data from the previous year. On-site emissions must be calculated in terms of CO_2e and based on the emissions factor of the purchased fuel. GHG emissions that have been captured through carbon capture and storage or processes that sequester carbon in the product are not included in the emissions total. To meet the offset requirement for a particular level, the given percentage of emissions must be compensated for by the purchase of offsets or via use of renewables such as biomass (i.e., the given percentage of emissions must be compensated for by the purchase of offsets, but the purchase of offsets for emissions resulting from the combustion of eligible renewable fuels, such as biomass, is not required).

   Emissions from renewable fuels must be tracked and reported during the certification process; however, the emissions generated by eligible renewable fuels will not be included in the final quantity of direct on-site emissions for which offsets need to be purchased at the Silver level and

above. By using eligible renewable fuels exclusively, it is thus possible to meet the Silver, Gold, and Platinum requirements without the purchase of offsets, since all direct on-site emissions from non-renewable sources will have been avoided (provided there are no other product-attributable greenhouse gas emissions during final manufacture). Similarly, no offsets need to be purchased if the final manufacture of a product does not generate any direct on-site emissions of greenhouse gases.

Eligibility of renewable fuels for this purpose is determined based on the definitions in Section II.A 5 in Appendix D of the Green-e National Standard. Renewable fuels that are not covered by the types (woody waste, agricultural crop residue, animal and other organic waste, certain energy crops, landfill gas and wastewater methane) and definitions in Section II.A 5 in the Green-e National Standard may be eligible, subject to a case-by-case review by C2CPII. The methodology presented to C2CPII must demonstrate that the eligible emissions are derived from the combustion of a fuel that can be considered renewable in accordance with the general definitions provided by Green-e. Additionally, it should be demonstrated that across its entire lifecycle, the qualifying fuel is expected to have a favorable impact on atmospheric greenhouse gas concentrations in terms of CO_2 equivalents.

2. To purchase offsets, navigate to the Verified Registry website of choice to set up an account and make a purchase. Offsets must be fully retired in a third party registry to meet this requirement. Below is a partial list of recommended registries.
   a. Clean Development Mechanism (CDM): http://cdm.unfccc.int/Registry/index.htm.
   b. Climate, Community, and Biodiversity: http://www.climate-standards.org/index.html.
   c. Verified Carbon Standard: http://www.vcsprojectdatabase.org/.
   d. Gold Standard: http://goldstandard.apx.com/index.asp.
   e. Green-e Climate Certified Carbon Offsets procured from an offset provider/retail seller or carbon credits procured directly from an offset project (or through a broker) certified by a Green-e Climate Endorsed Program: http://www.green-e.org.
3. There are some projects that do not take into account the surrounding natural resources and often can have adverse negative effects on humans and the environment. These projects will not be considered acceptable in the Cradle to Cradle Certified™ Products Program, although they may be verified carbon offsets. For non-electrical sources, it is recommended to avoid the following project types: carbon sequestration in the ocean, clean coal, methane sequestration, and any others that do not align with Cradle to Cradle®.
4. If it is determined that excess offsets or RECs were purchased in the prior year due to use of estimates, the excess may be credited toward the amount to be purchased at the next re-application. If it is determined that insufficient offsets or RECs were purchased in the prior year, this is to be made up at the next re-application.
5. If a percentage of the facility's electricity use and GHG emissions is compensated for with renewable electricity use or offsets, that percentage may be claimed for all certified products produced at that facility. If renewable electricity or offsets compensate for the production of only the product being assessed for certification, those purchases may not be claimed for any other products.

Required Documentation

It is recommended to use the data template provided by a Cradle to Cradle Certified accredited assessment body to calculate electricity use and GHG emissions, and to track on-site renewable electricity, REC purchases, and offsets.

1. Update electricity use and emissions calculations performed at the Basic level with the most current prior year data. If electricity consumption and/or emissions are expected to change significantly, include estimates for the upcoming two years.
2. If converting electricity to CO_2e, report country, nuclear share, multiplier, nuclear carbon conversion, and total CO_2e, (nuclear carbon conversion + total product-allocated CO_2e calculated initially).
3. Report sources of on-site renewable electricity and annual generation attributable to the final manufacturing stage of the product.
4. Indicate the amount and percentage of RECs purchased, including registry and/or retailer.
5. If converting electricity to CO_2e, indicate the amount and percentage of carbon offsets purchased to offset electricity. Provide the name of the offset registry, project, and project description.
6. Indicate the amount and percentage of carbon offsets purchased to offset emissions. Provide the name of the offset registry, project, and project description.
7. Provide receipt of purchase for offsets and/or RECs as provided by the issuing body.
8. At re-application, indicate and make up for any differences between amounts of offsets and RECs purchased in the prior year as compared to actual emissions estimates for that year.

5.4 EMBODIED GHG EMISSIONS

Standard Requirement

The embodied greenhouse gas (GHG) emissions associated with the product from Cradle to Gate (i.e., up to final manufacturing stage) are characterized and quantified, and a strategy to optimize is developed. At re-application, progress on the optimization plan is demonstrated.

Applicable Levels of Certification

This requirement applies to the Platinum level only.

Intent

The intent of this requirement is to assist a manufacturer with understanding the impacts of energy use associated with their supply chains, which can be significant in many cases. Also, the intent is to honor the importance of a product's GHG emissions throughout its lifecycle and encourage the development of a strategy to continuously improve beyond where a manufacturer has direct influence in the final manufacturing process.

Methods

1. Inventory carbon equivalent GHG emissions from resource extraction to production (applicant's gate) using primary and/or secondary data for input materials. Primary data are defined as those collected directly from suppliers and secondary data are published data that are aggregated to the material level. The use of primary data is ideal because it creates the most accurate energy and emissions profile associated with a product, but it is more resource-intensive. Secondary data for material types are more readily available as part of life cycle analysis (LCA) software or other online

tools and datasets, but do not account for optimization efforts in a unique supply chain. Conducting a full life-cycle emissions inventory and analysis, including storage and transport, use, and recycling phases, is encouraged, but not required. Note that a variety of methods will be considered acceptable for fulfilling this requirement, as long as the methods are reported and described in detail. The importance is not on the detail of the study, but full disclosure of the methods used.

2. The inventory threshold is left to the applicant to determine and define as part of the boundary and scope decision; however, at a minimum, all inputs representing 1% or more of the product's total inputs must be included. Ideally, all inputs will be included, as it is difficult to know until data are gathered whether they will contribute significantly to total emissions or not. For guidance, refer to a widely recognized methodology such as the GHG Product Lifecycle Standard or PAS 2050.
3. The following should be included in a strategy to optimize the embodied energy of a product from Cradle to Gate.
    a. Identify the highest-impact emissions sources in the supply chain and develop an outreach strategy to identify renewable electricity and carbon management strategies already in place and opportunities for optimization.
    b. Methods that are and/or will be employed to use renewable electricity and manage GHG emissions among high-impact supply chain actors, including a description of whether the focus is on installation of renewables, absolute reductions (i.e., improved energy efficiency measures), and/or intensity initiatives (e.g., efficiency improvements defined as reductions in emissions normalized by total production), or carbon sequestration projects.
    c. A timeline including dates that outreach activities or initiatives went or will go into effect.
    d. Progress made to date and what change in absolute emissions can be attributed to integration of renewables or efficiency improvements. If no progress has been made, explain why.
    e. Budget allocated to execution of the plan.

Required Documentation

It is recommended to report the following information, at a minimum (taken from the GHG Protocol Product Standard, Chapter 14). Other product-relevant embodied energy standards may be used, as long as methodology, information source, scope, and boundary are reported.

1. Inventory Information (14.1.1)
    a. Product name and description.
    b. Goal of inventory.
    c. Product rules or guidance that influenced boundary set methodology choice, allocation procedures, data collection sources, and software system used.
2. Scope (14.1.2)
    a. Unit of analysis and reference flow.
    b. Flow diagram.
3. Boundary of Inventory (14.1.3)
    a. Assumptions made.
    b. Methodology choice (i.e. Cradle to Gate, Use, End-of-Life, Cradle to Grave).

4. Allocation Method (14.1.4)
5. Data Information Used (14.1.6)
    a. Primary data (% of total emissions).
    b. Secondary data (% of total emissions).
    c. Sources.
6. Inventory Results (14.1.7)
    a. Total CO_2e per unit of analysis.
    b. Percent of total CO_2e attributed to each life cycle stage (if applicable).
    c. Global warming potential metric(s) used and description of the source.
7. Use of Results
    a. Describe the significance of inventory results.
    b. How will it be used to educate internal or external stakeholders appropriately?

5.5 ADDRESSING EMBODIED ENERGY USE WITH OFFSETS OR OTHER PROJECTS

Standard Requirement

At least 5% of the embodied energy associated with the product from Cradle to Gate is covered by offsets or otherwise addressed (e.g., through projects with suppliers, product re-design, savings during the use phase, etc.).

Applicable Levels of Certification

This requirement applies to the Platinum level only.

Intent

The intent of this requirement is to begin to address embodied energy impacts of production that occur upstream of final manufacture, as these impacts may be significant sources of emissions.

Methods

1. It is necessary to first estimate embodied energy from Cradle to Gate, as described in Section 5.4.
2. The most likely method of managing embodied energy emissions is through the purchase of offsets. Other project types that will be considered for this requirement include, but are not limited to, projects with suppliers, product re-design, and savings during the use phase.

Required Documentation

1. Supporting documentation showing how total emissions were calculated (see the Required Documentation section in Section 5.4).
2. If carbon offsets are used, quantity of offsets purchased, name of offset registry and project, receipt of purchase, and certificate from the issuing body.
3. For project types other than offset purchase, documentation clearly showing reductions or sequestration should be provided.

6 WATER STEWARDSHIP

Treating Clean Water as a Valuable Resource and Fundamental Human Right

Water stewardship creates awareness and drive towards the treatment of water as a valuable resource by encouraging effective management and use strategies. Every product manufacturer has an important responsibility to care for this vital resource, and would be wise to effectively manage water resources. These goals are addressed within the program by encouraging an understanding of, and responsibility for, water withdrawals, consumption, and releases within local ecosystem(s), and awarding innovation in the areas of conservation, quality, and social fairness.

lists each unique requirement within the Water Stewardship category. To achieve a given level, the requirements at all lower levels must be met as well. The sections to follow will provide interpretation and suggested methods for achievement.

Table 9 Water Stewardship Requirements

LEVEL	ACHIEVEMENT
BASIC	The manufacturer has not received a significant violation of their discharge permit within the last two years. Local- and business-specific water-related issues are characterized (e.g., the manufacturer will determine if water scarcity is an issue and/or if sensitive ecosystems are at risk due to direct operations). A statement of water stewardship intentions describing what action is being taken for mitigating the identified problems and concerns is provided. At re-application, progress on action plans is demonstrated.
BRONZE	A facility-wide water audit is completed.
SILVER	Product-related process chemicals in effluent are characterized and assessed. OR Supply chain-relevant water issues for at least 20% of Tier 1 suppliers are characterized and a positive impact strategy is developed (required for facilities with no product-relevant effluent).
GOLD	Product-related process chemicals in effluent are optimized (chemicals identified as problematic are kept flowing in systems of nutrient recovery; effluents leaving facility do not contain chemicals assessed as problematic). OR Demonstrated progress on the strategy developed for the Silver level requirements (required for facilities with no product relevant effluent).
PLATINUM	All water leaving the manufacturing facility meets drinking water quality standards.

6.1 REGULATORY COMPLIANCE FOR EFFLUENT

Standard Requirement

The manufacturer has not received a significant violation of their discharge permit related to the final manufacturing stage of the applicant product within the last two years.

Applicable Levels of Certification

This requirement applies to the Basic level of certification and above (Basic, Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to ensure, to the extent possible, that the product-relevant effluent discharged by manufacturing facilities does not degrade surface waters.

Methods

1. If the applicant is subject to well-developed and enforced regulations pertaining to effluent quality, the requirement is fulfilled if their facility has not received a significant violation of their discharge permit (related to the applicant product's manufacture) within the last two years (provided appropriate documentation is provided; see below). In the U.S., a manufacturer must not have been in "Significant Noncompliance" as defined in Title 40 Part 403.8(f) (2) (viii) of the U.S. Code of Federal Regulations, unless the violation was administrative. In other countries, the manufacturer must be in compliance with the equivalent regulation applicable to industrial or manufacturing facilities.
2. If there are no local regulatory requirements or regulations are poorly enforced, and the applicant's facilities discharge either process or sanitary effluent to surface waters, the applicant must develop an effluent management system, including analytical testing protocols, to meet contaminant threshold requirements specific to their business. The management system should be in place and within developed threshold compliance prior to certification.

Required Documentation

The following information must be provided to the assessor:

1. A qualitative description of how effluent is managed.
2. If applicable, a signed statement from the applicant stating that the facility or facilities at which the product is manufactured are subject to well-developed and enforced regulations pertaining to effluent quality and have not been subject to any significant product-relevant discharge violations in the past two years. If a significant discharge violation has occurred in the past two years at any final manufacturing stage facility, the applicant must demonstrate that it was due to processes unrelated to the final manufacture of the applicant product(s). This will require additional work to first document the reason for the violation, and then trace the source of that problem to show it was unrelated to the applicant product.
3. The required documentation to demonstrate regulatory compliance must be submitted with each application for certification, including recertifications. Note that an exception to this requirement is granted if the applicant provided a compliance statement to the assessor within the last 90 days (e.g., with a certification application for a different product manufactured at the same site).

If the final manufacturing stage of a product occurs at more than one facility, a regulatory compliance statement for each facility is required for certification. A single manufacturing site not meeting the requirement will result in the requirement not being met for the product applying for certification.

If the applicant is required to obtain permits and conduct periodic testing of effluent, the following may assist in determining if well-developed and enforced regulations pertaining to effluent cleanliness are in place:

a. Results of any required tests for biological oxygen demand (BOD), chemical oxygen demand (COD), total organic carbon (TOC), total suspended solids (TSS), ammonia as N, temperature, and pH.

b. A list of all chemicals known to be released to the biosphere via effluent discharges by chemical name and Chemical Abstract Service Registry Number (CAS #), including maximum and average allowable release limits by concentration and mass. The assumption is that this list will primarily, if not only, represent chemicals that are declared and tracked under existing permitting processes.

c. Reasons for the presence of the contaminants, an indication of which contaminants are currently covered by any required permits, and which discharges must be remediated prior to release to the publicly owned treatment works (POTW) or open water.

d. A description of any pre-treatment methods used to manage these contaminants.

e. A description of the analytical testing performed on water discharges that is required or conducted on a voluntary basis, including sample collection methods and analytic test methods for each contaminant.

f. An indication of which effluent chemicals are related to production of the applicant product or products.

3. If untreated or unregulated process and/or sanitary water is released to open water, the applicant is required to develop an effluent management system prior to certification. Required documentation includes a description of the rationale behind the plan, the reasons for selecting particular contaminants of concern, complete analytical testing protocols used to meet contaminant thresholds, and references indicating the basis for the plan, so that the plan's comprehensiveness and effectiveness can be evaluated by the assessor.

6.2 LOCAL AND BUSINESS-SPECIFIC WATER ISSUES

Standard Requirement

Local and business-specific water-related issues are characterized (e.g., the manufacturer will determine if water scarcity is an issue and/or if sensitive ecosystems are at risk due to direct operations).

Applicable Levels of Certification

This requirement applies to the Basic level of certification and above (Basic, Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to assist the manufacturer with understanding the water-related issues near their facility and encouraging them to consider their potential impact on these issues.

Methods

1. Identify the watershed, drainage basin, or catchment in which relevant facilities are located, and list the major demands and stressors on water sources within the catchment (e.g., industrial, agriculture, ecosystems, municipal). Suggested references for finding this information include U.S. EPA Surf Your Watershed, World Business Council for Sustainable Development (WBCSD) Global Water Tool, and local governmental and non-governmental organizations focusing on water.
2. Determine if relevant facilities are located in areas where water resources are scarce or stressed. Suggested references include the WBCSD Global Water Tool and scarcity/stress categories therein and UN Aquastat.
3. Determine if relevant facilities are located in areas where significant portions of the population (i.e., greater than 10%) do not have access to fresh or clean water and improved sanitation. Suggested references for finding this information include the WBCSD Global Water Tool and access categories therein, UN Aquastat, WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, and the Social Hotspots Database.
4. Determine if relevant facilities are adjacent to impaired waterways, endangered wetlands, or water bodies seriously impacted by eutrophication (i.e., a process where water bodies receive excess nutrients that stimulate excessive plant growth). Suggested references for this information include the U.S. EPA list of impaired waterways, WRI interactive global map of eutrophication and hypoxia, and Ramsar Listed wetlands.
5. Describe any additional water-related issues that are relevant to the applicant's industry, business, or location and are not covered above. This should include both direct and indirect impacts, such as problems with POTW overflow or specific effluent quality issues relevant to the industry. References for this information include local government and non-governmental organizations focusing on water, and industry associations.

Required Documentation

The information listed below, including the data sources used, must be provided to the assessor. Include ratings where applicable (e.g., the Global Water tool provides red to green ratings for access to improved sanitation). The Global Water Tool may be provided as supporting documentation.

1. Watershed or catchment name.
2. Major water sources within the catchment.
3. Major demands on sources.
4. Scarcity/stress level.
5. Access to improved water (% of population) and risk category (SHdb) or rating (WBCSD).
6. Access to improved sanitation (% of population) and risk category (SHdb) or rating (WBCSD).
7. Impaired waterway, endangered wetland, or water bodies impacted by eutrophication, if any.
8. Other issues.

6.3 WATER STEWARDSHIP INTENTIONS

Standard Requirement

A statement of water stewardship intentions describing actions being taken for mitigating identified problems and concerns is provided. At re-application, progress on any action plans is demonstrated.

Note: the "identified problems and concerns" mentioned here are those identified in the section above covering Local and Business-Specific Water Issues.

Applicable Levels of Certification
This requirement applies to the Basic level of certification and above (Basic, Bronze, Silver, Gold, and Platinum).

Intent
The intent of this requirement is to challenge manufacturers to develop an innovative plan for mitigating the water-related issues previously identified.

Methods
The following must be provided to the assessor for each local and business-specific water issue identified:

1. A description of what is already being done toward mitigating the identified issue.
2. An action plan for how each issue will be addressed in the future, including:
    a. A statement of intent and commitment.
    b. Measurable goals and timeline.
    c. A plan to address high or very high risk/opportunity categories (Social Hotspot Database) and red ratings (WBCSD Global Water Tool).
3. At re-application, a report on progress made against the action plan(s) developed at the initial certification. Progress on the plan(s) is required if local and business-specific issues that had not already been fully addressed were identified at the initial certification.

Required Documentation
Provide a strategy outline and narrative addressing the points listed above.
At re-application, provide the original plan and report progress on each individual action item.

6.4 WATER AUDIT

Standard Requirement
A facility-wide water audit is completed.

Applicable Levels of Certification
This requirement applies to the Bronze level of certification and above (Bronze, Silver, Gold, and Platinum).

Intent
The intent of this requirement is to assist manufacturers with understanding the amount of water used to manufacture the product and identifying opportunities for reduction in use.

Methods
Conduct a facility-wide water audit that includes the following information:

1. Total withdrawals by source, including water body type and name. Include all direct withdrawals and purchased municipal water. Be sure to include all water inputs, including those used in support of the

facility (e.g., landscaping, sanitary use). Report each input and withdrawal in units of total volume per year. If possible, identify the ultimate sources of purchased municipal water.

2. Rainwater collection systems (total annual volume and percentage of total withdrawals).
3. Water recycling and reclamation systems (total annual volume and percentage of total withdrawals).
4. Quantification of effluent discharge into receiving water body or POTW.
5. Flow diagram illustrating facility inputs and outputs.
6. Total consumption per year due to evaporation and/or incorporation into the product.

   Consumption = Total Withdrawals – Total Discharge (include units/year)

   Consumption includes all water that evaporates during production processes, is incorporated into products, or is not returned to the source catchment.
7. Detail regarding use (e.g., process, cooling, landscaping, sanitary, etc.). A breakdown by specific use within the facility is not required, although it is encouraged.
8. **Optional** - Identification of areas in which water of lower quality could be used, with the goal of increasing recycling, is encouraged.
9. **Optional** - Allocate facility-level data to the applicant product or products using the most appropriate method. For example, if products are of similar weight across SKUs, a weight allocation is appropriate. If products are not of similar weight across SKUs, product value or volume may be appropriate. Indicate the method used to allocate water use to the production of the applicant product.

Useful references for obtaining the above information include the WBCSD Global Water Tool, GEMI, Carbon Disclosure Project – Water, and GRI water indicators.

Required Documentation

Provide facility-level data as outlined above for the most recent calendar or fiscal year. If the product is produced in multiple facilities, including contract manufacturing facilities, provide data separately for each facility. An applicant must work with their accredited assessment body to obtain the appropriate template for conducting the water audit. Many of the required data fields are also contained within the WBCSD Global Water Tool. A completed WBCSD workbook may be provided as backup documentation.

Add rows to the table if relevant source and receiving water bodies are not included. For example, if water is withdrawn and/or discharged to more than one surface water body, add an additional row and collect data for each water body separately. The addition of rows to break out totals by use (e.g., process, cooling, etc.) may also be useful. It may be preferable to transfer the table into an Excel spreadsheet so that calculations can be automated.

6.5 CHARACTERIZING AND ASSESSING PRODUCT-RELATED PROCESS CHEMICALS IN EFFLUENT

Standard Requirement

Product-related process chemicals in effluent are characterized and assessed, or product-related process chemicals are not discharged to water systems because wastewater is kept flowing in systems of nutrient recovery.

Applicable Levels of Certification

This requirement applies to the Silver level of certification and above (Silver, Gold, and Platinum) and is one of two options at the Silver level. To reach the Silver level or higher, applicants with product-relevant wastewater must pursue this requirement, with two exceptions: (1) If water is only used to rinse the product, and product residue is not expected in the effluent, or (2) If product-relevant wastewater is produced, but no effluent is discharged from the facility, because any waste is shipped and treated as chemical waste off site. In these two cases, the applicant may choose whether to characterize and assess product-related process effluent chemicals as described here or whether to pursue the supply chain-related water requirements (Sections 6.6 & 6.8) instead. Note that this requirement partially fulfills the Platinum requirement for Material Health.

Intent

The intent of this requirement is not to require analytical testing beyond what is required by a manufacturer's regulatory permit or to identify all chemicals present in the effluent. The intent is for a manufacturer to understand the chemicals used in the manufacturing process and their potential concentrations in effluent. The requirement does not apply to chemicals in the influent to the manufacturing facility.

Methods

1. Determine whether a closed-loop water recycling system is in place and there is therefore no product-relevant effluent leaving the facility. If wastewater would have ordinarily been discharged to water systems without this water recycling system, no further assessment or optimization of process chemicals is necessary. If there is product-relevant effluent leaving the facility, proceed to item 2.
2. Identify the process chemicals used in the final manufacturing stage of the applicant product that are potentially entering effluent leaving the manufacturing facility through the process water, cooling system, input materials, and pipes by chemical name and CAS #. Process chemicals are defined in the Terms and Definitions section. At a minimum, include chemicals that are known or expected to be introduced into water intentionally or unintentionally. If chemical substances that are also part of the finished product are expected to be present in the effluent, these substances also need to be assessed as part of this requirement. It is not expected that analytical testing beyond what is already required for regulatory purposes will be conducted. If the facility has its own wastewater treatment system, the effluent subject to review is the effluent post-treatment, prior to any off-site treatment (e.g., by a municipal wastewater treatment facility). If the final manufacturing stage of a product occurs at more than one facility, chemicals in the effluent must be identified and assessed at each facility.
3. Determine the single chemical risk rating for all chemicals identified in #1 above as described in the C2C *Material Health Assessment Methodology*. The assessment is to be conducted on the primary hydrolyzed or reacted form of the parent chemical that would appear in the effluent.
4. Use the information above to create an effluent optimization plan including measurable goals, timeline, and budget. Detail the actions to be taken to either phase out each x-assessed chemical or keep it sequestered in nutrient recovery systems. The applicant may also wish to include plans to optimize c chemicals to b or a; however, if all chemicals are assessed as c or above, the applicant has already met the effluent optimization requirement for the Gold level (see Section 6.7).

Required Documentation

The following information is required:

1. In the case of a closed-loop water recycling system: A description of the system, confirmation that no product-relevant effluent leaves the facility, and confirmation that wastewater captured by the recycling system would have ordinarily been discharged to water systems. In this case, ignore items 2-6 below.
2. If product-relevant effluent leaves the facility: A list of the chemicals identified in the first step of the Methods section above, including name and CAS #.
3. For each chemical, identify the point in the manufacturing process at which the chemical is likely entering effluent (e.g., used in the process water or cooling system, or are input materials at a particular point in the manufacturing process).
4. Identify the single chemical risk rating (as a, b, c, or x) for each chemical identified. The single chemical risk rating considers the chemical's hazards and exposure to the chemical via the effluent. GREY single chemical risk ratings are permissible if the GREY rating is due to missing toxicity data rather than missing formulation information.
5. A description of the current management strategy, if any, and its effectiveness.
6. An optimization plan including the elements listed in the Methods section above.

6.6 SUPPLY CHAIN WATER ISSUES AND STRATEGY

Standard Requirement

Supply chain-relevant water issues for at least 20% of the total number of Tier 1 suppliers are characterized and a positive impact strategy is developed (required for facilities with no product-relevant effluent).

Applicable Levels of Certification

This requirement applies to the Silver level of certification and above (Silver, Gold, and Platinum) and is one of two options at the Silver level.

Intent

The intent of this requirement is to assist the manufacturer with understanding water-related issues in the supply chain and to challenge them to develop an innovative strategy for positively impacting the issues identified.

Methods

1. To fulfill the water issues characterization part of the requirement, the applicant can perform one or more of the following for at least 20% of the total number of Tier 1 suppliers: (1) characterize the local and business-specific water issues identified in Section 6.2; (2) characterize and quantify water use; and/or (3) determine whether or not a significant violation of their discharge permit has been received within the last two years. This requirement applies regardless of whether or not the Tier 1 suppliers use any process water.
    a. Local and business-specific water issues – follow the methods used in Section 6.2.

b. Characterize and quantify water use – characterize and quantify water use and/or discharge to water attributable to the product using primary and/or available secondary data. Follow the methods used in Section 6.4.

c. Determine whether or not a significant violation of their discharge permit has been received within the last two years – follow the methods used in Section 6.1.

2. Develop a positive impact strategy based on the issues identified, including quantitative targets, a timeline, and budget. Example strategies include working with the supply chain to effectively manage water use, particularly for water input and impact intensive materials, consideration of supplier's local water issues as a part of purchasing decisions, and material substitution. A positive impact strategy is required from the applicant regardless of whether any issues are identified during the supply chain water issues characterization. The strategy may include a plan to fulfill more of the investigation options for the same suppliers and/or a plan to increase the percentage of Tier 1 suppliers for which the investigation is conducted over time.

Required Documentation

1. For characterization of local and business-specific water issues, follow the "Required Documentation" in Section 6.2.
2. For characterization of the quantity of water use, provide a report detailing the methods used, the results, and data sources. Follow the "Required Documentation" in Section 6.4. Describe the significance of the results.
3. For determination of whether or not a significant violation of a supplier's discharge permit has been received within the last two years, follow the "Required Documentation" in Section 6.1.
4. Provide a positive impact strategy as follows for each option:
   a. For local and business-specific water issues, follow the "Required Documentation" listed in Section 6.3.
   b. For characterization of the quantity of water use, include a description of the strategy, quantitative targets, a timeline, and budget.
   c. For determination of whether or not a significant violation of a supplier's discharge permit has been received within the last two years, include a description of the strategy, quantitative targets, a timeline, and budget.

6.7 OPTIMIZING PROCESS-RELATED CHEMICALS IN EFFLUENT

Standard Requirement

Process-related chemicals in effluent are optimized. Chemicals identified as problematic are kept flowing in systems of nutrient recovery, and effluents leaving the facility do not contain chemicals assessed as problematic.

Applicable Levels of Certification

This requirement applies to the Gold level of certification and above (Gold and Platinum) and is one of two options at the Gold level. Note that this requirement partially fulfills the Platinum-level requirement for Material Health.

Intent
The intent of this requirement is to ensure that chemicals used in the product manufacturing process do not adversely impact human or environmental health.

Methods
See Section 6.5 for methods. "Optimized" in this case is defined as effluent containing only process-related chemicals that have single chemical risk ratings of a, b, or c (no x or GREY chemicals). See Section 6.5 of this document for more information. The applicable chemicals are those identified in Section 6.5 and any additional process-related chemicals that are currently used in the manufacturing process and are likely to be present in effluent, but that were not previously identified when effluent was initially characterized.

Required Documentation
The documentation required is the same as the documentation required in Section 6.5, with the exception of an optimization plan, which is not required.

6.8 ADDRESSING SUPPLY CHAIN WATER ISSUES

Standard Requirement
Demonstrated progress on the strategy developed for addressing supply chain-relevant water issues at the Silver level (required for facilities with no product-relevant effluent).

Applicable Levels of Certification
This requirement applies to the Gold level of certification and above (Gold and Platinum) and is one of two options at the Gold level.

Intent
The intent of this requirement is to challenge manufacturers to positively impact water issues in their supply chain.

Methods
Demonstrate progress made against the impact strategy/plan developed for the Silver-level requirement (see Section 6.6).

Required Documentation
Provide the original strategy/plan and report progress on each individual action item.

6.9 DRINKING WATER QUALITY

Standard Requirement
All water leaving the manufacturing facility meets drinking water quality standards.

Applicable Levels of Certification
This requirement applies to the Platinum level of certification only.

Intent

The intent of this requirement is to ensure, to the extent possible, that water leaving the manufacturing facility is safe for drinking.

Methods

1. Identify all process-related chemicals potentially entering effluent through the process water, cooling system, input materials, and pipes as a result of the product manufacturing process by chemical name and CAS # (use same method described in Section 6.5).
2. Determine the single chemical risk rating for all chemicals identified in #1 above as described in the *Cradle to Cradle Certified*™ *Material Health Assessment Methodology*. The assessment is to be conducted on the primary hydrolyzed or reacted form of the parent chemical that would appear in the effluent.
3. All chemicals must have single chemical risk ratings of a, b, or c (no x or GREY) in order to fulfill this requirement.
4. Gather documentation detailing local drinking water standards and conduct analytical testing to demonstrate compliance to those standards. Such standards should be at least as rigorous as the most recent international standard set by the World Health Organization.

Required Documentation

The following information is required:

1. A list of the chemicals identified in the first step of the Methods section above, including name and CAS #.
2. For each chemical, identify the point in the manufacturing process at which the chemical is likely entering effluent (e.g., used in process water or cooling system, or are input materials at a particular point in the manufacturing process).
3. Provide the single chemical risk rating for each chemical identified (must be a, b, or c).
4. Provide documentation on local drinking water standards.
5. Provide a description of the analytical test methods used, test results, and testing laboratory name and contact information.

7 SOCIAL FAIRNESS

Positive Support for Social Systems

Social Fairness ensures that progress is made towards sustaining business operations that protect the value chain and contribute to all stakeholder interests, including employees, customers, community members, and the environment. It is important for business ethics to go beyond the confines of the corporate office and permeate the supply chain, engaging it in responsible manufacturing, enforcing fair treatment of workers, and reinvesting in natural capital.

Table 10 highlights each unique requirement within the Social Fairness category across all levels. In general, to achieve a given level, the requirements at all lower levels are to be met as well. The sections to follow will provide interpretation and suggested methods for achievement.

Table 10 Social Fairness Requirements

LEVEL	ACHIEVEMENT
BASIC	A streamlined self-audit is conducted to assess protection of fundamental human rights. Management procedures aiming to address any identified issues are provided. Demonstration of progress on the management plan is required for re-application.
BRONZE	A full social responsibility self-audit is complete and a positive impact strategy is developed (based on UN Global Compact Tool or B-Corp).
SILVER	COMPLETE ONE OF THE FOLLOWING: Material-specific and/or issue-related audit or certification relevant to a minimum of 25% of the product material by weight is complete (FSC Certified, Fair Trade, etc.). OR Supply chain-relevant social issues are fully investigated and a positive impact strategy is developed. OR The company is actively conducting an innovative social project that positively impacts employees' lives, the local community, global community, social aspects of the product's supply chain, or recycling/reuse.
GOLD	Two of the Silver-level requirements are complete.
PLATINUM	A facility-level audit is completed by a third party against an internationally recognized social responsibility program (e.g., SA8000 standard or B-Corp). All Silver-level requirements are complete.

7.1 STREAMLINED SELF-AUDIT

Standard Requirement

A streamlined self-audit is conducted to assess protection of fundamental human rights.

Applicable Levels of Certification

This requirement applies to the Basic level of certification and above (Basic, Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to determine if any final manufacturing facilities, contract manufacturing facilities, or tier one supplier facilities are operating in countries and/or industries identified as having high or very high potential for issues with any of the following themes, per the Social Hotspots database (http://socialhotspot.org/):

1. Child labor.
2. Forced labor.
3. Excessive work time.
4. Provision of a living wage.
5. Worker health and safety.
6. Wage Assessment; Issue: Potential of Average wage being < non-poverty guideline.
7. Accidents and death in workplace.
8. Toxicity or chemical exposure in workplace (if data are available).

Methods

1. List final manufacturing and tier one facilities relevant to the product by name, location (i.e., country), and industry sector if available. Note that this has likely already been completed for the Material Health requirements. Commodity-type materials purchased from many and frequently changing locations, such as fasteners or other hardware and post-consumer recycled content paper and pulp, may be excluded.
2. Determine risk or opportunity level (as defined by the Social Hotspots database (SHdb); http://socialhotspot.org) for each location and/or sector. The SHdb is highly recommended for fulfilling this requirement because it contains both country and industry sector-specific information for each issue that needs to be addressed. Once a SHdb account is active, view the themes listed above within the category "Labor Rights & Decent Work" and determine the appropriate risk/opportunity levels. If SHdb provides a risk rating for the applicable industry sector, report that preferentially to the overall country rating. If not, refer to the additional references provided below to explore the applicability of the risk or opportunity level to specific industry sector(s) (although this is not required).

   Alternative references for exploring the applicability of the risk or opportunity level to specific industry sector(s) may be used. Recommendations include UNICEF, U.S. Department of Labor, List of Goods Produced by Child Labor (U.S. Dept. of Labor, 2009), International Labour Organization

(ILO) country reports, World Bank poverty data, UN Human Development reports, U.S. Department of State Human Rights reports, sweatfree.org non-poverty wages, the U.S. Bureau of Labor Statistics, AFL-CIO, International Trade Union Confederation country profiles, and the World Health Organization.

Regardless of the information source used, how the required information was identified for each issue needs to be specified. In the SHDB, the risk themes listed may not correspond directly to the issues listed in the requirement. The applicant must work with their assessor to select the most relevant categories and risk themes for their operations in each region.

A company that has received SA8000 certification or is a certified B Corporation will still need to fulfill the self-audit requirement for the Basic level and may have to do additional work for other social fairness requirements depending on the work conducted to receive the certification. Applicants will need to work with their assessor to determine which additional steps beyond the facility-level, third party audit are required.

Required Documentation

An applicant must work with their accredited assessment body to obtain the appropriate template for conducting the streamlined self-audit.

7.2 MANAGEMENT PROCEDURES TO ADDRESS HIGH RISK ISSUES AND OPPORTUNITIES

Standard Requirement

Management procedures aiming to address any high or very high risk or opportunity issues that were identified in the streamlined self-audit are provided. Demonstration of progress against the management plan is required for re-application.

Applicable Levels of Certification

This requirement applies to the Basic level of certification and above (Basic, Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to develop a plan for addressing the high or very high risk or opportunity issues that were identified in the streamlined self-audit in an effort to protect basic human rights of workers within the company's supply chain.

Methods

1. Were any final manufacturing or tier one facilities identified as having high or very high risk or opportunity upon conducting the streamlined self-audit? If yes, please continue to the next question. If not, no further action is required (i.e., the requirement to provide or develop management procedures does not apply).
2. Do those facilities identified as having high or very high risk or opportunity provide ≤1% of the value of the product combined? If yes, no further action is required (i.e., the requirement to provide or

develop management procedures does not apply). If no (i.e., facilities provide >1%), please continue as stated below.

3. If required (see #2 above), provide one of the following:
   a. Existing audit, remediation, and management procedures designed to identify and protect basic human rights of workers within the company's supply chain.

      OR

   b. A proposed plan for monitoring and addressing potential issues if the applicant does not have an existing audit and management process.
4. At a minimum, the management procedures must include a draft supply chain code of conduct to be integrated into supplier contracts, that prohibits child and forced labor, requires that a living wage be paid, and allows for unannounced audits. Child labor and living wage are to be defined according to the ILO and UN. Ideally, the plan will include all major points of the UN Declaration of Human Rights, UN Global Compact, and the ILO Core Conventions and Recommendations.
5. In cases where the final manufacturing facility (including contract manufacturing) is of high or very high risk or opportunity, management and self-auditing procedures must also be documented and provided. A third party audit according to SA8000 is a preferred alternative in this case (which would fulfill one Platinum-level requirement).
6. At re-application, a listing of actions taken in carrying out the plan since the initial certification or prior renewal is to be compiled. Examples of the type of information to include are monitoring activities that have been carried out and where they were carried out, identification of new or recurring issues, and results of any self-audits.

Required Documentation

The following information must be provided to the assessor:

1. If applicable, a signed statement indicating that the final manufacturing and tier-one facilities identified as having high or very high risk or opportunity provide ≤1% of the value of the product combined (as described in the Methods section above).
2. A list of facilities included in the plan/procedures, if required.
3. Management plan and procedures, if required. Include self-audit procedure where final manufacturing facility or contract facility is of high or very high risk/opportunity.
4. Example of applicant's supplier contract with integrated code of conduct.
5. Social responsibility report, if available.
6. A list of actions taken and results/findings since initial certification or prior re-application (see Methods).

7.3 FULL SELF-AUDIT

Standard Requirement

A full social responsibility self-audit is complete and a positive impact strategy is developed (based on UN Global Compact Tool or B-Corp).

Applicable Levels of Certification
This requirement applies to the Bronze level of certification and above (Bronze, Silver, Gold, and Platinum).

Intent
The intent of this requirement is for the applicant to continue to gather data about the social impacts of the final manufacturing process.

Methods
1. Conduct a social responsibility self-audit using the UN Global Compact Self-Assessment Tool (http://www.globalcompactselfassessment.org/) or B Impact Assessment. If the final manufacturing or contract manufacturing facility is found to be located in areas with high or very high potential for fundamental human rights issues (as required to be identified at the Basic level), it is recommended that the UN tool be employed.
2. Develop a positive impact strategy based on audit results, including a statement of intent and commitment, measurable goals, and timeline. If using the UN Global Compact Tool, include items in the strategy where answers are NO.

Required Documentation
The following information must be provided to the assessor:

1. The UN Global Compact (Excel spreadsheet) or B Corp survey results.
2. The impact strategy, including those points listed in the Methods section above.

7.4 MATERIAL-SPECIFIC OR ISSUE-SPECIFIC AUDIT

Standard Requirement
Material-specific and/or issue-related audit or certification relevant to a minimum of 25% of the product material by weight is complete (e.g., FSC Certified, Fair Trade, etc.).

Applicable Levels of Certification
This requirement applies to the Silver, Gold, or Platinum levels of certification.

Intent
The intent of this requirement is to encourage the use of materials that are produced and managed to high environmental and social standards.

Methods
1. Material- or supplier-specific certifications must apply to a minimum of 25% of the product material(s) by weight. However, if the certifying body has its own requirements, those will take precedence.
2. Input materials or manufacturers of input materials are certified and/or verified compliant (as appropriate) by an external party according to one or more of the following pre-approved programs:
    - B Corporation

- Blue Angel (when human rights issues are addressed as part of the Standard, such as in RAL-UZ 154 Textile)
- Business Social Compliance Initiative (BSCI) code of conduct
- CarbonNeutral product certification
- Certified Organic (US Department of Agriculture or Quality Assurance International)
- Conflict-free (third-party verified)
- Cotton made in Africa
- Cradle to Cradle Certified
- Electronic Industry Citizenship Coalition (EICC) code of best practice
- Ethical Trading Initiative base code
- Fair for Life
- FairTrade
- Forest Stewardship Council (FSC) Forest Management & Chain of Custody
- Global Organic Textile Standard (GOTS)
- Global Social Compliance Programme Reference Code
- Initiative Clause Sociale (ICS)
- International Council of Toy Industries (ICTI) code of business conduct
- ISCC PLUS
- Leaping Bunny
- Nordic Swan/Nordic Ecolabel for Textiles, hides/skins and leather
- NSF/ANSI 336 Sustainability Assessment for Commercial Furnishings Fabric
- Oeko-Tex Standard 1000 or 100plus
- Responsible Source - Scientific Certification Systems (SCS)
- RSPO Certified Sustainable Palm Oil tracked through the Identity Preserved, Segregated, or Mass Balance supply chain certification systems
- SA8000
- UTZ Certified
- Worldwide Responsible Accredited Production (WRAP)

Pre-approved programs are primarily, with some exceptions, those that are:

1. Focused on fundamental human rights issues, in particular fair labor practices, or on animal rights issues, or
2. Multi-attribute programs that address fair labor practices along with other issues (with social criteria relevant to fundamental human rights, in particular labor practices, required).

Programs that apply only to final consumer products as opposed to potential input materials may fit into the categories above but have not been included because such programs will not likely be relevant to product input materials and/or suppliers as required for this criterion.

The eco-label and verification/auditing environment continues to evolve and additional programs may apply as they become available. Assessors may request an addition to the list by providing C2CPII (certification@c2ccertified.org) with the name of the proposed program and the following details:

a. A summary of the program and how it addresses fundamental human rights and other social fairness issues;
b. A list of any ecolabels/standards (other than C2C) or government programs that reward for use of materials certified under the program; and

c. A summary of any major criticism the program has received from NGOs or governments.

3. Certifications are to be current (unexpired). Audits against programs that do not have expiration dates are eligible if they have been completed within the last three years.
4. Water weight may be excluded from the product weight when calculating the weight fraction of materials with material-specific and/or issue-related certifications/audits.

Required Documentation

The following information must be provided to the assessor:

1. A copy of the certification certificate or similar, signed and dated by the certifying or verifying body.
2. Calculations within the original Bill of Material (used for complying with the Material Health category requirements) showing that at least 25% of the product by weight is covered by the audit or certification.

7.5 SUPPLY CHAIN SOCIAL ISSUES AND IMPACT STRATEGY

Standard Requirement

Supply chain-relevant social issues are fully investigated and a positive impact strategy is developed.

Applicable Levels of Certification

This requirement applies to the Silver, Gold, or Platinum levels of certification.

Intent

The intent of this requirement is to challenge manufacturers to positively impact social issues throughout their supply chain.

Methods

1. Characterize and quantify social issues throughout the supply chain attributable to the product from resource extraction to production (applicant's gate) using primary data wherever possible. At a minimum, applicants must investigate the following:
   a) At least one relevant 'material-specific issue' related to initial resource extraction (palm oil, bauxite mining, etc.).
   b) Tier 1 suppliers' social issues (using primary data collected from their suppliers) or social issues pertaining to all or most of their Tier 2 suppliers at the same level of rigor required at the Basic level for the Tier 1 suppliers.
2. The inventory threshold is left to the applicant to determine and define as part of the boundary and scope decision; however, it is recommended that suppliers of all materials that are 1% or more of the product's total inputs by weight be investigated. Ideally all inputs will be included to identify as many social issues associated with the product as possible.

3. If primary data are not available or accessible, knowledge of industry type, supplier location data, and available data and information relevant to those locations and industries may be used instead. The SHdb and other references listed in Section 7.1 will be useful. This requirement may be seen as a continuation of the requirements set out in Section 7.1. The methods described there may be applied to the entire supply chain.
4. Social LCA methods should be consulted.
5. Develop a positive impact strategy based on the results. Include a statement of intent and commitment, quantitative targets, timeline, and budget.

Required Documentation

The following information must be included in a report to the assessor:

1. Inventory results.
    a. Description of at least one relevant 'material-specific issue' related to initial resource extraction.
    b. Description of the method used to investigate social issues among Tier 1 or Tier 2 suppliers and a summary of the issues identified.
2. Use of results.
    a. Provide a positive impact strategy that addresses the inventory results in 1a and 1b, including those points listed in the Methods section above.

7.6 INNOVATIVE SOCIAL PROJECT

Standard Requirement

The company is actively conducting an innovative social project that positively impacts employees' lives, the local community, the global community, the social aspects of the product's supply chain, or recycling/reuse.

Applicable Levels of Certification

This requirement applies to the Silver, Gold, or Platinum levels of certification.

Intent

The intent of the innovative social project requirement is to develop and implement a company program that positively impacts social issues and implements the Cradle to Cradle principles. The key aspect of this requirement is that the program or project is an integrated part of company strategy.

Methods

Completion of this requirement involves the development of an innovative company program, as an integrated part of company strategy, that includes communication, education, traineeships, communities of practice, purchasing, and/or political engagement that actively supports (local, national, continental or global) implementation of the Cradle to Cradle principles.

Projects that seek to address all three Cradle to Cradle principles simultaneously are encouraged. Set social responsibility targets and initiatives in a variety of areas, and use these to strategize which innovative social projects to pursue.

The criteria provided for the requirement are broad-based to allow for the development of a wide variety of program types. Because there is a wide range in social fairness policies and practices around the world, the definition of innovative may vary.

The innovative social project can be new to the company, the country, or the world. There may be programs or activities that a company is already engaging in for compliance purposes that would fulfill this requirement; however, basic compliance is not the intent.

The following are examples of applicable goals, targets, and initiatives.

1. Increasing the diversity of the workforce.
2. Creation of programs to engage special needs groups in the local community.
3. Decreasing the wage disparity between upper management and the workforce.
4. Increasing employee involvement in positive community service activities.
5. Actively encouraging staff participation in creative Cradle to Cradle® design and research projects as an integrated part of company strategy.
6. Improvements on the positive impact on all people, places, and things that are indirectly or directly involved in the making or remaking and/or use of the products.
7. Company programs as an integrated part of company strategy that actively support the quality of life of its employees (i.e., health, satisfaction, happiness, enjoyment).
8. Development and implementation of a company-wide Cradle to Cradle "roadmap" including:
    a. Creation of a Cradle to Cradle team with representatives in each operational unit and local markets.
    b. The development of Cradle to Cradle tools and resources.
    c. Company purchasing programs that actively support the purchasing of Cradle to Cradle Certified™ products. This might include a public list of "approved" vendors and venues and a public statement on company purchasing.
9. Taking an active role in organizing workshops, facilitating traineeships, generating public debate, etc. This might include checklists for client-facing teams to create experiences and events that implement the use of exhibits and mobile tours based on the Cradle to Cradle principles, and/or thought leadership blogs, articles, and speakerships on Cradle to Cradle events.
10. Researching successful government or trade association sustainability programs and actively engaging in helping to support those.

Required Documentation

A detailed description of the program or project, including goals and progress made to date, is required.

7.7 FACILITY-LEVEL THIRD PARTY AUDIT OR CERTIFICATION

Standard Requirement

An internationally recognized social responsibility certification (e.g., SA8000 or B-Corp) is obtained, or a facility-level audit is completed by a third party against an internationally recognized social responsibility program.

Applicable Levels of Certification

This requirement applies to the Platinum level of certification only.

Intent

The intent of this requirement is to ensure that manufacturers have adopted policies and procedures that protect the basic human rights of workers.

Methods

1. The applicant must receive certification or be audited at the facility level by a third party against an internationally recognized social responsibility program. The following programs are pre-approved:

   a. B Corp Certification.

   b. Business Social Compliance Initiative (BSCI) audit.

   c. Global Social Compliance Program (GSCP) audit.

   d. SA8000 certified (Social Accountability International).

   e. Worldwide Responsible Apparel Production (WRAP).

   Please contact an assessor or the Cradle to Cradle Products Innovation Institute regarding the applicability and approval of other audits and certifications that fulfill this requirement. At a minimum, other programs are to be internationally accepted and address child labor, forced labor, health and safety, freedom of association and collective bargaining, discrimination, discipline/harassment, working hours, and compensation.

2. Certifications are to be current (unexpired). Audits against programs that do not have expiration dates are eligible if they have been completed within the last three years.

Required Documentation

A copy of the certification certificate or similar, signed and dated by the certifying or verifying body, is required.

8 CONTINUOUS IMPROVEMENT AND OPTIMIZATION

Standard Requirement

Certification holders are required to make a good faith effort toward materials optimization at each recertification period, unless optimization is already complete or is incomplete due to technological constraints. Progress on materials optimization includes both demonstrated progress on eliminating X-assessed materials or x-assessed chemicals in those materials and work toward increasing the percentage of the product assessed as A, B, C, or X at each recertification period.

Applicable Levels of Certification

This requirement applies to the Basic level of certification and above (Basic, Bronze, Silver, Gold, and Platinum).

Intent

The intent of this requirement is to ensure that manufacturers are committed to making a good faith effort toward optimization of their product.

Methods

1. If an applicant has completed their materials optimization work, or if they have reached a point where they cannot go further with materials optimization due to technology constraints, it is required that progress is made in some other program category or categories.
2. In addition to materials optimization, there are several other cases where progress on optimization strategies or plans may be required at re-application (see Table 11 below).
3. An alternative compliance pathway exists for companies that have several certified products and where it is extremely challenging to make progress on each individual product at each recertification. The continuous improvement and optimization requirement can be met by demonstrating significant optimization at the corporate level that impacts many products, but perhaps not all certified products. A clear explanation of the progress that has been made on optimization of other Cradle to Cradle Certified™ products at recertification is required in such cases.

Table 11 Progress on Optimization Strategies or Plans Required Throughout the Program

Strategy/Plan	Levels	Re-application Requirement
Materials Optimization	Bronze and above	Progress required at re-application unless complete or incomplete due to technology constraints.
Nutrient Management	Gold	No specific requirement.
Renewable Energy and Carbon Management (facility level)	Bronze and above	No specific requirement.
Water Stewardship Intentions	Basic and above	Progress may be required at re-application depending on outcome of the local and business-specific water issues investigation.
Supply Chain Water Issues Strategy	Silver and above	No specific requirement.
Social Responsibility Management Procedures	Basic and above	Progress may be required at re-application depending on outcome of the streamlined self-audit.
Positive impact strategy based on Full Social Responsibility Self-Audit	Bronze and above	No specific requirement.
Positive impact strategy based on Supply Chain Social Issues investigation	Silver and above	No specific requirement.

Required Documentation

The original action plan or strategy and a report on the progress against each individual action item are required.

9 SITE VISIT OF PRODUCTION FACILITY

Standard Requirement

A site visit of the final manufacturing facility or facilities is completed.

Applicable Levels of Certification

This requirement applies to the Bronze level of certification and above (Bronze, Silver, Gold, and Platinum).

Intent

The intent of the site visit is to focus on verifying the manufacturing process, the product materials, and the process chemicals used in the final manufacturing step for the finished product that is being assessed for certification. A site visit is also used by the assessment body to verify the product's bill of materials, and, to the extent possible, it serves as quality assurance that the applicant has reported accurate information. It can also be used to increase the percentage of the product that is inventoried and therefore the percentage of the product that is considered assessed (i.e., chemicals identified and evaluated for their material health following the Standard's material health assessment process). The purpose of the site visit is not to verify the specific details regarding the social fairness criteria at the facility or the supplier facilities.

Methods

It is necessary for the assessor assisting with each project to tour the production/assembly process for the applicant product(s) to see how suppliers' components come together to make the finished product and understand some basics on process steps and process chemicals. All parts of the plant involved in the manufacturing of the applicant product(s), including raw material storage, manufacturing processes, and waste streams will need to be shown to the certification assessor. Questions may be asked about process times, process temperatures, pollution controls, and personal protective equipment. Energy use and emissions, water, and social fairness data may also be discussed and reviewed.

The assessor would like to meet with someone who can give them a tour of the manufacturing facility, the contact person at the applicant company that will be responsible for day-to-day data needs for the project, and someone with knowledge of the procurement of purchased materials that go into the product in order to discuss the project's data needs. This may be a group of people or it may be one person, depending on the company. The applicant should be prepared to discuss their manufacturing flow, including inputs and outputs. It is preferred that the applicant also have an outline of the supply chain for the applicant product(s) to review during the site visit meetings. The applicant should also have reviewed the Cradle to Cradle Certified™ application and program documents prior to the arrival of the auditors, so that they can address any questions.

A site visit is required once per product or product group at the time of initial certification. An additional site visit is required if the manufacturing process changes significantly. More than one site visit may be necessary for the same facility if applicants choose to certify multiple products over time. The product must be on the production line during the site visit in order to be valid.

A site visit is required for the main final manufacturing facility and any other facilities involved in select manufacturing processes for which exposure concerns are considered exceptionally high. These select manufacturing processes are marked with a '*' in the *Final Manufacturing Stage Guidance*. If there is more than one final manufacturing facility, the assessor determines which facility is the "main" facility to be visited based on which one performs the most significant manufacturing processes.

Unless the product's final manufacture involves a process marked with a '*' in the *Final Manufacturing Stage Guidance*, only one site visit is required, regardless of how many individual facilities are included in the final manufacturing stage. For example, if five facilities are involved in the final manufacturing stage, and none of them performs a process marked with a '*,' only one of them needs to be visited.

Required Documentation

A statement confirming that the site visit was conducted by a representative from an accredited assessment body is required. If there is more than one final manufacturing facility, an explanation of how the assessor determined which facility is the "main" facility to be visited is also required.

10 CERTIFICATION DISCLAIMER

The Cradle to Cradle Products Innovation Institute warrants only that any product which has been certified as Basic, Bronze, Silver, Gold or Platinum meets the Institute's Cradle to Cradle Certified™ Product Standard criteria for such certification and except as expressly set forth herein.

(A) The Cradle to Cradle Products Innovation Institute makes no warranty, express or implied as to any product which has been certified under the Institute's Cradle to Cradle Certified Product Standard, including any warranty as to merchantability or fitness for a particular purpose and the Institute hereby expressly disclaims all other warranties;

(B) The Cradle to Cradle Products Innovation Institute shall not be liable for any loss, injury, claim, liability, or damage of any kind resulting in any way from any errors, omissions, content, information, opinions or assessments contained in the Institute's Cradle to Cradle Certified Product Standard; and,

(C) The Cradle to Cradle Products Innovation Institute shall not be liable, in any event, for any incidental, consequential, special, exemplary or punitive damages (including without limitation for lost data, lost profits or loss of goodwill) of any kind or nature arising out of the certification of any product under the Institute's Cradle to Cradle Certified Product Standard, whether such a liability is asserted on the basis of contract, tort, or otherwise, even if the Institute has been made aware of the possibility of such loss or damage in advance.

11 ACRONYMS

ABS	acrylonitrile butadiene styrene
BBP	benzyl butyl phthalate
BOD	Biological oxygen demand
BOF	basic oxygen furnace
BSCI	Business Social Compliance Initiative
CAS	Chemical Abstract Service
CMR	carcinogenic, mutagenic, or reproductively toxic
CO_2	carbon dioxide
COD	chemical oxygen demand
CONEG	Coalition of Northeastern Governors
COTE	Committee on the Environment
CPVC	chlorinated Polyvinyl chloride
DBP	dibutyl phthalate
DEHP	di(2-ethylhexyl)phthalate
EAF	electric arc furnace
EMC	externally managed component
EPEA	Environmental Protection Encouragement Agency
FSC	Forestry Stewardship Council
FTC	Federal Trade Commission
GHG	greenhouse gas
GSCP	Global Social Compliance Program
HDPE	high density polyethylene
IARC	International Agency for Research on Cancer
ICP/AES	inductively coupled plasma/atomic emission spectroscopy
ICP/MS	inductively coupled plasma/mass spectroscopy
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
IPS	Intelligent Products System
LCA	life cycle assessment
MBDC	McDonough Braungart Design Chemistry, LLC
MSDA	material safety data sheets
MWh	megawatt hours
PAHs	polycyclic aromatic hydrocarbons
PC	polycarbonate
PCP	pentachlorophenol
PET	polyethylene terephthalate

PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
POTW	publicly owned treatment works
PP	polypropylene
PTFE	polytetrafluoroethylene
PU	polyurethane
PVC	polyvinyl chloride
PVDC	polyvinylidene chloride
REC	renewable energy credit
RECs	renewable energy certificates
RoHS	restriction of hazardous substances
SCCP	short chain chlorinated paraffin
SHdb	Social Hotspots database
SKU	stock keeping unit
TOC	total organic carbon
UNCED	World Urban Forum of the Rio Earth Summit
U.S. EPA	United States Environmental Protection Agency
WBCSD	World Business Council for Sustainable Development
WRAP	Worldwide Responsible Apparel Production
XRF	X-ray fluorescence

12 TERMS AND DEFINITIONS

TERM	DEFINITION
ACRYLONITRILE BUTADIENE STYRENE	A common thermoplastic.
ASTM D6400-04	Standard specification for compostable plastics.
BIODEGRADABLE	The process by which a substance or material is broken down or decomposed by microorganisms and reduced to organic or inorganic molecules which can be further utilized by living systems. Biodegradation can be aerobic, if oxygen is present, or anaerobic, if oxygen is not present. The OECD defines the appropriate testing methods for ready and inherent biodegradability. If making biodegradability claims for materials that are not commonly known to be biodegradable, testing should be done according to these (or comparable) methods.
BIOLOGICAL METABOLISM	The cycle in which biological nutrients flow. Any material that comes into intentional or likely unintentional contact with the biological metabolism should be designed to safely come into contact with living organisms.
BIOLOGICAL NUTRIENT	A product usable by defined living organisms to carry on life processes such as growth, cell division, synthesis of carbohydrates, energy management, and other complex functions. Any material emanating from product consumption that comes into intentional or likely unintentional and uncontrolled contact with biological systems is assessed for its capacity to support their metabolism. Metabolic pathways consist of catabolism (degradation, decrease in complexity) and anabolism (construction, increase in complexity), both occurring generally in a coupled manner. The status of products as a biological nutrient (or source of nutrients) depends on the biological systems that meet them. They can be more or less complex along the following organizational hierarchy: • Organisms (nutrients for predators) • Organic macromolecules (and combinations thereof) (nutrients for fungi, microorganisms, vegetarian animals; oral, dermal or olfactory nutrients) • Minerals (nutrients for autotrophic plants) Generally, products as biological nutrients fit in with the two last levels.
BIOMASS	Organic, non-fossil material that is available on a renewable basis. Biomass includes all biological organisms, dead or alive, and their metabolic by-products that have not been transformed by geological processes into substances such as coal or petroleum. Examples of biomass are forest and mill residues, agricultural crops and wastes, wood and wood wastes, animal wastes, livestock operation residues, aquatic plants, and some municipal and industrial wastes.
CA PROPOSITION 65	A list of substances known by the state of California to cause cancer or reproductive harm.
CARBON DISCLOSURE PROJECT	Organization that helps companies voluntarily disclose greenhouse gas emission accounting.

TERM	DEFINITION
CARBON OFFSET	Reduction of greenhouse gas emissions to compensate for the release/production of emissions from another source.
CARCINOGEN - KNOWN	A causal relationship has been established between exposure to the agent and human cancer (MAK 1 or TLV A1 or IARC Group 1).
CARCINOGEN - POSSIBLE, OR SUSPECTED	A known animal carcinogen, but evidence of carcinogenicity in humans is non-existent, or there is limited evidence of carcinogenicity in humans and insufficient evidence of carcinogenicity in animals (MAK 3 or TLV A3 or IARC Group 2B).
CARCINOGEN - PROBABLE	A known animal carcinogen, but carcinogenicity in humans has not been definitely proven (MAK 2 or TLV A2 or IARC Group 2A).
CAS NUMBER	Chemical Abstract Service number. This number uniquely identifies each pure chemical compound. This is also designated as Chemical Abstract Service Registry Number (CASRN).
CEN	CEN is a major provider of European Standards and technical specifications. It is the only recognized European organization according to Directive 98/34/EC for the planning, drafting, and adoption of European Standards in all areas of economic activity with the exception of electrotechnology (CENELEC) and telecommunication (ETSI).
CHEMICAL SUBSTANCE	A substance represented by a single Chemical Abstract Service Registry Number (CAS #).
CHEMICAL	AKA chemical substance.
CHEMICAL CLASS	Grouping of elements or compounds according to certain chemical functional or structural properties.
CHEMICAL PROFILE	The process of using human and environmental health endpoints and their associated criteria to determine the inherent hazards of a single chemical.
CHLORINATED POLYVINYL CHLORIDE	A chlorinated version of PVC used for temperature stability.

TERM	DEFINITION
CHILD LABOR	UNICEF definition: work that exceeds a minimum number of hours, depending on the age of a child and on the type of work. Such work is considered harmful to the child and should therefore be eliminated. http://www.unicef.org/protection/index_childlabour.html • Ages 5-11: At least one hour of economic work or 28 hours of domestic work per week. • Ages 12-14: At least 14 hours of economic work or 28 hours of domestic work per week. • Ages 15-17: At least 43 hours of economic or domestic work per week. International Labour Organization (ILO) definition: The minimum age at which children can start work (with some possible exceptions for developing countries): http://www.ilo.org/ipec/facts/ILOconventionsonchildlabour/lang--en/index.htm • Ages 13-15: May perform light work that does not threaten health and safety, or hinder education or vocation orientation and training. • Age 15: The age at which compulsory schooling in generally finished; may begin to work Age 18: May perform hazardous work (that which may jeopardize physical, mental or moral health, safety or morals)
CLEAN DEVELOPMENT MECHANISM	Stimulates sustainable development by allowing emission reduction projects in developing countries while allowing industrialized nations to meet emission reduction targets.
CLEARANCE TIME (CT)	The CT indicates the time needed to eliminate or biodegrade a substance to a certain percentage in an organism. For example, the CT50 indicates the time needed to eliminate 50% of a certain substance, analogous to the half-life time measure t1/2.
CLIMATE ACTION RESERVE	National offset program founded to guarantee transparency, integrity, and financial value of voluntary U.S. carbon market.
CLIMATE, COMMUNITY, AND BIODIVERSITY ALLIANCE, THE	Partnership organization comprised of corporations, international non-government organizations, and research institutions that supports and promotes GHG emission mitigation and removal projects that are "land-based."
CLIMATIC RELEVANCE	This is a measure of the climate-influencing characteristics of the substance. All compounds that contribute to global warming are listed here. Examples include carbon dioxide, methane, CFCs, and sulfur hexafluoride.
CO2 EQUIVALENTS (CO2e)	A quantity that describes the amount of CO2 for a particular greenhouse gas that has the same Global Warming Potential when measured for a specific timescale.
COLORANT	Any chemical or substance used to impart color to matter, such as a pigment or dye.

TERM	DEFINITION
COMPOSTABLE	A material capable of undergoing biological decomposition in a compost site as part of an available program, such that the material is not visually distinguishable and breaks down into carbon dioxide, water, inorganic compounds, and biomass at a rate consistent with known compostable materials. If making claims on the compostable nature of materials that are not commonly known to be compostable, testing should be done according to the appropriate ASTM, ISO, CEN, or DIN standard (for example, ASTM D6400-04 for plastics).
DEGRADATION	Decomposition of a compound by stages, exhibiting well-defined intermediate products.
DIN	The German Institute for Standardization. By agreement with the German Federal Government, DIN is the acknowledged national standards body that represents German interests in European and international standards organizations.
DOWNCYCLING	Consequences of design failures to provide products a status as defined biological nutrients or technical nutrients. It is the name for the practice of recycling a material in such a way that much of its inherent value is degraded (e.g. recycling plastic into park benches), revealing poor design of a lifecycle and the related material flows.
EARTHSTER	A free open-source platform for assessing and reporting a product's social and environmental impact.
EFFECT CONCENTRATION 50 (EC50)	The median exposure concentration (EC50) is the median concentration of a substance that causes some effect in 50 percent of the test animals.
EXCESSIVE WORK TIME	ILO definition: More than 48 hours/week; more than 8 hours/day http://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/working-time/lang--en/index.htm .
EXTERNALLY MANAGED COMPONENT (EMC)	An Externally Managed Component is a sub-assembly, component, or material within a product that is exempt from the general requirement of full characterization to the 100 ppm level because it is managed in a technical nutrient cycle as part of a supplier or manufacturer commercialized nutrient management program. To be considered an EMC, the sub-assembly, component, or material within a product must meet the following criteria: i. The supplier of the EMC has provided the applicant with a guarantee for take back and appropriate nutrient management. The supplier may designate a third party or parties for implementation. ii. The supplier has signed a declaration that chemicals in the EMC will not negatively impact humans or the natural environment during the intended and unintended but highly likely use of the product for which the EMC is a component. The EMC has undergone testing by an accredited analytical laboratory to ensure that harmful substances are not being emitted from the EMC above the chemicals' analytical detection limits.

TERM	DEFINITION
FACILITY	A facility is termed as the final step of the manufacturing process before distribution to the end-user market.
FINISH (noun)	A surface pretreatment or coating for a variety of materials.
FORCED LABOR	UN Global Compact definition: work or service which is exacted from any person under the menace of a penalty and which the person has not entered into of his or her own free will.
FUNDAMENTAL HUMAN RIGHTS	Please refer to The Universal Declaration of Human Rights, (United Nations, 1948) http://www.un.org/en/documents/udhr/index.shtml .
GHG PROTOCOL CORPORATE ACCOUNTING AND REPORTING STANDARD,THE	International accounting tool to quantify, manage, and report greenhouse gas emissions.
GHG PROTOCOL PRODUCT STANDARD	Standardized methodology for quantifying, managing, and reporting greenhouse gas emissions throughout a product's life-cycle.
GLOBAL WARMING POTENTIAL (GWP)	A scale used to relate a compound to the CO2 equivalents to measure the potential heating effects on the atmosphere. The GWP of a gas is the warming potential caused by the emission of one ton of the gas relative to the warming caused by the emission of one ton of CO2, for the same time period.
GOLD STANDARD, THE	International organization that provides transparency in carbon offset projects and awards projects that are driving sustainable development and local benefits.
HALF-LIFE (T1/2)	The amount of time it takes half of an initial concentration of substance to degrade in the environment.
HALOGENATED ORGANIC COMPOUNDS	The column in the periodic chart of the elements that begins with Fluorine contains the halogens. These elements, when combined with organic compounds, form halogenated organic compounds. Most of these compounds are toxic, carcinogenic, persistent, ozone-depleting, bioaccumulative, or form hazardous substances during production and disposal (e.g., PVC).
HAZARD ENDPOINT	For the purposes of the Cradle to Cradle® Chemical Profiling Methodology, this term refers to the list of human and environmental health endpoints that are reviewed for each chemical in the chemical hazard assessment process.
HAZARD RATING	The traffic light system that assigns a GREEN, YELLOW, RED, or GREY rating to each hazard endpoint based on the hazard criteria. The hazard criteria are based on available toxicity and fate information for each chemical.

TERM	DEFINITION
HOMOGENEOUS MATERIAL	A material of uniform composition throughout that cannot be mechanically disjointed, in principle, into different materials (RoHS definition). A homogenous material is composed of one or more chemical substances.
INPUT	Inputs refer to the chemicals, mixtures, simple and complex materials, assemblies, or sub-assemblies that make up a product.
INSEPARABLE COMPONENT	Smallest unit of an object that is either not designed to or cannot be readily disassembled by the end user into individual materials.
ISO	The International Organization for Standardization is the world's largest developer and publisher of International Standards.
LETHAL CONCENTRATION 50 (LC50)	The inhalative median lethal concentration (LC50) is the median concentration of a substance that causes death in 50 percent of the test animals.
LIVING WAGE	The ILO defines a living wage as that "sufficient to meet the basic living needs of an average-sized family in a particular economy." Living wage is not covered by the ILO conventions.
MATERIAL	AKA homogenous material.
MATERIAL ASSESSMENT	A modified risk assessment process for rating materials based on the intrinsic human and environmental health hazards posed by their ingredients as well as the relevant routes of exposure for those ingredients in the material and in the finished product. This analysis takes into account the intended use of the material/product as well as highly likely unintended uses, throughout the product's lifecycle.
MIXTURE	AKA homogenous material.
PAS 2050	Method designed by Publicly Available Specification (PAS) to assess life-cycle emissions of goods and services.
PART	A vended component or input to a product that is made of only one specific type of material.
PERSISTENCE	This is a measure of a substance's ability to remain as a discrete chemical entity in the environment for a prolonged period of time. A common measuring tool for persistence is "half-life" (t1/2), which is the amount of time required for half of the substance to break down. If half-life is greater than 30 days in the air, or if half-life is greater than 50 days in soil, water, or any other media, the substance is considered to be persistent.
POST-CONSUMER RECYCLED CONTENT	Materials that have been collected for recycling after consumer use.
PRECAUTIONARY PRINCIPLE	The precautionary principle states that if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is harmful, the burden of proof that it is not harmful falls on those taking the action.

TERM	DEFINITION
PRE-CONSUMER RECYCLED CONTENT	Material collected for recycling prior to consumer use, comes from sources outside of the applicant manufacturer's facility, and has been modified before being suitable for recycling back into a manufacturing process. Waste materials directly incorporated back into the manufacturing process within the applicant facility do not apply.
PRIMARY DATA	Observed process data specific to the given processes owned and operated by the reporting company, such as direct emissions, energy, or physical data.
PROCESS CHEMICAL	A process chemical is defined as any substance that comes into direct contact with the product or any of its material constituents during any of processes that constitute the final manufacturing stage of the product. It is used as an intentional part of any of these processes to fulfill a specific function or achieve a specific effect in the product or any of its material constituents. Within this definition, process chemicals are limited to pure chemical substances and chemical substances present in a mixture at a concentration of 1,000 ppm or above. Mixtures include liquids, sprays, gases, aerosols, solids, etc. The concentration threshold applies to process mixtures directly as received by the supplier and prior to any dilution that may take place at the manufacturing site. This definition does not include maintenance agents for machinery, effluent or wastewater treatment chemicals, chemicals used in steam boilers, or cleaning agents used for the production area, offices, and/or lavatories. Distilled water, tap water, and ambient air in their unaltered state are excluded from the assessment.
PRODUCT	A product is a finished good as sold by one entity to another (can be business-to-business or business-to-consumer). It is composed of parts, assemblies, sub-assemblies, materials, and/or chemicals. In addition, a product is the result of design decisions of its producer. The design encompasses the functional use of the product, the post-use handling, the fate of supplied ingredients used to produce it, and decisions made (or not made) for a contribution to success (or failure) of the product to be beneficial under all these circumstances.
PROGRAM CATEGORY	The term "CATEGORIES" in this context will refer to the five program attributes in which products are rated: material health, material reutilization, renewable energy and carbon management, water stewardship, and social fairness.
RAPIDLY RENEWABLE RESOURCE	A material that is able to grow back in 10 years. See also RENEWABLE RESOURCE.
READILY DISASSEMBLED	Capable of being deconstructed with the use of common hand tools (i.e. wrench, screw driver, pliers, scissors, etc.).

TERM	DEFINITION
RECYCLABLE MATERIAL	A material that can technically be recycled at least once after its initial use phase. At a minimum, the material's physical and mechanical properties allow it to be re-melted or size-reduced and used as filler with similar or dissimilar materials (downcycled). It is preferable to select materials that may be recycled into like or higher-value products when possible. However, it is understood that this is difficult to define, as the collection infrastructure and recycling technologies are still in the early stages of development and the economic value of materials will change in the future. Unless there is an automated process for disassembling and reducing size of materials with adequate identification and sorting technologies to produce the highest quality recyclate possible, then attention must be paid to the design and construction of products so that dissimilar materials can be economically separated for recycling. Ideally, disassembly instructions are provided to the end user and/or recycling facilities, recyclable parts are marked, and disassembly is possible using commonly available tools. If the product is too complex for the consumer or third parties to disassemble and/or is designed as a Managed Nutrient, the consumer should be provided with instructions on where to send the product after use. The Cradle to Cradle definition of "recyclable" is different from the U.S. Federal Trade Commission (FTC) definition. While the intentions of the FTC to protect consumers from deceptive marketing claims is logical and laudable, it may also be unintentionally creating disincentives for manufacturers because it limits their ability to use the diversity of materials whose physical properties are very recyclable, but that are not actually recycled, due to the lack of economically profitable collection and recycling systems.
RECYCLED CONTENT	Proportion, by mass, of recycled material within a product that has been recovered or diverted from the solid waste stream, either during the manufacturing process (pre-consumer/post-industrial) or after consumer use (post-consumer).
RENEWABLE ENERGY CREDIT	Tradable certificates produced by an authorized body that verifies electricity was generated from an eligible renewable energy resource.
RENEWABLE RESOURCE	A material from an agricultural source. See also RAPIDLY RENEWABLE RESOURCE.
SECONDARY DATA	Generic or industry average data from published sources that are representative of a company's operations, activities, or products.
SOLAR INCOME	The ultimate goal of Cradle to Cradle® Design is to have all energy inputs come from "current solar income." Forms of current solar income include geothermal, wind, biomass, hydro (in certain circumstances – to be determined on a case-by-case basis) and photovoltaic.
SUB-ASSEMBLY	A unit assembled separately but designed to fit with other units in a manufactured product. It is composed of different materials and makes up an inseparable component of the product.
SUBSTANCE	AKA chemical substance.

TERM	DEFINITION
TECHNICAL METABOLISM	The cycle that technical nutrients flow in. Materials potentially hazardous to life and health may be used in a technical metabolism, if they are sequestered from uncontrolled contact with life. Note that biological nutrients may flow in technical cycles (e.g., paper and bio-based polymers).
TECHNICAL NUTRIENT	A product capable of "feeding" technical systems. Any material that cannot be processed by biological systems is assessed for its capacity to be processed as a resource in systems of human artifice ("Technical Organisms"). In homology to biological nutrients, technical nutrients are catabolized (deconstruction) and anabolized (construction) according to the following hierarchy: • (Dismantle and) Reuse • (Dismantle and) Physical transformation (e.g. plastic remolding) • (Dismantle and) Chemical transformation (e.g. plastic depolymerization, pyrolysis, gasification) The management of technical nutrients occurs by transferring ownership to the users of only the service, not the materials. It is the service offering side that manages materials as technical nutrients, once the phase of functional use is over.
TERATOGEN	A substance shown to cause damage to the embryo or fetus through exposure by the mother (MAK-list: Pregnancy risk group, category A).
TERATOGEN - SUSPECTED	Currently available information indicates that a risk of damage to the embryo or fetus can be considered probable when the mother is exposed to this substance (MAK-list: Pregnancy risk group, category B).
THIRD PARTY AUDIT	An assessment of an organization's conformance to a standard, regulation, or other set of criteria, by an outside auditor. The auditor is to be independent of the organization being audited.
TOXICOLOGICAL ENDPOINT	Also referred to as "endpoint" or "hazard endpoint."
UPCYCLING	Any measure and activity in the design phase targeting optimal handling of products as nutrients.
UTZ CERTIFIED	UTZ Certified is a label and program for sustainable farming of agricultural products launched in 2002, which claims to be the largest program for coffee in the world.
VERIFIED CARBON STANDARD	Provides a framework for developing a project for quantification, reduction, and removal of GHG emissions.

13 REFERENCES

1. The term "cradle to cradle" was used in the 1980s by Walter Stahel and Dr. Michael Braungart. The term was first used in a limited way to counter the prevailing "cradle to grave" paradigm in Germany related to manufacturing processes. Braungart and McDonough expanded this to a more holistic, design led framework.

2. Braungart's organization, Environmental Protection and Encouragement Agency (EPEA) Internationale Umweltforschung GmbH, was formed in 1987 and subsequently created the "Intelligent Products System," which described materials as nutrients flowing in either biological or technical cycles. (*An "Intelligent Product System" to replace "Waste Management".* In: Fresenius Envir Bulletin 1, 1992, p. 613-619. Braungart, M.; Engelfried, J.:) (http://epea.com)

3. "*The Hannover Principles – Design for Sustainability"* was first published in 1992 and republished as a 10th Anniversary edition in 2002 and a 20th Anniversary edition in 2012. (http://www.mcdonough.com/wp-content/uploads/2013/03/Hannover-Principles-1992.pdf)

4. Dr. Braungart and William McDonough co-founded McDonough Braungart Design Chemistry, LLC (MBDC) in the United States in 1995 to help companies learn and implement the Cradle to Cradle design framework. (http://MBDC.com)

5. In October 1998 the Atlantic magazine published an article entitled "*The NEXT Industrial Revolution"*. This article posited the idea that humans could incorporate positive intentions for equity, economy and ecology though product design. (http://www.theatlantic.com/magazine/archive/1998/10/the-next-industrial-revolution/4695/)

6. In 2001 the documentary film "*The Next Industrial Revolution"* was released by Earthome Productions. This chronicled several active Cradle to Cradle projects. (http://www.earthome.org/designfuture.html)

7. In 2002 the book "*Cradle to Cradle: Remaking The Way We Make Things"* was published in the United States of America by Farrar, Straus and Giroux.

8. In October 2005 MBDC launched the Cradle to Cradle Certified™ Program. By 2010, over 400 products from over 100 companies had achieved certification.

9. In August 2010 The Green Products Innovation Institute (the original name of the Cradle to Cradle Products Innovation Institute) was granted a free, exclusive worldwide license by MBDC to independently manage the product certification program Version 2.1.1.

14 DATA AND INFORMATION SOURCES

1. AFL-CIO report (based in part on data from the U.S. Bureau of labor statistics): http://www.aflcio.org/issues/safety/memorial/doj_2010.cfm
   Industries with Highest Total Injuries and Illness Rates, 2008
   Workplace Fatality Rates by Industry Sector 1970-2002.
2. American Conference of Governmental Industrial Hygienists. 2009 TLVs and BEIs, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH Worldwide 2009.
3. B Corporation http://www.bcorporation.net/.
4. BSCI Code of Conduct. 2009. Business Social Compliance Initiative. http://www.bsci-intl.org/resources/code-of-conduct (example code of conduct).
5. CAL PROP 65, California Proposition 65 list of Carcinogens and Reproductive Toxins. http://www.oehha.org/prop65/prop65_list/Newlist.html.
6. Carbon Disclosure Project – Water https://www.cdproject.net/en-US/Programmes/Pages/cdp-water-disclosure.aspx.
7. Carbon Disclosure Project. Guidance for Responding Companies. 2011. https://www.cdproject.net/Documents/Guidance/CDP2011ReportingGuidance.pdf.
8. Carbon Disclosure Project. Guidance for Responding Companies: Target and Initiatives. https://www.cdproject.net/Documents/Guidance/CDP2011ReportingGuidance.pdf.
9. CCRIS, Carcinogenicity and mutagenicity data. (Chemical Carcinogenesis Research Information System, National Cancer Institute) http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?CCRIS.
10. ChemID Plus, Detailed structure data by CAS number. (National Library of Medicine) http://chem.sis.nlm.nih.gov/chemidplus/setupenv.html.
11. Clean Development Mechanism. CDM Registry. http://cdm.unfccc.int/Registry/index.html.
12. Climate Action Reserve. Projects. Version 1.0.0. https://thereserve1.apx.com/myModule/rpt/myrpt.asp?r=111.
13. Cullen, Jonathan; Allwood, Julian; Borgstein, Edward. Reducing Energy Demand: What Are the Practical Limits? Environ. Sci. Technol., 2011, 45, 1711-1718.
14. DART/ETIC, Developmental and Reproductive Toxicity/Environmental Teratology Information Center- Literature (bibliographic & abstract information) on developmental and reproductive toxicology. (National Library of Medicine). http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?DARTETIC.htm.
15. Earthster. http://www.earthster.org/.
16. Eco-Tox, Environmental toxicity database. (Environmental Protection Agency) http://www.epa.gov/ecotox.

17. EFDB, Environmental Fate Data Base. http://esc.syrres.com/efdb.htm.

18. EMIC, Environmental Mutagen Information Center. (bibliography and abstracts) http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?EMIC.

19. European Commission Joint Research Center, Soil & Waste Unit, Institute for Environment and Sustainability. Beata Houskova & Luca Mntanarella. Parent Material as a Source of Natural Background Values in Soils. 2007. http://eusoils.jrc.ec.europa.eu/ESDB_Archive/eusoils_docs/Poster/ParentMaterial.pdf.

20. EU RAPEX: http://ec.europa.eu/consumers/safety/rapex/index_en.htm.

21. Fisher-Acros MSDS. http://www.fishersci.ca/homepage2.nsf/(waSearch)?openagent&lang=E&DB=msds.nsf.

22. Franz, R., Mauer, A and Welle, F. European Survey of Post-consumer Poly(ethylene terephthalate) (PET) Material to Determine Contamination Levels and Maximum Consumer Exposure From Food Packages Made from Recycled PET. Food Additives and Contaminants 21(3): 265-286. 2004.

23. GEMI Water Sustainability Tool http://www.gemi.org/water/ and Case Studies http://www.gemi.org/water/casestudies.htm.

24. GENE-TOX, Mutagenicity data. (Environmental Protection Agency) http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?GENETOX.

25. Global Reporting Initiative. Water key performance indicators. http://www.globalreporting.org/Home.

26. Global Sullivan Principles http://www.thesullivanfoundation.org/about/global_sullivan_principles.

27. Gold Standard. The Gold Standard Registry. 2011. http://goldstandard.apx.com/index.asp.

28. Hazardous Substances Data Bank (HSDB), A comprehensive source for toxicology data for relevance to Human Health. Peer- reviewed. (National Library of Medicine). http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.

29. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?EMIC.

30. IARC (International Agency for Research on Cancer). A list of chemicals that have been evaluated and classified by IARC as to carcinogenic risk to humans. http://193.51.164.11/monoeval/grlist.html.

31. Intergovernmental Panel on Climate Change (IPCC). 2006. Guidelines for National Greenhouse Gas Inventories. http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

32. International Energy Administration. (a) 2010. International Energy Outlook. http://www.iea.org/ and (b) 2004. Energy Statistics Manual.

33. International Labor Organization. Child labor country reports: http://www.ilo.org/ipec/ChildlabourstatisticsSIMPOC/Questionnairessurveysandreports/lang--en/index.htm.

34. International Trade Union group, country profiles: http://www.tradeunionsdunit.org/profiles/profiles.php?ID=0&Lang=ENG.

35. IUCLID, International Chemical Information Database (IUCLID). 2000. (European Commission, European Chemicals Bureau) http://ecb.ei.jrc.it.

36. List of Ozone Depleting Substances. (Environmental Protection Agency) http://www.epa.gov/ozone/ods.html.

37. LogKOW Estimation, Environmental toxicity database. (Environmental Protection Agency) http://esc.syrres.com/interkow/kowdemo.htm.

38. MAK List of Carcinogenic, Teratogenic, or Sensitizing Substances, Deutsche Forschungsgemeinschaft. 2010. List of MAK and BAT Values 2010: Maximum Concentrations and Biological Tolerance Values at the Workplace. Commission for the Investigation of Health Hazards if chemical Compounds in the Work Area. Report No. 36. Weinheim: Wiley-VCH.

39. Mathews, Emily. The Weight of Nations: Material Outflows From Industrial Economies. World Resources Institute.

40. National Library of Medicine. Hazardous Substances Data Bank. 2010. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.

41. National Renewable Energy Lab. 2002. International Performance Measurement and Verification Protocol. http://www.nrel.gov/docs/fy02osti/31505.pdf.

42. Nuclear Power Plant Information, International Atomic Energy Agency, URL accessed 12 June 2006.

43. Pacific Institute. At the Crest of a Wave: A Proactive Approach to Corporate Water Strategy. 2007. http://www.pacinst.org/topics/water_business/index.html.

44. PAS 2050.

45. Ramsar Listed wetlands http://www.ramsar.org/cda/en/ramsar-about-sites/main/ramsar/1-36-55_4000_0__; map: http://www.wetlands.org/reports/rammap/mapper.cfm.

46. RTECS, Registry of Toxic Effects of Chemical Substances. (subscription required) http://ccinfoweb.ccohs.ca/rtecs/search.html.

47. Sigma-Aldrich MSDS. http://www.sigma-aldrich.com/msds.

48. Social Accountability International. SA 8000. http://www.sa-intl.org/.

49. Social Audit Guidelines. 2009. Business Social Compliance Initiative.

50. Social Hotspots Database. http://www.socialhotspot.org/.

51. Supply Chain Sustainability: A Practical Guide for Continuous Improvement. 2010. United National Global Compact Office and Business for Social Responsibility.

52. Sweatfree.org. 2007-8. Non-poverty Wages. http://www.sweatfree.org/nonpovertywages.

53. The Greenhouse Gas Protocol. A Corporate Accounting and Reporting Standard (including associated tools and conversion factors). http://www.ghgprotocol.org/standards/corporate-standard.

54. The Greenhouse Gas Protocol. Product Accounting and Reporting Standard (currently in draft version). http://www.ghgprotocol.org/standards/product-and-supply-chain-standard.

55. The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard – Setting a GHG Target http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf.

56. The World Bank. Poverty data: http://data.worldbank.org/topic/poverty.

57. Theo Colborn's List of Endocrine Disruptors. http://www.ourstolenfuture.org/Basics/chemlist.htm

58. U.S. Energy Information Administration. Voluntary Reporting of Greenhouse Gasses Program. http://www.eia.doe.gov/oiaf/1605/coefficients.html.

59. U.S. Environmental Protection Agency list of impaired waterways http://iaspub.epa.gov/waters10/attains_nation_cy.control?p_report_type=T.

60. U.S. Environmental Protection Agency. eGRID. http://cfpub.epa.gov/egridweb/ (emissions factors for purchased electricity in the U.S.).

61. U.S. Environmental Protection Agency. Power Profiler: http://www.epa.gov/cleanenergy/energy-and-you/how-clean.html.

62. U.S. Environmental Protection Agency. Surf your Watershed. http://cfpub.epa.gov/surf/locate/index.cfm.

63. UN Aquastat http://www.fao.org/nr/water/aquastat/dbase/index.stm.

64. UNICEF ChildInfo.org: http://www.childinfo.org/labour_countrydata.php.

65. United National Global Compact Self Assessment Tool (examples of auditing questions).

66. United National Global Compact Self Assessment Tool: http://www.globalcompactselfassessment.org/.

67. United Nations Global Compact http://www.unglobalcompact.org/AboutTheGC/TheTenPrinciples/index.html.

68. United Nations Human Development Reports. map data: http://hdr.undp.org/en/ country profiles: http://hdr.undp.org/en/data/profiles/.

69. U.S. Bureau of Labor Statistics, Census of Fatal Occupational Injuries http://www.bls.gov/iif/oshcfoi1.htm.

70. U.S. Consumer Product Safety Commission http://www.cpsc.gov/cpscpub/prerel/prerel.html.

71. U.S. Department of Labor, 2010. List of Goods Produced by Child Labor or Forced Labor. View the 2010 report (PDF). Available in map form here: http://productsofslavery.org/.

72. U.S. Department of State. Human Rights Reports. http://www.state.gov/g/drl/rls/hrrpt/.

73. U.S. Geological Survey. Hansford T. Shacklette and Josephine G. Boerngen. Professional Paper 1270. Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States. 1984. http://pubs.usgs.gov/pp/1270/pdf/PP1270_508.pdf.

74. Verified Carbon Standard. The VCS Project Database. 2011. http://www.vcsprojectdatabase.org/.

75. Vinggaard, Anne Marie, Körner, Wolfgang, Lund, Kirsten H., Bolz, Ulrike, and Petersen, Jens Højslev. Identification and Quantification of Estrogenic Compounds in Recycled and Virgin Paper for Household Use As Determined by an in Vitro Yeast Estrogen Screen and Chemical Analysis. Chemical Research in Toxicology 13: 1214-1222. 2000.

76. WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation http://www.wssinfo.org/data-estimates/introduction/; http://www.wssinfo.org/documents-links/documents/?tx_displaycontroller[type]=country_files.

77. World Business Council for Sustainable Development. Global Water Tool. http://www.wbcsd.org/templates/TemplateWBCSD5/layout.asp?type=p&MenuId=MTc1Mg&doOpen=1&ClickMenu=LeftMenu.

78. World Nuclear Power Reactors & Uranium Requirements". World Nuclear Association. 2010-10-01. http://www.world-nuclear.org/info/reactors.html. Retrieved 2010-10-23..

79. World Resources institute (2008).GHG Protocol tool for stationary combustion. Version 4.0.

80. World Resources Institute. interactive global map of eutrophication and hypoxia http://www.wri.org/project/eutrophication/map.

81. Worldwide Responsible Apparel Production http://www.wrapcompliance.org/.

15 APPENDIX: BANNED LISTS OF CHEMICALS

The following lists contain the chemicals and substances that are banned for use in Cradle to Cradle Certified™ products as intentional inputs above the applicable threshold in any homogeneous material subject to review in the product (1000ppm in most cases, see below and Section 3.3). These substances were selected for inclusion on the Banned Lists due to their tendency to accumulate in the biosphere and lead to irreversible negative human health effects. In addition, several substances were selected due to hazardous characteristics associated with their manufacture, use, and disposal.

See Section 3.3 for complete details regarding the banned list chemical requirement. The applicable threshold is 1000ppm, with exceptions for metals in biological nutrients. Lead, PTFE, and PAHs are not banned in technological nutrients, except for as noted in Section 3.3.

There are two Banned Lists provided: a banned list of chemicals for technical nutrients (Table A-1) and a banned list of chemicals for biological nutrients (Table A-2). A key component of Cradle to Cradle® design is the recognition of and design for the two nested cycles – biological and technical. Banned Lists were thus created separately for biological and technological nutrients to allow for the use of some substances like lead or cadmium in materials where exposure to humans or the environment is unlikely to occur. Lead, for example, is often used in cast aluminum, from which it does not migrate out of the material and can therefore be managed in safe technical cycles. However, lead should not be used in biological nutrients, which ultimately cycle into the biosphere. On the other hand, mercury is not suitable for either type of nutrient cycles due to its ability to easily migrate out of materials. The overall intention is to inspire and promote innovation in quality products in a way that supports 10 billion people on earth without increasing the natural background level of materials or harming people or the environment.

The intention for the "Banned Lists" is not to simply provide a checklist to eliminate chemicals of concern. Rather, it should be viewed as specific examples that may also be used to guide substitution. There may be chemicals similar in structure that are not on the list but exhibit similar properties to the listed chemical. Thoughtful substitutions using the intentional design approach of Cradle to Cradle would suggest that chemicals with similar properties would not be a good substitution choice.

Table A-1 Banned List of Chemicals for Technical Nutrients

SUBSTANCE	CAS #	COMMENTS
Metals		
Arsenic	7440-38-2	
Cadmium	7440-43-9	Banned only for products with no guaranteed nutrient management.
Chromium VI	18540-29-9	
Mercury	7439-97-6	
Flame Retardants		
Hexabromocyclododecane	3194-55-6; 25637-99-4	
Penta-BDE	32534-81-9	
Octa-BDE	32536-52-0	
Deca-BDE	1163-19-5	
Polybrominated Diphenyl Ethers (PBDEs)	Several	
Tetrabromobisphenol A	79-94-7	
Tris(1,3-dichloro-2-propyl)phosphate	13674-87-8	
Phthalates		
Bis(2-ethylhexyl)phthalate	117-81-7	
Butyl benzyl phthalate	85-68-7	
Dibutyl phthalate	84-74-2	
Halogenated Polymers		
Polyvinyl chloride (PVC)	9002-86-2	
Polyvinylidenechloride (PVDC)	9002-85-1	
Chlorinated polyvinyl chloride (CPVC)	68648-82-8	
Polychloroprene	9010-98-4	
Chlorinated Hydrocarbons		
1,2-Dichlorobenzene	95-50-1	
1,3-Dichlorobenzene	541-73-1	
1,4-Dichlorobenzene	106-46-7	
1,2,4-Trichlorobenzene	120-82-1	
1,2,4,5-Tetrachlorobenzene	95-94-3	
Pentachlorobenzene	608-93-5	
Hexachlorobenzene	118-74-1	
PCB and Ugilec	Several	
Short-chain chlorinated paraffins	Several	
Others		
Pentachlorophenol	87-86-5	
Nonylphenol	104-40-5, 84852-15-3	
Octylphenol	27193-28-8	
Nonylphenol ethoxylates	Several	
Octylphenol ethoxylates	Several	
Tributyltin	688-73-3	
Trioctyltin	869-59-0	

SUBSTANCE	CAS #	COMMENTS
Triphenyltin	892-20-6	
Perfluorooctane sulfonic acid	1763-23-1	
Perfluorooctanoic acid	335-67-1	

Table A-2 Banned List of Chemicals for Biological Nutrients

SUBSTANCE	CAS #	COMMENTS
Metals		
Arsenic	7440-38-2	Restricted to 10 ppm
Chromium	18540-29-9	Restricted to 100 ppm
Mercury	7439-97-6	Restricted to 1 ppm
Cadmium	7440-43-9	Restricted to 2 ppm
Lead*	7439-92-1	Restricted to 90 ppm
Flame Retardants		
Hexabromocyclododecane	3194-55-6; 25637-99-4	
Penta-BDE	32534-81-9	
Octa-BDE	32536-52-0	
Deca-BDE	1163-19-5	
Polybrominated Diphenyl Ethers (PBDEs)	Several	
Tetrabromobisphenol A	79-94-7	
Tris(1,3-dichloro-2-propyl)phosphate	13674-87-8	
Phthalates		
Bis(2-ethylhexyl)phthalate	117-81-7	
Butyl benzyl phthalate	85-68-7	
Dibutyl phthalate	84-74-2	
Halogenated Polymers		
Polyvinyl chloride (PVC)	9002-86-2	
Polyvinylidenechloride (PVDC)	9002-85-1	
Chlorinated polyvinyl chloride (CPVC)	68648-82-8	
Polychloroprene	9010-98-4	
Polytetrafluoroethylene (PTFE)*	9002-84-0	
Chlorinated Hydrocarbons		
1,2-Dichlorobenzene	95-50-1	
1,3-Dichlorobenzene	541-73-1	
1,4-Dichlorobenzene	106-46-7	
1,2,4-Trichlorobenzene	120-82-1	
1,2,4,5-Tetrachlorobenzene	95-94-3	
Pentachlorobenzene	608-93-5	
Hexachlorobenzene	118-74-1	
PCB and Ugilec	Several	
Short-chain chlorinated paraffins	Several	
Other		
Pentachlorophenol	87-86-5	

SUBSTANCE	CAS #	COMMENTS
Nonylphenol	104-40-5, 84852-15-3	
Octylphenol	27193-28-8	
Nonylphenol ethoxylates	Several	
Octylphenol ethoxylates	Several	
Tributyltin	688-73-3	
Trioctyltin	869-59-0	
Triphenyltin	892-20-6	
Perfluorooctane sulfonic acid	1763-23-1	
Perfluorooctanoic acid	335-67-1	
Polycyclic Aromatic Hydrocarbons*		
PAH group (as defined in TRI)	Not applicable	
Benzo(a)pyrene	50-32-8	
5-Methylchrysene	3697-24-3	
Acenaphthene	83-32-9	
Anthracene	120-12-7	
Benz(a)anthracene	56-55-3	
Benz(j)aceanthrylene	202-33-5	
Benzo(b)fluoranthene	205-99-2	
Benzo(c)phenanthrene	195-19-7	
Benzo(g,h,l)perylene	191-24-2	
Benzo(j)fluoranthene	205-82-3	
Benzo(k)fluoranthrene	207-08-9	
Chrysene	218-01-9	
Cyclopenta(c,d)pyrene	27208-37-3	
Dibenzo(a,h)anthracene	53-70-3	
Dibenzo(a,h)pyrene	189-64-0	
Dibenzo(a,i)pyrene	189-55-9	
Dibenzo(a,l)pyrene	191-30-0	
Fluoranthene	206-44-0	
Fluorene	86-73-7	
Indeno(1,2,3,c,d)pyrene	193-39-5	
Naphthalene	91-20-3	
Phenanthrene	85-01-8	
Pyrene	129-00-0	

** Note these chemicals are on the Banned List for Biological Nutrients only*

REFERENCE DOCUMENTS
NEW FOR V4.0

Cradle to Cradle Certified Restricted Substances List (RSL)*

Cradle to Cradle Certified Volatile Organic Compound (VOC) Emissions

Cradle to Cradle Certified Volatile Organic Compound (VOC) Content

Cradle to Cradle Certified Required Percentages of Cycled and Renewable Content by Product and Material Type*

Cradle to Cradle Certified Circularity Data Report & Cycling Instructions*

Cradle to Cradle Certified Water & Soil Stewardship Key Materials

*CLICK TO DOWNLOAD EXCEL FILE

cradle to cradle products innovation institute

CRADLE TO CRADLE CERTIFIED® VERSION4.0

VOLATILE ORGANIC COMPOUND (VOC) EMISSIONS TESTING

Demonstrating Low VOC Emissions

For the Silver level in Material Health, one of the following or an equivalent must be used to demonstrate low VOC emissions:

1. Schemes that are recognized as meeting the "general level criteria" in Table 2 of the latest version of the BREEAM Guidance Note GN22 for the VOC Emissions from Building Products credit. Formaldehyde emissions must be ≤10 µg/m³ at 28 days or sooner following storage in a ventilated test chamber. [Reference: GN22: BREEAM Recognized Schemes for Emissions from Building Products, Table 2, version 2.1 of October 2016]
2. The "general level" emission limits and testing requirements in the BREEAM International New Construction 2016 Technical Standard. Formaldehyde emissions must be ≤10 µg/m³ at 28 days or sooner following storage in a ventilated test chamber. [Reference: BREEAM International New Construction 2016 Technical Standard, Hea 02 Indoor Air Quality, Table 17: "Emission criteria by product type".]
3. Certifications and labels recognized for LEED v4 or later EQ Credit Low-Emitting Materials. [Reference: LEED v4 EQ Credit Low-Emitting Materials Third Party Certifications and Labels - June 2017 or later version] Any mentioned additional requirements, supplemental to the respective program, must also be fulfilled.
4. Per LEED v4 or LEED v4.1 General emissions evaluation, option 1 - compliance with CDPH Standard Method v1.1 or later, including a statement of the exposure scenarios and disclosure of the TVOC range.
5. Per LEED v4 or LEED v4.1 General emissions evaluation, option 2 - compliance with AgBB (2015 or later), including formaldehyde emissions ≤10 µg/m³. The TVOC range must be disclosed if complying with LEED v4.1.
6. Schemes and labels listed in DGNB System 2018, ENV 1.2 Local and Environmental Impact, Appendix 1 Criteria Matrix as follows (Note: This also fulfills the Gold level requirement below):
    a. For textile floor coverings (line 6), compliance with any quality level and demonstration that formaldehyde is ≤10 µg/m³ at 28 days or sooner following storage in a ventilated test chamber.
    b. For primers, precoats, fillers, and adhesives under wall and floor coverings (line 8), compliance with quality levels 2, 3, or 4.
    c. For barrier coatings, resin screeds, and seals under tiles (line 9), compliance with quality levels 3 or 4.
    d. For polyurethane and silane modified polymers used as sealing compounds (line 11), compliance with quality levels 3 or 4.
7. For resilient/elastic floor coverings: Compliance with RAL UZ 120 and formaldehyde ≤10 µg/m³ at 28 days or sooner following storage in a ventilated test chamber (Note: This also fulfills the Gold level requirement below).
8. For composite wood (not in finished products such as furniture or flooring): Compliance with CARB ULEF or NAF requirements, or 100% of the European E1 formaldehyde class as tested per EN 717 or EN 16516.
9. For furniture: Compliance with ANSI/BIFMA e3-2014 or later version Furniture Sustainability Standard, Section 7.6.2 or 7.6.3 (Note: This also fulfills the Gold level requirement below).

Demonstrating Very Low to No VOC Emissions

For the Gold and Platinum levels in Material Health, one of the following or an equivalent must be used to demonstrate very low to no VOC emissions:

1. Schemes that are recognized as meeting the "exemplary level criteria" in Table 2 of the latest version of the BREEAM Guidance Note GN22 for VOC Emissions from Building Products credit. [Reference: GN22: BREEAM Recognized Schemes for Emissions from Building Products, Table 2, version 2.1 of October 2016]
2. The "exemplary level" emission limits and testing requirements in the BREEAM International New Construction 2016 or later Technical Standard. [Reference: BREEAM International New Construction 2016 or later Technical Standard, Hea 02 Indoor Air Quality, Table 18: "Exemplary level emission criteria by product type"]
3. Per LEED v4 or LEED v4.1 General emissions evaluation, option 1 - compliance with CDPH Standard Method v1.1 or later and TVOC emissions no higher than 0.5 mg/m³ (500 µg/m³) after no more than 14 days of storage in a ventilated test chamber, or no more than 10 days conditioning and 4 days of storage in a ventilated test chamber.
4. Per LEED v4 or LEED v4.1 General emissions evaluation, option 2 - compliance with AgBB (2015 or later), including formaldehyde emissions ≤10 µg/m³ and TVOC emissions ≤ 0.3 mg/m3 (300 µg/m3) after no more than 28 days of storage in a ventilated test chamber.
5. Schemes and labels listed in DGNB System 2018, ENV 1.2 Local and Environmental Impact, Appendix 1 Criteria Matrix as follows:
    a. For textile floor coverings (line 6), compliance with any quality level and demonstration that formaldehyde is ≤10 µg/m³ at 28 days or sooner following storage in a ventilated test chamber.
    b. For primers, precoats, fillers, and adhesives under wall and floor coverings (line 8), compliance with quality levels 2, 3, or 4.
    c. For barrier coatings, resin screeds, and seals under tiles (line 9), compliance with quality levels 3 or 4.
    d. For polyurethane and silane modified polymers used as sealing compounds (line 11), compliance with quality levels 3 or 4.
6. For resilient floor coverings: Compliance with RAL UZ 120 and formaldehyde ≤10 µg/m³ at 28 days or sooner following storage in a ventilated test chamber.
7. For composite wood (not in finished products such as furniture or flooring): Compliance with CARB ULEF or NAF requirements, or 50% of the European E1 formaldehyde class as tested per EN 717 or EN 16516.

For furniture: Compliance with ANSI/BIFMA e3-2014 or later version Furniture Sustainability Standard, Sections 7.6.2 or 7.6.3.

cradle to cradle products innovation institute

CRADLE TO CRADLE CERTIFIED® VERSION4.0

VOLATILE ORGANIC COMPOUND (VOC) CONTENT LIMITS

Demonstrating Low VOC Content

The VOC content related provisions (including both limits and testing requirements) of one of the following standards or an equivalent must be used to demonstrate low VOC content, as applicable, to meet the Silver level requirement in Material Health:

1. For architectural coatings/wet-applied products:
    a. South Coast Air Quality Management District (SCAQMD) Rule 1113 (03 June 2011).
    b. South Coast Air Quality Management District (SCAQMD) Rule 1168 (06 October 2017).
    c. European Decopaint Directive (2004/42/EC)
    d. Free of solvents, as defined in TRGS 610 (January 2011)
2. Programs that are listed as acceptable for the VOC Content evaluation requirements, see the list "LEED v4 EQ Credit Low-Emitting Materials Third Party Certifications and Labels" - June 2017 or later version
3. BREEAM International New Construction 2016 Technical Standard, section "Hea 02 Indoor Air Quality," Table 19 "Maximum TVOC content for paints and coatings"
4. GEV classification criteria for Installation Products, Adhesives and Building Materials to award the EMICODE, sections 2.2 and 2.3
5. CARB Regulation for Reducing Volatile Organic Compound Emissions from Antiperspirants and Deodorants (Antiperspirants and Deodorants Regulation, 2015)
6. CARB Regulation for Reducing Emissions from Consumer Products (Consumer Products Regulation, 2015). For the purpose of Cradle to Cradle Certified, ethanol and isopropanol do not count towards the limits on VOC content set out in this standard.
7. CARB Regulation for Reducing the Ozone Formed from Aerosol Coating Product Emissions (Aerosol Coating Products Regulation, 2015)
8. CARB Alternative Control Plan Regulation for Consumer Products and Aerosol Coating Products (Alternative Control Plan Regulation, 2015)
9. DGNB System 2018 (or later) ENV 1.2 Local and Environmental Impact, Appendix 1 Criteria Matrix at the following quality levels:
    a. Decorative paints, primers, etc., for floors (line 2): level 1, 2, 3, or 4.
    b. Dust binding coatings, etc. (line 3): level 1, 2, 3, or 4.
    c. Wallpaper paste (line 4): level 1, 2, 3, or 4.
    d. Coatings for exterior surfaces (line 5): level 1, 2, 3, or 4.
    e. Installation materials (line 8): level 1, 2, 3, or 4.
    f. Barrier coatings, seals, and screeds (line 9): level 1, 2, 3, or 4.
    g. Stone flooring impregnations (line 10): level 4.
    h. Polyurethane adhesives and silane modified polymers (line 11): level 1, 2, 3, or 4.
    i. Facade adhesives (line 13): level 3 or 4.
    j. Fire safety coatings for metal (line 15): level 2, 3, or 4.
    k. Corrosion protection coatings of load-bearing metal components category C2 (line 16): level 2, 3, or 4.
    l. Corrosion protection coatings of load-bearing metal components category C3 (line 17): level 1, 2, 3, or 4.
    m. Corrosion protection coatings of load-bearing metal components category higher than C3 (line

18): level 2, 3, or 4.

n. Corrosion protection coatings of non-load-bearing metal components (line 19): level 2, 3, or 4.
o. Polyurethane coatings (line 20): level 1, 2, 3, or 4.
p. Wood coatings (line 21): level 3 or 4.
q. Epoxy coatings (line 23): level 1, 2, 3, or 4.
r. EP/PU primers (line 24): level 1, 2, 3, or 4.
s. Wood oils and waxes (line 27): level 2, 3, or 4.
t. PU system adhesives (line 46): level 2, 3, or 4.

One of the following test methods must be used to quantify VOC content:

1. ASTM D2369
2. ASTM D6886
3. SCAQMD method 304
4. SCAQMD method 313
5. CARB method 310
6. EPA method 24
7. ISO 11890-1
8. ISO 11890-2
9. Any testing method proven to be equivalent to any of the above

cradle to cradle products innovation institute

CRADLE TO CRADLE CERTIFIED® VERSION4.0

WATER & SOIL STEWARDSHIP KEY MATERIALS

Key Materials: Materials Typically Associated with Pollutant Intense and/or High-Volume Water Use Processes

A key material is defined as a material that is typically produced using a high-volume water use process or a pollutant intense process. The production of a key material may also typically include one or more processes that negatively impact aquatic and soil environments (e.g., deforestation, soil erosion, runoff into surface waters). The table below contains the list of key materials and processes that, if applicable to the product seeking certification, must be addressed to meet the Bronze, Silver, and Gold level requirements where key materials are referenced in the Water & Soil Stewardship category.

A high-volume water use process is a process that typically requires a high volume of water. Facilities (including supplier facilities where key materials are manufactured) that use (i.e., withdraw and/or purchase) ≥ 100,000 cubic meters (m^3) of fresh water per year are considered high-volume water users. Any supplier of a key material carrying out a process marked as "high volume" below is considered to use a high volume of water unless water use data are provided that demonstrate otherwise.

A pollutant intense process is a process with high potential to negatively affect conventional water quality parameters such as biological oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solids (TSS), and/or result in the release of hazardous chemicals with effluent or runoff. A pollutant intense process is defined broadly to include soil erosion and loss, which, in addition to resulting in reduced topsoil quality and availability on land, also contributes to poor surface water quality.

Key Material	Manufacturing, Extractive, and Environmental Process(es)	High-volume Water Use	Pollutant Intense	
			Chemicals and Effluent Quality Impacts	Soil Erosion Impacts
Cement	Slurry preparation, use of wet kiln instead of dry kiln process	✓	-	-
Ceramic tile	Wet process: milling	✓	-	-
Chemicals (i.e., the transformation of organic and inorganic raw materials by a chemical process to form products) Includes plastics (primary production only)	Process cooling and heating (high volume); Cleaning/rinsing, process water and sludge disposal (pollutant intense)	✓	✓	-

Crops: cotton, maize/corn, soy, sugarcane	Irrigation Use of pesticides (insecticides, herbicides, fungicides, etc.) and fertilizers, associated chemical runoff to surface water. Deforestation and other unmanaged/ poorly managed land conversion to agriculture, excessive tilling and associated soil erosion and siltation of surface water.	✓	✓	✓
Other crops	Use of pesticides (insecticides, herbicides, fungicides, etc.) and fertilizers, associated chemical runoff to surface water. Deforestation and other unmanaged/ poorly managed land conversion to agriculture, excessive tilling and associated soil erosion and siltation of surface water.	-	✓	✓
Glass	Float process - cooling, washing recycled material	✓	-	-
Leather	All wet leather processing steps including curing, prepping, tanning, and dyeing; waste handling.	✓	✓	-
Material sourced from grazing species/ungulates (leather, wool, etc.)	Deforestation and poor management resulting in soil erosion and runoff	-	-	✓
Metals (ferrous and non-ferrous)	Primary metal production processes: cleaning, cooling, etc.	✓	✓	-
Mined metal ores (includes iron, aluminum, nickel, copper, zinc, and other ores[1])	Hydraulic mining. Mine dewatering, acid and metalliferous drainage and tailings production, soil erosion and runoff (from surface mining), material separation and transport, etc. Extraction of valuable metals (silver and gold) using mercury and cyanide	✓	✓	✓

1 Refer to the following reference for a full list of metal ores included in this key material category: U.S. EPA, "Mineral Mining and Processing Effluent Guidelines," United States Environmental Protection Agency. Available: https://www.epa.gov/eg/ore-mining-and-dressing-effluent-guidelines. [Accessed 01 February 2021].

Mined minerals (includes stone, sand, gravel, gypsum, clay, and other minerals[2])	High volume: Mine dewatering (if necessary) - potential to lower the water table. Pollutant intense: soil erosion and runoff	✓	-	✓
Metal finishes (includes chrome, galvanization, etc.)	Finishing/plating, rinsing/cleaning, rectifier cooling	✓	✓	-
Oil and gas	Hydraulic fracturing/fracking, water injection/waterflooding.	✓	✓	-
Plastics (recycled)	Washing post-consumer plastic for recycling	✓	-	-
Pulp and paper (includes all cellulosic pulp, e.g., pulp used to make textile fibers)	Debarking, pulping, pulp washing, pulp bleaching. Papermaking: Pulp dilution and dewatering	✓	✓	-
Semiconductors	Cleaning/rinsing with ultrapure water (UPW) and ultrapure water production, cooling	✓	✓	-
Textiles (includes fiber and yarn stages)	Wet processing, including scouring, bleaching and other wet pre-treatment steps, sizing and desizing woven textile materials, dyeing, finishing including denim finishing, washing, coatings	✓	✓	-
Wood/timber	Debarking (high volume), sawmill timber processing (pollutant intense)	✓	✓	-
Wood/timber	Deforestation, forest management (poor management resulting in soil erosion and runoff, use of pesticides and fertilizers)	-	✓	✓

2 Refer to the following reference for a full list of minerals included in this key material category: U.S. EPA, "Mineral Mining and Processing Effluent Guidelines," United States Environmental Protection Agency, [Online]. Available: https://www.epa.gov/eg/mineral-mining-and-processing-effluent-guidelines#facilities. [Accessed 01 February 2021].

GUIDANCE DOCUMENTS

Cradle to Cradle Certified® Product Standard V4 User Guidance

Cradle to Cradle Certified® Product Standard V3.1 Guidance

cradle to cradle products innovation institute

CRADLE TO CRADLE CERTIFIED® VERSION 4.0

Product Standard

User Guidance

COPYRIGHT

TRADEMARK

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

Table of Contents

Table of Contents

Table of Contents

Foreword

The Cradle to Cradle Products Innovation Institute (C2CPII) is an independent, nonprofit organization dedicated to maximizing the positive impacts of products and materials. As the standard setting and certification body for the Cradle to Cradle Certified® Product Standard, C2CPII works closely with leading organizations worldwide to guide and validate their efforts to apply the principles of material health, product circularity, clean air and climate protection, water and soil stewardship, and social fairness to product design and manufacturing. The standard provides designers, manufacturers, and suppliers with a framework for continually improving what products are made of and how they are made. Cradle to Cradle Certified is a respected mark of products and materials made for the circular economy.

Version 4.0 was released on 16 March 2021.

The effective date of Version 4.0 is 1 July 2021. Products certified to Version 3.1 are required to certify to Version 4.0 by 30 June 2024.

Further information about C2CPII and the Cradle to Cradle Certified Product Standard is available at www.c2ccertified.org.

Inquiries regarding C2CPII and the Cradle to Cradle Certified Product Standard may be directed to info@c2ccertified.org.

1 // Introduction

1.1 User Guidance Overview

This document is designed to provide the information needed to implement Version 4.0 of the Cradle to Cradle Certified Product Standard.

The guidance in this document includes the following:

- **Version 4.0 Standard Requirements** (grey font): The requirements are listed in the same order as they appear in the Version 4.0 standard, with the same section numbers.
- **Further Explanation** (blue boxes): These sections provide guidance regarding how to meet each requirement, including links to resources, lists of C2CPII-recognized standards and certification programs, applicable test methods, and background information.
- **Required Documentation** (green boxes): These sections list the information and documents that must be submitted with a certification application and at recertification to demonstrate compliance with the standard requirements.

Ongoing improvements to the Cradle to Cradle Certified Product Standard are developed by C2CPII staff, volunteer committees, and external subject matter experts under the direction of the C2CPII Standards Steering Committee, as detailed in the Process for Development of the Cradle to Cradle Certified Product Standard. This guidance document will be regularly updated to reflect improvements made to the standard, add interpretations and C2CPII recognized standards/programs where applicable, and provide additional clarifying information.

1.2 Cradle to Cradle Certified Product Standard Version 4.0

The vision of C2CPII is a world where safe materials and products are designed and manufactured in a prosperous, circular economy to maximize health and well-being for people and planet. C2CPII's mission is to lead, inspire, and enable all stakeholders across the global economy to create and use innovative products and materials that positively impact people and planet.

1.2.1 Standard Requirement Categories

The standard requirements are based on the Cradle to Cradle® design principles outlined in William McDonough and Michael Braungart's 2002 book, Cradle to Cradle: Remaking the Way We Make Things, and provide guidance in five key categories. These requirement categories and their intended outcomes are listed below.

Material Health – Chemicals and materials used in the product are selected to prioritize the protection of human health and the environment, generating a positive impact on the quality of materials available for future use and cycling.

Product Circularity – Products are intentionally designed for their next use and are actively cycled in their intended cycling pathway(s).

Clean Air & Climate Protection – Product manufacturing results in a positive impact on air quality, the renewable energy supply, and the balance of climate changing greenhouse gases.

Water & Soil Stewardship – Water and soil are treated as precious and shared resources. Watersheds and soil

ecosystems are protected, and clean water and healthy soils are available to people and all other organisms.

Social Fairness – Companies are committed to upholding human rights and applying fair and equitable business practices.

1.2.2 Certification Requirements and Levels

The Cradle to Cradle Certified Products Program is based on the concept of continuous improvement and, thus, there are four possible levels of achievement within each of the standard's five key requirement categories: Bronze, Silver, Gold, and Platinum. To reach a desired achievement level within each category, the product must meet all of the requirements for that level, in addition to the requirements at all lower levels.

Certification is awarded to a product when it meets the requirements for the desired achievement level in each of the five key categories (Sections 4-8), as well as the general requirements (Section 3), the packaging requirements (Section 9, if applicable), and the animal welfare requirements (Section 10, if applicable). The product's overall certification level is equal to the lowest level achieved in the five categories (Bronze, Silver, Gold, or Platinum).

The product's certification level is stated on the Cradle to Cradle certificate, and the certification level, along with a scorecard indicating the level achieved in each of the five categories, is stated in the Cradle to Cradle Certified Products Registry on the C2CPII website (www.c2ccertified.org).

Note: Some requirements in the standard address activities that are also subject to regulation by local, state, or federal authorities. However, nothing contained in the Cradle to Cradle Certified Product Standard changes legal regulatory requirements or prescribes how compliance is to be achieved. Demonstration of compliance with certain key regulations is required in some sections of the standard, but this in no way changes the underlying regulatory requirements.

1.2.3 Restrictions to Bronze Level Certification

At the Bronze level, a product is starting out on the path to Cradle to Cradle certification. A company must conduct an inventory of the materials used to make the product, energy use, water and soil stewardship, and social fairness issues affecting their industry and production region. The company must also define optimization strategies and take initial steps toward the development of circular products and responsible manufacturing practices. The Bronze level of certification is designed to recognize a company's intent to improve the way their product is made, establishing a commitment to ongoing assessment and optimization.

As such, a product may be certified at the Bronze level for a maximum of four years (i.e., two, two-year certification cycles), and must recertify at the Silver level or higher once the second, two-year Bronze certification has expired or it will be delisted from the program. Alternatively, in cases where technical, performance, or market barriers prevent the achievement of the Silver level in any standard category, the product may be recertified at the Bronze level if:

1. The applicant publicly discloses an explanation of the limitation(s) preventing achievement of the Silver level requirements,
2. On-going measurable improvement is achieved (see Section 3.3), and
3. The product meets the Silver achievement level in at least one other category by the end of the fourth year of Bronze level certification (i.e., the expiration date of the second two-year certification).

1.3 Certification Process

Key steps in the process for achieving Cradle to Cradle certification, certification fees, and resources for implementation including the standard and supporting reference documents, assessment methodologies, program policies, and other guidance documents are available on the C2CPII website (www.c2ccertified.org). For all levels of certification, a final manufacturing facility site visit must be conducted as part of the certification process to verify that the standard requirements have been met. The manufacturing facility site visit requirements are provided in Appendix 1.

2 // Product Eligibility

2.1 Products Eligible for Certification

The Cradle to Cradle Certified® Products Program applies to products. For certification purposes, a "product" is defined as any physical item that can be routinely and individually purchased from the certification applicant by other entities. This definition includes materials, sub-assemblies, and finished products.

Please see the Cradle to Cradle Certified Products Registry on the C2CPII website for a complete listing of all currently certified products. To determine the eligibility for a product type that is not currently certified, please contact C2CPII before submitting a certification application or beginning a product assessment. C2CPII reserves the right to refuse to certify a product type for which the standard is not currently designed to certify, or is determined to not align with C2C principles in its sole discretion.

For a list of product types that are not eligible for certification, see the Cradle to Cradle Certified Version 4.0 User Guidance.

Further Explanation

The following product types are not eligible for Cradle to Cradle certification:

1. **Products that are contrary to the intent of the Cradle to Cradle principles,** including:
    a. Weapons or other items intended to harm, kill, hurt, or incapacitate living beings (e.g., guns, tasers, mace, barbed wire, electric fencing),
    b. Tobacco and other products intended or used for smoking or vaping (e.g., pipes),
    c. Products used exclusively to produce non-renewable fuel or electricity (nuclear reactor equipment, fracking fluid, oil rigs, etc.),
    d. Products that consume nuclear or non-renewable fuel (e.g., gasoline car; does not apply to electricity purchased from the grid or to plugged products),
    e. Products containing material from threatened, vulnerable, or endangered species (e.g., African mahogany (Khaya spp.), Brazilian rosewood (Dalbergia nigra), Rhodesian teak (Baikiaea plurijuga); see the Definitions section for the definition of threatened, vulnerable, and endangered),
    f. Products containing:
        i. Material and substances derived from vertebrates, and invertebrates where there is clear evidence of sentience (e.g., cephalopods), that are killed primarily or only for their hides, skins, feathers, or other fibers and parts (e.g., snake, crocodile, alligator, lizard, and galuchat/stingray skins),
        ii. Down, feathers, or hair from any live plucked animal (e.g., ducks, geese) and substances derived from these materials,
        iii. Fur, including when the fur is shorn or otherwise removed from the hide or skin (e.g., fox, mink, beaver, ermine, and rabbit including angora rabbit fur/wool).
    g. Products that are chemicals or raw materials that cannot be optimized (e.g., monomers that are carcinogens, mutagens, and/or reproductive toxicants (CMRs),
    h. Products for which the core functionality is intrinsically tied to toxic active ingredients, thus rendering the product non-optimizable (e.g., herbicides, insecticides, rodenticides, and antimicrobial products

with x-assessed antimicrobial agents) or textiles/apparel with such products intentionally added,

i. Disinfectants (including those used for human hygiene) containing active ingredients/substances that are not approved for use per leading regulations. This is defined as disinfectants containing substances that are not approved for use in the relevant product type per the European Union's Biocidal Products Regulation (e.g., antimicrobial cleaning products, soaps, or hand sanitizers/hand rubs with triclosan or triclocarban),

j. Products that are designed/intended to be non-circular or promote non-circularity:

   i. The following single use plastic products: cotton buds/swab sticks, cutlery (forks, knives, spoons, chopsticks), plates, straws, beverage stirrers, balloon sticks, food and beverage containers (including beverage cups) made from expanded polystyrene, bags < 50 microns (e.g., grocery, waste, and courier bags) except for food bags with a thickness of < 15 microns intended for composting, agricultural mulch, and disposable plastic items for hotels,

   ii. Oxo-degradable additives and plastics containing these additives,

   iii. Plastic microbeads and products containing plastic microbeads, and

   iv. Products marketed as/for throw-away (e.g., products with the terms "waste", "disposable" or "garbage" in the product name, or products intended for landfill or incineration).

k. Packaging for any product type that is contrary to the intent of the Cradle to Cradle principles and thus not eligible for certification.

2. Products that the program requirements were not written to address, including:

a. Food, beverages, and other products intended for ingestion,

b. Pharmaceuticals (see definition below), including products and substances for which claims of a pharmaceutical nature are made (e.g., creams for treating psoriasis or fungal infections),

   Pharmaceutical – A compound manufactured for use as a medicinal drug. This includes any substance or combination of substances presented as having properties for treating or preventing disease; or any substance or combination of substances that may be used in or administered to human beings and/or animals either with a view to restoring, correcting, or modifying physiological functions by exerting a pharmacological, immunological, or metabolic action, or to making a medical diagnosis.

c. Medical devices and products for which specialized biocompatibility testing is required that is not included in the Cradle to Cradle Certified Material Health Assessment Methodology (e.g., syringe, pacemaker),

d. Products that are or contain live multicellular organisms (e.g., live animals, plants, and seeds. Includes all algae, some of which are multicellular.),

e. Fuels and other products intended for combustion during use (e.g., candles, fireworks, explosives), and

f. Buildings,

g. Soil amendments (e.g., fertilizer, compost).

3. Products that are not in compliance with applicable local, state, and federal laws and regulations.

2.2 Products Not Eligible for the Bronze Achievement Level in Material Health

Children's products, cosmetics, and personal care products are not eligible for certification at the Bronze achievement level in the Material Health category (i.e., they must meet the Silver achievement level requirements or higher in Material Health). The intent is to ensure they do not contain carcinogens, mutagens, or reproductive toxicants (CMRs); persistent, bioaccumulative, and toxic substances (PBTs); very persistent and very bioaccumulative substances (vPvBs); or substances that cause an equivalent level of concern.

Further Explanation

Personal care products include formulated products (e.g., shampoo, shaving cream, face powder, solid soap) and articles used for personal care that frequently contact the skin (e.g., makeup applicator, cotton swab).

Formulated cosmetics and personal care products are further defined within the Cradle to Cradle Certified Restricted Substances List as follows: *Any substance or chemical mixture intended to be placed in contact with the external parts of the human body, or with the teeth and the mucous membranes of the oral cavity, with a view exclusively or mainly to clean them, perfume them, change their appearance, protect them, keep them in good condition, or correct body odors. This includes makeup and hair, face, body and hand care products, including hand soaps and sanitizers.*

2.3 Products Not Eligible for the Bronze or Silver Achievement Level in Product Circularity

Eligible single-use plastic products and plastic packaging products (when certified as a separate product) are not eligible for certification at the Bronze or Silver achievement level in the Product Circularity category (i.e., they must meet the Gold or Platinum achievement level requirements in Product Circularity). The intent is to ensure alignment with the Cradle to Cradle principles for these typically non-circular product types. An exemption is made for plastic packaging that is part of a refill/reuse system (e.g., soap refill pouches), which may be certified at any achievement level in the Product Circularity category.

Further Explanation

The definition of a single-use plastic product is provided in Section 12.

In addition to the eligibility requirements above, several requirements specific to single-use plastic products and plastic packaging products may be found in the following Product Circularity sections of the standard:

- Section 5.4 Increasing Demand: Incorporating Cycled and/or Renewable Content (see sub-section titled Alternative to Meeting Required Percentages of Cycled and/or Renewable Content: Feasibility Analysis)
- Section 5.5 Material Compatibility for Technical and/or Biological Cycles (see Gold level requirement #3)
- Section 5.9 Active Cycling

3 // General Requirements

3.1 Certification Compliance Assurance

Intended Outcome(s)

A compliance assurance system is in place to ensure the certification requirements are met at all times.

Applicable Achievement Level(s)

Bronze

Requirement(s)

A documented certification compliance assurance system is in place.

The certification applicant/holder company must have a documented certification compliance assurance system in place that includes:

1. Designated staff responsible for maintaining the integrity of certified product(s) as defined by the standard.
2. A process for controlling for changes pertinent to the certification and notifying the certification body when relevant changes are planned or otherwise identified. Pertinent changes include, but are not limited to, changes to certified product names or group names, and the list of specific product variations included in or excluded from a certified group.
3. A method of staying informed about and/or controlling for material changes that may occur in the supply chain. One of the following is required:
    a. Suppliers must be required to communicate any proposed changes to the manufacturing process or to intentional product inputs that may alter the chemical composition of the product, or other aspects relevant to certification (e.g., recycled content), to the certification holder. When there are multiple supply chain tiers, suppliers must communicate this requirement to their own suppliers.
    b. All suppliers that provided chemical composition data, or other product relevant data (e.g., amount of recycled content), for the prior certification must be contacted again prior to renewal and asked to provide updated data or to confirm that no relevant changes were made by them or their (sub-)suppliers.
4. Management system best practices including:
    a. A document control process,
    b. Internal self-audits conducted at regular planned intervals (at least once each certification cycle), and
    c. A corrective action process.

Required Documentation

- List of responsible staff and qualifications.
- Description of compliance assurance process (i.e., requirement #2) and method (i.e., requirement #3.a and/or b).

- Evidence of management system best practices including document control, self-audit, and corrective action procedures.

3.2 Environmental Policy and Management

Intent

Companies are committed to protecting the environment and are responsibly managing potential environmental impacts.

Requirements Summary

Bronze	Environmental risks are assessed for the final manufacturing stage and for the product.
	An environmental policy based on the environmental risks associated with the final manufacturing stage and the product is in place.
	A strategy is developed for implementing the policy at all final manufacturing stage facilities. At recertification, progress toward achieving the strategy is measured.
	Company executives demonstrate commitment and support for establishing and maintaining a culture for achieving high levels of environmental performance.
Silver	Management systems are in place that support the implementation and oversight of the policy at final manufacturing stage facilities.
Gold	Responsible sourcing management systems are in place that support the implementation and oversight of the environmental policy within the product's supply chain.
Platinum	Environmental objectives are incorporated into relevant employee performance evaluations, and incentives are provided to encourage top management and employees to actively participate in achieving the company's environmental goals.

3.2.1 Assessing Environmental Risks and Opportunities

Intended Outcome(s)

Environmental risks and opportunities relevant to the company and product are examined and understood.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Identify environmental risks and opportunities for all final manufacturing stage facilities and for the certified product.

The risk and opportunity assessment must include:

1. Identification of environmental risks associated with processes occurring at final manufacturing stage facilities, countries in which the final manufacturing stage facilities are located, the product's supply chain, product use, and product end of use.
   The following issues are de facto high-risk in the noted scenarios:

a. Greenhouse gas emissions and contribution to climate change are high-risk issues for:
    i. Final manufacturing stage facilities with combined total scope 1 and 2 greenhouse gas emissions ≥ 10,000 metric tons CO2e/year.
    ii. Products requiring energy during the use phase (unless the product saves more energy than it uses).
b. Air pollution is a high-risk issue for:
    i. Final manufacturing stage facilities with on-site combustion power plants (including biomass combustion).
    ii. Final manufacturing stage facilities at which processes commonly known to be air pollutant intense take place. This includes (but is not limited to): Smelting metals, refining oil, producing cement, using high volumes of organic solvents, and incinerating waste.
c. Water availability is a high-risk issue for:
    i. Final manufacturing stage facilities purchasing and/or withdrawing ≥ 100,000 m3 of freshwater per year when located in medium to high stress location(s) (as defined per the Water & Soil Stewardship requirements).
    ii. Products requiring high volumes of water during the use phase.
d. Water and/or soil quality (i.e., pollution) are high-risk issues for:
    i. Final manufacturing stage facilities with pollutant intense processes (defined per the Water & Soil Stewardship requirements).
    ii. Final manufacturing stage facilities for which stormwater discharge is regulated per the corresponding regional regulatory permitting system. In regions where stormwater is not regulated, any facility within the specific categories of industrial activity that must be covered under the U.S. National Pollutant Discharge Elimination System is de facto high-risk for this issue.
    iii. Products that are primary contributors to microfiber and microplastic pollution (i.e., textile and apparel products made from synthetic fibers that are wet processed and/or that require washing with water during the use phase, tires, and plastic pellets).
e. Waste generation is a high-risk issue for:
    i. Final manufacturing stage facilities for which hazardous waste is regulated per the corresponding regional regulatory permitting system. In regions where hazardous waste is not regulated, any facility producing waste that is listed or characterized as hazardous waste as defined by the European Union's Waste Framework Directive and associated List of Waste or the U.S. Environmental Protection Agency is de facto high-risk for this issue.

2. Identification of best practices employed to address the risks.
3. Information regarding the impact and importance of identified risks.
4. Prioritization of the risks and opportunities identified.

Further Explanation

The requirements in this section apply to final manufacturing stage facility(ies), the supply chain of the certified product, and product end of use. The risk and opportunity assessment itself must be conducted by the applicant company. It must be completed in collaboration with the company or companies owning the final manufacturing stage facilities in cases where the applicant does not manufacture the product.

Definition of Final Manufacturing Stage Facilities

These are the facilities where the final production steps used to manufacture the product occur. The term 'final manufacturing stage' is used throughout the standard. For the definition of the final manufacturing stage by product type see the Methodology for Applying the Final Manufacturing Stage Requirements.

The processes that must be included in the final manufacturing stage typically align with the manufacturing stage as defined in product category rules, where available. For product types that are not yet listed in the Methodology for Applying the Final Manufacturing Stage Requirements, it is recommended to refer to existing product category rules (if any) as the starting place for defining final manufacturing. Please contact C2CPII in cases where the product category for an applicant product is not represented in the methodology.

Identifying Environmental Risks and Opportunities (Requirement #1)

The standard requires that applicant companies identify the *environmental risks associated with processes occurring at final manufacturing stage facilities, countries in which the final manufacturing stage facilities are located, the product's supply chain, product use, and product end of use.* Risks may be identified based on desk research and it is expected that information be obtained from a variety of sources. However, a list of de facto high-risk issues are also provided, and a majority of the de facto high-risk issues are relevant to final manufacturing facilities. The de facto high-risk issues are issues that must always be considered high risk if a facility manufacturing the product carries out the process or otherwise fits into the category described. Several issues apply to other stages of a product's life cycle, as follows:

- Requirement #1.a.ii: *Products requiring energy during the use phase (unless the product saves more energy than it uses).*
- Requirement #1.b.ii: *Products requiring high volumes of water during the use phase.*
- Requirement #1.d.iii: *Products that are primary contributors to microfiber and microplastic pollution (i.e., textile and apparel products made from synthetic fibers that are wet processed and/or that require washing with water during the use phase, tires, and plastic pellets).*

Although not required as part of the risk assessment, it is recommended that applicants also consider and include any environmental risks associated with raw material extraction and/or production. Note that the other categories of the standard aim to address these risks through requirements to, for example, quantify and address embodied greenhouse gas emissions, use responsibly sourced raw materials, and use positively assessed recycled materials.

Identifying Best Practices to Address the Risks (Requirement #2)

Once the full set of environmental risks and opportunities has been identified as described above (requirement #1), the next step is to identify best practices for addressing the risks. These may be practices that are already in place, planned for future implementation, or that have just been identified as part of the research conducted for Cradle to Cradle certification. In some cases, best practices may not yet be available (e.g., in the case of microfiber pollution from washing of synthetic textiles). In this case, applicants must identify the current status of the problem, including who is already working to solve the problem, research that has been conducted to identify solutions, and opportunities for engaging/collaborating.

Gathering Information Regarding the Impact and Importance of Identified Risks (Requirement #3)

This type of information may also be obtained from publicly available sources (e.g., regulatory commissions/ departments, non-governmental organizations, and the academic literature). It is also recommended that internal and external stakeholders be directly consulted. The information obtained on the impact and importance of risks may help to refine the risk assessment (requirement #1) and inform prioritization (requirement #4) as described below.

Prioritizing Risks (Requirement #4)

Issues associated with the greatest negative environmental impact (or that would result in highly negative impact were they to occur), and any issues related to legal compliance, must be prioritized. ISO 14001 refers to the risks that should be managed as the most significant environmental aspects. Refer to the process of prioritization described in Social Fairness Section 8.1 Assessing Risks and Opportunities for additional guidance.

Facilities with ISO 14001 Certification or Equivalent

Assessing environmental risks and opportunities for final manufacturing is similar to cataloging environmental aspects and identifying those that can result in significant impacts as required for ISO 14001. This means that for facilities that are ISO 14001, some (if not all) of the risks relevant to the final manufacturing facility will have already been identified. **In some cases, the risk assessment will be complete**. However, it will always be necessary to review the list of de facto high-risk issues listed in the standard to ensure that these are included in the ISO management system. This is because ISO provides a process for use in identifying risks, but it is not prescriptive regarding what risks are identified – rather it is left to the ISO applicant to determine the scope. In addition, some of the de facto high risks are not typically included in scope for facility level management systems. In particular, these are the three de facto high-risk issues that are appliable to the product's use: microfiber pollution, energy, and water use.

Required Documentation

Bronze level

- Description of the risk assessment methods and results that demonstrates the risk assessment was conducted using the required scope (i.e., final manufacturing facilities, and product use and end of use)
- List of relevant best practices for addressing the risks and opportunities identified
- Description of the methods used to determine the importance of, and thereby prioritize, risks and opportunities
- List of high-risk issues, indication of which are high priority, and why
- References used, including any information obtained (either directly or indirectly) from stakeholders

For facilities with ISO 14001 certification

- Valid ISO 14001 certificate and evidence that the list of de facto high-risk issues have been evaluated and included in the management system, if relevant. If all relevant de facto high-risk issues have been determined to be significant environmental aspects per ISO, the other documents and evidence listed above are not required.

3.2.2 Environmental Policy

Intended Outcome(s)

The company has formally committed to protecting the environment through company policy approved at the executive level.

Applicable Achievement Level(s)

Bronze

Requirement(s)

For the applicant company OR for all final manufacturing stage companies, commit to protecting the environment through company policy.

The policy or policies must:

1. Establish expectations for final manufacturing stage facilities, the product's supply chain, and other relevant stakeholders.
2. Include the company's commitment to address any high-risk environmental issues identified via the risk assessment, including any de facto high-risk issues. (If no high-risk issues were identified, the policy may address environmental protection in a general way.)
3. Define staff responsibilities for implementation.
4. Be formally approved and signed by a duly empowered officer of the applicant company or by the board of directors.

Further Explanation

The requirements in this section apply to the applicant company. Alternatively, the requirements may be met by the company or companies owning the final manufacturing stage facilities (i.e., for cases where the applicant does not manufacture the product).

Required Documentation

Bronze level

Policy document(s) that:

- Set expectations for the company, supply chain, and other relevant stakeholders.
- Explicitly include the company's commitments to address any high-risk issues identified in Section 3.2.1 Assessing Environmental Risks and Opportunities.

- Define staff responsibilities (this may be part of the policy or included in other relevant documents).
- Are signed by a duly empowered officer of the company or by the board of directors. Note: Brands that have legal and fiduciary responsibility may develop, sign, and submit their own unique policy (i.e., the policy may be different from the parent company's policy in this case).

3.2.3 Strategy for Environmental Policy Implementation

Intended Outcome(s)

Environmental performance data are regularly analyzed to ensure manufacturing processes are not having a negative impact on the environment and to measure progress toward environmental performance goals.

Applicable Achievement Level(s)

Bronze

Requirement(s)

For the applicant company OR for all final manufacturing stage companies, develop a strategy for implementing the environmental policy at all final manufacturing stage facilities and report on implementation progress at each recertification.

The strategy must:

1. Address priority risks and opportunities (per Section 3.2.2).
2. Include specific time-bound performance and impact objectives to guide decision-making.
3. Define the scope of implementation.
4. Define the company's human, technical, and material resource allocation for implementation.

For recertification, environmental performance data must be collected and analyzed to measure progress toward achieving environmental targets and objectives, and areas for improvement must be identified. For any identified areas of poor performance, methods of improving outcomes must also be identified and evaluated and the strategy refined accordingly.

Further Explanation

The requirements in this section apply to the applicant company. Alternatively, the requirements may be met by the company or companies owning the final manufacturing stage facilities (i.e., for cases where the applicant does not manufacture the product).

The environmental strategy is expected to reflect the commitments made in the environmental policy and demonstrate how the company (or final manufacturing company(ies) will operationalize these commitments. This entails developing a framework for implementing the policy, defining the scope of implementation, identifying accountable parties and designated resources within the business, and a sound measurement system.

Priority Risks and Opportunities (Requirement #1): At a minimum, the strategy is expected to focus on the priorities determined per the risk and opportunity assessment (see Section 3.2.1).

Time-bound Performance and Impact Objectives (Requirement #2): The specific objectives and related targets included in the strategy will depend on the priority action areas identified in requirement #1. Examples of performance objectives and related targets include:

- Consistent compliance with all applicable environmental laws and regulations at all final manufacturing facilities with a target of zero instances of permit exceedance
- Minimizing waste with a related target to increase recycling of manufacturing 'waste' by a certain percentage within a designated timeframe
- Targets that communicate expectations and track efforts to manage emerging opportunities (e.g., addressing microfiber pollution).

In some cases, there may be some overlap with targets set per the other Cradle to Cradle Certified program category requirements (e.g., Section 6.3 Clean Air & Climate Protection Strategy).

Scope of Implementation (Requirement #3): This is a requirement to define the geographies and tier(s) of the applicant's operations and supply chain that are addressed by the strategy.

Defining Resources (Requirement #4): The human, technical, and materials resource allocation to support the plan's implementation must be defined. It is best practice to also define the financial resources allocated (or spend) for effective implementation. Resource allocation could, for example, include a description of relevant business units and staff experience assigned to implementation, agreements with external stakeholders or service providers who are or will be engaged to support implementation efforts, or a training plan and budget for supplier capacity building.

Preparing for Recertification: The framework for implementing the policy is required to identify how implementation will be monitored and measured. Measurement must include performance metrics to evaluate existing processes and outcomes, and define improvement areas. This is in preparation for achieving the recertification requirements that *environmental performance data must be collected and analyzed to measure progress toward achieving environmental targets and objectives*.

Recertification: *For any identified areas of poor performance, methods of improving outcomes must also be identified and evaluated and the strategy refined accordingly.* Examples of evaluation methods that can be used include:

- Management reviews at appropriate intervals
- Industry or competitor benchmarking
- Obtaining feedback from internal and/or external stakeholders

Facilities with ISO 14001 Certification or Equivalent

For facilities with ISO 14001 certification or equivalent, it may be assumed that the requirements in this section have been achieved, as long as all of the high-risk issues identified per Section 3.2.1 are within the scope of the management system.

Required Documentation

Bronze level

- Strategy(ies) that includes the required points #1-4
- Description of how implementation will be monitored and measured

Bronze level recertification

- Evidence of performance data analysis specific to the defined objectives in the original strategy
- List of areas of poor performance identified from the analysis conducted (if any)
- Description of plans to improve performance outcomes, and description of how the plan is selected/developed and evaluated
- Description of how the strategy has been updated to incorporate the need to improve poor performance

For facilities with ISO 14001 certification:

- Valid ISO 14001 certificate and evidence that the list of de facto high-risk issues have been evaluated and included in the associated management system. If all relevant de facto high-risk issues have been determined to be significant environmental aspects per ISO, the documents and evidence listed above for Bronze level (including for recertification) are not required

3.2.4 Demonstrating Commitment

Intended Outcome(s)

A culture that prioritizes environmental protection is established, promoted, and improved by company leadership.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Demonstrate commitment and support for establishing and maintaining a culture whereby employees and business partners are able to achieve high levels of environmental performance.

The applicant's leadership team (i.e., C-level executive and/or Board of Directors) must demonstrate commitment and support by:

1. Communicating the company's environmental aspirations and strategy for protecting the environment internally and/or externally.
2. Defining a position to actively lead on protecting the environment, oversee implementation of the strategy, and drive continuous improvement efforts.
3. Ensuring there are defined procedures for escalating environmental risks and identified impacts to the executive team.

Further Explanation

The requirements in this section apply to the applicant company.

Who is Expected to Demonstrate Commitment

The applicant's leadership team (i.e., C-level executive and/or Board of Directors) must demonstrate commitment. In practice, positions with this responsibility can include:

- Board director or executive that has accountability for the environment (e.g., Head of Sustainability),
- Business unit functional head that has accountability and responsibility for environment. This could be a leader within procurement, purchasing, sourcing, risk management, compliance, sustainability, corporate responsibility, etc.

Communicating (Requirement #1): For the Bronze level, communication of the company's environmental aspirations, values, and strategy may be either internal or external. This may include, for example, sustainability reports and/or signed policy documents. See Required Documentation section for additional examples.

Defining a Position to Actively Lead on the Environment (Requirement #2)*:* The position often has responsibility for the company's environmental management plan, internal and/or external progress reporting on implementation efforts, and/or KPIs to measure and assess progress. The designated position to lead on the environment may be full time or part time, as appropriate and feasible for company size.

Procedures for Escalating Risks and Impacts (Requirement #3): In assigning roles and responsibilities, the senior executive is expected to also have accountability for environmental risks and identified impacts that have been escalated to the executive team. Examples of escalation procedures can include internal monitoring and reporting procedures, employee hotlines, and/or procedures maintained by internal risk management departments. The escalation process should be included in training for key roles responsible for implementing environmental policy and demonstrating the organization's commitment to protect the environment.

Required Documentation

Bronze level

- Evidence that the applicant company is *Communicating the company's environmental aspirations and*

strategy for protecting the environment internally and/or externally may include one or more of the following:

- An environmental policy document with executive level signature that is publicly available and/or circulated internally to all employees,
- A company press release on this topic,
- A sustainability report, and/or
- A transcript from a public speech given by a C-suite representative.

- Description of the designated position to lead on the environment
- Defined processes and procedures for escalating and reviewing environmental risks and identified impacts by the executive team

3.2.5 Environmental Management Systems

Intended Outcome(s)

An environmental performance management system is in place, ensuring that environmental performance of the applicant company and product is improved over time.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: For the final manufacturing stage facility, implement a management system that supports achievement of the environmental policy commitments within facility operations.

Gold level: For the applicant company OR for all final manufacturing stage companies, implement a responsible sourcing management system that supports achievement of the environmental policy commitments within the product's supply chain.

For the Silver level, the management system must include the following elements:

1. Designated staff with environmental compliance responsibilities.
2. Designated oversight function and process.
3. Procedures that support implementation of the environmental policy at all final manufacturing stage facilities.
4. Education for staff with environment-related duties on environmental best practices relevant to the facilities.
5. Procedures to measure and evaluate activities against the environmental policy.
6. Policies and procedures for the prompt implementation of corrective and preventive actions.

Further Explanation

The Silver level requirements in this section are to implement environmental management system(s) at all final manufacturing stage facilities. Guidance on environmental management systems implementation is widely

available through other sources, for example for ISO 14001 or EMAS implementation (see references below).

Facilities with ISO 14001 Certification or Equivalent

For facilities with ISO 14001 certification or equivalent, it may be assumed that the requirements in this section have been achieved, as long as all of the high-risk issues applicable to final manufacturing as identified per Section 3.2.1 are within the scope of the management system.

References

EU Eco-Management and Audit Scheme (EMAS)

ISO 14001 (2015)

Learn About Environmental Management Systems, US EPA

Required Documentation

Silver level

The following information is required in order to demonstrate that the management system has been implemented. The numbers below align with the individual requirement numbers in this section.

1. Internal organizational charts and/or descriptions of the functions, business units, or staff responsible for environmental compliance, including job descriptions for relevant staff.
2. Description of who and what processes create accountability for environmental compliance and policy implementation. For example, this might include oversight by an Environmental, Health and Safety lead, with support from a cross functional committee of business units.
3. Detailed information about how the environmental policy is integrated into the organization – this may be through written procedures, description of processes, reference to several standard operating procedures, and/or intra-department collaboration for managing the policy implementation or processes.
4. Examples of any training for individuals with environmental related duties. Provide examples of training materials and a training log to show completion of training.
5. Key performance indicators or example progress reports to evaluate the effectiveness of implementation plans and the management system. This may include documentation for processes to review compliance with the environmental policy and also compliance with local laws. If third-party assessments of activities and/or reports have been conducted by an external stakeholder, provide this information to document supporting implementation of different activities.
6. Written policies and procedures that outline requirements for implementation of corrective and preventive actions if risks and/or impacts are identified.

Silver level recertification:

- Evidence that the design and effectiveness of the management system (policies, practices, and programs)

have been reviewed to identify deficiencies/changes required for improved performance. This must include regular internal management reviews (annual review is recommended) of the environmental management system and written records from management review meetings.

- Evidence that improvements identified in the previous review are underway.

For facilities with ISO 14001 certification:

- Valid ISO 14001 certificate and evidence that the list of de facto high-risk issues have been evaluated and included in the associated management system. If all relevant de facto high-risk issues have been determined to be significant environmental aspects per ISO, the documents and evidence listed above are not required.

Gold level: For the applicant company OR for all final manufacturing stage companies, implement a responsible sourcing management system that supports achievement of the environmental policy commitments within the product's supply chain.

For the Gold level, the responsible sourcing management system must include the following elements:

1. Designated staff with responsible sourcing responsibilities.
2. Designated oversight function and process.
3. Procedures to communicate to suppliers the company's environmental policy and any associated sourcing business processes.
4. Supplier contractual requirements for environmental policy compliance and monitoring (e.g., supplier codes of conduct if defined as a contractual term). Contracts must require suppliers to extend environmental compliance expectations to their suppliers.
5. Evaluation of new suppliers prior to the awarding of contracts to determine if the supplier can meet requirements.
6. Policies and procedures for the prompt implementation of corrective and preventive actions.
7. Education for sourcing and/or procurement team(s) on responsible sourcing best practices.
8. Business procedures for identifying and documenting the cause and resolution of environmental issues and/or impacts in the supply chain.

For recertification at the Silver or Gold level, the policy, procedures, practices and/or programs must be reviewed to identify deficiencies and implement changes (if needed) that will lead to improved performance. Remedial activities (if needed) must be underway and seek to identify and address root causes. (Note: This applies to the company-level management system at the Silver level and also to the responsible sourcing management system at the Gold level.)

Further Explanation

The requirements in this section apply to the applicant company. Alternatively, the requirements may be met by the company or companies owning the final manufacturing stage facilities (i.e., for cases where the applicant does not manufacture the product).

This section of the standard is very similar to the Gold level Social Fairness requirements in Section 8.6 Management Systems. See Section 8.7 for additional guidance.

Required Documentation

Gold level

The following information is required in order to demonstrate that the responsible sourcing management system has been implemented. The numbers below align with the individual requirement numbers in this section.

1. Internal organizational charts and/or descriptions of the functions, business units, or staff responsible for responsible sourcing, including job descriptions for relevant staff.
2. Description of who and what processes create accountability for environmental compliance in the product's supply chain. For example, this might include oversight by a Chief Procurement Officer, with support from a cross functional committee of business units such as sourcing, compliance, sustainability, product development, design, etc.
3. Written procedures and supplier requirements or guidance materials that set expectations for supplier compliance with the environmental policy. This may include the supplier code of conduct and documentation in the form of steps for communication and adherence, such as emails or contract terms that specify required compliance.
4. A supplier contract template and/or excerpts of a valid supplier contract that include language requiring suppliers adhere to the applicant's responsible sourcing requirements as a condition of business, and setting expectations for their suppliers to do the same. This could include a supplier code of conduct if the supplier is required to sign this as a contractual term. It is best practice to stipulate that suppliers will be monitored for social compliance.
5. Written procedures and/or guidance that stipulates how new suppliers are evaluated to determine if the supplier meets the applicant's responsible sourcing and/or environmental compliance requirements. Written procedures and/or guidance that explain how evaluation of environmental compliance is included in decisions to award contracts to new suppliers.
6. Written policies and procedures requiring corrective and preventive actions for suppliers if non-compliances are identified in their production facilities. Credible corrective action plans define timelines for expected corrective actions, which may relate to the severity of the non-compliance.
7. Description of the training and/or a sample of training or education materials that explain key human rights issues and applicant procedures for sourcing and procurement team(s) to incorporate into their everyday activities to achieve responsible sourcing goals.
8. Written procedures for identifying and documenting environmental issues and/or impacts raised by employees or third parties. This could include escalation and/or remediation processes, including identification of issues and corrective actions in audit reports in the supply chain.

Gold level recertification:

- Evidence that the design and effectiveness of the management system (policies, practices, and programs) have been reviewed to identify deficiencies/changes required for improved performance. This may include regular internal management reviews (annual review is recommended) of the responsible sourcing system, where documentation is written records from management review meetings. This must include evidence that improvements identified in the previous review are underway.

3.2.6 Environmental Protection Incentives

Intended Outcome(s)

Company management is motivated to take action to protect the environment as relevant to company operations.

Applicable Achievement Level(s)

Platinum

Requirement(s)

For the applicant company OR for all final manufacturing stage companies, incorporate environmental performance results into relevant employee and executive performance evaluations and incentive structures.

The following are required:

1. Performance assessments of any executives or employees with designated environmental responsibilities must include consideration of metrics derived from the environmental policy and strategy.
2. Environmental performance results must be considered in compensation packages / incentive plans for top company executives and management with environmental management or oversight functions (i.e., from C-suite executives to business unit and functional heads).

Further Explanation

The requirements in this section apply to the applicant company. Alternatively, the requirements may be met by the company or companies owning the final manufacturing stage facilities (i.e., for cases where the applicant does not manufacture the product).

This section of the standard is very similar to the Platinum level Social Fairness requirement #8 in Section 8.11 Fostering a Culture of Social Fairness. See Section 8.11 for additional guidance.

Performance Assessments (Requirement #1):

Environmental criteria or metrics must be evaluated in the same manner as traditional performance metrics and hold equal weight in these evaluations. Examples include the following:

- A Vice President in a management role may be evaluated on resource allocation that supports environmental objectives

- A Human Resources lead responsible for implementing employee programs may be evaluated on the number of trainings that contain environmental topics
- A legal professional may be evaluated based on the percentage of contracts that require compliance with the organization's environmental policy or code of conduct

Required Documentation

- Evidence of inclusion of environmental goals in annual performance objectives and assessments for executives and/or employees with designated social responsibilities. Metrics included in performance assessments may include implementation of employee training, risk assessment, sourcing decisions that include environmental performance evaluation, supplier management, evaluation of supplier non-compliances, etc. Provide a sample of performance reviews to demonstrate that environmental criteria are included.
- Description of compensation package terms for executives and management with social responsibility oversight to confirm inclusion of environmental performance results/criteria. Where there are several executives and/or management team members with these responsibilities, provision of an example (i.e., one or two plan(s)) is sufficient.

3.3 Measurable Improvement

Intended Outcome(s)

What a product is made of and how it is made is measurably improved until the product achieves at least the Gold level requirements in all five Cradle to Cradle Certified key categories. While the Gold level reflects high achievement, reaching the Platinum level in all categories is the ultimate goal.

Applicable Achievement Level(s)

Bronze and Silver

Requirement(s)

At recertification, demonstrate that at least one measurable improvement has been made in at least one of the five program categories since the prior certification.

The measurable improvement required is *in addition to* any actions already required in individual program categories (e.g., progress on strategies and optimization plans).

Further Explanation

Examples of measurable improvements:

Material Health

- Increased percentage assessed for at least one product within the product group

- Reduced percentage of GREY+X materials or grey+x substances for at least one product within a product group.
- Increased number of chemicals or materials assessed (applied to either materials or chemicals subject to review within the product or to all process formulations or chemicals).
- Reduction in the total impact due to hot spot reduction (either within an impact category if using option A, or across all stages, etc., if using option B, as described in the Further Explanation box of Section 4.11).

Product Circularity

- Increased percentage of cycled or rapidly renewable content
- Increased cyclable content for one or more products in the product group
- Improvement in the design of the product for easy disassembly
- Additional Circular Design Opportunity plan developed for a product group
- Additional cycling partner identified (for disassembly, recovery, or processing) (must apply to the entire product group)
- Increased cycling rates (may apply to only one product in a product group)

Clean Air & Climate Protection

- Increased purchase of RECs or GoOs relative to total electricity use (i.e., increased percentage)
- Increased purchase of carbon offsets relative to total emissions (i.e., increased percentage)
- Increased absolute amount of energy produced from on-site renewables or increased percentage of on-site renewables
- Reductions in energy intensity or carbon intensity (relative per unit) resulting from conservation & efficiency (C&E) improvements if these have not received credit otherwise
- Absolute reductions in energy use or emissions resulting from C&E improvements
- Increased percentage of embodied emissions offset or otherwise addressed

Water & Soil Stewardship

- Effluent water quality improved which is demonstrated via test data (reduced concentration of hazardous chemicals, reduced BOD, etc.)
- Increased optimization (i.e., increased number of a, b, and c assessed chemical(s) of product-relevant chemistry entering the effluent
- Increased number of conservation (quantity or quality) best available techniques/practices implemented
- Increased water use efficiency

Social Fairness

- Decreased gender and/or top executive-worker wage gap
- Decreased gap between actual and living wage
- Increased diversity of the workforce

General

- Moving to the next achievement level
- Fulfilling one additional requirement at any higher level (even if the overall level does not increase)
- Applying for certification of additional product(s)

Required Documentation

- Description of the measurable improvement made and supporting quantitative data

4 // Material Health Requirements

Category Intent

Chemicals and materials used in the product are selected to prioritize the protection of human health and the environment, generating a positive impact on the quality of materials available for future use and cycling.

Requirements Summary

To achieve a desired level within the category, the requirements at all lower levels must also be met.

Bronze	Product is in compliance with the Restricted Substances List.
	Product does not contain organohalogen substances of special concern, or functionally-related, non-halogenated classes of equivalent concern, above relevant thresholds.
	Product is 100% characterized by generic material.
	Product is ≥ 75% assessed (complete formulation information collected for 100% of materials released directly into the biosphere).
	Strategy developed to phase-out or optimize all x-assessed or grey-rated chemicals.
Silver	Product is ≥ 95% assessed (complete formulation information collected for 100% of materials released directly into the biosphere).
	Product does not contain materials with > 1% carbon-bonded halogens by weight, or recognized PBTs or vPvBs. Product does not contain EU CLP Cat.1 and 2 CMRs or substances causing an equivalent level of concern, or exposure is unlikely or expected to be negligible.
	Product has low VOC emissions (required for products permanently installed in buildings).
	Product complies with VOC content limits (required for liquid and aerosol consumer and construction products).
Gold	100% of homogeneous materials subject to review are assessed (i.e., none have a grey rating due to insufficient data).
	Product is optimized for material health (i.e., all x-assessed chemicals replaced or phased out).
	Strategy developed to either increase the percentage of preferred (A/a and/or B/b assessed) materials and chemicals in the product or optimize the chemistry in the supply chain.
	Product has very low VOC emissions or is inherently non-emitting (required for products permanently installed in buildings).

	All product relevant process chemicals are assessed (i.e., none have a grey rating due to insufficient data) and no x-assessed chemicals are used.
	> 50% of the product by weight is assessed as A/a or B/b.
Platinum	≥ 75% of the product's input materials or chemicals have a C2CPII Material Health Certificate at the Gold or Platinum level or ≥ 50% of the product's input materials or chemicals are Cradle to Cradle Certified at the Gold or Platinum level or equivalent. A strategy is developed to increase percentages over time. OR Environmental health impact hotspot analysis based on life cycle assessment completed, emissions and resource use hotspots that impact human and environmental health are identified, and material health optimization strategy is developed based on the results.

4.1 Restricted Substances List Compliance

Intended Outcome(s)

In alignment with leading regulations that aim to protect human health and the environment, the use of well-known toxic chemicals in the product is avoided.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Comply with the Restricted Substances List (RSL).

The product and its homogeneous materials comply with relevant restrictions on the Restricted Substances List (see *Cradle to Cradle Certified® Restricted Substances List* reference document). Note: The RSL consists of a core list, which is applicable to all material and product types, as well as additional lists that are applicable to specific material and product types. Unless noted otherwise, the lists indicate the maximum allowable concentration of each restricted substance in any homogeneous material subject to review (as defined in Section 4.3) in a certified product.

For textile chemical formulations, the product also complies with the most recent version of the Zero Discharge of Hazardous Chemicals (ZDHC) Manufacturing Restricted Substances List (MRSL) or equivalent.

Further Explanation

Complying with the Restricted Substances List

The *Cradle to Cradle Certified® Restricted Substances List (RSL)* reference document can be found on C2CPII's website. In addition, the RSL, including lists of chemical names and Chemical Abstract Service (AS) Registry Numbers for substances that are listed as a group in the RSL reference document, is available on pharosproject.net.

Compliance with the RSL must be demonstrated via supplier declarations. A Supplier RSL Declaration template

is available to Cradle to Cradle Certified assessors. It is recommended that the RSL declaration, CMR & SVHC declaration (see Section 4.6) and full material disclosure information (see Section 4.3) be requested from each supplier at the same time.

As noted in the standard: *Unless noted otherwise, the lists indicate the maximum allowable concentration of each restricted substance in any homogeneous material subject to review*. Homogeneous materials are defined as materials of uniform composition throughout that cannot be mechanically disjointed, in principle, into different materials. Examples of homogeneous materials are polypropylene, steel, shampoo, glass cleaner, nylon yarn, finish, and coating. Examples of non-homogeneous materials are powder-coated steel, a printed bottle label, plywood, laminate, and chair casters. Additional detail regarding the homogeneous material definition as well as interpretations regarding how to apply it to specific product and materials can be found in the Methodology for Defining Homogeneous Materials.

RSL Updates and Transition Period: As noted in the Background section of the RSL reference document "To reflect additional restrictions that are added to the source regulations over time, the RSL will be updated annually. With each revision of this reference document, current certification holders will be granted a transition period for their certified products to become certified under the newly released version." The transition period will be communicated to current certification holders and assessors, and published on the C2CPII website.

Complying with the ZDHC MRSL (Textile Chemical Formulations)

The following is required: *For textile chemical formulations, the product also complies with the most recent version of the Zero Discharge of Hazardous Chemicals (ZDHC) Manufacturing Restricted Substances List (MRSL) or equivalent.*

As noted, this requirement is only relevant when the product seeking certification is a textile chemical formulation (e.g., a textile dye formulation). Refer to the ZDHC documentation for guidance on how to comply:

- ZDHC Programme
- MRSL v1.1

Note that there are several levels of conformance defined by ZDHC, with a self-declaration from a supplier considered level 0 conformance. For the purposes of Cradle to Cradle Certified, Level 1 conformance is required at a minimum.

Required Documentation

For each homogeneous material in the product, **including materials for which full material disclosure information has been collected,** the following is required:

- A declaration regarding any substances on the RSL that are present in the material, signed by an entity with sufficient knowledge of the material's chemical composition to verify declaration. Note: A Supplier RSL Declaration template is available to C2CPII assessors.
- For biological, geological, and recycled content materials, analytical testing reports demonstrating that any substances on the RSL with the potential for being present in the material are below relevant restriction limits.

- For exempt metallic components (as defined per Section 4.3 Material and Chemical Inventory, evidence of Restriction of Hazardous Substances (RoHS) compliance.

Additionally, for textile chemical formulations (e.g., a textile dye formulation), a ZDHC ChemCheck report or equivalent report or declaration verifying ZDHC MRSL compliance is required. The report or declaration must demonstrate conformance to ZDHC level 1 at a minimum.

4.2 Avoidance of Organohalogens and Functionally Related Chemical Classes of Concern

Intended Outcome(s)

Organohalogens, a class of substances associated with toxicity concerns in multiple use-cycle stages, are progressively avoided, beginning with high organohalogen content materials, classes of special concern, and functionally related, non-halogenated classes of equivalent concern (e.g., organophosphate ester flame retardants being used in lieu of halogenated flame retardants).

Applicable Achievement Level(s)

Bronze, Silver, Gold

Requirement(s)

Bronze level: Use materials that are not and do not contain organohalogen substances of special concern, or functionally related, non-halogenated substances of equivalent concern, above relevant thresholds (i.e., per- and polyfluoroalkyl substances (PFASs), halogenated flame retardants (HFRs) and organophosphate ester flame retardants (OPFRs), halogenated polymers, halogenated organic solvents, and other highly halogenated, carbon-based materials). Certain exemptions apply.

Silver level: Use materials in the product that do not contain organohalogen substances in exceedance of 1% by weight. Certain exemptions apply.

Gold level: Use materials in the product that do not contain organohalogen substances above subject to review limits (i.e., 100 ppm or lower if specific concentration limits are defined).

The percentage of organohalogen substances within a homogeneous material is equal to the percentage by weight of all carbon-bonded halogen atoms (Cl, Br, F, and I) within the material.

For the Bronze level, the applicable restrictions for organohalogen substances of special concern are:

1. PFASs: Per- or polyfluoroalkyl substances are defined as fluorinated organic chemicals containing at least one fully fluorinated carbon atom. PFAS-based materials, including fluoropolymers and PFAS-coatings, are not permitted for use (except in exempt materials/parts as noted below). If present as an impurity or minor additive in an otherwise non-fluorinated organic material, carbon-bonded fluorine within PFASs in the material must be < 1,000 ppm of the homogeneous material by weight.
2. HFRs: Halogenated flame retardants are defined as any chlorinated or brominated substance added to a material for the purpose of increasing heat/fire resistance or decreasing flammability. In addition to the restrictions on specific HFRs on the RSL, carbon-bonded chlorine and bromine within any flame retardant in the material (intentionally added or present as an impurity) must be < 1,000 ppm of the homogeneous material by weight (except in exempt materials/parts as noted below).

3. OPFRs: Organophosphate ester flame retardants are defined as any organic esters of phosphoric acid, containing either alkyl chains or aryl groups, that are added to a material for the purpose of increasing heat/fire resistance or decreasing flammability. In addition to the restriction(s) on specific OPFRs on the RSL (e.g., TCEP), OPFR content (intentionally added or present as an impurity) must be < 1,000 ppm of the homogeneous material by weight (except in exempt materials/parts as noted below).
4. Halogenated polymers, halogenated organic solvents, and other highly halogenated, carbon-based materials: Any material containing a sum total of 10% or more of carbon-bonded fluorine, chlorine, and/or bromine by weight is considered a highly halogenated carbon-based material and is thus not permitted for use (except in exempt materials/parts as noted below).

Further Explanation

Identifying PFASs (Bronze Level Restriction #1)

Per- or polyfluoroalkyl substances (PFASs) are defined as *fluorinated organic chemicals containing at least one fully fluorinated carbon atom*. This includes molecules with one or more -C_nF_{2n}- moiety (with n ≥1) and molecules with one or more -$C_nF_{(2n+1)}$ moiety (with n ≥1).[1] A moiety is a distinct part of a molecule that may be repeated within a single molecule and may also be found in other molecules.

PFAS "are of concern because of their high persistence (or that of their degradation products) and their impacts on human and environmental health that are known or can be deduced from some well-studied PFAS. Currently, many different PFAS (on the order of several thousands) are used in a wide range of applications".[2]

The supplementary information provided in reference #2 below lists many PFASs, including their uses, and is helpful for identifying where such compounds may be found within products and process chemistry. PFASs commonly found in consumer products include non-stick, stain, and scratch-resistant coatings (e.g., coatings containing polytetrafluoroethylene (PTFE)). A non-exhaustive list of products that may contain PFASs may be found here.

[1] Kwiatkowski et al., Scientific Basis for Managing PFAS as a Chemical Class. Environ. Sci. Technol. Lett. 2020, 7, 8, 532–543. https://pubs.acs.org/doi/full/10.1021/acs.estlett.0c00255

[2] Glüge et al., An overview of the uses of per- and polyfluoroalkyl substances (PFAS), Environ. Sci.: Processes Impacts, 2020, 22, 2345-2373. [supplementary information: http://www.rsc.org/suppdata/d0/em/d0em00291g/d0em00291g1.pdf]

Identifying Halogenated Flame Retardants (Bronze Level Restriction #2)

As noted in the standard: *Halogenated flame retardants are defined as any chlorinated or brominated substance added to a material for the purpose of increasing heat/fire resistance or decreasing flammability.* Toxicity concerns associated with halogenated flame retardants may be found here. A non-exhaustive list of halogenated flame retardants may be found here.

Identifying Organophosphate Ester Flame Retardants (Bronze Level Restriction #3)

As noted in the standard: *Organophosphate ester flame retardants are defined as any organic esters of phosphoric acid, containing either alkyl chains or aryl groups, that are added to a material for the purpose of increasing heat/*

fire resistance or decreasing flammability. Toxicity concerns associated with organophosphate ester flame retardants may be found here. A non-exhaustive list of organophosphate ester flame retardants may be found here.

Identifying Halogenated Polymers, Halogenated Organic Solvents, and Other Highly Halogenated, Carbon-based Materials (Bronze Level Restriction #4)

As noted in the standard: *Any material containing a sum total of 10% or more of carbon-bonded fluorine, chlorine, and/or bromine by weight is considered a highly halogenated carbon-based material and is thus not permitted for use (except in exempt materials/parts as noted below).* An example of a highly halogenated polymer is polyvinyl chloride (PVC). Highly halogenated materials are restricted in the standard due to concerns relating to the production and release of reaction products that are more toxic than reaction products that are released by non-halogenated materials under equivalent conditions, during unintended low-temperature combustion.

Whether or not a substance or material is subject to this restriction requires reviewing the molecular structure and determining whether or not the material contains 10% or more of carbon-bonded fluorine, chlorine, or bromine.

Example: The solvent tetrachloroethylene (C_2Cl_4, CAS number 127-18-4, molecular weight 165.82 g/mol) has four carbon-bonded chlorine atoms. The combined weight of the four carbon-bonded chlorine atoms is 141.8 (i.e., 35.45 g/mol x 4). The percentage of carbon-bonded chlorine within this substance is therefore 85.5% (i.e., 141.8/165.82). This is greater than the allowable 10%, which means that this substance is not eligible for certification at the Bronze level. In addition, if this substance was present within an otherwise non-halogenated formulation/material above 11.7%, the formulation/material would not be eligible for the Bronze level.

Additional Reference: In addition to the references listed above, a list of restricted PFASs, HFRs, OPFRs, halogenated polymers, halogenated organic solvents, and other highly halogenated, carbon-based materials is available through pharosproject.net

Verifying Compliance with the Bronze and Silver level Restrictions

For the Bronze level of certification, certain classes or substances are restricted as described in restrictions #1-4, while for the Silver level all organohalogenated substances are restricted. For Silver level, *materials in the product do not contain organohalogen substances in exceedance of 1% by weight*. This restriction applies to each material rather than to the product overall. See the Exceptions section for exceptions to this rule.

As noted in the standard, *the percentage of organohalogen substances within a homogeneous material is equal to the percentage by weight of all carbon-bonded halogen atoms (Cl, Br, F, and I) within the material.* The limits for organohalogen content are intentionally defined as the weight fraction of carbon-bonded halogen atoms (Cl, Br, F, and I) within the material, rather than the weight fraction of organohalogen molecules to allow for the use of elemental analysis (such as X-ray fluorescence (XRF) analysis) to establish compliance for a given material.

Bronze Level: For restrictions #1, #2, and #4: Compliance may be established based on elemental analysis. A material is in compliance with all three of these restrictions if the elemental concentration of Cl and Br are cumulatively below 1,000 ppm and the elemental concentration of F is also below 1,000 ppm of the material by weight. (Note: Although the limit for restriction #4 is much higher

than 1,000 ppm (i.e., 10% for carbon-bonded fluorine, chlorine, and/or bromine), the elemental analysis as described would ensure compliance with all three of these restrictions combined.)

- For restriction #4: Compliance may alternatively be established by a Material Health assessor based on general information available for the material on the Safety Data Sheet (SDS) or elsewhere.
- For restrictions #1-3: Compliance may be established by a Material Health assessor based on full material disclosure obtained from the supplier (see Section 4.3) or a declaration from the supplier stating that:
  - OPFRs are not present in the material at 1,000 ppm by weight or above.
  - HFRs and PFASs are not present in the material at 1,000 ppm or above by weight of carbon-bonded Cl+Br and F, respectively.

  Compliance for restrictions #1-3 may not be established based on the information available on the SDS since substances present at concentrations < 1% in a material may not be reported on SDSs .

Silver Level: Compliance may be established based on elemental analysis. If the elemental concentration of Cl, Br, F, and I are cumulatively below 1% of a material by weight, the material automatically is in compliance with this requirement. If the elemental concentration of Cl, Br, F, and I are cumulatively found to be above 1% of a material by weight, the material may potentially still be in compliance if it can be demonstrated through further analytical testing or formulation information obtained by the material manufacturer or formulator that halogens are present in inorganic form and that the weight fraction of carbon-bonded halogen atoms (Cl, Br, F, and I) within the material is below 1%.

To determine the concentration of carbon-bonded halogen by weight based on chemical composition information, it is necessary to know the molecular weight, structure, and concentration of all organohalogen compounds present in a material.

Example: A homogeneous material contains 2% of the organohalogen pigment Phthalocyanine Green G, by weight. From the molecular structure it can be seen that there are 16 Cl atoms in the molecule, each of them bound to carbon atoms. The molecular weight of the molecule is 1056.28 g/mol. The weight of each Cl atom is 35.45 g/mol. Thus, assuming no other organohalogen compounds are in the material, the concentration of carbon-bonded halogen in the material by weight is:

2% × 16 × 35.45 g/mol ÷ 1056.28 g/mol = 1.07%

Thus, use of this material would not be permitted in a Cradle to Cradle Certified product at the Silver level, unless it is covered by one of the exemptions.

Exemptions

For the Bronze and Silver levels, a homogeneous material may be exempt from meeting this requirement if any of the following conditions are met:

1. It is present at < 1% of the finished product by weight. Materials that are surface coatings applied to foodservice ware or textiles, including apparel, carpets, and furnishings do not qualify for this exemption.

2. It is contained in a part that is < 1% of the finished product by weight.
3. The use of a halogenated organic substance or functionally related chemical of concern in the material is required to meet regulatory requirements (e.g., fire standards). To claim this exemption the following conditions must be met:
    a. alternative methods of meeting the regulatory requirement must not exist, and
    b. the applicant must conduct ongoing research into alternative ways of complying with the regulation without the use of the substance or other x-assessed substance.

Exemptions 1 and 2 may be claimed for homogeneous materials that in sum make up no more than 5% by weight of the finished product. No exemptions may be claimed to meet the Gold level requirement.

Further Explanation

Exemptions

Exemption #1: This exemption applies to the total weight of a homogeneous material in the finished product. If the exact same homogeneous material (i.e., a homogeneous material with the exact same chemical composition) is used in several different individual parts of the product, the sum total weight of that material (including all individual parts) must be < 1% of the product by weight to be exempt.

Example: Five different wires within an electrical product are insulated with the same highly halogenated polymer. In each instance, the halogenated polymer is present at < 1% of the product by weight. However, the combined weight of the halogenated polymer is > 1%. This means that the product is not eligible for the Bronze level via exemption #1. If the combined weight of the halogenated polymer was < 1%, the product would be eligible for the Bronze level via exemption #1.

Exemption #2: This exemption applies to the weight of a part or component in the finished product. If the product contains multiple parts/components, each individual part/component must be < 1% of the product by weight to be exempt (i.e., parts/components that are composed of the exact same homogeneous materials are not summed first and then compared to the 1% by weight of the finished product threshold as for exemption #1). Note: A part is a physical unit within the product made of one or more homogeneous materials (e.g., a wire, a screw, or a component (see definition of "component" in the Definitions section)). In addition, materials that are surface coatings applied to foodservice ware or textiles qualify for this exemption. The intention of Exemption #2 is to allow for the exemption of small parts/components for which the full chemical and material composition of the part/component is unknown.

Example: An applicant has developed a rain jacket using non-halogenated, PFAS alternatives; however, for performance purposes, the jacket contains the same fluorinated coating on four small parts (e.g., zippers, fasteners) that are each present at < 1% of the product by weight. The product would be eligible for the Bronze and Silver levels since each part is < 1% of the product by weight and the total weight of the parts is < 5% of the product by weight (assuming the product does not contain any other restricted materials or parts/components that would sum to > 5% of the product by weight).

Regarding the allowance that, *Exemptions 1 and 2 may be claimed for homogeneous materials that in sum make up no more than 5% by weight of the finished product,* note that 'homogeneous materials' includes parts and components. One or both of the exemptions may be claimed for materials in the product as long as the conditions for each exemption are met. To be eligible for certification, the total weight fraction of exempt homogeneous materials, including parts/components, may not exceed 5% of the finished product by weight.

Example: A product may contain five different halogenated organic polymers that are otherwise restricted at the Bronze level if the total weight of each different polymer type is < 1% of the finished product by weight (resulting in a total % by weight for all types that is < 5%).

Required Documentation

For each homogeneous material in the product, one of the following is required (this may be provided on the Bill of Materials template or through an alternate equivalent format):

- Complete chemical composition information for the material (i.e., list of substances present at 100 ppm or above). At a minimum, concentrations or concentration ranges need to be provided for all listed organohalogen compounds. Requirement fulfillment must be verified by the Material Health assessor in this case. Calculations to determine the concentration of carbon-bonded halogens by weight in each material must be provided.
- A declaration from the material supplier that the material is not highly halogenated (carbon-bonded Cl+Br+Fl < 10% by weight) and that no PFAS, HFRs, or OPFRs are used intentionally or otherwise present in the material above the thresholds prescribed in the standard (Note: This can be documented via the RSL declaration discussed in the previous section).
- An analytical test report from an ISO 17025 accredited laboratory documenting total halogen (elemental concentration only) or carbon-bonded halogen concentrations for Cl, Br, F, and I in the material. In addition, a declaration from the material supplier that OPFRs are not present in the material at 1,000 ppm by weight or above (Note: This can be documented via the RSL declaration discussed in the previous section).
- Calculations and/or other evidence that the conditions for any claimed exemptions are met.

If a company is claiming exemption #3 for one or more materials in the product, the following additional evidence is required:

- The text of the regulatory requirement that cannot be met without the use of a halogenated organic substance in the exempt material
- An explanation of the halogenated organic substance's role in complying with the regulation and why the regulatory requirement cannot currently be met without the use of a halogenated organic substance
- A summary of due diligence conducted by the applicant and assessor to verify that competing manufacturers of similar products in the same market are also all using a halogenated organic substance in order to comply with the regulatory requirement
- For initial certification, a strategy, including concrete planned actions and timeline for these actions (must include actions within the next two years), for how the company intends to work towards complying with the regulation without the use of the halogenated organic substance (this may include assessment and performance tests of non-halogenated alternatives, lobbying efforts to get the regulation amended, etc.)
- For recertification, a summary of research or other concrete actions that took place over the course of the previous certification period to advance this strategy

4.3 Material and Chemical Inventory

Intended Outcome(s)

An increasing percentage of the product's material and chemical composition is known so that possible risks the materials and chemicals may pose to human health and the environment can be assessed and strategies for using safer chemistry can be developed.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirement(s)

Bronze level: Characterize all homogeneous materials in the product by concentration and generic material type or category/name. In addition, fully define the chemical composition of products that are released directly into the biosphere as part of their intended use (e.g., soaps, paints). For other product types, collect the chemical composition information necessary to assess at least 75% of the product.

Further Explanation

Generic Material Type

The generic material type is the descriptor of the material that would be included in commercial descriptions, technical manuals, or on bills of materials (e.g., aluminum, polyethylene, steel, wood, cotton, adhesive, paint). Wherever possible, the most specific descriptor known and/or the trade name of the material should also be reported (e.g., 6061 aluminum, DOWLEX™ polyethylene, 304 stainless steel, oak wood, GOTS-certified cotton, Prismatic "INK BLACK" powder coat, 3M Super 77 Spray Adhesive, etc.) as this will facilitate information collection for the higher-level Material Health requirements.

Products Released Directly to the Biosphere

Products that are released directly into the biosphere as part of their intended use includes all personal care and cleaning products, and all liquid, aerosol, or gaseous consumer products. It also includes solid materials and/or products released directly into the biosphere as part of their intended use (e.g., products intended for home composting or other biodegradation pathways). This list is not exhaustive, please contact C2CPII if in doubt.

Products that abrade during their intended use, but are not themselves intended for direct release into the biosphere (e.g., brake pads, tires, shoe soles) are not subject to this requirement.

Silver level: Fully define the chemical composition of products released directly into the biosphere as part of their intended use (e.g., soaps, paints). For other product types, collect the chemical composition information necessary to assess at least 95% of the product.

Gold level: Fully define the chemical composition of all homogeneous materials within the product.

Platinum level: Fully define the chemical composition of all process chemistry that comes into contact with the product or its material constituents during the final manufacturing stage.

Characterizing Materials in the Product

The concentration of each material as a percentage of the total product weight must be determined.

Fully Defining the Chemical Composition of Materials

Toxicological assessment of a material requires full material disclosure from the supplier(s)/formulator(s) controlling the chemical composition of the material. A homogeneous material is considered fully defined when the chemical names and chemical identifiers are known for all chemicals subject to review. The chemicals subject to review in each homogeneous material are those present at a concentration ≥ 0.01% (100 ppm), with the following exceptions:

1. If a limit below 100 ppm is indicated for a specific substance by the Restricted Substances List, the lower limit applies.
2. If a specific concentration limit (SCL) for any toxicity endpoint of a substance is below 100 ppm as indicated by the Table of Harmonized Entries in Annex VI to the Classification, Labelling, and Packaging of Substances and Mixtures regulation, the lower limit applies.
3. Exemption: A product may contain a maximum of 1% exempt components by weight. The exemption is allowed for minor, commodity type components including sewing thread and solid, preformed fasteners and bearings. Homogeneous materials and substances in these component types may be exempt from review if the following conditions are met:
    a. Metallic components are in compliance with the Restriction of Hazardous Substance (RoHS) directive.
    b. Non-metallic components are in compliance with the Restricted Substances List.
4. In any case where the relevant specialized assessment methodology (e.g., Recycled Content Materials Assessment Methodology, Geological Materials Assessment Methodology, Externally Managed Component Assessment Methodology) allows or requires a different method of defining materials, including different methods and/or limits for determining what chemicals are subject to review, the methods indicated by the relevant methodology document(s) take precedence.

Note: For the Bronze and Silver levels, the percentage assessed is calculated using the methodology in Section 4.4.

Further Explanation

Defining Chemical Composition/Obtaining Full Material Disclosure

Full material disclosure information must be obtained directly from the material manufacturer or formulator controlling the chemical composition of the material, or be provided in a format that can be unambiguously attributed to the specific material manufacturer or formulator. Applicants may work with a Cradle to Cradle Certified assessor to collect this information directly from each material supplier and sub-suppliers as needed.

In order for a full material disclosure to be considered complete, all substances present in a material above the relevant subject to review threshold must be reported. NOTE: This does not apply only to intentionally added substances. Rather, it applies to all substances present that are subject to review. Since the lists of exceptions to the subject to review threshold (listed above in sub-section 'Fully Defining the Chemical Composition of Materials') will expand over time, it is recommended that a **list of all intentionally used substances and**

all substances known to be contained in each homogeneous material in the finished product (excluding exempt components as defined per Section 4.3) is requested as follows:

1. Request a list of
   a. All substances and/or mixtures that are intentionally used (including process chemicals) in the production of the material.
   b. All substances known to be present (including contaminants) in the finished material.
2. For each substance and mixture, ask the supplier to provide
   a. the substance name or specific manufacturer trade name and grade in the case of purchased chemicals or chemical mixtures;
   b. the percentage ranges at which the substance or mixture is present in the finished material or material input;
   c. the function the substance or mixture serves within the material or material input; and
   d. the CASRN or INCI for each substance (if one exists).

   If the list includes only pure substances (with CASRN or INCI), the process is complete (i.e., no suppliers of the material manufacturer or formulator need to be contacted and full material disclosure has been obtained). If the list includes any mixtures or substances identified by trade name only, repeat steps 1-5 in this section for each (sub-)supplier of a mixture or substance used in making the material that is identified by trade name only. Note: Formulators are not expected to be able to provide full material disclosure unless they purchase only pure substances from chemical manufacturer suppliers.
3. The (sub-)supplier must report any chemical reactions that are an intentional part of their production process (e.g., the polymerization reaction during polymer manufacture). For any reaction, the reaction product(s) need to be listed with the percentage ranges at which they are present in the finished material or material input and a chemical identifier (if one exists).
4. The (sub-)supplier must list any known contaminants and impurities with the percentage ranges at which they are present in the finished material or material input and a chemical identifier (if one exists). For each contaminant or impurity, the source must also be described.
5. Along with the list of substances, the (sub-)supplier must provide a statement guaranteeing that all substances used intentionally in the production of the material by the supplier or sub-suppliers have been listed along with any known reaction products of those substances, impurities, and contaminants. Further, a signed declaration regarding any substances on the Restricted Substances List (RSL) (as per Section 4.1) or listed in Annex VI to CLP that are present in the material above the RSL thresholds or any of their Specific Concentration Levels (SCLs), respectively, must be provided.
6. The percentages of the substances listed in the above steps have to sum to 100%; otherwise, further explanation needs to be provided as to why the substances do not sum to 100% and whether there may be other unknown substances present.

After the completion of these steps, the formulation information for the material or material input is considered complete. Among the listed substances, the ones that are subject to review are identified and assessed by a Material Health assessor.

Note: As stated in Section 4.1, it is recommended that an RSL declaration and a CMR & SVHC declaration (see Section 4.6) are requested from suppliers at the same time at which full material disclosure information is requested.

Exempt Components

Exempt components are currently limited to sewing thread, fasteners, and bearings. The inclusion of additional commodity type components for exemption may be considered in the future. RoHS compliance for metallic components means that certain toxic metals need to be below the thresholds defined in Directive 2011/65/EU of the European Parliament. Specifically, lead (Pb), mercury (Hg), and hexavalent chromium (Cr(VI)) need to be below 0.1% and cadmium (Cd) needs to be below 0.01%.

Additional Information/Resources

The Material Health Assessment Methodology and specialized assessment methodologies may be found on the Resources page of C2CPII's website.

Fully Defining Process Chemistry

Process chemistry is considered fully defined when the chemical names and chemical identifiers are known for all process chemicals subject to review.

Process chemicals subject to review are those that are used as an intentional part of any of the processes included in the final manufacturing stage, including:

1. Pure chemical substances.
2. Chemical substances present in mixtures at a concentration ≥ 0.1% (1000 ppm) prior to any dilution at the manufacturing site(s). The exceptions listed above for materials apply (per #1-4 in the sub-section titled Fully Defining the Chemical Composition of Materials, with the default limit as 1000 ppm instead of 100 ppm). Additionally, for textile processing, the limits indicated by the Zero Discharge of Hazardous Chemical (ZDHC) Manufacturing Restricted Substances List (MRSL) take precedence if lower.

Further Explanation

The steps for obtaining full material disclosure for process chemistry are the same as that described in the prior Further Explanation box for materials within the product.

Required Documentation

- For the Bronze through Gold levels, a C2CPII Bill of Materials Form or equivalent listing all materials in the product or product group seeking certification (a Bill of Materials form is available to C2CPII assessors).

- For the Platinum level,
  - A description of what substances are used during the processes constituting the final manufacturing stage of the product and how process chemicals subject to review were determined
  - A separate C2CPII Bill of Materials Form or equivalent for process chemistry
- For each material to be assessed:
  - Safety Data Sheet(s) (SDSs)
  - Full material disclosure information that can be unambiguously attributed to the relevant manufacturer(s), formulator(s), or other supplier(s) and cross referenced with the bill of materials
  - A signed declaration regarding any substances on the Restricted Substances List (RSL) (Note: RSL declarations are required for all materials per Section 4.1)
  - Recommended: A signed declaration regarding any substances listed in Annex VI to CLP that are present in the material above any of their Specific Concentration Levels (SCLs). Note: CMR & SVHC declarations are an alternative for achieving the Silver level Section 4.6 Using Optimized Materials requirements when full material disclosure cannot be obtained. Obtaining these declarations for all materials will also provide additional assurance that substances with low Specific Concentration Limits (which may be at risk of being overlooked in the data collection and disclosure process) are identified.

4.4 Assessing Chemicals and Materials

Intended Outcome(s)

To encourage continued improvement of material health, an increasing percentage of the product's chemicals and materials are assessed. By the time a product reaches the Gold level, all materials and chemicals subject to review within the product have been assessed as compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirement(s)

Bronze level: Assess at least 75% of the product.

Silver level: Assess at least 95% of the product.

Gold level: Assess 100% of the product.

Platinum level: Assess 100% of the product AND all process chemistry that comes into contact with the product or its material constituents during the final manufacturing stage.

Assessing Chemicals and Materials

Homogeneous materials and chemicals subject to review, including process chemistry subject to review at the Platinum level, must be assessed according to the Material Health Assessment Methodology and supporting documents. Based on these methods, chemicals subject to review are assigned a, b, c, x, or grey chemical risk ratings and homogeneous materials are assigned A, B, C, X or GREY ratings.

A chemical substance is considered to be assessed when it has been assigned an a, b, c, or x (abc-x) chemical risk rating.

A homogeneous material is considered to be assessed when it has been assigned an A, B, C, or X (ABC-X) assessment rating or is otherwise considered to be assessed based on the specific, relevant methodology (e.g., recycled content assessment methodology, externally managed component methodology).

A material or component that is separately certified and used in another product seeking certification may count as assessed at the same Material Health level and percentage assessed at which it was certified. Materials assessed as A, B, or C may only contain chemicals subject to review that have been assigned a, b, or c chemical risk ratings. Materials assessed as X will contain at least one chemical subject to review that has been assigned an x risk rating, and may also contain chemicals with grey ratings indicating insufficient data for assessment.

Further Explanation

For a material to receive an A, B, or C rating, each of the substances subject to review within the material must receive an a, b, or c rating specific to the use in the applicant material/product (see the Material Health Assessment Methodology and supporting documents). Ratings are assigned by a Cradle to Cradle Certified Material Health assessor.

Alternative Compliance Pathway for Safer Choice Certified Products

There is significant overlap between the requirements for assessing and using optimized chemicals in the Cradle to Cradle Certified Product Standard and the United States Environmental Protection Agency's Safer Choice standard. For this reason, products that have already undergone the assessment and certification process for Safer Choice and have an active certification to Safer Choice, do not need to undergo the full Cradle to Cradle Certified assessment process in order to document fulfillment of the Bronze, Silver, and Gold level requirements in this section or the Gold level requirements in Section 4.6. Instead, a Material Health assessor may follow the following simplified assessment process for products with an active Safer Choice certification:

- Check if ***Terrestrial Toxicity*** data are available for the chemicals subject to review in the product. If data are available, confirm that no chemical would be rated RED in accordance with the criteria for this endpoint in the Cradle to Cradle Certified Material Health Assessment Methodology.
- Confirm that each chemical subject to review in the product meets the GREEN hazard rating for the ***Organohalogens*** endpoint in accordance with the criteria for this endpoint in the Cradle to Cradle Certified Material Health Assessment Methodology (chemical does not contain a carbon to halogen bond).
- Confirm that each chemical subject to review in the product meets the GREEN hazard rating for the ***Toxic Metals*** endpoint in accordance with the criteria for this endpoint in the Cradle to Cradle Certified Material Health Assessment Methodology (i.e., does not contain a toxic metal compound (e.g., antimony, arsenic, cadmium, chromium VI, cobalt, lead, mercury, nickel, thallium, tin (organotins only), radioactive elements, and vanadium)[1].

- If **certain solvents**[2] are contained in the formulation, check that data are available and that the criteria for at least a YELLOW hazard rating are met for the endpoints *Skin and Respiratory Sensitization* and *Mutagenicity* in accordance with the criteria for this endpoint in the Cradle to Cradle Certified Material Health Assessment Methodology.
- Confirm if any **"VOC-exempt" solvents**[3] or **oxidant stabilizers** are contained in the formulation. In case there are, collect data for all toxicity endpoints in accordance with the Cradle to Cradle Certified Material Health Assessment Methodology and confirm that they do not meet the criteria for a RED hazard rating in any endpoints.
- If any **preservatives** or **polymer-related chemicals** (monomers, catalysts, contaminants, byproducts, etc.) are contained in the formulation, confirm for each chemical whether additional data are available for the *Acute Mammalian Toxicity*, *Repeated Dose Toxicity,* or *Skin Sensitization* endpoints. If data are available, confirm that none of the chemicals meet the criteria for a RED hazard rating in any endpoints in accordance with the Cradle to Cradle Certified Material Health Assessment Methodology.
- If any **colorants** (dyestuffs or pigments) are contained in the formulation, confirm for each dyestuff chemical whether additional data are available for *Acute Mammalian Toxicity (Oral)*, or *Skin Sensitization* endpoints. If data are available, confirm that each dyestuff chemical would receive at least a c-assessment rating according to the Cradle to Cradle Certified Colorants Assessment Methodology. For pigment chemicals, make sure that no cleavable aromatic amines are present in the molecule.
- If any **fragrances** are contained in the formulation, they must undergo full assessment according to the Cradle to Cradle Certified Material Health Assessment Methodology.

If any of the above criteria cannot be met by the relevant substances in the product, the Material Health assessor must follow the normal Cradle to Cradle Certified assessment approach for the substances in question. If in doing so, any of the substances are x-assessed or cannot be assessed, the product cannot be certified at the Gold level in the Material Health category. Otherwise, the Bronze, Silver, and Gold level requirements in this section and the Gold level requirement in Section 4.6 are considered fulfilled.

[1] If toxic metals are contained in pigments with rutile, spinel, inverse spinel, or hematite structure the product may still qualify for the Gold level in Material Health if the special conditions for a c-assessment contained in the Cradle to Cradle Certified Colorants Assessment Methodology are met.

[2] These solvents are chemicals that belong to one of the following chemical classes: alcohols, esters, ethylene glycols, ethers, or propylene glycol ethers. Chemicals in these chemical classes are named and defined by their incorporation of specific chemical functional groups. For example, the alcohol class includes chemicals such as isopropanol, ethanol, and methanol due to the incorporation of the -OH group in the chemical.

[3] According to US EPA regulation, a chemical is VOC-exempt if: it has vapor pressure of less than 0.1 millimeters of mercury (at 20 degrees Celsius); Or, if the vapor pressure is unknown: consists of more than 12 carbon atoms, or has a melting point higher than 20 degrees C. and does not sublime (i.e., does not change directly from a solid into a gas without melting).

Required Documentation

- For each material and chemical that is counted as assessed, the final ABC-X or abc-x rating, along with any relevant notes, assessment rationale, and supporting information, as provided by a Cradle to Cradle Certified Material Health Assessment Body.

- Cradle to Cradle certificate(s) for certified materials counted as assessed. The certification must be active (i.e., not expired) and certified to the same standard version in Material Health as that used to assess the other materials in the product. The achievement level must be the same as or higher than the desired achievement level for the product. This information may be listed in the Bill of Materials Form (i.e., certificate numbers, achievement levels, and expiration dates).
- If the alternative compliance pathway is used for a Safer Choice certified product, (1) a copy of the unexpired Safer Choice certificate and (2) documentation from a Cradle to Cradle Certified Material Health assessor demonstrating that the criteria for the alternative compliance pathway have been evaluated and met.

Determining Percentage Assessed

The percentage of the product that is assessed must be determined as follows:

1. For each homogeneous material in a product the applicant must either:
    a. Count the entire material as assessed, by weight, if the material has received an A, B, C, or X (ABC-X) assessment rating. Or,
    b. Count the material as partially assessed based on assessed chemicals subject to review in the material. In this case, the percentage assessed for the material is equal to the lower of:
        i. the percentage by weight of all abc-x assessed chemicals within the material, and
        ii. the percentage by number of all abc-x assessed chemicals within the material.
2. For products consisting of a single homogeneous material, the percentage assessed must be calculated as per 1b above (1a is not allowed).
3. For products composed of two or more homogeneous materials, the percentage assessed is calculated as the weighted average of the percentages assessed for each homogeneous material subject to review in the product.

Further Explanation

Determining Percentage Assessed

For product groups, the overall percentage assessed is equal to the product configuration with the lowest percentage assessed among all those covered by the certification. For modular products, the overall percentage assessed is equal to the individual module with the lowest percentage assessed among those covered by the certification.

Exempt components (defined in Section 5.3 Material and Chemical Inventory) do not count as assessed or count towards the total product weight to be assessed. Note that exempt components are the only materials within a product that are not 'subject to review'.

Any chemical known to meet the criteria for being x-assessed may not be counted as GREY (i.e., hazardous substances present at low concentrations may not be 'hidden' and therefore not count as assessed at the given certification level by giving it a GREY rating).

At the Silver level, assurance that listed SVHCs or x-assessed CMRs are not present in any homogeneous materials, including unassessed homogeneous materials, is required. In other words, if using pathway

#1a, a CMR & SVHC declaration is required for any GREY material and the GREY portion of any X-assessed homogeneous material counting as assessed. If using pathway #1b, a CMR & SVHC declaration is required for any undefined chemicals that are not counted as assessed. See Section 4.6 for additional information.

When following pathway #1b for a material, it is necessary to know or estimate the number of individual substances present in any undefined fraction of the material. To do this, the supplier of the material must provide the total number of substances that are present in the material above the subject to review limits. The supplier may be able and willing to share this information, even if they are not willing to share the identity of the substances. If the supplier provides a number, this number must be used. If the supplier is unable or unwilling to provide this number, a Cradle to Cradle Certified Material Health assessor may estimate the number and provide the estimate and rationale to C2CPII for approval. If approved, the estimate may be used.

Example: Determining the percentage assessed for a homogeneous material (PET):

Chemical name	**CAS**	**% by weight**	**# of chemicals ≥ 100 ppm (i.e., 0.01%)**	**Chemical risk rating**
Polyethylene terephthalate	25038-59-9	97.97	1	b
Antimony trioxide	1309-64-4	0.03	1	x
Titanium dioxide	13463-67-7	1.00	1	c
Additive mixture	unknown	1.00	2	grey (i.e., insufficient data for assessment)
Percentage assessed (calculated via pathway 1b.)		**99%**	=⅗=60%	

Pathway #1a (homogeneous material method): As noted above in the sub-section titled Assessing Chemicals and Materials: *Materials assessed as X will contain at least one chemical subject to review that has been assigned an x risk rating, and may also contain chemicals with grey ratings indicating insufficient data for assessment.* Based on this, in combination with pathway #1a, the PET material would be X-assessed and 100% assessed. The material would be eligible for the Bronze level, but not the Silver level, due to the presence of an x-assessed Cat. 2 CMR (antimony trioxide).

NOTE: This is provided as an example only for how to calculate the percentage assessed for a homogeneous material within a finished product containing multiple homogeneous materials. Pathway #1a is not applicable to single homogeneous material products per the following requirement: *For products consisting of a single homogeneous material, the percentage assessed must be calculated as per 1b above (1a is not allowed).*

Pathway #1b (chemical method): This material would not be eligible for the Bronze level using pathway #1b if only the PET material alone was being assessed for certification since the requirement is for the material to be > 75% assessed. The material is 99% assessed by weight, but only 60% assessed by number of chemicals. The lower percentage assessed must be used if choosing pathway #1b. In this example, the supplier of the "grey" additive is assumed to have stated that there are two chemicals present in the additive mixture at a concentration that would result in their presence above 100 ppm in the PET (given that the concentration of the additive mixture within the PET is 1%).

Example: Determining percentage assessed for a multi-material product: As noted in the standard, use of method #1a only, use of method #1b only, or a combination of methods #1a and #1b may be used to calculate percentage assessed for multi-material products. For all options, *the percentage assessed is calculated as the weighted average of the percentages assessed for each homogeneous material subject to review (*i.e., excluding exempt components, if any) *in the product.*

Scenario: An example product contains three homogeneous materials, as follows:

- Material #1 makes up 55% of the product by weight. Full material disclosure has been obtained and the material is C-assessed.
- Material #2 makes up 41% of the product by weight. The supplier disclosed 99.9% of the formulation by weight which includes nine chemicals, but refuses to provide composition information on the remaining 0.1%, which includes two chemicals (per the supplier). All disclosed substances are c-assessed and the remaining two chemicals are grey. This results in an overall 'grey' rating for the material.
- Material #3 makes up 4% of the product by weight. The supplier has not disclosed any formulation information and so the material is 'grey'.

If employing pathway #1a to determine percentage assessed, the product is 55% assessed (i.e., only material #1 may count as assessed because material #2 and #3 are grey). However, material #2 is 99.9% assessed by weight and 81.8% assessed by number of chemicals (i.e., 9/11*100 = 81.8%). Percentage assessed by number of chemicals is less than the percentage assessed by weight and so must be employed in determining the percentage assessed for the product overall if employing pathway #1b. The percentage of the product assessed using pathway #1b for material #2 is determined as follows:

- Material #1: 100% assessed x 55% of the product by weight = 55%
- Material #2: 81.8% assessed x 41% of the product by weight = 33.5%
- Material #3: 0% assessed x 4% of product by weight = 0%
- Percentage assessed for the product = 88.5% (i.e., 55% + 33.5% + 0%)

Note that in practice it is not necessary to calculate a weighted average if, for each material that is partially assessed, the percentage of assessed chemicals by weight is lower than the percentage of assessed chemicals by number. If this is the case, percentage assessed may be determined by summing the weights of all assessed materials and chemicals in the product and dividing by the total product weight.

Counting Certified Products and Products with Cradle to Cradle Certified Material Health Certificates as Assessed

A certified product for which percentage assessed was calculated using the chemical method (pathway #1b) may count toward the percentage assessed when used as an input to another certified product seeking certification. For example, if an input material was previously found to be 90% assessed via the chemical method, this % would be multiplied by its weight in the new product seeking certification and the result added to the % sum of assessed materials in this new product. This is allowed as long as the product will be certified at the same or lower level as the input material (i.e., a Bronze certified material may be used as an input to a Bronze certified product and count as assessed. A Silver certified material may be used as an input to a Bronze or Silver certified product and count as assessed). Furthermore, in order to count as assessed, the certified

material must be certified to the same standard version in the Material Health category as the product in which it is used (i.e., a product that has a Gold level MHC under Version 4.0 of the standard may count as assessed when used in a product seeking certification under Version 4.0, but it may not count as assessed in a product seeking certification under any other standard version).

Certified products for which the percentage assessed was calculated using the homogeneous material method (pathway #1a) may also count as assessed and are subject to the same conditions. However, they count as assessed at the minimum percentage required for their achievement level in Material Health (i.e., a Bronze level multi-material product will count as 75% assessed when used as an input to another multi-material product, etc.). Alternatively, if the actual percentage is known, that percentage may be used instead.

Required Documentation

- Calculations showing how the percentage assessed for the product or product group was derived. Calculation fields for determining percentage assessed are included in the Bill of Materials form. A separate Bill of Materials form must be completed for product(s) with a unique composition within a product group if using the form for this purpose. For complex product groups, percentage assessed calculations may be provided in other formats.
- Silver level: CMR & SVHC declarations, if required (see guidance above). Note: A CMR & SVHC declaration template is available to Cradle to Cradle Certified assessors.

4.5 Material Health Optimization Strategy

Intended Outcome(s)

A strategy is in place for prioritizing the use of materials and chemicals known to be compatible with human and environmental health. Demonstrable progress is made toward achieving the strategy.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirement(s)

Develop a Material Health optimization strategy and demonstrate progress toward achieving the strategy at each recertification.

For the Bronze and Silver levels, the strategy must include a plan for assessing and optimizing or eliminating all X/x assessed and GREY/grey materials and chemicals subject to review. One or more material(s) or chemical(s) must be targeted for specific optimization actions in the near-term (defined as 0-2 years). Optimization work relevant to at least one material or chemical must have been completed during the two-year period between certification and recertification.
For the Gold and Platinum levels, the strategy must focus on:

1. Increasing the percentage of A/a and/or B/b assessed materials and chemicals in the product, or
2. Optimizing chemistry in the supply chain per Section 4.9.

Further Explanation

The Material Health optimization strategy must cover all X/x assessed and GREY/grey materials and chemicals subject to review across all products covered by the certification. The strategy may apply either to the specific product or product group to be certified, or to all products that are certified across a company's entire certified product portfolio.

For recertification, optimization work that has been completed must apply to at least one product within the product group (i.e., improvements that are applicable only to products covered by other certifications obtained by the same applicant company do not count), or in the case of modular products, may apply to a single module or part that is available as an option across the entire modular product group.

Examples of Optimization Work Receiving Credit

Most optimization work examples listed below may apply either to product constituents or to process chemicals. Although assessment and optimization of process chemicals and identification of hotspots is not required until the Platinum level, optimization work relevant to these may receive credit for any achievement level. Additional actions not listed below may also apply, at C2CPII's discretion.

- Phase out or elimination of the use of one or more X or GREY material(s) (in cases where it is determined the substance or substance alternative is not needed)
- Collection of full material disclosure information in support of the assessment of GREY materials
- Replacement of one or more X or GREY material(s) with preferable alternatives
- Research into possible alternative materials, including availability, performance issues, and costs (Note: **Research alone may count as acceptable optimization work for only one certification period**. In the subsequent certification period, the applicant will be required to move on to performance testing or another one of the acceptable actions listed here)
- Performance testing on one or more alternative materials
- Reduced use of an X or GREY material (in some cases this can lead to a better assessment rating if it is possible to reduce use of the substance to a level at which the substance is below the subject to review threshold or sufficiently low to reduce the overall hazard of the material based on mixture rules, where applicable)
- Assessment of materials or chemicals that were previously GREY
- Work to complete or refine a life cycle hot spot analysis used to identify problematic emissions relevant to human and/or environmental health and attributable to the product (including emissions due to stages outside of the final manufacturing stage)*
- Creation of a plan to address emissions hot spots within stages other than the final manufacturing stage (required at the Platinum level but may receive credit as optimization work at lower levels) and/or taken action against this type of plan (action against plan required for Platinum level renewal)*

* This is an optimization action that is also applicable at the Gold or Platinum level.

Required Documentation

Strategy

- A strategy to optimize, assess, or phase out all X/x assessed and GREY/grey materials and chemicals subject to review (including specification of which materials and/or chemicals will be targeted for optimization work in the near term, i.e., next 0-2 years)
- For recertification, the original strategy and plan, a description of tangible actions that have been taken over the previous certification period, and a revised plan that includes additional near term planned actions.

Section 3.3 Measurable Improvement Credit in Material Health

If applying the measurable improvement credit in the Material Health category, documentation must include one or more of the following (as relevant depending on how the requirement was met):

- Statement and calculation of the percentage assessed increase for at least one product within the group, including prior and current percentage and description of the optimization work that led to the change in percentage
- Statement and calculation of the percentage decrease in the GREY+X assessed fraction for at least one product within the group, including the prior and current percentage of the GREY+X assessed fraction and a description of the optimization work that led to the improvement
- Identification of the material(s) or chemical(s) (if any) that were newly assessed
- Description of the optimization work that led to the measurable improvement
- For the Platinum level hot spot analysis, normalized before and after hotspot results and description of actions taken that caused the change in results (applicant may receive credit for this at any level). See the guidance for standard Section 4.9 Optimizing Chemistry in the Supply Chain for additional information and references for hotspot analysis.

4.6 Using Optimized Materials

Intended Outcome(s)

The product is made from chemicals and materials that have been intentionally selected based on their preferred safety attributes.

- At the Silver level, the product does not contain chemicals classified or listed as carcinogenic, mutagenic, or reproductive toxicants (CMRs), or, if these substances are present, exposure to them is unlikely or expected to be negligible. In addition, the product does not contain persistent, bioaccumulative, and toxic (PBTs) or very persistent and very bioaccumulative (vPvBs) substances. The product also does not contain substances that cause an equivalent level of concern or exposure to them is unlikely or expected to be negligible.
- At the Gold level, chemicals and materials intentionally added to the product are assessed as compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology. Exposure to hazardous chemicals during final

manufacture, use, and end-of-use of the product is unlikely or expected to be negligible.

- At the Platinum level, an increased percentage of the product is made from chemicals and materials that are assessed as preferable for human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology. Additionally, process chemicals are assessed as compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology.

Applicable Achievement Level(s)

Silver, Gold, and Platinum

Requirement(s)

Silver level: Use materials in the product that do not contain substances that are:

- Classified or listed as known or suspected to cause cancer, birth defects, genetic damage, reproductive harm (CMRs), or cause an equivalent level of concern, unless exposure to these substances during the product's final manufacturing, use, and end-of-use is unlikely or expected to be negligible, or
- Listed as persistent, bioaccumulative, and toxic (PBTs) or very persistent and very bioaccumulative (vPvBs).

Gold level: Use materials that are assessed as compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology, including only A/a, B/b, and C/c assessed materials and chemicals in the product.

Platinum level: Use materials and process chemicals that are assessed as preferable for human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology, including > 50% A/a and B/b assessed materials and chemicals in the product (see "Determining Percentage Assessed" in Section 4.4), and only A/a, B/b, and C/c assessed process chemistry.

For the Silver level, CMRs are defined as substances that have received a harmonized classification of Category 1 or 2 in one or more of the CMR endpoints as listed within the EU's Classification, Labelling, and Packaging regulation (CLP) Annex VI, or are CMR substances listed on the REACH Candidate list of Substances of Very High Concern (SVHC) for Authorisation (including those on Annex XIV). PBTs, vPvBs, and substances causing an equivalent level of concern are defined per the REACH Candidate list of Substances of Very High Concern (SVHC) for Authorisation (including those on Annex XIV).

Further Explanation

Assessment Ratings

For a material to receive an A, B, or C rating, each of the substances subject to review within the material must receive an a, b, or c rating. The ratings for each substance consider its specific use in the applicant material/product and are determined by the Cradle to Cradle Certified Material Health assessor (see the Material Health Assessment Methodology and supporting documents).

Alternative compliance pathway for US EPA Safer Choice certified products to meet the Gold level requirement

Please see Section 4.4 regarding the alternative compliance pathway for US EPA Safer Choice certified products to demonstrate compliance with the Gold level requirement in this section.

Silver Level: Verifying Absence of CMRs, PBTs, vPvBs, and Substances of Equivalent Concern

For each homogeneous material in the product (excluding exempt components as defined in Section 4.3 Material and Chemical Inventory), absence of CMRs, PBTs, vPvBs, and Substances of Equivalent Concern must be verified by a signed CMR & SVHC declaration from the material supplier, analytical testing (in the case of recycled content, biological, or geological materials), and/or full material disclosure. For any listed substance that is present at 100 ppm or above and not a PBT or vPvB, a Cradle to Cradle Certified Material Health Assessor (not a supplier or the applicant) may conduct an exposure assessment to determine whether exposure to the substance is expected to be negligible or may be considered unlikely. Note that reproductive toxicants that have received YELLOW hazard ratings per the Cradle to Cradle Certified Material Health Assessment Methodology are considered to be of negligible exposure concern when used below the limit indicated on the RSL or SCL, whichever is lower. This is true unless the applicable substance is listed on the Candidate List of Substances of Very High Concern or on REACH Annex XVII (in which case a YELLOW hazard rating is not allowed). Once absence of CMRs, PBTs, vPvBs, and substances of equivalent concern, or negligible or unlikely exposure has been verified for all listed substances present in the product's homogeneous materials, the requirement is fulfilled.

Category 1 and 2 CLP CMRs

The European Chemicals Agency (ECHA) has prepared an Excel table containing all updates to the harmonized classification and labelling of hazardous substances, which is available in Table 3.1 of Annex VI to the CLP Regulation. The harmonized classification and labelling of hazardous substances is updated through an "Adaptation to Technical Progress (ATP)", which is issued yearly by the European Commission. Following the adoption of the opinion on the harmonized classification and labelling of a substance by the Committee for Risk Assessment (RAC), the European Commission publishes the updated list in an ATP: https://echa.europa.eu/information-on-chemicals/annex-vi-to-clp

Note that the Specific Concentration Limits (SCLs) as specified in Annex VI to the CLP for the relevant endpoints apply for the purpose of this requirement. If a substance is listed as a Category 1 or 2 in one or more of the CMR endpoints with SCL(s) assigned to that/those endpoints, it is only considered classified for the relevant endpoints at or above the SCL(s). Such substances are allowed at the Silver level in the Material Health category if they are present in the homogeneous materials of the finished product below their defined SCL(s) for any classified CMR endpoints.

PBTs, vPvBs, and substances of equivalent concern listed on REACH SVHC list

The SVHC candidate list is maintained by ECHA here: https://echa.europa.eu/candidate-list-table. Any substances listed as PBT or vPvB on this list would prevent a product from meeting this requirement if present above the subject to review threshold. For other substances listed, the Cradle to Cradle Certified Material Health Assessor may conduct an assessment following the usual methodology. If the substance present is x-assessed in the product, this would prevent the product from meeting the Silver level requirement. However, if the substance is c-assessed or better, its presence does not prevent a product from meeting this requirement.

CMR & SVHC declarations

To demonstrate compliance with this requirement, declarations/attestations must be obtained from the supplier of each homogeneous material in the product for which full material disclosure is not available (excluding exempt components as defined per Section 4.3). C2CPII provides assessors with a supplier declaration form for this purpose. Declarations must be signed and dated, reference the specific EU lists included in this requirement at the stated date, and attest to the presence or absence of all of the substances on these lists. If any listed substances are present, their identity and concentration must be disclosed on the form. For materials for which full material disclosure has been obtained, the assessor may check the disclosed information against the CLP and SVHC lists. However, collection of a signed supplier declaration regarding presence or absence of listed CMRs and SVHCs is still recommended as an added precaution.

Required Documentation

All certification levels

- For each material and chemical that is counted as assessed, the final ABC-X or abc-x rating, along with any relevant notes, assessment rationale, and supporting information, as provided by a Cradle to Cradle Certified Material Health Assessment Body

Silver level

The following are required for each homogeneous material in the product (excluding exempt components as defined per Section 4.3):

- Full material disclosure regarding the chemical composition of the material and confirmation from a Cradle to Cradle Certified Material Health assessor regarding the absence of classified CMRs or listed PBTs, vPvBs, or substances of equivalent concern (or negligible or unlikely exposure to these substances).
  OR
  If full material disclosure is not available, signed and dated CMR & SVHC declaration(s) referencing the current version of Table 3.1 in Annex VI to the CLP Regulation and the REACH SVHC list.
- For recycled content, biological materials, and geological materials, analytical testing in compliance with the restricted substance list requirements as specified in the appropriate material specific methodology. If these materials contain additives or other inputs beyond the biological, geological, or recycled material, CMR & SVHC declaration(s) or full material disclosure as described in the bullet above is required in addition to analytical testing.

Determining Percentage A/a and B/b-assessed for Platinum level

The percentage of the product that is assessed must be determined as follows:

1. For each homogeneous material in a product the applicant must either:
   a. Count the entire material as assessed, by weight, if the material has received an A or B

assessment rating. Or,

b. Count the material as partially assessed based on assessed chemicals subject to review in the material. In this case, the percentage assessed for the material is equal to the lower of:
   i. the percentage by weight of all a or b assessed chemicals within the product, and
   ii. the percentage by number of all a or b assessed chemicals within the product.

2. For products consisting of a single homogeneous material, the percentage A/a- and B/b-assessed must be calculated as per 1b above (1a is not allowed).
3. For products composed of two or more homogeneous materials, the percentage A/a and B/b assessed is calculated as the weighted average of the percentages assessed for each homogeneous material subject to review in the product.

Further Explanation

The method for calculating the percentage of A/a and B/b-assessed materials and/or chemicals is the same as the method for calculating the percentage assessed for the product in Section 4.4, with one exception: only the percentage of A/a and B/b-assessed materials and/or chemicals, rather than the percentage of all assessed materials and/or chemicals, is determined.

For product groups, the overall percentage of A/a and B/b-assessed materials and/or chemicals is equal to the percentage for the product with the lowest percentage A/a and B/b-assessed materials and/or chemicals among all products covered by the certification. For modular products, the overall percentage of A/a and B/b-assessed materials and/or chemicals is equal to the percentage for the individual module with the lowest percentage A/a and B/b-assessed materials and/or chemicals among all those covered by the certification.

Required Documentation

- Calculations showing how the percentage of A/a and B/b-assessed materials and/or chemicals for the product or product group was derived. Calculation fields for determining the percentage of the product that is A/a- and B/b-assessed are included in the Bill of Materials form. A separate Bill of Materials form must be completed for product(s) with a unique composition within a product group if using the form for this purpose. For complex product groups, percentage assessed calculations may be provided in other formats.

4.7 Volatile Organic Compound (VOC) Emissions

Intended Outcome(s)

Indoor air quality is protected.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Products designed for permanent indoor use comply with leading standards that demonstrate low VOC emissions.

Gold level: Products designed for permanent indoor use comply with leading standards that demonstrate very low to no VOC emissions.

Products designed for permanent indoor use are products that are installed or placed into a building and remain there (e.g., this includes furniture, but not cleaning products).

To demonstrate fulfilment of this requirement, an applicant must show compliance of the product with the requirements of at least one regional set of best practices for qualifying low VOC emission products. Best practices are defined by the current versions of the leading green building certification systems or standards in a given region (such as BREEAM, DGNB, or LEED). See the *Cradle to Cradle Certified® Volatile Organic Compound Emissions Testing* reference document for a list of recognized standards for the Silver and Gold levels.

Test Report and Laboratory Accreditation Requirements

For the Silver and Gold levels, the following conditions must also be met:

1. Test report or certificate must refer to a test completed/performed no more than two years prior to the date of application, and
2. The analytical laboratory conducting the test must be ISO/IEC 17025 accredited and the accreditation scope must include the applied test method, either explicitly or implicitly within the scope of a flexible ISO/IEC 17025 accreditation for VOC product emission testing.

Further Explanation

The *Cradle to Cradle Certified® Volatile Organic Compound Emissions Testing* reference document can be found on C2CPII's website.

ISO/IEC 17025 accreditation is valid for specific test methods (as opposed to applying to an entire lab). Some testing laboratories claim to be ISO/IEC 17025 accredited even though their accreditation is only valid for certain test methods, and not for all test methods. To ensure compliance, it must be confirmed that the applied test method is covered by the scope of the chosen laboratory's accreditation.

It must further be ensured that the tested sample(s) are representative of the range of products covered by the certification. If sample selection was conducted by the testing laboratory or third-party samplers, the test report should include a description of the sampling approach and an explanation of why the selected samples are expected to be representative of the entire range of products covered by the certification. If the applicant selected the samples, this description must be submitted separately from the testing report.

Regarding the requirement that the test report must refer to a test completed/performed no more than two years prior to the date of application:

- For new certifications, the date of application is the date on which the certification application is received by C2CPII.
- For re-certifications, a new test must have been conducted at some point during the previous certification period. Since the certification period is currently two years, this results in repeat testing being necessary approximately every two years.

Required Documentation

- Explanation of which pathway from the C2CPII Volatile Organic Compound Emissions reference document was followed and how the specific requirement(s) of the pathway have been met
- Test report from an ISO/IEC 17025 accredited laboratory demonstrating compliance
- Evidence of the laboratory's ISO/IEC 17025 accreditation and confirmation that the specific test method used is covered by the accreditation
- If not part of the report, description of sampling approach and explanation of how the selected samples are representative of the products covered in the scope of the certification

Exemption

Products made entirely from the following material types are exempt from VOC emissions testing and may be assumed to have low to no VOC emissions:

1. Materials classified as inherently non-emitting sources per the LEED v4 Building Design and Construction EQ Credit Low-Emitting Materials (stone, ceramics, powder-coated metals, plated metals or anodized metals, glass, concrete, clay brick, and unfinished/untreated solid wood) if they do not include integral organic-based surface coatings, binders, or sealants, and
2. Plaster and stucco that have < 1% organic additives.

Note: Unfinished/untreated wood (i.e., wood without organic-based surface coatings, binders, or sealants) can emit VOC and therefore it is not technically non-emitting. However, it is still exempt from this requirement in keeping with LEED v4 Building Design and Construction EQ Credit Low-Emitting Materials.

Further Explanation

If it is unclear whether a product is inherently non-emitting per the LEED v4 Building Design & Construction EQ Credit Low-Emitting Materials (for example, because surface treatments have been applied), the applicant must verify the non-emitting status of their product via expert evaluation and explanation, supplier statements, or "streamlined" (i.e., short duration, high intensity) VOC emissions tests.

Required Documentation

One of the following:

- Statement(s) from material suppliers asserting that materials are non-emitting
- Streamlined VOC emissions test report documenting no detectable emissions
- Expert evaluation asserting that the materials/product are non-emitting and explaining why

4.8 Volatile Organic Compound (VOC) Content

Intended Outcome(s)

Outdoor air quality and the health of product installers and users are protected.

Applicable Achievement Level(s)

Silver

Requirement(s)

For liquid, viscous, or aerosol consumer or construction products, limit volatile organic compound (VOC) content to low levels as established by leading standards.

To demonstrate fulfilment of this requirement, an applicant must show compliance of the product with the requirements of at least one regional set of best practices for qualifying low VOC content products. Best practices are defined by the current versions of the leading green building certification systems or standards in a given region (such as BREEAM, DGNB, or LEED). See the *Cradle to Cradle Certified® Volatile Organic Compound Content Limits* reference document for a list of recognized standards and test methods.

The following conditions must also be met:

1. Test reports or certificate (if applicable) must refer to a test performed within two years prior to the date of application, and
2. The analytical laboratory conducting the test (if applicable) must be ISO/IEC 17025 accredited and the accreditation scope must include the applied test method, either explicitly or implicitly within the scope of a flexible ISO/IEC 17025 accreditation for VOC product testing.

Exemptions

Products that are not covered by any of the standards or regulations listed in the *Cradle to Cradle Certified® Volatile Organic Compound Content Limits* reference document are exempt from this requirement.

Water-based consumer products are exempt from this requirement if the only organic substances with vapor pressure ≥ 0.1 mm Hg at 20°C that are subject to review are ethanol, isopropanol, or fragrances and legally mandated denaturants (e.g., 2-butanone for ethanol products).

Further Explanation

The *Cradle to Cradle Certified® Volatile Organic Compound Content Limits* reference document can be found on C2CPIIs website.

ISO/IEC 17025 accreditation is valid for specific test methods (as opposed to applying to an entire lab). Some testing laboratories claim to be ISO/IEC 17025 accredited even though their accreditation is only valid for certain test methods, and not for all test methods. To ensure compliance, it must be confirmed that the applied test method is covered by the scope of the chosen laboratory's accreditation.

It must further be ensured that the tested sample(s) are representative of the entire range of products covered by the certification. If sample selection was conducted by the testing laboratory or third-party samplers, the test report should include a description of the sampling approach and an explanation of why the selected samples are expected to be representative of the range of products covered by the certification. If the applicant selected the samples, this description must be submitted separately from the testing report.

Required Documentation

- Explanation of which pathway from the C2CPII Volatile Organic Compound Content Limits reference document was followed and how the specific requirement(s) of the pathway have been met
- If applicable, test report from an ISO/IEC 17025 accredited laboratory demonstrating compliance
- Evidence of the laboratory's ISO/IEC 17025 accreditation and confirmation that the specific test method used is covered by the accreditation
- If applicable and not part of the report, description of sampling approach and explanation of why the selected samples are representative of the products covered in the scope of the certification

4.9 Optimizing Chemistry in the Supply Chain

Intended Outcome(s)

The use and emissions of hazardous chemicals in the product's supply chain are reduced or eliminated over time.

Applicable Achievement Level(s)

Platinum

Requirement(s)

Address hazardous chemicals in the product supply chain and develop a strategy to further reduce hazardous chemical use and/or emissions in the supply chain. Demonstrate progress toward achieving reductions at each recertification.

Hazardous chemicals in the product supply chain must be addressed by meeting one of the following:

1. 75% or more of the product's input materials or chemicals have a C2CPII Material Health Certificate OR 50% or more are Cradle to Cradle Certified at the Gold or Platinum level or equivalent (percentage is calculated following the approach described for "Determining Percentage Assessed" in Section 4.4, but summing certified materials and/or chemicals rather than assessed materials and/or chemicals).

Further Explanation

The method for calculating the percentage of certified input materials or chemicals is the same as the method for calculating the percentage assessed for the product in Section 4.4, with one exception: only the percentage of certified input materials and/or chemicals, rather than the percentage of all assessed materials and/or chemicals, is determined.

For product groups, the overall percentage of certified inputs is equal to the percentage for the product with the lowest percentage of certified inputs among all the products covered by the certification. For modular products, the overall percentage of certified inputs is equal to the percentage for the individual module with the lowest percentage of certified inputs among all those covered by the certification.

It is possible to combine Cradle to Cradle Certified inputs and inputs with Cradle to Cradle Certified Material

Health Certificates in order to fulfill this requirement. If (1.5*%C2C Certified inputs in the product by weight + % inputs with Cradle to Cradle Certified Material Health Certificates by weight) = 75% or more, the requirement has been met.

Required Documentation

- Calculations showing how the percentage of certified inputs for the product or product group was derived
- Certificates or registry links as evidence that all inputs being claimed as certified are covered by active certifications

2. A cradle to cradle human and environmental health impact hot spot analysis has been performed based on life cycle assessment per ISO 14040, and each of the hot spots identified through this analysis are addressed by the strategy to reduce hazardous chemical use and/or emissions in the supply chain of the product. The life cycle assessment must be verified by a qualified third party.

Further Explanation

The methodology for completing a hotspot analysis must be informed by the EU Product Environmental Footprint (PEF) project (see Annex D) and Product Environmental Footprint (PEF) Guide. Please see these documents for further guidance.

In alignment with the PEF guidance, the following impact categories, with data expressed in the units listed in Table 2 of the PEF guidance (e.g., tCO2eq), are to be used:

Impact Category	Indicators (units)	Model and Source
Human toxicity - cancer effects	CTUh (Comparative Toxic Unit for humans)	USEtox model, Rosenbaum et al., 2008
Human toxicity - non-cancer effects	CTUh (Comparative Toxic Unit for humans)	USEtox model, Rosenbaum et al., 2008
Particulate matter/Respiratory inorganics	kg PM2.5 equivalent	RiskPoll model, Humbert, 2009
Photochemical ozone/Smog formation	kg NMVOC equivalent	LOTOS-EUROS model, Van Zelm et al., 2008 as applied in ReCIPe
Ionizing radiation - human health effects	kg U235 equivalent (to air)	Human Health effect model, Dreicer et al., 1995
Acidification	Mol H+ eq	Accumulated Exceedance model, Seppälä et al, 2006; Posch et al., 2008
Ozone depletion	kg CFC-11 equivalent	EDIP Model, WMO, 1999

The following impact categories are not required to be included for the Material Health category analysis

(although these are required per the PEF guidance and will be useful in meeting the requirements of other Cradle to Cradle program categories):

- Climate change: This endpoint is covered within the Clean Air & Climate Protection category
- Ecotoxicity - aquatic freshwater: This endpoint will be covered in the Water & Soil Stewardship category
- Eutrophication - freshwater, terrestrial, and marine: This endpoint will be covered in the Water & Soil Stewardship category and is also indirectly tied to energy use and type/quality
- Resource depletion (water): This endpoint will be covered in the Water & Soil Stewardship category
- Resource depletion (fossil/mineral): This endpoint is indirectly covered by the Product Circularity requirements and Clean Air & Climate Protection requirements
- Land Transformation: Data may not be available. Not required at this time

Also in alignment with the PEF pilot phase project, the following life cycle stages are to be included in the analysis:

- Raw material acquisition and pre-processing (including production of parts and unspecific components);
- Production of the main product;
- Product distribution and storage;
- Use stage scenario (if in scope);
- End-of-life (including product / part reuse, recovery / recycling, if in scope).

A hotspot is defined as either of the following (see EU Product Environmental Footprint (PEF) Annex D including *D.5 Example* for additional guidance):

- OPTION A: (1) life cycle stages, (2) processes and (3) elementary flows cumulatively contributing at least 50% to any impact category (before normalization and weighting)
- OPTION B: At least the two most relevant life cycle stages, processes and elementary flows (i.e., a minimum of six hotspots in total). This is defined as the two life cycle stages, two processes and two elementary flows contributing cumulatively more than 80% to any impact category. Note: The procedure to identify the most relevant life cycle stages, processes and elementary flows is detailed in section D.3 and D.4 of EU Product Environmental Footprint (PEF) Annex D. Please see the linked document for further information.

Additional methods that may inform the analysis are as follows. These may be employed as long as the requirements in the standard and guidance are also met.

- UNEP/SETAC Life Cycle Initiative Hotspots Analysis: Methodological Framework and Guidance
- Other methods may be added here in the future at the discretion of C2CPII

Required Documentation

- All points mentioned in *Section 8.2.1 Summary* of the PEF Guidance document (see link or most recent

version if document is updated) are to be provided:

- Key elements of the goal and scope of the study with relevant limitations and assumptions;
- A description of the system boundary;
- The main results for each of the impact categories (i.e., totals for each category);
- If applicable, environmental improvements compared to previous periods;
- Relevant statements about data quality, assumptions, and value judgements;
- A description of what has been achieved by the study, any recommendations made and conclusions drawn. This must include a list of the hotspots identified using the definition above (see Appendix D, Section D.5.5 of the EU Product Environmental Footprint (PEF) project guidance).

- Evidence of Life Cycle Assessment verification and third-party qualifications.

Depending on how hazardous chemicals in the product supply chain are addressed, the strategy must include one of the following:

1. Steps to increase the percentage of the product's input materials or chemicals that have a C2CPII Material Health Certificate or are Cradle to Cradle Certified at the Gold or Platinum level (or equivalent) over time and also specifically to increase the percentage of inputs that are certified at the Platinum level.
2. Steps to positively impact (i.e., eliminate or reduce use or emissions of hazardous chemicals) for each of the supply chain hotspots identified through the life cycle assessment.

Required Documentation

- Strategy addressing the required points (Note: This strategy may be incorporated into the Section 4.5 strategy)
- At recertification, a description of progress made

5 // Product Circularity Requirements

Category Intent

Products are intentionally designed for their next use and are actively cycled in their intended cycling pathway(s).

Requirements Summary

To achieve a desired level within the category, the requirements at all lower levels must also be met.

Bronze	Applicant is involved in a circularity education initiative to gain an understanding of relevant cycling infrastructure development.
	Intended cycling pathway(s) for the product and its materials are defined.
	A plan has been created to address challenges with the cycling infrastructure at the end of the product's first use; potential cycling partners have been identified.
	Select product and material types contain cycled and/or renewable content. Alternative: Limitations that prevent achievement of this requirement are publicly reported.
	≥ 50% of materials by weight are compatible with the intended cycling pathway(s) (i.e., recyclable, compostable, or biodegradable).
	Circularity data and cycling instructions are publicly available.
Silver	Partnerships for cycling (recovery and processing) of the product have been initiated. If the product is intended for cycling via municipal systems, materials are compatible with those systems.
	Percentage of cycled and/or renewable content, by weight, is equal to or higher than industry averages and/or is consistent with common practice. Alternative: Limitations that prevent achievement of this requirement are publicly reported.
	≥ 70% of materials by weight are compatible with the intended cycling pathway(s) (i.e., recyclable, compostable, or biodegradable).
	A strategy for improving product circularity is developed including plans for: • Increasing the amount of post-consumer recycled content and/or responsibly sourced renewable material, as relevant to the product type, • Implementing a circular opportunity or innovation, and • Improving the product's design for disassembly (if relevant).

Gold	Percentage of cycled and/or renewable content, by weight, is consistent with values achieved by industry leaders for the product type. Alternative: Limitations that prevent achievement of this requirement are publicly reported.
	≥ 90% of materials by weight are compatible with the intended cycling pathway(s) (i.e., recyclable, compostable, or biodegradable) and support high-value cycling. This means that the materials are of high quality and are likely to retain their value for subsequent use. If relevant, parts containing these materials are designed for easy disassembly.
	The strategy has been implemented including: Increased use of post-consumer and/or responsibly sourced renewable material as relevant to the product type. Alternative: Limitations that prevent increased use are publicly reported. A circular opportunity or innovation that increases product circularity.
	The product is actively cycled (recovered and processed) and/or a program is implemented to increase the cycling rate or quality of the product's materials after use. (Both are required for short-use phase products; one is required for long-use phase products.) For select single-use plastic products, a minimum cycling rate of 50% is achieved.
Platinum	At least two intended cycling pathways are defined for the product and its materials.
	Percentage of cycled and/or renewable content, by weight, has reached the technically feasible maximum.
	≥ 99% of materials by weight are compatible with the intended cycling pathway(s) (i.e., recyclable, compostable, or biodegradable). If relevant, parts containing these materials are designed for easy disassembly.
	The product is actively cycled in an amount consistent with the product's use phase (the shorter the use phase, the higher the minimum percentage required) and a program is implemented to increase the cycling rate or quality of the product's materials after use.
	Cycling rates and quality are monitored over time, and an increase in cumulative cycling rate or quality is demonstrated.

5.1 Circularity Education

Intended Outcome(s)

The applicant has an increased scope of knowledge regarding the circularity potential of their product and has identified opportunities and solutions for overcoming barriers to actively cycling their product via biological and/or technical pathways.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Participate in a circularity education initiative to obtain practical knowledge about developing or improving upon the infrastructure needed for the product to be part of a circular system.

The circularity education initiative must be led by:

1. A company or organization other than the applicant company, and focused on developing the circular economy, or
2. The applicant company, and be a collaborative platform that involves other companies or organizations.

The initiative must:

1. Support learnings toward implementing the company's circularity strategies and cycling infrastructure.
2. Aim to drive progress within an industry or across multiple industries.
3. Ensure that the initiative allows for adequate voice for all participants.

The applicant company must have actively participated in an initiative within the last two years prior to certification or recertification.

Further Explanation

Selecting a Circularity Education Initiative

Examples of applicable circularity initiatives include the following:

- Education initiative
- Attendance at conferences or workshops addressing circular economy topics
- Building of infrastructure (e.g., International Electronics Manufacturing Initiative)
- Cooperation with government or municipalities (e.g., San Francisco Recology)
- Membership to and active participation in consortiums or group initiatives (e.g., Ellen MacArthur Foundation CE100, Circular Fibers Initiative, New Plastics Economy, Sustainable Packaging Coalition, Sustainable Purchasing Leadership Council, Industry Association where circular initiatives are being discussed, Healthy Printing Initiative)
- Contributing to public debate through engagement in networking events on the subject
- Member of the Product Stewardship Institute
- Internal training from external organization (e.g., consultant)

Required Documentation

- Name and description of the project or initiative addressing all required points.
- Evidence that the initiative exists and that the applicant is currently actively involved. For example, a link to or copy of web page where the initiative is described that lists the applicant as a participant or a signed and dated contract for training services provided.

5.2 Defining the Product's Technical and/or Biological Cycles

Intended Outcome(s)

The applicant has designated all homogeneous materials in the product as either biological or technical and has identified appropriate cycling pathways for those materials once the product has reached the end of its current use cycle.

Applicable Achievement Level(s)

Bronze and Platinum

Requirement(s)

Bronze level: Designate all homogeneous materials in the product as being intended for technical and/or biological cycles and define the intended cycling pathway(s) for each material. For materials designated for technical cycles, recycling must be one intended cycling pathway.

Platinum level: Define at least two intended cycling pathway(s) for each homogeneous material in the product.

The following homogeneous materials must be designated for the biological cycle:

1. Materials designed to be released directly to the biosphere as part of their intended use or cycling pathway (e.g., liquid cleaning products, soaps, perfume, toilet paper),
2. Biological or biologically derived materials commonly released to the biosphere (e.g., paper), and
3. Coatings, finishes, or liquids applied to materials intended for biological cycles.

For intermediate and wet-applied products, the Bronze level requirements must be applied in the context of at least one relevant finished product or applied substrate example application, respectively.

Exemption

Intermediate and wet-applied products are exempt from the Platinum level requirement.

Further Explanation

Designating Materials for Technical and/or Biological Cycles

For the Bronze level, all homogeneous materials in the product must be designated as being intended for technical and/or biological cycles. The following definitions are included in the Definitions section:

- **Biological cycle** – The cycle by which materials or parts are released to, and ideally reprocessed in, the environment via composting, biodegradation, nutrient extraction, or other biological metabolic pathways.
- **Technical cycle** – The cycle by which a product's materials or parts are reprocessed for a new product use cycle via recycling, repair, refurbishment, remanufacturing, or reuse.

Metals (e.g., steel, aluminum) are examples of materials that are appropriate for the technical cycle. Cleaning products and personal care products that are used in 'down the drain' type applications (e.g., shampoo) are, by design, intended for the biological cycle. Note that some materials may be appropriate for both the biological and technical cycle. Paper, for example, is highly recyclable as well as commonly biodegradable. In addition,

during recycling processes, paper fibers are unavoidably released to the environment. For these reasons, it is appropriate (and required) to designate and design paper for both cycles.

Defining the Intended Cycling Pathways

In addition to designating materials for the biological and/or technical cycle, the intended cycling pathway(s) for each material must be defined. The following definition is included in the Definitions section:

- **Cycling pathway** – A specific method, system, or other means of processing a material at the end of its use phase. Examples include: municipal recycling, home composting, aerobic biodegradation in wastewater (i.e., at municipal treatment plant), take-back and repair/remanufacture by the manufacturer.

Technical Cycling Pathways

If a material is designated for the technical cycle, one or more of the following must be selected as the intended cycling pathway(s) – **one of which must be recycling**. Recycling must always be a designated pathway because it is not possible to endlessly reuse and repair.

- Reuse/Recontextualizing
- Repair
- Refurbish
- Remanufacture
- Recycling

Biological Cycling Pathways

If a material is designated for the biological cycle, one or more of the following must be selected as the intended cycling pathway(s):

- Nutrient extraction
- Anaerobic digestion
- Composting (Home)
- Composting (Industrial)
- Biodegradation (Soil)
- Biodegradation (Water)
- Biodegradation (Anaerobic)

It must be possible to cycle the product via the chosen intended pathway(s), at least at the pilot scale (e.g., at small-scale under "normal" processing conditions). This may be demonstrated specifically for the product or for one or more similar product(s) that is/are already being cycled in the intended pathway(s). A similar product is defined as a product with similar application/use, material composition, disassembly requirements, and end-of-use conditions.

In addition to specifying the pathway (i.e., process(es) in the lists above), the applicant must also specify the entity intended to carry out the process (i.e., consumer, municipal waste processing facility, the applicant, current or future partner organization(s), etc.).

Required Documentation

- Bill of Materials Form or similar including the intended cycling pathway for each homogeneous material.
- Evidence that materials in the product can be cycled via the chosen intended pathway(s), including a description of at least pilot scale cycling for the applicant product or similar. If the evidence is for a similar product, a description of how the comparable/similar product is similar in application/use, material composition, disassembly requirements, and end-of-use conditions is required.

5.3 Preparing for Active Cycling

Intended Outcome(s)

The applicant has taken demonstrable steps toward addressing any barriers to material recovery and processing in order to actively cycle those materials for their next use.

Applicable Achievement Level(s)

Bronze and Silver

Requirement(s)

Bronze level: Develop a cycling plan to address challenge(s) inhibiting development of the cycling infrastructure for the product at the end of its first use, and identify potential partners that are capable of recovering and processing the product. Report on progress made toward achieving the plan at recertification.

Silver level: Initiate partnerships for recovery and processing of the product according to its intended cycling pathway(s). If the product is intended for cycling via municipal systems, use materials that are compatible with those systems.

For the Bronze level, the cycling plan must include the following:

1. Discrete planned actions and an associated timeline.
2. Identification of potential partners or internal resources for product recovery and processing in accordance with the intended cycling pathway(s) in countries and/or states that cumulatively cover a region accounting for 60% or more of product sales (with one exception per #3 below). Products intended to be cycled via municipal systems or addressed by regional/national product stewardship laws are exempt from this requirement.

Further Explanation

Determining If 60% or More of Product Sales are Covered (Requirement #2)

Requirement #2 above requires that potential partners or internal resources be *identified in countries and/or states that cumulatively cover a region accounting for 60% or more of product sales*. To determine whether or not the required 60% has been achieved:

- List the countries and/or (for the United States and other countries where appropriate) states/regions where the product is sold and where the partners and/or internal resources for product recovery and

processing have also been identified.

- List the percentage of applicant product sales that occurs in each of these countries and/or states/regions.
- Check that the sum of these percentages is ≥ 60%.

3. For intermediate and wet-applied products, the plan must address challenges inhibiting development of the cycling infrastructure for at least one finished product or applied substrate example application, respectively. Identification of potential partners is not required for these product types.
4. For products containing electronic components, the plan must address the recovery and recycling of intentionally used trace elements whose extraction is associated with risks of limited supply (i.e., "scarce elements").

At recertification, progress must be demonstrated on any planned actions.

Further Explanation

Definition of Scarce Elements (Applicable to Electronic Components)

Scarce elements are defined per the European Commission's Critical Raw Materials list. This list includes trace and major elements that are used in electronic components and other applications (e.g., phosphorus used in agriculture). The trace elements typically used in electronic components, and for which electronics represent a clear driver of demand, are required to be addressed in cycling plans for electronics (if used). Currently, these are:

- All rare-earth elements: Cerium, dysprosium, erbium, europium, gadolinium, holmium, lanthanum, lutetium, neodymium, praseodymium, promethium, samarium, scandium, terbium, thulium, ytterbium, and yttrium.
- Platinum-group metals: Platinum, palladium, rhodium, iridium, ruthenium, and osmium.
- Others: Antimony, barium, beryllium, bismuth, cobalt, fluorine (inorganic), gallium, germanium, hafnium, indium, niobium, tantalum, tungsten, silicon, vanadium.

Excluded materials are: Graphite, natural rubber, phosphate rock, phosphorus, borate, magnesium.

Demonstrating Progress on Implementing the Cycling Plan

For recertification, examples of progress that would receive credit include:

- Furthering and/or finalizing some of the contracts with potential partners that were identified at the initial Bronze level certification
- Initiating pilot project(s) to test recovery options and/or partnership effectiveness
- Plan refinement informed by a cradle to cradle life cycle assessment (i.e., use of life cycle assessment to identify the lowest impact cycling option(s) from an environmental perspective and refine the plan accordingly).

For the Silver level, one or more of the following is required in countries and/or states that cumulatively cover a region accounting for 60% or more of product end sales:

1. The applicant company or retail partner has initiated partnership(s) or dedicated internal resources for product recovery and processing. (Initiation of a partnership is defined as the applicant company having an active agreement or contract(s) with entities involved in the recovery and processing of the product for another use cycle.)
2. A product stewardship law or program for the particular product type is in place (e.g., California Carpet Stewardship Law).
3. If intended for cycling via municipal systems, materials are a type that is commonly recycled or composted via curbside pickup and the material is accepted by municipal recycling programs in the region(s) where the product is sold.

Further Explanation

Determining If 60% or More of Product Sales are Covered

To determine whether or not the required 60% has been achieved:

- List the countries and/or (for the United States and other countries where appropriate) states/regions where the product is sold and where one or more of the cycling solutions as listed in #1-3 above has been initiated.
- List the percentage of applicant product sales that occurs in each of these countries and/or states/regions.
- Check that the sum of these percentages is ≥ 60%.

The following may be considered 'commonly recycled or composted via curbside pickup' for #3 above. If these materials are accepted by municipal recycling programs in the region (country or state) where the product is sold, the region may be counted towards the required 60%.

- For all regions: aluminium/aluminum, steel, paper, and glass
- For the European Union: PET, HDPE, PP, and compostable plastics
- For the United States and other regions outside of the European Union: PET, HDPE, and compostable plastics

Exemptions

Products with a use phase greater than one year that have been on the market for less than their average use phase are exempt from the Silver level requirement at initial certification.

Intermediate products and liquid formulations are exempt from Silver level requirements in all cases.

Further Explanation

Exemptions

The standard states that *liquid formulations are exempt from Silver level requirements*. This exemption also applies more generally to products that are designed to be biodegradable, are demonstrated to be compatible

for the biodegradation pathway (per the applicable requirements in Section 5.5 Material Compatibility for Technical and/or Biological Cycles), and for which no intervention is needed to ensure active cycling occurs. This will be true when the most likely cycling pathway aligns with the intended end-of-use pathway. For example, in addition to liquid formulations, this may also include non-liquid cosmetics and personal care consumables (e.g., solid soaps, face powder, and lipstick).

The exemption for liquid formulations applies in this way to all instances where liquid formulations are noted as being exempt throughout the Product Circularity category.

Required Documentation

Bronze level

- Cycling plan, including timeline
- Description of challenges inhibiting the development of the cycling infrastructure for the product at the end of its first use
- List of partners identified

Silver level

- Calculations used to determine that the required area or percentage of sales is covered by the partnership(s)
- Evidence of partnership(s)
- If claiming the exemption for products with a use phase greater than one year that have been on the market for less than their average use phase, evidence of how use phase duration was determined per Section 5.9 Active Cycling, Required Documentation section.

5.4 Increasing Demand: Incorporating Cycled and/or Renewable Content

Intended Outcome(s)

Demand for circularly sourced materials is increased as a result of the increased use of cycled or renewable materials in the product, helping to close the loop and advance the circular economy. Negative impacts of virgin material use are also minimized.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirement(s)

Bronze level: For select commonly cycled product and material types, incorporate a minimum percentage of cycled and/or renewable content into the product. Alternatively, publicly disclose an explanation of the limitation(s) preventing achievement of the required minimums.

Silver level: Incorporate a percentage of cycled and/or renewable content into the product equal to or greater than industry averages and/or consistent with common practice. Develop a plan for increasing the use of post-consumer recycled and/or responsibly sourced renewable content, and demonstrate progress toward achieving the plan at recertification. Alternatively, publicly disclose an explanation of the limitation(s) preventing achievement of the required percentage(s).

Further Explanation

At a minimum, the plan for increasing the use of post-consumer recycled and/or responsibly sourced renewable content must include the type and source of content intended to be included or increased in the product, a timeline with targets for increasing the content, and a method for achieving these increases.

Gold level: Incorporate a percentage of cycled and/or renewable content into the product that is consistent with industry leaders for the product type. Depending on material type, incorporate either post-consumer recycled or responsibly sourced renewable content. Alternatively, publicly disclose an explanation of the limitation(s) preventing achievement of the required percentage(s).

Platinum level: Incorporate the maximal technically feasible percentage of cycled and/or renewable content into the product.

For the Bronze through Platinum certification levels, the required minimum percentages of cycled and/or renewable content are listed by homogeneous material and application type in the *Cradle to Cradle Certified® Required Percentages of Cycled and Renewable Content by Product and Material Type* reference document. In general, the percentages increase with achievement level, but for products and materials where it is challenging to use cycled materials, the percentage may be zero at one or more levels. The required percentages must be met at the homogeneous material level or the product level as noted below and in the "Instructions for Use" tab in the *Cradle to Cradle Certified® Required Percentages of Cycled and Renewable Content by Product and Material Type* reference document.

The following are required for multi-material products (i.e., products containing more than one homogeneous material), with one exception as noted below:

1. For the Bronze and Silver levels, at least 90% of the homogeneous materials by weight must meet the required minimum percentages of cycled or renewable content.
2. For the Gold and Platinum levels, at least 95% of the homogeneous materials by weight must meet the required minimum percentages of cycled or renewable content.

Exception: For multi-material products where there is only one percentage listed per achievement level, the percentages provided are product-level percentages that may be met in a variety of ways, as long as the finished product overall achieves the required percentage of cycled or renewable content by weight. In these cases, there are no minimum percentages required for individual materials in the product.

Further Explanation

Determining If 90% or More of the Homogeneous Materials in the Product Meet the Required Percentages

It is not necessary to identify the amount of cycled and renewable content in all materials in the product to determine if the required percentages have been achieved. Use of the following process is recommended:

1. Identify the homogeneous materials that make up 90% or 95% (for the Bronze/Silver and Gold/Platinum levels, respectively) of the product by weight.
2. List these materials along with
   - Their concentration in the total product, and
   - Any known amounts of cycled and renewable content for this sub-set of materials.
3. Identify the appropriate material categories and required percentages from the Required Percentages of Cycled and Renewable Content by Product and Material Type reference document, and
4. Paste these into additional columns of the spreadsheet.

This format will help to determine whether or not it will be necessary to contact additional suppliers to determine if cycled or renewable content is used and/or where to best focus additional action to increase the percentages used. The Bill of Materials Form provides a section for gathering and reporting this information.

Note: Externally Managed Components (EMCs) are not exempt from the Section 5.4 Increasing Demand requirements.

See the "Instructions for Use" tab in the *Cradle to Cradle Certified® Required Percentages of Cycled and Renewable Content by Product and Material Type* reference document further information.

For the Bronze, Silver, Gold, and Platinum levels,

1. For cycled content to count toward the required percentages, the amount of cycled content must be verified based on chain of custody documentation (with the exception of steel and aluminum material that can be traced via specification).

Further Explanation

Chain of custody may be verified as part of the Cradle to Cradle certification process (see Required Documentation box below for additional information). Alternatively, recycled content certifications may be employed. There are not yet any C2CPII-recognized recycled content certifications. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition.

2. For biologically derived plastics and liquid formulations to count as renewable, the amount of bio-based content must be determined based on:
   a. Established standards that quantify bio-based content using radiocarbon dating, or
   b. Chain of custody documentation.

Further Explanation

ASTM D6866 is currently accepted as a means of quantifying biobased content using radiocarbon dating. Chain of custody may be verified as part of the Cradle to Cradle certification process (see Required Documentation box below for additional information).

3. For biological and biologically derived materials associated with extensive evidence of ecosystem destruction due to land conversion and/or poor management practices (e.g., palm oil, wood, peat) to count as renewable, the material must be certified to a C2CPII-recognized responsible sourcing standard, or an alternative equivalent to certification must be in place, that requires:
    a. Compliance with all applicable laws and regulations of the country in which farming or harvesting operations occur.
    b. Operations that respect land rights and land use rights, and are unlikely to cause displacement of food production.
    c. Planning, monitoring, management, and continuous impact assessment for the farming and/or harvesting of material.
    d. Maintenance, conservation, or enhancement of biodiversity in the forest/vegetation or other ecosystem.
    e. Maintenance or enhancement of the productive function of the forest/vegetation or other ecosystem area and efficient use of harvested materials (e.g., rate of harvest does not exceed rate of regrowth in the long term).
    f. Maintenance or enhancement of the health and vitality of the forest/vegetation or other ecosystem and its protective systems (soil and water).

Further Explanation

Bronze Level Responsible Sourcing Requirements

Materials that are associated with extensive evidence of ecosystem destruction that must be certified to a C2CPII-recognized responsible sourcing standard at the Bronze level currently include the following:

- Wood,
- Oil palm,
- Sugarcane,
- Peat,
- Soy and leather if sourced from de facto high-risk tropical regions, or if region unknown (de facto high risk is as defined in the Social Fairness category), and
- Materials sourced from fisheries (due to the risk of destructive fishing practices occurring).

C2CPII-recognized Responsible Sourcing Certification Programs

Currently recognized certification programs for responsibly sourced material are as follows:

- Forest Stewardship Council (FSC)
- Roundtable on Sustainable Palm Oil (RSPO)

Additional programs may be recognized and subsequently added to this list. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition. Appendix 2 also lists requirements for alternative equivalents to certification.

Note that this requirement does not apply to material that meets the definition of pre- or post-consumer recycled content.

4. For commonly recycled biological and biologically derived materials, renewable content counts half as much as recycled content toward meeting the required cycled content percentages (e.g., if the percentage of cycled content required is 30%, then 60% renewable content OR 30% recycled content is required). This requirement does not apply to biological fibers used in apparel (i.e., for biological fibers used in apparel, renewable content counts in the same way as recycled content toward meeting the required percentages).

Further Explanation

The purpose of this requirement is to encourage the use of recycled content over virgin renewable content for biological materials that are commonly recycled.

Materials that are considered "commonly recycled biological and biologically-derived materials" subject to this requirement are:

- Cellulose-based paper, corrugated fiberboard, paperboard, and similar
- Wood sawdust (used in particleboard, MDF, and similar)

Paper Bag Example:

The Gold level requirements for paper bags per the *Cradle to Cradle Certified® Required Percentages of Cycled and Renewable Content by Product and Material Type* reference document are 75% post-consumer recycled content and 100% total cycled and/or renewable content. Given that for cellulose-based paper, renewable content counts half as much as recycled content toward meeting the required percentages, 100% recycled content is required for Gold level (i.e., there is no way to achieve the required 100% when using virgin renewable given the constraints of the requirements). The remaining 25% may be from either post-consumer or pre-consumer sources.

The Silver level requirement for paper bags is 50% renewable and/or cycled content. There is no post-consumer requirement at the Silver level. This means that Silver level can be achieved by using 100% renewable content, or 50% post-consumer and/or pre-consumer recycled content. If the paper is made from virgin wood fibers, then the material must also be certified as responsibly sourced (this is required for wood at the Bronze level per #3 in this section). If some recycled content is used (but less than 50%), the remainder of the required percentage can be fulfilled by using renewable content. For example, 25% recycled content and 50% responsibly sourced renewable content. For non-wood cellulose-based paper, the Silver level requirement could be met by using 100% renewable material without a responsible sourcing certification.

For the Gold and Platinum levels:

1. For any type of biological material to count as renewable, the material must be certified to a C2CPII-recognized responsible sourcing standard, or an alternative equivalent to certification must be in place (see #3 above for required responsible sourcing program elements applicable at the Bronze level and above).
2. For recycled content to count toward the required percentages, at least some of the recycled content must be post-consumer (with specific percentages required for certain material and product types per the *Cradle to Cradle Certified® Required Percentages of Cycled and Renewable Content by Product and Material Type* reference document).

Alternative to Meeting Required Percentages of Cycled and/or Renewable Content: Feasibility Analysis

For the Bronze, Silver, and Gold levels: A feasibility analysis may be applied as an alternative to meeting required percentages of cycled and/or renewable content in any case where an applicant is unable to meet the required percentages, including post-consumer recycled and responsibly sourced content as relevant. This alternative may be used for one or more materials in a product and at any achievement level.

The following are required:

1. An explanation of the limitation(s) preventing the incorporation of the target amount of cycled or renewable content (including post-consumer or responsibly sourced as relevant) and how, based on these limitation(s), the amount of cycled or renewable content currently used represents the maximum that is currently feasible.
2. The explanation must be reported publicly.
3. A strategy for addressing the identified limitation(s) and increasing the amount of cycled and/or renewable content (including post-consumer or responsibly sourced as relevant) over time must be developed. The strategy must include discrete objectives and an associated timeline.
4. For recertification:
    a. The applicant must demonstrate progress toward achieving the objectives.
    b. A description of progress made must be reported publicly.

For single-use plastic products and plastic packaging products (certified as separate products), excluding packaging that is part of a refill/reuse system (e.g., detergent refill pouch), the following two limitations preventing the incorporation of the target amount of cycled or renewable content are accepted:

1. The product or package is used in food contact applications and regulations applicable to the region(s) where the product is sold do not permit the use of recycled content.
2. Product or packaging performance specifications cannot be achieved when using the required percentages of cycled or renewable content.

For all other product types, including plastic packaging that is part of a reuse/refill system, other types of limitations (e.g., cost and availability) are accepted.

Required Documentation

- Bill of Materials Form or similar listing percentages of cycled and/or renewable content. Include material type and CASRN if possible, indication of pre- or post-consumer content, weights and concentrations.
- Calculations demonstrating how the total percentage was determined.

- For cycled content, chain of custody documentation (see below) or cycled content certification certificate.
- For renewable content, C2CPII-recognized responsible sourcing standard certificate(s) and evidence of purchase.
- For biologically derived plastics and liquid formulations, certificate, test results, and/or chain of custody documentation.
- If unable to meet the required percentages for cycled or renewable content, an explanation of the limitation(s) and a strategy for addressing the identified limitation(s).

To verify chain of custody for cycled or renewable content (when the material is not already certified to a cycled content standard or, for renewable content, a responsible sourcing standard that includes chain of custody tracking), the following must be provided:

- A description of how each cycled or renewable material meets the definition of pre- or post-consumer cycled content or renewable content, as applicable (see Definitions section).
- A diagram and/or a description of the manufacturing process showing how cycled or renewable materials are tracked and chain of custody is maintained. Include a description of all inputs of materials, and all internal material flows (e.g., reuse or recycling of scrap).
- Records that demonstrate the applicant has an active business relationship with each supplier of the cycled or renewable material. These records might include invoices, bills of lading, delivery receipts, supplier affidavits, or manufacturer evaluations/audits of suppliers. If the applicant does not purchase the cycled or renewable content directly (i.e., if the material is first processed, re-packaged, or (re) sold by an entity other than the original recycling facility and/or renewable material producer), this documentation must also be collected from supplier(s).
- Production records confirming the amounts of virgin and cycled or renewable material used. A minimum of five production batch records must be provided for each product. If five product specific production batch records are unavailable (i.e., less than five batches have been produced), then provide as many product-specific records as possible, plus production records from similar cycled or renewable material products (with the goal of providing five in total). If the applicant does not purchase the cycled or renewable content directly (i.e., if the material is first processed or re-packaged by an entity other than the original recycling facility and/or renewable material producer), this documentation must also be collected from supplier(s).
- A description of the processes for collection, separation, identification, and cleaning for the cycled material (not required for renewable content)
- If they are available, any standard operating procedures (SOPs) related to handling the cycled or renewable material (used to identify controls on source of materials in the final product).
- If they are available, quality manuals/internal processes used to verify materials (for suppliers, manufacturers, assemblers).

Progress for the alternative compliance pathway may include:

- Work that has been done toward investigating the feasibility of incorporating more cycled content
- Establishment of partnerships that will allow for incorporating more cycled content

5.5 Material Compatibility for Technical and/or Biological Cycles

Intended Outcome(s)

Product materials with the highest capacity for biological and/or technical cycling have been intentionally selected, increasing the likelihood that such materials will retain their value and move through subsequent cycles of use.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirements

Bronze level: For 50% of the product by weight, incorporate materials that are compatible with the intended cycling pathway(s).

Silver level: For 70% of the product by weight, incorporate materials that are compatible with the intended cycling pathway(s).

Gold level: For 90% of the product by weight, incorporate materials that are compatible with the intended cycling pathway(s) and have high-value technical or biological cycling potential.

Platinum level: For 99% of the product by weight, incorporate materials that are compatible with the intended cycling pathway(s).

For a material to count toward the percentage of materials compatible with the intended cycling pathway(s) the following conditions must be met:

1. Homogeneous materials that need to be separated in order to be cycled must be separable by the entity implementing the intended cycling pathway with given instructions and no additional special knowledge.
2. For products that are installed prior to use (e.g., in a building, a vehicle, or fixed within a sidewalk), it must be possible to extract the product from the installed location.
3. For products and materials intended for technical municipal cycling (i.e., municipal recycling), the product and/or material must be compatible for municipal cycling systems (e.g., painted plastics and plastic laminated paper are not currently compatible for municipal recycling).

Further Explanation

Determining Compatibility for Technical Municipal Cycling Systems

To be considered "compatible for municipal cycling systems" as required per requirement #3 above, the material must meet the following requirements:

- **For plastic, metals, and glass**, meet the requirements for determining recyclability according to section 7.3 of UL ECVP 2789: "Calculation of Estimated Recyclability Rate".
- **For plastic**, contains no attributes that are classified as "Renders the Plastic Non-recyclable" as per the Association of Plastic Recyclers' Design-for-Recyclability Guidance, or all attributes are classified for at least "Limited Compatibility" as per the Plastics Recyclers of Europe's Guidelines for Recycling.

- **For paper**, the material may not contain the materials or substances that are noted in the Sustainable Packaging Coalition's Design Guide for Sustainable Packaging as features that can complicate recycling at ≥ 1% of the material by weight:
  - Plastic film lamination or extruded coatings (exception: if the entire product has passed compostability testing, bioplastic film lamination may be considered 'compatible'. Refer to the Gold level guidance within this section for additional information.)
  - Foil stamping
  - UV-cured printed inks
  - Wax and moisture-preventative coatings
  - E-beam inks

  Paper materials that have municipal recycling as an intended cycling pathway and meet these conditions do not need to demonstrate compatibility per point #4 below in order to count towards the percentage of materials compatible with the intended cycling pathways. Note that biodegradability and/or compostability must be demonstrated via a C2CPII-recognized standard or test to demonstrate compatibility with high-value cycling at the Gold level (since paper must be designated for at least one biological cycling pathway per Section 5.2 Defining The Product's Technical and/or Biological Cycles).

4. For solid materials intended for the biological cycle, one of the following conditions must be met:
   a. The material must biodegrade in the intended cycling pathway(s) within the time period and to the extent specified by a C2CPII-recognized compostability or biodegradability standard test.
   b. For paper and biological materials with ≥ 99% unmodified organic material:
      i. The material, at its maximum thickness and/or density, must disintegrate in the intended cycling pathway(s) within the time period and to the extent specified by a C2CPII-recognized compostability or biodegradability standard test, and
      ii. If the intended cycling pathways include composting, a soil sample that is exposed to the material, after disintegration tests have been performed, must pass an ecotoxicity test demonstrating that the exposed soil sample is conducive to plant growth (OECD 208 or equivalent).
   c. For plastic materials, biologically derived materials, and biological materials with < 99% unmodified organic material (including paper that is < 99% cellulose), all of the following conditions must be met:
      i. The material must biodegrade in the intended cycling pathway(s) within the time period and to the extent specified by a C2CPII-recognized compostability standard test.
      ii. For any individual organic additives (e.g., pigments, inks, colorants, scents, secondary polymers, glues) present at a concentration of ≥ 1%, the additive must biodegrade in the intended cycling pathway(s) within a specific time period and to the extent specified by:
         1. A C2CPII-recognized biodegradability standard test, or
         2. The available scientific literature and/or research studies.
      iii. The material, at its maximum thickness and/or density, must disintegrate in the intended cycling pathway(s) within the time period and to the extent specified by a C2CPII-recognized

compostability standard test, and

iv. A soil sample that is exposed to the material, after disintegration tests have been performed, must pass an ecotoxicity test demonstrating that the exposed soil sample is conducive to plant growth (OECD 208 or equivalent).

Further Explanation

C2CPII-recognized Compostability and Biodegradability Testing Methods

C2CPII-recognized compostability and biodegradability testing methods currently include those in the list below. To receive credit, the test(s) employed must be applicable to the intended cycling pathway(s).

- EN 13432 Packaging – Requirements for Packaging Recoverable Through Composting and Biodegradation – Test Scheme and Evaluation Criteria for the Final Acceptance of Packaging
- EN 14995 Plastics - Evaluation of Compostability - Test Scheme and Specifications
- ISO 17088 Specifications for Compostable Plastics
- ISO 18606 Packaging and the Environment — Organic Recycling
- ASTM D6400 Test for Compostability (This specification covers plastics and products made from plastics that are designed to be composted in municipal and industrial aerobic composting facilities.)
- ASTM D6868 Standard Specification for Labeling of End Items that Incorporate Plastics and Polymers as Coatings or Additives with Paper and Other Substrates Designed to be Aerobically Composted in Municipal or Industrial Facilities
- AS 4736 Biodegradable Plastic-Biodegradable Plastics Suitable for Composting and Other Microbial Treatment - Australian Capital Territory
- Standardized tests (e.g., ISO, ASTM) employed by the following certification programs (with certification encouraged but not required at the Bronze and Silver levels):
  - European Bioplastics: Seedling
  - DIN-Geprüft: Industrial Compostable
  - Biodegradable Products Institute (BPI)
  - TÜV AUSTRIA: OK Compost HOME, OK Compost INDUSTRIAL, OK biodegradable SOIL, WATER, and MARINE.
  - Renewable Energy Assurance Limited: Compostable Materials Certification Scheme (CMCS)

Additional testing methods may also be recognized and subsequently added to this list. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition.

Analytical laboratories conducting required tests must be accredited or certified for the specific analysis per ISO 17025, DIN CERTCO approved, or equivalent.

5. For materials with unavoidable release to the environment during product use (e.g., tires, shoe soles, brake pads), the fraction of material that on average is likely to be released to the environment

from the total product over its lifetime may not be counted as compatible with the intended cycling pathway, unless it is biodegradable in the likely environment where release occurs.

6. For wet-applied products that are intended to be applied to materials with likely biological cycling pathways (e.g., paints intended to be applied to wood), one of the following conditions must be met:
    a. The wet-applied product must not typically comprise > 1% by weight of the base material(s) to which it is likely to be applied and the wet-applied product, in combination with the one likely base material, must meet the requirements for solid materials intended for biological cycling (per #4b), OR
    b. The wet-applied product, in combination with one likely base material, must meet the requirements for solid materials intended for biological cycling (per #4c).
7. For wet-applied products that are intended to be applied to materials with likely technical cycling pathways, one of the following conditions must be met:
    a. If the wet-applied material is an ink for printed products, it must pass the qualifications for de-inkability stated in INGEDE Method 11.
    b. If the wet-applied material is an adhesive for printed products, it must pass the qualifications for adhesive separation stated in INGEDE Method 12.
    c. Evidence must be provided that the wet-applied material will not adversely affect the reprocessing value of the material to which it has been applied.
8. For products that are liquid formulations (excluding wet-applied products), individual substances within the formulation, or the formulation as a whole may be evaluated when determining the percentage compatible for the biological cycle.
    a. When evaluating based on individual substance(s), the following conditions apply:
        i. For organic chemicals and surfactants to count toward the percentage compatible, the substance must biodegrade in the intended cycling pathway(s) within the time period and extent specified by a C2CPII-recognized biodegradability standard test. In addition,
            1. Organic chemicals with a log K_{oc} < 4.5 must meet the OECD definition for ultimate biodegradability (aerobic), and
            2. Organic chemicals with a log K_{oc} ≥ 1.5 must meet the OECD definition of anaerobic biodegradability.
        ii. For inorganic chemicals, benign minerals may be counted toward the percentage compatible.
        iii. Water weight is excluded from the calculation.
    b. When evaluating the formulation as a whole, if one of the following requirements have been met the product counts as 100% compatible for the biological cycle:
        i. The formulation has demonstrated ready biodegradability in both anaerobic and aerobic conditions as demonstrated by a C2CPII-recognized biodegradability standard test. (The formulation may also contain benign mineral nutrients.)
        ii. For consumable consumer products (e.g., shampoo, detergents), the material must biodegrade in the intended cycling pathway(s) within the time period and to the extent specified by a C2CPII-recognized biodegradability standard test.

Further Explanation

Determining Compatibility (i.e., Biodegradability) of Substances within Formulations

Organic Chemicals and Surfactants

For requirement 8.a.i, *For organic chemicals and surfactants to count toward the percentage compatible, the substance must biodegrade in the intended cycling pathway(s) within the time period and extent specified by a C2CPII-recognized biodegradability standard test*.

1. *Organic chemicals with a log Koc < 4.5 must meet the OECD definition for ultimate biodegradability (aerobic), and*
2. *Organic chemicals with a log Koc ≥ 1.5 must meet the OECD definition of anaerobic biodegradability.*

As noted in the standard, compatibility (i.e., biodegradability) may be determined on an individual chemical substance basis for formulations. To determine which OECD biodegradability test(s) is/are required for an individual chemical, it is first necessary to determine the log K_{oc} for that chemical. K_{oc} data can often be located in chemical databases (e.g., the European Chemical Agency's (ECHA) Chemicals Information system). In addition, K_{oc} may be estimated by a Cradle to Cradle Certified Material Health assessor through substance group-specific, appropriate Quantitative Structure Activity Relationship (QSAR) techniques (see for example Doucette, 2001) when no experimental values are available for a substance. Once log K_{oc} has been determined, the next step is to search the literature and other publicly available information for the appropriate biodegradability test data. Note that if log K_{oc} falls between 1.5 and 4.5, any of the tests listed below are acceptable.

C2CPII-recognized biodegradability standard tests for chemical substances include the following:

- For inherent ultimate biodegradability (aerobic): OECD 302A, OECD 302B, or OECD 302C | > 70 % DOC Removal is required.
- For anaerobic biodegradability: OECD 311 | > 60 % DOC Removal is required.
- For ready biodegradability: OECD 301 | > 60 % DOC removal or > 50 % ThOD or ThCO2 removal is required

Note that it typically will not be necessary to carry out these tests for the purposes of Cradle to Cradle certification. OECD biodegradability test data for individual substances are often available in the publicly available literature and/or chemical information databases. If test data are not available, QSAR results, although less accurate, may be applied as an alternative. Cradle to Cradle Certified Material Health assessors are qualified to identify appropriate QSAR derived results.

Benign Minerals

For requirement 8.a.ii, *For inorganic chemicals, benign minerals may be counted toward the percentage compatible.*

The following salts that contain a combination of the cations or anions listed in the table below may be considered benign minerals:

Element	Cations	Anions
Phosphorus (P)		H_2PO^{4-}, HPO_4^{2-}
Potassium (K)	K^+	
Sulfur (S)	SO_4^{2-}	
Calcium (Ca)	Ca^{2+}	
Nitrogen (N)	NH_4^+	NO_3^-, NO^{2-}
Iron (Fe)	Fe^{3+}, FeO^+	
Magnesium	Mg^{2+}	
Molybdenum (Mo)	MoO_2^{2+}	MoO_4^{2-}
Manganese (Mn)	Mn^{2+}	
Zinc (Zn)	Zn^{2+}	
Boron (B)		BO_3^{3-}, $B_4O_7^{2-}$
Copper (Cu)	Cu^{2+}	
Sodium (Na)	Na^+	
Silicon (Si)	Si_4^+	$[SiO_{4-x}^{(4-2x)-}]_n$, $0 \leq x \leq 2$
Cl (Chlorine)	Cl^-	
Al (Aluminum)	Al^{3+}	AlO^{2-}
Ti (Titanium)	Ti^{4+}	TiO_3^{2-}
Others (if contained in a salt with the above cations or anions)		OH^-, CO_3^{2-}, O^{2-}

Note: Additional minerals or salts may be added to this list upon request to C2CPII and at C2CPII's discretion.

Calculating Percentage Compatible for Formulations

Per requirement 8.a.iii: *Water weight is excluded from the calculation.*

Therefore, the total percentage compatible is equal to the sum of the percentages of benign minerals, biodegradable organic substances, and surfactants within the formulation when water is excluded from the percentage calculations. Example: For a formulation that is 75% water, 20% benign minerals and biodegradable organic substances, and 5% non-biodegradable organic substances, the percentage compatible (excluding water) = (20/25)*100 = 80%.

Evaluating Whole Formulas for Compatibility (i.e., Biodegradability)

Per requirement 8b, formulations may be evaluated as a whole (rather than by individual substance as described above). Note that the OECD biodegradabiliy tests specified above for substances may not be used on complex mixtures (although they may be acceptable for simple mixtures of structurally similar substances). Currently, there are no C2CPII-recognized standard tests for evaluating the biodegradability of formulas as a whole. Biodegradability standard tests may be added to this list with pre-approval from C2CPII and at C2CPII's discretion.

For the Gold level: The use of materials with high-value cycling potential (i.e., high-quality material as defined in #1-2 below) is required.

1. For a material to count toward the required percentage (90%) of materials compatible with the intended cycling pathway(s), the following conditions must be met:
    a. Materials intended for technical cycles and solid materials intended for biological cycles:
        i. Must not contain additives or features that are likely to result in low-value (i.e., low-quality) reprocessed material, and
        ii. Must be able to substitute for virgin material without loss of essential product function or material durability, contain at least 80% renewable or post-consumer recycled content, or have at least two plausible next uses.
    b. Solid materials intended for biological cycles must be certified by a C2CPII-recognized compostability program.
2. Select liquid formulations (e.g., soaps, cleaning products, lubricants) must meet minimum percent ready biodegradability and/or anaerobic biodegradability requirements per C2CPII-recognized standards; testing may be required. (Note: > 90% biodegradation of organic substances is required in some cases.)
3. For plastic beverage containers, plastic caps and lids must remain attached to the container during the product's intended use.

Analytical laboratories conducting required tests must be accredited or certified for the specific analysis per ISO 17025, DIN CERTCO approved, or equivalent.

Further Explanation

Defining High-value Cycling Potential (Gold Level)

The requirements in this section of the standard essentially define what it means to not downcycle. The opposite of this definition, and what is encouraged by the standard, is upcycling. Note that each point in this section (#1 a-b above) is addressed in separate 'Further Explanation' boxes.

For requirement 1.a.i, *Materials intended for technical cycles and solid materials intended for biological cycles must not contain additives or features that are likely to result in low-value (i.e., low-quality) reprocessed material*:

Additives or features that are likely to result in low-value (i.e., low quality) reprocessed material are listed in the table below. Materials with these features do not meet requirement 1.a.i above. Information regarding meeting requirements 1.a.ii and 1.b are included below this table.

All Plastics	• Photo-, oxo-degradable additives (Note that materials containing such additives also render the product as ineligible for certification per Section 2.0 Product Eligibility of this guidance document. Note also the oxo-degradable additives are different from oxo-biodegradable additives.) • Optical brighteners • Dense additives making overall density > 1 g/ml (except for polyethylene terephthalate (PET)) • Incompatible, inseparable polymer coatings (see below for specifics) • Additives that change viscosity of polymer after remelting

Polyethylene Terephthalate	• Additives that create opaque and metallic colors • Additives that create transparent colors other than clear, light blue, light green, and other light colors • Nucleating agents • Oxygen scavengers • UV Stabilizers • Hazing agents • Fluorescers • Incompatible polymers: Polylactic acid (PLA), polyvinyl chloride (PVC), polystyrene (PS), polyethylene terephthalate glycol (PETG), polyamide (PA) > 1% • Ethylene vinyl alcohol (EVOH) layer
Polypropylene	• Additives that create black or opaque colors • Additives that create any other colors besides light transparent ones • Incompatible polymers: EVOH > 1 %, PA, PET, PETG, PVC, polyvinylidene chloride (PVDC), PLA > 1 %
High-Density Polyethylene	• Additives that create dark colors • Incompatible polymers: PLA, PVC, PS, PET, PETG, PA, PVDC, EVOH > 1%
Low Density Polyethylene	• Additives that create dark colors • Any other polymer • Barrier layers • Additives ≥ 0.97 g/ml • Optional: Ensure that the product does not include additives, viscosity, density, or discoloration that negatively affect recycling per the APR Benchmark Polyethylene(PE) Films and Flexible Packaging Innovation Test Protocol (Association of Plastic Recyclers, 2018).
Paper and other Solid BN Substrates	• Plastic film lamination or extruded coatings (exception: if the entire product has passed compostability testing as required per requirement 1b in this section, bioplastic film lamination may be considered 'compatible') • Foil stamping • UV-cured printed inks • Wax and moisture-preventative coatings • E-beam inks • Copper containing pigments blue PB 15:3 and Green PG 7
Steel	• Lead-based ink • Attached features containing other metals
Aluminum	• Too many different types of aluminum (> 3 types) • Thin-foil laminations
Glass	• Cobalt blue pigment • Metal tamper-evident rings • Metal-based inks • Glass colors other than flint, green, or amber

NOTE: This list is derived from Plastic Recyclers of Europe's RecyClass Tool Guidance (additives or features noted for Limited Compatibility or No Compatibility) and the Association for Plastic Recycler's Design Guide for Plastics Recyclability (additives or features noted "Detrimental to Recycling" or "Renders Packaging Non-Recyclable") for plastics, and the Sustainable Packaging Coalition (SPC) Design Guidelines for Sustainable Packaging for paper, metal, and glass materials.

Further Explanation

For requirement 1.a.ii, *Materials intended for technical cycles and solid materials intended for biological cycles must:*

- *be able to substitute for virgin material without loss of essential product function or material durability,*
- *contain at least 80% renewable or post-consumer recycled content, or*
- *have at least two plausible next uses.*

Evaluating for Loss of Function and Durability

The following materials, after undergoing reprocessing, may be assumed to have similar properties (i.e., minimal to no loss in function or durability): Glass, metal, clay, chemically recycled polymers.

For other materials, loss of function must be assumed if cycled material must be mixed with > 50% virgin material and other additives in the next use. Loss in material durability must be assumed if there is a > 10% change in one of the following physical indicators in the cycled material compared to virgin material (i.e., > 10% decrease for the parameters currently listed).

- Polymeric plastics
  - Decrease in ductility
  - Decrease in number, weight, or viscosity average molecular weight (g/mol)
  - Decrease in impact strength (kj/m^2)
  - Decrease in tensile strength (MPa)
- Cellulosic fibers
  - Decrease in tensile strength
  - Decrease in bursting strength
  - Decrease in apparent density

Additional indicators may be added upon request to C2CPII.

Renewable or Post-consumer Recycled Content

- Renewable content: In alignment with standard Section 5.4 Increasing Demand, renewable content must be responsibly sourced to count as renewable. In addition, for the Gold level, the alternative compliance pathway (i.e., "Alternative to Meeting Required Percentages of Cycled and/or Renewable Content: Feasibility Analysis") may be applied.

- Post-consumer recycled content: The verification requirements in the standard and guidance Section 5.4 Increasing Demand apply. The alternative compliance pathway may not be applied.

Plausible Next Uses

A next use is plausible if there are existing examples (i.e., more than one example) of the next use occurring for that material in one or more similar products. Products are 'similar' when they have similar application/use, material composition, disassembly requirements, and end-of-use conditions. To receive credit as a plausible next use, the next use must also be part of the Active Cycling plan and implementation (per Sections 5.3 Preparing for Active Cycling and 5.9 Active Cycling).

Further Explanation

For requirement 1.b, *Solid materials intended for biological cycles must be certified by a C2CPII-recognized compostability program)*.

C2CPII-recognized Compostability Certification Programs

The following are currently recognized compostability certification programs:

- European Bioplastics: Seedling – *provisionally recognized through 31 December 2022; pending review*
- DIN-Geprüft: Industrial Compostable – *provisionally recognized through 31 December 2022; pending review*
- Biodegradable Products Institute (BPI) – *provisionally recognized through 31 December 2022; pending review*
- TÜV AUSTRIA: OK Compost HOME and OK Compost INDUSTRIAL – *provisionally recognized through 31 December 2022; pending review*
- Renewable Energy Assurance Limited: Compostable Materials Certification Scheme (CMCS) – *provisionally recognized through 31 December 2022; pending review*

Additional programs may be recognized and added to this list. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition.

Analytical laboratories conducting required tests must be accredited or certified for the specific analysis per ISO 17025, DIN CERTCO approved, or equivalent.

Further Explanation

For requirement #2, *Select liquid formulations (e.g., soaps, cleaning products, lubricants) must meet minimum percent ready biodegradability and/or anaerobic biodegradability requirements per C2CPII-recognized standards; testing may be required. (Note: > 90% biodegradation of organic substances is required in some cases.)*

The following are required:

- All surfactants used must be both readily biodegradable and anaerobically biodegradable. Refer to the

most recent version of the Detergents Ingredients Database (DID) for indication of ready and anerobic biodegradability. If data are not available for the applicable surfactant(s) in the DID, the following apply:

- For ready biodegradability, OECD 301 or equivalent must be used; > 60% DOC removal or > 50% ThOD or ThCO2 removal is required.
- For anaerobic biodegradability, OECD 311 or equivalent must be used; > 60% DOC removal is required.

- The organic substances in the product must all achieve the following percentages of readily biodegradable and anaerobically biodegradable content, based on product type:

Product Type	% Readily Biodegradable	% Anaerobically Biodegradable
Shampoo, and other shower products	75	75
Solid soaps	90	90
Hair care products	55	55
Shaving, foams, shaving gels, shaving creams	30	60
Solid shaving soaps	90	90
Dishwashing detergents, all-purpose cleaners, sanitary cleaners, and glass cleaners	No requirement	No Requirement
Lubricants and hydraulic fuels	95	No requirement

Required Documentation

For a material to count towards the percentage compatible, the following must be provided:

- Bill of Materials form or similar listing the materials that are compatible for technical or biological cycling
- Description of how each material meets the compatibility requirements
- Calculations demonstrating how the total percentage was determined
- Evidence of the relevant certifications and/or tests conducted to verify compatibility as required per the standard and guidance above (i.e., certificate(s) and/or test results)

In addition, at the Gold level the following are required:

- An explanation of how the high-value cycling potential requirements were met.
- For materials intended for technical cycles and solid materials intended for biological cycles: Confirmation and documentation (i.e., within the Bill of Materials) that additives or features likely to result in low-value reprocessed material are not used.
- For materials intended for technical cycles and solid materials intended for biological cycles, one of the following (these are the three options within Requirement #1.a.ii):

- Evidence of minimal loss of function or durability: An explanation of a currently implemented process for reprocessing of the material and its use in the same application for a similar product, AND
  An explanation and supporting evidence showing that there is < 10% decrease from originally sourced virgin material (or increase in the case that a decrease would lead to improved performance for the specific application) in one of the physical indicators relevant to the material (per guidance above)
- Evidence that the material contains 80% renewable or post-consumer recycled content (renewable and post-consumer are as defined in Section 5.4 Increasing Demand)
- Evidence of at least two plausible next uses: An explanation of the physical capability of cycling the material for the next use identified. Supporting evidence must include cited examples of the next use occurring for that material in one or more similar products. Similarity of the products must be supported by a description of how the comparable/similar product is similar in application/use, material composition, disassembly requirements, and end-of-use conditions is required.

- For select liquid formulations: Evidence of achieving the minimum percent ready biodegradability and/or anaerobic biodegradability requirements
- For solid materials intended for biological cycles, compostability certification certificate

Requesting Additions to the List of Physical Indicators Used to Demonstrate Durability: The following must be provided:

- Identity of the material
- The physical indicator proposed
- Academic publications (i.e., more than one) showing a strong correlation between the physical indicator and the mechanical durability and performance of the material
- A summary of the justification provided within the publications/articles for the high degree of correlation between mechanical performance and that physical indicator
- Testing data showing how the specific product or material meets the threshold for the physical/mechanical property based on the corroborated indicator (to be provided after use of the specific indicator has been approved by C2CPII)

5.6 Circularity Data and Cycling Instructions

Intended Outcome(s)

Circularity information for proper end-of-use handling of the product is publicly available, increasing the likelihood that the product's materials will be actively recovered and processed for a next cycle of use.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Make data to support cycling of the product in its intended pathway(s) and instructions for how to cycle the product publicly available.

The applicant must make data to support cycling of the product in its intended pathway(s) publicly available. The data may be reported via the Cradle to Cradle Certified® Circularity Data Report (see *Cradle to Cradle Certified® Circularity Data Report* reference document) or a C2CPII-recognized circularity reporting standard.

When applicable, the applicant must make instructions for how to cycle the product publicly available. The instructions must include how to identify the materials for cycling, any required product maintenance, and how to recover, reprocess, or recycle the product (see Cycling Instructions section in the *Cradle to Cradle Certified® Circularity Data Report* reference document).

Further Explanation

Scope: The requirements in this section apply to all products except those that are designated for a biological cycling pathway and for which no intervention is needed to ensure active cycling occurs. For example, this includes cleaning products, soaps, personal care products, and cosmetics.

The product circularity data and cycling instructions that are required to be made publicly available are listed in the *Cradle to Cradle Certified® Circularity Data* reference document.

Data may be made publicly available by completing the Cradle to Cradle Certified® Circularity Data form. Alternatively, data may be made public through other means (e.g., on the company's website).

A C2CPII-recognized circularity reporting standard that is made publicly available may be used as an alternative to providing the circularity data listed in the *Cradle to Cradle Certified® Circularity Data* reference document. However, if the C2CPII-recognized circularity reporting standard does not include instructions for how to cycle the product, cycling instructions must also be made publicly available.

There are currently no C2CPII-recognized circularity reporting standards. Standards and communication tools may be recognized and subsequently listed in the User Guidance. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition.

Required Documentation

- Completed C2CPII Circularity Data Report form
  OR
  Completed C2CPII-recognized circularity reporting standard document and cycling instructions
- Evidence of public availability

5.7 Circular Design Opportunities and Innovation

Intended Outcome(s)

The product is designed in a way that creates more end-of-use cycling opportunities.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Develop a plan for implementing a circular design opportunity or innovation that increases product circularity; demonstrate progress toward achieving the plan at recertification.

Gold level: Implement a circular design opportunity or innovation.

For the Gold level, circular design opportunities and innovations receiving credit are those that are commonly known and/or can be demonstrated to contribute to one or more of the following:

1. Increased end-of-use cycling
2. Greater engagement with users for end-of-use cycling
3. Prolonged use of the product
4. Decreased need to extract and produce virgin materials

For intermediate and wet-applied products, the applicant company must communicate how to implement the circular design opportunity to finished product manufacturer(s) or the customers of the wet-applied material, respectively.

Further Explanation

Scope

Products that are designed to be biodegradable, are compatible for the biodegradation pathway (per the applicable requirements in Section 5.5 Material Compatibility for Technical and/or Biological Cycles), and for which no intervention is needed to ensure active cycling occurs are out of scope for these requirements. For example, this includes cleaning products, soaps, personal care products, and cosmetics.

Implementing a Circular Design Opportunity or Innovation

Choose at least one of the circular design opportunities or innovations below to meet this requirement. The work to implement the design opportunity or innovation may have occurred at any time in the past, as part of the initial product design process or following initial product launch.

1. Designed to Minimize Material Weight
   a. Description: Any product design strategy that will lead to or has led to at least a 10% decrease in material weight, resulting in a product with the same or better performance and durability. Alternatively, the product requires at least 10% less material than the average product of the same type.
   b. Examples of acceptable progress for Silver level recertification: Any work that has been done toward decreasing material weight in the product or establishing partnerships that will allow for decreasing material weight.
2. Design Strategy for Prolonging the Use Phase of the Product
   a. Description: Any product design strategy used by the manufacturer to extend the use of the product beyond the most common use phase time (i.e., mode) for the product type.
   b. Examples of acceptable progress for Silver level recertification:
      i. Any work that has been done toward prolonging the use phase time of the product or establishing partnerships that will allow for prolonging the use phase time.

ii. Market research to identify methods of encouraging product users to purchase a product with a longer use phase.

c. For the Gold level, determining what is a longer than the most common (i.e., mode) product use phase time: The length of the use phase for any given product may be derived from warranties, public marketing claims, quality tests that address common failure modes, or another data source (if a logical rationale for using the other data source is provided). The product use phase time must be compared to available data on the *most common (i.e., mode)* use phase time for the product type. The most common use phase times for many product types are available in the International Living Future Institute's (ILFI) Product Life Database, If data on the most common (i.e., mode) use phase time (i.e., 'lifetime' per the database) for the product type is not available in the ILFI reference, the applicant must submit an alternative appropriate source of data and an explanation of how the data were derived.

3. Designed for Product as a Service

a. Description: A product that is designed to be rented/leased or shared among customers of the product.

b. Examples of acceptable progress for Silver level recertification: Any work that has been done toward implementing a product as a service business model or establishing partnerships that will allow for implementing a product as a service business model.

4. Designed for Modularity or Upgradability

a. Description: A product that is designed with parts that are replaceable, and replacement of these parts can be used toward the maintenance, upgrade, or expansion of the product.

b. Examples of acceptable progress for Silver level recertification: Any work that has been done toward implementing a modular or upgradable product design or partnerships that will allow for implementing a modular or upgradable product design.

5. Designed for Maintenance, Repair, or Refurbishment Services

a. Description: A product that is designed for maintenance, repair, or refurbishing services that are offered by the manufacturer at low cost (i.e., less than the cost of the product) to help maintain or prolong the use phase of the product.

b. Examples of acceptable progress for Silver level recertification: Any work that has been done toward establishing a process or program for maintenance, repair, or refurbishing services, or partnerships that will allow for maintenance, repair, or refurbishing services.

6. Designed for Manufacturer Recovery and Reuse

a. Description: A product that is designed for a company take-back program or other company-based recovery initiative.

b. Examples of acceptable progress for Silver level recertification: Any work that has been done toward establishing a take-back program or partnerships that will allow for a company take-back program.

7. Designed for Product Compatibility

a. Description: A product that is designed for standardization or compatibility with other parts or products, enabling extension of the use phase of the product.

b. Examples of acceptable progress for Silver level recertification: Any work that has been done toward designing the product for standardization or compatibility with other parts or products, or establishing partnerships that will allow for standardization or compatibility with other products.

8. Designed for Remanufacturing

a. Description: A product that has been designed for manufacturer recovery and can have components re-used for other product applications.

b. Examples of acceptable progress for Silver level recertification: Any work that has been done toward implementing a remanufacturing program for the product or establishing partnerships that will allow for remanufacturing of the product.

9. Designed for Industrial Symbiosis

a. Description: A product that is designed to utilize waste material from a local manufacturing process (within 160 km or 100 miles).

b. Examples of acceptable progress for Silver level recertification: Any work that has been done toward establishing an industrial symbiosis business plan or partnerships that will allow for industrial symbiosis.

10. Designed for Extending Resource Value

a. Description: A product that is designed to incorporate the residual value of otherwise "wasted" materials or resources.

b. Examples of acceptable progress for Silver level recertification: Any work that has been done toward prolonging the residual value of wasted materials or establishing partnerships that will allow for prolonging the residual value of wasted materials.

11. Designed for Other Innovation

a. Description: A product that is designed in a way that contributes meaningfully to its increased circularity.

b. Examples of acceptable progress for Silver level recertification: Any work that has been done toward implementing the plan or establishing partnerships that will allow for the plan to succeed.

Required Documentation

Silver level

- Implementation plan, including:
  - A description of the circular design opportunity or innovation to be implemented per the list above
  - Potential partners/collaborators and their roles, if relevant
  - A description of how the design opportunity or innovation is expected to increase product circularity and/or create more end-of-use cycling opportunities (i.e., how is the opportunity innovative?)
  - A description of the next step(s) and timeline for implementation
- At recertification, a description of the progress made toward implementation of the plan

Gold level

- A description of the circular design opportunity or innovation implemented for the product (per the list above in the 'Further Explanation' box), including:
  - Partners/collaborators and their roles, if relevant
  - A description of how the design opportunity or innovation increases product circularity and/or creates more end-of-use cycling opportunities
- The documentation indicated below for the circular design opportunity or innovation implemented:
  1. Designed to Minimize Material Weight
     - A description of how the design enabled the use of less material, and data showing how the product weight changed over time.
  2. Design Strategy for Prolonging the Use Phase of the Product
     - The most common (i.e., mode) use phase time for the product type, including references used.
     - A description of how the design has extended the use phase time of the product beyond the mode.
     - Warranties, public marketing claims, or other data sources for verification of product use phase time.
  3. Designed for Product as a Service
     - No additional documentation required.
  4. Designed for Modularity or Upgradability
     - A description of the product design and any case studies. The description must address the ease of assessing the condition of components and tasks required to maintain product performance.
  5. Designed for Maintenance, Repair, or Refurbishment Services
     - A description of the service program and any case studies. The description must address the ease of assessing the condition of components and tasks required to maintain product performance.
  6. Designed for Manufacturer Recovery and Reuse
     - A description of the program and/or partnerships involved in the initiative.
  7. Designed for Product Compatibility
     - A description of how the product is designed for standardization or compatibility, including how the standardization or compatibility with other parts or products works in practice and how it is expected to extend the use phase of the product and/or create more end-of-use cycling opportunities.
  8. Designed for Remanufacturing
     - A description of the remanufacturing process and any collaborating partners involved in utilizing product components.
  9. Designed for Industrial Symbiosis
     - No additional documentation required.

10. Designed for Extending Resource Value
    - No additional documentation required.
11. Designed for Other Innovation
    - A description of the product design or program and how it contributes to increased circularity in accordance with Cradle to Cradle principles.

5.8 Product Designed for Disassembly

Intended Outcome(s)

The product may be easily disassembled into discrete materials compatible for its intended cycling pathway(s) making it more likely that a large percentage of the materials in the product will be cycled.

Applicable Achievement Level(s)

Silver, Gold, and Platinum

Requirement(s)

Silver level: For products with multiple materials requiring separation for cycling in the intended pathway, develop a plan for increasing the ease of product disassembly into discrete materials for intended cycling pathway(s).

Gold level: For products with multiple materials requiring separation for cycling in the intended pathway, and for 90% of materials by weight, intentionally design the product for ease of disassembly.

Platinum level: For products with multiple materials requiring separation for cycling in the intended pathway, and for 99% of materials by weight, intentionally design the product for ease of disassembly.

For the Silver level, the plan for increasing the ease of product disassembly must include at least one of the design or communication elements required at the Gold level.

For the Gold and Platinum levels, the following design and communications elements define "ease of disassembly" and are required as applicable for ≥ 90% (for Gold) and ≥ 99% (for Platinum) of materials by weight:

1. The product includes at least one design feature that improves the ease of disassembly compared to a commonly or previously used alternative product.
2. Processes that result in the loss of specific materials in the product in order to recover other materials (e.g., burning plastics to recover metals) must be avoided.
3. If disassembly operations are conducted by an entity other than the applicant company, comprehensive disassembly instructions must be publicly available and accessible to the party(ies) involved in disassembly.
4. If disassembly operations are conducted by the general public, components must be separable using common tools (e.g., hammer, screwdriver, pliers) with minimal technical experience and instruction.
5. For products with ≥ 30 homogeneous materials and/or if disassembly is performed by an entity other than the product user, the disassembly process:

a. Must be at least semi-automated (e.g., for electronics), or
b. Can occur in a reliably consistent manner with clear instructions (e.g., via a Standard Operating Procedure, or another standardized process for training those who are disassembling the product).

For the Platinum level, the design and communications elements above are required as applicable for ≥ 99% of materials by weight.

Exemption

Liquid products, intermediate products, and products that do not require separation for the intended cycling pathway, including multi-material products that are cycled either intact or into a new hybrid material, are exempt from the requirements in this section.

Further Explanation

Design Features that Improve Ease of Disassembly

Requirement #1 is that: *The product includes at least one design feature that improves the ease of disassembly compared to a commonly or previously used alternative product.*

One or more of the following design features (a non-exhaustive list) may be used toward fulfillment of this requirement:

- Does not require any disassembly to be cycled under the intended cycling pathway
- Uses fewer fasteners
- Decreased number of disassembly operations
- Elimination of destructive processes
- Minimized the tools needed to disassemble the product
- Use of detachable/resolvable fasteners
- Full accessibility to critical parts
- Increased automation of disassembly and/or improved other mechanisms for material separation that minimize loss of material

Alternatively, an example of a different design feature (not listed above) may be provided along with evidence supporting its contribution to improved ease of disassembly.

Requirements for Disassembly Instructions

Requirement #3 is that: *If disassembly operations are conducted by an entity other than the applicant company, comprehensive disassembly instructions must be publicly available and accessible to the party(ies) involved in disassembly.*

If disassembly instructions are required, they must include the following elements:

- A description of each step in the disassembly operation
- Identification of parts and components
- The type of connectors involved
- How to access components and parts

- Tools required for each step
- Accompanying audio or visual instructions or diagrams (e.g., disassembly precedence graph, disassembly tree, state diagram, hypergraph)

Alternative Compliance Pathways

Alternatively, implementation of one of the following Circular Design Opportunities or Innovations, as described in Section 5.7 for the Gold level, may count towards fulfillment of this requirement. In this case, the same design opportunity may receive credit in this section and in Section 5.7.

- Designed for Product as a Service/Service Product
- Designed for Modularity or Upgradability
- Designed for Maintenance or Repair Services
- Designed for Manufacturer Recovery or Reuse
- Designed for Product Compatibility

Required Documentation

Silver Level

- Plan for increasing the ease of product disassembly into discrete materials for intended cycling pathway(s) using at least one design feature (per list above).

Gold Level

- An explanation of the product design optimization work that was conducted to implement the design feature(s).
- An explanation of how the product is disassembled, addressing all required points.
- If disassembly is carried out by an entity other than the applicant company and/or by the general public: Disassembly instructions.
- For products with ≥ 30 homogeneous materials and/or if disassembly is performed by an entity other than the product user: Evidence of the automated disassembly process in place and/or documented standard operating procedure (SOP) for disassembly operations.
- Evidence that the design feature(s) apply to 90% of materials in the product by weight.

Platinum Level

- Evidence that the design feature(s) apply to 99% of materials in the product by weight.

Silver, Gold, and Platinum Levels: If using the alternative compliance pathway described in the Further Explanation box above, documentation as required per Section 5.7 Circular Design Opportunities and Innovation, instead of the documentation listed above.

5.9 Active Cycling

Intended Outcome(s)

The product's materials are actively being recovered and processed for their next use via the intended cycles and/or the product manufacturer is demonstrably invested in a program that will lead to higher product and material cycling rates and/or a higher quality of materials available for cycling.

Applicable Achievement Level(s)

Gold and Platinum

Requirement(s)

Gold level:

For select single-use plastic products and single-use plastic packaging (when certified as a separate product), actively cycle ≥ 50% of the product's materials and implement a program to increase the cycling rate or quality of the product for its next use.

For other short-use phase products, actively cycle at least some (> 0%) of the product's materials and implement a program to increase the cycling rate or quality of the product for its next use.

For long-use phase products, actively cycle at least some (> 0%) of the product's materials or implement a program to increase the cycling rate or quality of the product for its next use.

Platinum level:

For long-use phase products, actively cycle the product's materials and implement a program to increase the cycling rate or quality of the product for its next use.

Monitor cycling rates and quality over time, and demonstrate an increase in either cumulative cycling rate or quality.

Actively cycle a minimum percentage of the product's materials based on the duration of the product's use phase.

Active cycling includes both recovery and processing of the product's materials for their next use.

Requirements for a material or product to be considered high quality or have high value cycling potential are provided in Section 5.5 for the Gold level.

The 'select' single-use plastic products and single-use plastic packaging required to achieve ≥ 50% active cycling at the Gold level are eligible product and packaging types that are subject to extended producer responsibility regulations and/or regulatory measures intended to reduce use. This includes: Beverage cups including covers and lids, beverage bottles, take-out or immediate consumption food containers, packets and wrappers made from flexible materials used to contain food that is intended for immediate consumption, wet wipes, and balloons. Exception: If the plastic material within the product is made from responsibly sourced renewable material and it is demonstrated to readily biodegrade in all relevant environmental compartments where there is potential for release and disposition (e.g., soil, freshwater including wetlands, marine water including surface and deep water conditions), the active cycling rate for other short-use phase products may be applied (> 0%).

Further Explanation

Determining the Length of a Product's Use Phase

For the Gold level, active cycling is required for short-use phase products and is optional for long-use phase products (with the alternative for long-use phase products at the Gold level to implement a program to increase the cycling rate or quality of the product for its next use). This means that the first step for this section of the standard is to determine if the product is a short-use phase or long-use phase product.

Short-use phase and long-use phase products are defined in the standard Definitions Section as follows:

- Long-use phase product – A product with a use phase time that is typically greater than 1 year.
- Short-use phase product – A product with a use phase time that is typically less than 1 year.

The estimated average use phase time for a product may be derived from warranties, public marketing claims, or quality tests that address common failure modes.

Determining the Percentage of the Product that is Actively Cycled

The percentage of the product that is actively cycled must be calculated at the Gold level for 'select' single-use plastic products and single-use plastic packaging (e.g., beverage cups and bottles as indicated above in Section 5.9), and at the Platinum level for all other product types.

For product types other than the 'select' single-use plastic products and single-use plastic packaging listed above, evidence of active cycling (> 0%) may be provided at the Gold level. The actual cycling rate does not have to be determined.

The percentage of actively cycled (%AC) of the product is calculated as follows:

$$\%AC = \frac{\textit{total weight of the product or its components and materials cycled in a recent reference year}}{\textit{total weight of products sold in (recent reference year — L)}}$$

Where:

- *Total weight of the product or its components and materials cycled* = the weight of all components and materials that are cycled pre-processing (after collecting and sorting), not the weight of recovered material. Note that weight is used instead of the number of products since components or materials are usually cycled rather than whole products.
- *Recent reference year* = the most recent full calendar or fiscal year for which data are available (e.g., the calendar year prior to the certification application), and
- *L* = the product's estimated average use phase time as described above (e.g., based on warranties, public marketing claims, or quality tests).

If possible, representative sales and recovery (i.e., pre-processing) weights should be obtained for every region in which the product is sold. At a minimum, the applicant must use representative data for regions representing at least 60% of sales, where 'region' is defined as an individual state/region (e.g., in the United States) or an individual country.

For example, a table similar to the one below could be used to make the required calculations. In the case below (for a product with a use phase of 10 years), it would be acceptable to only obtain data for Country #3

since 67.5% of sales occurred in this country.

Location	Product sold in 2010 (kg)	% sold in 2010 (by weight)	Product cycled in 2020 (kg)	Active cycling (%)
Country 1	500	0.6%	100	20.0%
Country 2	20,000	24.5%	25	0.1%
Country 3	55,000	67.5%	5000	9.1%
Country 4	6,000	7.4%	160	2.7%
Total	81,500		5285	6.5%

Applying Municipal Cycling Rates

For products that are cycled via municipal systems, the percentage of the product that is actively cycled may be determined using data on cycling rates for the product type in the regions where the product is sold, in combination with the product's sales weight in each region in which data are available. For example, if the product is a PET bottle sold in California, the cycling rate for PET bottles in California is 50%, and 60% of the product's manufactured weight is sold in California, the % actively cycled for the product may be assumed to be at least 30% (i.e., 50% x 60%).

Applying the Exception for Select Single-use Plastic Products and Single-use Plastic Packaging

For product types required to achieve ≥ 50% active cycling at the Gold level, the following exception applies:

If the plastic material within the product is made from responsibly sourced renewable material and it is demonstrated to readily biodegrade in all relevant environmental compartments where there is potential for release and disposition (e.g., soil, freshwater including wetlands, marine water including surface and deep water conditions), the active cycling rate for other short-use phase products may be applied (> 0%). Note that commonly employed standardized tests do not currently exist for all environmental compartments and potential conditions. Therefore, acceptable methods for demonstrating that the requirements included in the exception have been met will be determined on a case-by-case basis.

Further Explanation

Programs to Increase Cycling Rate or Quality

For the Gold level, programs to increase cycling rate or quality are required for short-use phase products and are optional for long-use phase products (with the alternative for long-use phase products at the Gold level to actively cycle at least some of the product). See the Further Explanation box above for how to determine if a product has a short or long use phase.

Increasing Cycling Rates

The following are examples of acceptable programs to increase the cycling rate or quality of the product:

- Circular accounting - To receive credit, the applicant must have invested in a system that facilitates tracking of product cycling. Examples include:

- Using RFID or similar tracking technology.
- Targeting waste management inefficiencies in the recycling stream (e.g., Recycle Track Systems).
- Implementing a system for tracking take-back rates of products in the company's take-back program (e.g., retrievr.com, previously 'Curb my Clutter').
- Implementing a leasing program where products are tracked by leasing ownership.
- For products that are cycled through municipal systems, determining the recycling or composting rates of products based on state or regional statistics, if available, or by country statistics for recycling rates of various materials (specific to the product type if possible) in the product. Examples include CalRecycle recycling rates for plastic and metal, United States National Plastics Recycling Report, and European Union Packaging Waste Statistics.

- Circular incentives - To receive credit, the applicant must contribute monetarily to incentivize cycling by the user of the product, or must contribute to a program that encourages increased adoption of cycling activity of their product. Examples include:
  - Providing a monetary incentive to customers to cycle the product
  - Developing a product-as-a-service program
- Other programs that increase cycling rates:
  - Increasing the scale of the cycling program (e.g., through TerraCycle)
  - Initiating an additional partnership for take-back
  - Increasing engagement with partners involved in cycling (e.g., expansion of take-back program to other communities)

Improving Cycling Quality

To receive credit, the program must lead to a measurable improvement in cycling quality based on the requirements for high-value cycling per standard and guidance Section 5.5 Material Compatibility for Technical and/or Biological Cycles.

For the Platinum level:

1. If demonstrating an increase in cumulative cycling rate, the increase must be via one or more intended cycling pathway(s).
2. The minimum required percentage of actively cycled product is a function of the product's use phase duration or the average use phase duration for the product type (the shorter the use phase, the higher the minimum percentage required). This minimum required percentage is calculated as follows:

   $\frac{100}{2+L}$ where L is the product use phase time (in years) or the average use phase time for the product type (in years). If using the use phase time for the product, lifetime warranties may not be used for its derivation.

Exemptions

Long-use phase products that have been on the market for a time period less than the product's average use phase are exempt from the Platinum level requirement.

Intermediate products and liquid formulations are exempt from all requirements in this section.

Further Explanation

Platinum Level: Calculating the Minimum Required Percentage Actively Cycled: 100/(2+L)

For the Platinum level, the following is required: *Actively cycle a minimum percentage of the product's materials based on the duration of the product's use phase.* As noted previously, the use phase time or average use phase time (i.e., duration) for any given product may be derived from warranties, public marketing claims, and/or quality tests that address common failure modes. Note that average use phase time in this calculation refers to the average for the specific product, not the average for all products of this type on the market.

For single-use products, L=0 when calculating the minimum percentage. The result is that the minimum percentage that must be actively cycled for this product type is 50% (i.e., = 100/(2+0)). For the Gold level, 50% is already the required percentage for select single-use plastic products and single-use plastic packaging. Therefore, the Platinum level requirements for this product type are to *Monitor cycling rates and quality over time, and demonstrate an increase in either cumulative cycling rate or quality*.

Required Documentation

Applicable Achievement Level by Product Type	Required Documentation
Gold Level: All products	• Documentation to verify the use phase time of the product applying for certification, including one or more of the following: Warranties, public marketing claims, quality tests that address common failure modes, or another data source. If using another data source, the applicant must provide an explanation for why that data source is accurate in estimating the use phase time.

Gold Level: • Short-use phase products (including select single-use plastics) • Long-use phase products if selecting the option to actively cycle at least some (> 0%) of the product's materials Platinum Level: • Long-use phase products	• If the product is cycled via a manufacturer or third-party take-back program, active cycling may be assumed to be occurring if the following are provided: ○ A description of how the company is able to verify that active cycling is actually occurring via the chosen intended cycling pathway(s) (i.e., a description of the evidence available). ○ If it is not possible to differentiate between the applicant product and others that are collected through the program, a description of how the products collected are all of the same type and fulfill the same function as the applicant product. ○ A description of the partnership companies involved in the recovery and processing of materials in the product. Supporting evidence must include a statement on a website or an active contract. • If the product can be cycled via municipal systems and is sold in regions where the municipal system is available, active cycling may be assumed to be occurring if the following are provided: ○ Evidence of the municipal program's existence in the applicable state(s)/region(s)/country(ies) in which the product is sold. ○ A description of how the product or products of the same type are recycled through the program(s).
Gold Level: • Short-use phase products (including select single-use plastics) • Long-use phase products if selecting the option to implement a program to increase the cycling rate or quality of the product for its next use Platinum Level: • Long-use phase products	• A description of the program that has been implemented to increase cycling rates or quality, and how it will do so. If implementing a program to increase quality, the description must refer to the high-value cycling potential requirements in Section 5.5 Material Compatibility for Technical and/or Biological Cycles (Gold level).
Gold Level: • Select single-use plastics Platinum Level: All products	• Percent of product actively cycled and the required minimum percentage, including calculations and supporting sales and cycling data used to determine the percentages.

Platinum Level: All products	• A description of the method used for tracking the cycling rates or quality of the product. • Relevant data and calculations that demonstrate that an increase in cycling rates or quality was achieved. The source of the statistics, calculations, and rationale must also be provided.

6 // Clean Air & Climate Protection Requirements

Category Intent

Product manufacturing results in a positive impact on air quality, the renewable energy supply, and the balance of climate changing greenhouse gases.

Requirements Summary

To achieve a desired level within the category, the requirements at all lower levels must also be met.

Bronze	Final manufacturing facilities comply with air emissions regulations or guidelines - i.e., permits, international guidelines, or industry best practice.
	Annual electricity use and greenhouse gas emissions associated with the final manufacturing stage of the product have been quantified.
	A strategy for increasing use and/or procurement of renewable electricity and addressing greenhouse gas emissions has been developed. The strategy includes near and mid-term targets.
	5% target(s)* for procuring or producing renewable electricity and/or addressing greenhouse gas emissions have been achieved. Applicable to final manufacturing stage electricity and emissions only.
	Products that use energy during the use phase (e.g., appliances) or that greatly impact the energy efficiency of buildings (e.g., windows, insulation), are certified using a C2CPII-recognized energy efficiency standard or similar, if available.
	Greenhouse gas emissions data for the applicant company, for all final manufacturing stage facilities, or for the final manufacturing stage of the product are made available to stakeholders.
Silver	For construction products and building materials used to construct primary building elements, the embodied emissions associated with the product from cradle to gate or through end of use have been quantified.
	The renewable electricity and greenhouse gas reduction strategy includes long-term target(s) in addition to the near and mid-term targets.
	20% target(s)* for procuring or producing renewable electricity and/or addressing greenhouse gas emissions have been achieved. Applicable to final manufacturing stage electricity and emissions only. Alternative: 25% of the embodied emissions associated with the product from cradle to gate or through end of use are offset or otherwise addressed (e.g., through projects with suppliers, product redesign, savings during the use phase). Note: This is required at the Gold level in all cases.

Gold	For all product types, the embodied emissions associated with the product from cradle to gate or through end of use have been quantified.
	For construction products and building materials used to construct primary building elements, a third-party critical review of the quantification of embodied greenhouse gas emissions is conducted, and an Environmental Product Declaration produced. For other product types, third-party verification or an internal review is conducted.
	50% target(s)* for procuring or producing renewable electricity and/or addressing greenhouse gas emissions have been achieved. Applicable to final manufacturing stage electricity and emissions only. 50% of the renewable electricity (25% of total electricity used) is either produced on site or procured through long-term power purchase agreements supporting new renewable electricity installations. Alternative: Renewable electricity procurement matches 100% of electricity used at final manufacturing facilities.
	Embodied greenhouse gas emissions data are made available to stakeholders.
	Blowing agents used in the manufacture of the product's foam materials (any foam > 1% of product by weight) have low to no global warming potential and no ozone depletion potential.
	25% of the embodied emissions associated with the product from cradle to gate or through end of use are offset or otherwise addressed (e.g., through projects with suppliers, product redesign, savings during the use phase).
Platinum	For all product types, a third-party critical review of the quantification of embodied greenhouse gas emissions associated with the product from resource extraction through end of use is conducted, and an Environmental Product Declaration produced.
	> 100% of electricity is renewably sourced. The electricity is produced on site or procured through long-term power purchase agreements supporting new renewable electricity installations. For other on-site energy demands (if any), eligible sources of bioenergy are used. > 100% of any remaining greenhouse gas emissions are offset. Applicable to final manufacturing stage electricity and emissions only.
	100% of the embodied emissions associated with the product from cradle to gate or through end of use are offset or otherwise addressed (e.g., through projects with suppliers, product redesign, savings during the use phase).

*Depending on the achievement level, the "targets" may apply to renewable electricity procurement or on-site production and use, performance improvements (emissions intensity reductions), absolute emissions reductions, use of eligible bioenergy sources, purchase of carbon offsets, and/or financial donations or investments.

6.1 Air Emissions Compliance

Intended Outcome(s)

The final manufacturing stage facilities where the product is manufactured are in compliance with regulatory and/or industry best practice air emissions limitations.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Final manufacturing stage facilities comply with air emissions regulations or guidelines.

Facilities must comply with the corresponding regional regulatory (if any), international, or industry best practice air emissions guidelines.

Compliance with all applicable laws and regulations, including compliance with regional regulatory air emissions limitations, is required as a baseline. For final manufacturing stage facilities meeting this requirement based on regulatory compliance, the parameters addressed in the permit must also be consistent with leading regulations, international guidelines, or industry best practice. Leading regulations are defined as those that include a functioning mechanism through which ambient air quality-based limits are set (i.e., assessment of the existing ambient air quality is used to inform and set the permitted limits with the goal of maintaining high quality standards).

Further Explanation

Determining if a Facility is Subject to These Requirements

The requirements in this section apply to final manufacturing facilities, not only to air emissions that occur as a result of manufacturing the product(s). This means that in some cases, facilities will be subject to these requirements when the process to produce the certified product does not produce emissions to air.

The requirements in this section apply to facilities that are required to hold air emissions permits or that would otherwise be subject to international guidelines as described below.

For final manufacturing facilities that are not subject to the Bronze level requirements in this section, a signed statement and evidence that the facility is out of scope are required. Refer to the Required Documentation box below for additional information.

Determining What is Required for Final Manufacturing Facilities in Scope

For facilities that are subject to the requirements in this section, what specifically must be done depends on whether or not the facility is in a region with leading regulations. The following definition applies:

Leading regulations: *Leading regulations are defined as those that include a functioning mechanism through which ambient air quality-based limits are set (i.e., assessment of the existing ambient air quality is used to inform and set the permitted limits with the goal of maintaining high quality standards).* This is in contrast to technology-based limits that are set based on what is economically and/or otherwise technically feasible. An exhaustive list of locations with functioning mechanisms through which ambient air quality-based limits are set has not been developed. However, such mechanisms do exist in the European Union and the United States. It may currently be assumed that facilities in the European Union, United Kingdom, Switzerland, and the United States are subject to leading regulations. This means that in these locations, the parameters addressed in the permits are by definition *consistent with leading regulations* as required. Other regions may be added to this list upon consultation with and pre-approval from C2CPII.

Requirements Specific to Facilities That are in Regions with 'Leading Regulations'

As noted above, facilities in the European Union, United Kingdom, Switzerland, and the United States are currently assumed to be subject to leading regulations. For facilities in this category, it must be demonstrated that the facility is in compliance with its permitted limits.

Definition of Compliance: Compliance means that the manufacturing facility is adhering to the limitations required by the permit. This must be true currently and for the two years prior to certification. Compliance is more specifically defined per the applicable regulations. If the permitting authority allows minor exceedances (e.g., exceedances of a certain frequency and amount may be allowed without corrective action required and/or violations may be otherwise categorized as major and minor), such exceedances are also accepted for the purposes of Cradle to Cradle Certified.

To determine if a facility is in compliance, emissions test results, summarized as required by the permitting authority, must be compared to what is allowed according to the permit. Permits and test results must be provided by the manufacturer. Alternatively, the compliance status of manufacturing facilities may be demonstrated based on publicly available information (e.g., through the Enforcement and Compliance History Online (ECHO) database in the United States).

See the final sub-section in this Further Explanation box titled When Final Manufacturing Facilities are not in Compliance for additional information.

Requirement Specific to Facilities in Other Regions (i.e., Without 'Leading Regulations')

For facilities in this category, it must be demonstrated that the facility is in compliance with its permitted limits and that the *parameters addressed in the permit are consistent with leading regulations, international guidelines, or industry best practice.* If the parameters are not consistent, additional work is required as described below.

Definition of Compliance: Compliance means that the manufacturing facility is adhering to the limitations required by its permit and/or leading regulations, international guidelines, or industry best practice. This must be true currently and for the two years prior to certification. Compliance is more specifically defined per the applicable regulations, guidelines, or best practices. If minor exceedances are permitted, such exceedances are also accepted for the purposes of Cradle to Cradle Certified.

To determine if a facility in in compliance, emissions test results (summarized as required by the permitting authority), international guidelines, or industry best practice (as applicable), must be compared to the allowable limits.

Determining Parameter Consistency with Leading Regulations:

To determine whether or not the parameters included in existing permits* for direct discharge are consistent with leading regulations, international guidelines, or industry best practice:

- Select a set of guidelines from the references listed below that are relevant to the industry and processes occurring at the facility.
- If guidelines specific to the industry are not available, reference guidelines for an industry sector with analogous processes (this aligns with the International Finance Corporation's (IFC) approach).
- Compare the existing permits to these guidelines. The permits must include limitations on all

parameters and specific chemical substances that are included in the selected set of comparative guidelines in order to be considered consistent.

- If any parameters or substances are missing from the permits, the applicant must identify appropriate limits for the additional parameters and/or substances per the international or industry best practice guidelines and demonstrate adherence to these limits as described in the applicable reference below.

*If permits do not exist, and processes that are typically controlled per international guidelines are occurring regularly at the facility (per the IFC reference below at a minimum), the same steps apply.

International and industry best practice guidelines include the following:

- International Finance Corporation (IFC) - Environmental Health and Safety Guidelines
- European Union - Best Available Techniques Reference document (BREFs)
- United States – U. S. Environmental Protection Agency, Clean Air Act Standards and Guidelines and National Emissions Standards for Hazardous Air Pollutants

Note: This list does not currently include 'industry best practice' guidelines (only international guidelines). The term is included so that the list can be expanded in the event that such guidelines become available (e.g., the similar Water & Soil Stewardship requirements refer to the ZDHC Wastewater Guidelines).

Confirming that Emissions Control Capacity is Sufficient for Compliance

For manufacturing facilities in this category (i.e., in regions without leading regulations), **the capacity of the on-site emissions control equipment must be compared to throughput to determine if the facility is able to consistently control its emissions as required**. If equipment capacity is insufficient, then the issue must be resolved prior to certification.

When Final Manufacturing Facilities are Not in Compliance

Products manufactured in facilities that are not in compliance as defined in the guidance above are not eligible for certification unless it can be demonstrated that the issues resulting in non-compliance have been corrected. If this is demonstrated, non-compliances that have occurred in the prior two years are acceptable.

Required Documentation

For all facilities: A signed statement from the applicant or final manufacturer stating that the facility or facilities at which the product is manufactured (1) is/are not required to hold air emissions permits, or (2) is/are in compliance with the corresponding regional regulatory (if any), international, or industry best practice guidelines (as applicable), and have been in compliance for the prior two years.

For facilities that are not subject to the requirements in this section: A description of how this was determined and any applicable supporting evidence (e.g., process flow diagrams, photos of the facility, and/or reference to a manufacturing site visit conducted for the purposes of Cradle to Cradle certification).

For facilities subject to the requirements in this section, the following (as applicable):

- A copy of the permit(s) including all controlled parameters and limitations, and/or other air emissions

guidelines employed (either in place of permits or used to determine consistency) as relevant.

- Test results as required by the permits or other guidelines. Test results are to be summarized as required by the permitting authority or other guideline, as relevant. At a minimum, biannual testing is required (i.e., two times per year). For the initial certification provide two sets of test data from the prior year at a minimum. For recertification, provide four sets of test data (i.e., two per year for the prior two-year certification cycle).
- For facilities in locations without leading regulations, evidence of emissions control equipment capacity and throughput (e.g., description of system design, technical manuals and specifications, and throughput volume).
- If guidelines other than those indicated by permits are used, and guidelines specific to the industry are not available, provide the rationale for selecting the comparative guidelines, including a description of how the processes occurring at the facility are analogous to the relevant industry.

6.2 Quantifying Electricity Use and Greenhouse Gas Emissions

Intended Outcome(s)

Electricity use and greenhouse gas emissions associated with final manufacturing and the product's embodied greenhouse gas emissions have been quantified and verified, creating a baseline against which reductions can be measured, and helping to identify areas for improvement.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirement(s)

Bronze level: Quantify annual electricity use and greenhouse gas emissions associated with the final manufacturing stage of the product.

Silver level: For construction products and building materials used to construct primary building elements (i.e., products for which life cycle assessment is common practice), quantify the embodied greenhouse gas emissions associated with the product from resource extraction through final manufacturing or end of use.

Gold level: For construction products and building materials used to construct primary building elements (i.e., products for which life cycle assessment is common practice), conduct a third-party critical review and produce an Environmental Product Declaration (EPD). For other product types, quantify the embodied greenhouse gas emissions associated with the product from resource extraction through final manufacturing or end of use and, if self-reported, conduct an internal review.

Platinum level: For all product types, conduct a third-party critical review of the quantification of embodied greenhouse gas emissions associated with the product from resource extraction through end of use and produce an Environmental Product Declaration (EPD).

For the Bronze level:

1. Report electricity in terms of kWh or equivalent and the resulting greenhouse gas emissions in terms of CO_2e.

2. Report greenhouse gas emissions from all other sources (e.g., direct emissions from burning fuels, including biofuels) in terms of CO_2e.

The methods employed must follow a recognized greenhouse gas accounting methodology (i.e., the Greenhouse Gas Protocol or others listed by CDP).

For the Silver, Gold, and Platinum levels, the methods employed to quantify embodied emissions must follow ISO 14040 and ISO 14044 (Environmental management – Life cycle assessment –Principles and framework and – Requirements and guidelines) or other standards or guidance based on ISO 14040 and ISO 14044 (e.g., the Greenhouse Gas Protocol Product Life Cycle and Accounting Standard). If available, product category rules must be followed.

For the Gold and Platinum levels, Environmental Product Declarations (EPDs) must conform to ISO 14025 and EN 15804 or ISO 21930.

Primary building elements are defined as:

1. The structural frame, including beams, columns, and slabs,
2. External walls, cladding, and insulation,
3. Floors and ceilings,
4. External walls,
5. Internal walls,
6. Windows,
7. Roofs, and
8. Foundations and substructures.

For product types where a third-party critical review is not required at the Gold level (i.e., all products except construction products and building materials), if embodied emissions were quantified by a qualified third party, an internal review is not required. If embodied emissions were quantified by the applicant company (i.e., self-reported), third-party verification may be requested by C2CPII should the application audit surface concerns about whether the data are complete or accurate.

Further Explanation

Bronze Level

Quantifying Electricity Use and Greenhouse Gas Emissions for the Final Manufacturing Stage

The Bronze level requirement is to *Quantify annual electricity use and greenhouse gas emissions associated with the final manufacturing stage of the product.*

At a minimum, electricity use and greenhouse gas emissions for all final manufacturing stage processes must be included. The processes that constitute the final manufacturing stage are defined by industry category in the Cradle to Cradle Certified® Methodology for Applying the Final Manufacturing Stage Requirements. The final manufacturing stage will typically align with the "production" phase in the Greenhouse Gas Protocol Product Lifecycle Accounting and Reporting Standard (i.e., scope 1 and scope 2* emissions attributable to the product). Unless product specific inline metering is in place, this will typically require first quantifying electricity and greenhouse gas emissions for the entire facility and then allocating a certain amount of electricity and emissions to manufacture of the certified product. **If allocation from facility-level data to the product is necessary, allocate using the most appropriate method and units** (e.g., as

recommended by the most recent version of the Greenhouse Gas Protocol Product Lifecycle Accounting and Reporting Standard or other guidance based on ISO 14040) and relevant Product Category Rules, if available. Allocation is commonly done by weight, volume, number of units, or sales value. Non-attributable processes (e.g., facility overhead energy use) may be excluded if it is possible to do so given how energy use is measured and tracked. **All greenhouse gases (i.e., not only CO_2) and all product-attributable electricity use and greenhouse gas emissions must be quantified.** This includes emissions from non-energy sources (e.g., methane from wastewater treatment ponds, carbon dioxide emissions from cement production, and fugitive refrigerant emissions).

*Per the Definitions section of the standard:

Scope 1 emissions – Emissions from operations that are owned or controlled by the reporting (i.e., applicant) company.

Scope 2 emissions – Indirect emissions from the generation of purchased or acquired electricity, steam, heat, or cooling consumed by the reporting (i.e., applicant) company.

An alternative that removes the need to allocate (which can be imprecise) is to quantify annual electricity use and greenhouse gas emissions associated with entire final manufacturing stage facility(ies) and apply the targets applicable to final manufacturing (per Section 6.4 Using Renewable Electricity and Addressing Greenhouse Gas Emissions in Final Manufacturing) to entire facilities as well. This approach is recommended when inline metering is not available and also as a best practice for more comprehensively addressing emissions.

To calculate greenhouse gas emissions, usage data (e.g., the amount of electricity or natural gas consumed) must be multiplied by greenhouse gas emissions factors. Greenhouse gas emissions factors applicable to some electric grid regions (the European Union and United States) and for commonly used fuel types are provided in C2CPII's Clean Air & Climate Protection Form. Note that it will be necessary to purchase emissions factors for some electric grids from the International Energy Agency directly. In general, if it is necessary to employ emissions factors from other sources (i.e., other than those provided in the C2CPII CA&CP form), 100-year Global Warming Potentials (GWPs) must be employed.

Reporting Electricity Use and Greenhouse Gas Emissions for the Final Manufacturing Stage

The standard requires the following:

1. *Report electricity in terms of kWh or equivalent and the resulting greenhouse gas emissions in terms of CO2e.*
2. *Report greenhouse gas emissions from all other sources (e.g., direct emissions from burning fuels, including biofuels) in terms of CO2e.*

Electricity use and the resulting (scope 2) greenhouse gas emissions are reported separately from all other emissions combined (i.e., both scope 1 and 2) to facilitate achieving the targets in Section 6.4 via the use of energy attribute certificates (i.e., Renewable Energy Certificates (RECs) and/or Guarantees of Origin (GOs)), which are in terms of units of energy rather than emissions (i.e., one REC or GO represents 1 MWh of electricity). Greenhouse gas emissions attributable to the electricity must still be reported when attribute certificates will be employed, but should not be added to emissions from other sources (per #2 above). If using carbon offsets to address emissions attributable to purchased electricity and achieve the

targets in Section 6.4, greenhouse gas emissions from all scope 1 and 2 sources may be combined for the purposes of meeting the targets. In addition, residual emissions factors, if available, must be employed. Otherwise, average emissions factors for the relevant grid, if available, or country if not, may be applied.

For facilities with on-site cogeneration: If using fossil fuels, report the resulting greenhouse gas emissions as part of 'emissions from all other sources' (#2 above). If using bio-based fuels, refer to the sub-section of this document titled "Accounting for Bioenergy and Applying the Bioenergy Credit" (in Section 6.2) for how to account for this.

References

- World Resources Institute and World Business Council for Sustainable Development, Greenhouse Gas Protocol Product Lifecycle Accounting and Reporting Standard, 2013.
- Greenhouse Gas Protocol Calculation Tools (e.g., GHG Emissions from Stationary Combustion)
- Intergovernmental Panel on Climate Change (IPCC) - (this is the United Nations body for assessing the science related to climate change and is an authoritative reference on climate change science including the cause, impacts, mitigation, and adaptation as well as a reference for global warming potentials)
- The International Energy Agency (IEA) - source of country level emissions factors for purchased electricity (fee based)
- Association of Issuing Bodies, European Residual Mix
- United States Environmental Protection Agency, eGRID - source of emissions factors for purchased electricity by grid region for the United States

Further Explanation

Silver, Gold, and Platinum Levels

Quantifying Embodied Greenhouse Gas Emissions

Cradle to Cradle requires that embodied greenhouse gas emissions be quantified either at the Silver or Gold level depending on the product type. The achievement level at which an Environmental Product Declaration (EPD) and critical review are required also varies by product type. See the table below for a summary of requirements in this section.

The total embodied greenhouse gas emissions associated with a product are the emissions resulting from raw material production or extraction, manufacturing, use, and end of use. **The scope** of quantification for the Silver and Gold levels is *from resource extraction through final manufacturing or end of use*, and at Platinum the scope is *from resource extraction through end of use*. In other words, the scope must be cradle to gate at a minimum though the Gold level, and **must cover the entire life cycle at Platinum**. Recycling of the product should be included in the analysis to the degree feasible. For Silver or Gold level (depending on product type), only greenhouse gas emissions are required to be quantified as part of the assessment; however, once an EPD is required, other impacts must also be included (see section below regarding EPDs).

Who May Quantify and Verify Embodied Greenhouse Gas Emissions

Applicants may quantify the product's embodied emissions themselves at the Silver level for construction products and building materials and at the Gold level for other product types. An internal review is required to be conducted when applicants quantify this information themselves. Steps for conducting an internal review are covered in the Greenhouse Gas Protocol's Product Lifecycle Accounting and Reporting Standard, Chapter 12 (Assurance). Third-party assurance is accepted and recommended as an alternative to internal assurance. As noted in the Cradle to Cradle Certified standard: *If embodied emissions were quantified by the applicant company (i.e., self-reported), third-party verification may be requested by C2CPII should the application audit surface concerns about whether the data are complete or accurate.*

Critical Review Requirements

A critical review of the life cycle assessment (LCA) conducted to quantify embodied emissions per ISO 14044 is required at the Gold level for construction products and building materials and at the Platinum level for other product types. Critical reviews must be conducted by qualified third parties. These are defined as life cycle assessment (LCA) practitioners with demonstrated experience conducting LCAs and critical reviews per ISO 14040.

Environmental Product Declarations (EPDs)

As noted in the standard, *Environmental Product Declarations (EPDs) must conform to ISO 14025 and EN 15804 or ISO 21930*. All EPDs must conform with a product category rule (PCR). The impact categories specified by the PCR must be reported via the EPD. This means that additional information beyond embodied greenhouse gas emissions (i.e., beyond Global Warming Potential in terms of CO_{2e}) is required to be reported. Typically, this will also include acidification, eutrophication, tropospheric ozone formation, ozone depletion, and abiotic depletion.

Table – Summary of Silver through Platinum Level Requirements to Quantify Embodied Emissions by Product Type

Requirement	Construction Products and Building Materials (per the list specified in the standard)	Other Products
Quantify embodied emissions (i.e., conduct a product life cycle assessment that includes greenhouse gas emissions at a minimum)	Silver	Gold
Scope: Through final production at a minimum ('cradle to gate')	Silver	Gold
Scope: Through end of use	Platinum	Platinum
Internal assurance/internal review (at a minimum)	Silver	Gold

Critical review of LCA by a qualified third party	Gold	Platinum
Environmental Product Declaration (EPD) per ISO 14025 and EN 15804 or ISO 21930	Gold	Platinum

References

- Greenhouse Gas Protocol Product Lifecycle Accounting and Reporting Standard
- International EPD system list of verifiers
- American Center for Life Cycle Assessment (ACLCA) - directory of LCA certified professionals

Required Documentation

Bronze Level

- C2CPII Clean Air & Climate Protection Form or equivalent with tables 1a and 2a completed at a minimum. Note: Additional tables must be completed depending on how the requirements in Section 6.4 Using Renewable Electricity and Addressing Greenhouse Gas Emissions will be met. See Section 6.4 for further information.
- Utility bills, fuel purchase receipts, meter readouts, etc., as relevant for the prior two years (as supporting evidence for values entered in the C2CPII CA&CP form).
- List of references for emissions factors and Global Warming Potentials (GWPs) employed (if other than those provided in the Clean Air & Climate Protection form).

Silver Level (Construction Products and Building Materials) or Gold Level (Other Products):

- Life Cycle Assessment report. The report must include all reporting elements required per the Greenhouse Gas Protocol Life Cycle Accounting and Reporting Standard or equivalent.
- Assurance statement (internal/first party or third party). Per the GHG Protocol Product Lifecycle Accounting and Reporting Standard (2013, page 94), the statement must include:
  - Whether the assurance was performance by the applicant (first party) or a third party
  - Level of assurance achieved (limited or reasonable)
  - Summary of assurance process
  - Relevant competencies of the assurers
  - How any potential conflicts of interest were avoided (if the applicant has carried out its own assurance)

Gold Level (Construction Products and Building Materials) or Platinum Level (Other Products):

- Critical review report
- Environmental Product Declaration

6.3 Clean Air & Climate Protection Strategy

Intended Outcome(s)

A clean air and climate protection strategy that includes targets aligned with international climate science and goals is established, providing a pathway for increasing the amount of renewable energy used to manufacture the product and reducing or offsetting greenhouse gas emissions during the product manufacturing process.

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirements

Develop a Clean Air & Climate Protection strategy and report on progress made toward achieving the strategy at each recertification.

The strategy must include the following:

1. Quantitative targets for increasing renewable electricity use and/or procurement and addressing greenhouse gas emissions (as applicable by achievement level below).
    a. For the Bronze, Silver, and Gold level, near-term (0-2 years) and mid-term (2-20 years) targets must be set.
    b. For the Silver and Gold levels, long-term (2050 or before; > 20 years) targets must also be set.
    c. For the Gold level, the long-term targets must be to achieve > 100% renewable and/or a better than carbon neutral final manufacturing stage for the product. Alternatively, the long-term targets must be science-based (see Definitions section).
    d. For the Platinum level, the timeline for meeting the selected target(s) may be determined by the applicant.
2. Proposed activities and method(s) for reaching each target and the rationale for selecting the specific targets, including how the targets are considered to be sufficiently ambitious. Base year(s) and target year(s) must be indicated. Note: Methods that receive credit are further described in Section 6.4 Using Renewable Electricity and Addressing Greenhouse Gas Emissions in Final Manufacturing and in 6.10 Addressing Embodied Greenhouse Gas Emissions.
3. A report of progress made toward meeting the targets that were set at the last certification renewal (not applicable for initial certification).
4. For the Bronze, Silver, and Gold levels, the estimated cost of moving to the next achievement level in the Clean Air Renewable Energy & Climate Protection category via one or more of the methods described in Section 6.4.

Scope

1. For the Bronze, Silver, and Gold levels, product attributable electricity use and greenhouse gas emissions associated with the final manufacturing stage of the product must be within the scope of the strategy.
2. For construction products and building materials used to construct primary building elements at the Silver level, and for all products at the Gold and Platinum levels, the strategy must take into account the product's (or products') embodied greenhouse gas emissions.

Further Explanation

The Clean Air & Climate Protection Strategy may focus only on using renewable electricity and addressing greenhouse gas emissions. However, it is important to note that transitioning to clean renewable energy sources will also positively impact air quality. This is because burning fuels is one of the primary contributors to poor air quality. Although not required, applicants are encouraged to also explicitly include plans for reducing emissions of hazardous air pollutants in the strategy. Note that the General Requirements section of the standard may also require a strategy and management system applicable to air emissions, depending on activities occurring at the facility.

A strategy for using renewable electricity and addressing greenhouse gas emissions is required at all achievement levels, including Platinum level. The reason that a strategy is still required for Platinum level is because there will typically always be additional work that can be done to more thoroughly and directly address emissions in the supply chain. In addition, there may still be some emissions occurring in final manufacturing at the Platinum level that can be further reduced (e.g., from non-energy sources or from bioenergy receiving partial credit).

Scope: The required scope for the strategy aligns with the scope for quantification requirements by product type (per Section 6.2) and with the expectation of eventual achievement at the next level, as noted in the table below.

Table – Strategy Scope: Silver through Platinum Level Requirements by Product Type

Strategy Requirement	Construction Products and Building Materials (per the list specified in the standard)	Other Products
Strategy must address all product attributable electricity use and emissions occurring during the final manufacturing stage of the product, at a minimum (note: other scopes such as facility or company level are accepted if they include the certified product(s)).	Bronze	Bronze
Strategy must address embodied emissions. Scope: Initial resource extraction or production through final manufacturing.	Silver	Gold
Strategy must address embodied emissions. Scope: Initial resource extraction or production through end of use.	Platinum	Platinum

Setting Targets: The standard requires that applicants explain the *rationale for selecting the specific targets, including how the targets are considered to be sufficiently ambitious.* See reference below for guidance on target setting. Note that when setting mid-term targets, it is recommended that these be set at no more than 15 years from the current certification date. This aligns with the mid-term target requirements of the Science Based Targets Initiative. In addition, note that it is considered best practice to set targets that require at least 2.1% reduction each year (per CDP).

The targets set per the strategy do not necessarily need to align with those required per standard Section 6.4

Using Renewable Electricity and Addressing Emissions and Section 6.8 Addressing Embodied Greenhouse Gas Emissions (although applicants are also encouraged to consider what it will take to achieve the next level via the requirement to estimate the cost of doing so). For example, a company-level target to achieve a 15% absolute reduction in scope 1 and 2 greenhouse gas emissions by 2025 would be accepted for the Bronze level as long as the certified product is within scope. This is even though the Silver level target (applicable to product attributable electricity and emissions at a minimum) is 20%.

References

- CDP 2021 Climate Change Scoring Methodology, cdp.net
- Science Based Targets Initiative, sciencebasedtargets.org

Required Documentation

Bronze Level

- A documented strategy that includes quantitative near and mid-term targets including base year(s) and target year(s), a description of the proposed methods of achieving the targets and for moving to the next Cradle to Cradle Certified achievement level.
- Rationale for selecting the targets and explanation regarding how they are sufficiently ambitious.
- Documented cost estimate for achieving the next level, including one or more of the following:
  - Total cost for moving to the next level
  - Total cost for moving to the next level on a per unit product basis
  - % change in the total per unit product cost from the current per unit product cost

Silver Level

- All of the Bronze level documentation, plus evidence/inclusion of long-term targets.

Gold Level

- All of the Bronze level documentation, plus evidence/inclusion of targets to achieve better than carbon neutral or science-based targets for final manufacturing.

Silver Level (Construction Products and Building Materials) and Gold Level (Other Products)

- Strategy per the Bronze level that also includes quantitative targets specific to embodied emissions. (i.e., all required documentation listed for the Bronze level must have elements applicable to both the final manufacturing stage and embodied emissions).

Platinum Level

- Strategy per the Bronze level that includes target(s) for addressing embodied emissions. Associated timeline(s) are required, but the targets may be near, mid, and/or long term. The cost estimate is optional.

Recertification (All Achievement Levels)

Strategy progress report, including the following:

- The original strategy, a description of any changes to the original strategy, and an explanation of why these changes were made.
- Indication of progress made toward the targets including the percent of each target that has been reached to date.
- Reporting on progress made on all activities identified in the original strategy that were to be employed in meeting the targets.
- If a target that was set to be met during the prior two years was not met, an explanation of why it was not met, and evidence that the strategy has been revised accordingly.

6.4 Using Renewable Electricity and Addressing Greenhouse Gas Emissions in Final Manufacturing

Intended Outcome(s)

Depending on achievement level and methods used, applicants are:

- Employing efficiency and conservation measures to reduce energy use and greenhouse gas emissions,
- Signaling demand for renewable energy,
- Supporting carbon offset projects that go beyond business as usual,
- Avoiding the use of fuels that may contribute to reduced food security, conversion of forested and other natural areas to cropland, and/or cause a near-term increase in atmospheric carbon dioxide,
- Producing renewable electricity in excess and releasing it to the grid for all to use, and/or
- Positively impacting the balance of climate changing greenhouse gases attributable to the final manufacturing stage of the product (i.e., more are offset than are generated).

Applicable Achievement Level(s)

Bronze, Silver, Gold, and Platinum

Requirements

Bronze level: For the final manufacturing stage of the product, procure or produce renewable electricity and/or address greenhouse gas emissions, achieving 5% target(s)* for electricity and other greenhouse gas emissions sources.

Silver level: For the final manufacturing stage of the product, procure or produce renewable electricity and/or address greenhouse gas emissions, achieving 20% target(s)* for electricity and other greenhouse gas emissions sources. Alternatively, meet the embodied emissions target (25%) required for all products at the Gold level.

Gold level: For the final manufacturing stage of the product, procure or produce renewable electricity and/or address greenhouse gas emissions, achieving 50% target(s)* for electricity and other greenhouse gas emissions sources.

Platinum level: For the final manufacturing stage of the product, procure or produce renewable electricity and/or address greenhouse gas emissions, achieving > 100% target(s)* for electricity and other greenhouse gas emissions sources.

*The target(s) may be met via a variety of methods. Depending on the achievement level, these include renewable electricity procurement, on-site renewable electricity production and use, performance improvements (i.e., greenhouse gas intensity reduction), absolute emissions reductions, use of eligible bioenergy sources, purchase of carbon offsets, and/or financial donations and investments. See the Renewable Electricity and Greenhouse Gas Emissions Targets section below for more information.

Renewable Electricity and Greenhouse Gas Emissions Targets

There are separate targets applicable to (1) electricity, including purchased electricity and on-site renewable electricity, and (2) greenhouse gas emissions from other scope 1 and 2 sources. One or more of the methods listed below may be applied toward achieving the targets. For example, if the renewable electricity target for a given achievement level has been partially met, then one or more of the other listed methods may be used to achieve the remainder of the target. See the supplementary sub-sections below for additional requirements pertaining to the accepted methods. The targets below apply to the final manufacturing stage of the product unless otherwise noted.

For the Bronze level:

1. For electricity (including purchased electricity resulting in scope 2 emissions and on-site renewable electricity):
    a. Procure or produce renewable electricity to match 5% of the electricity used (Note: Renewable electricity that is part of a utility's default offer receives credit only if there is no voluntary renewable electricity market in the applicable market region),
    b. Provide financial support to a climate-relevant public policy initiative (must be valued at 2x the cost of purchasing renewable electricity attribute certificates or other voluntary purchase matching 5% of the electricity used),
    c. Purchase carbon offsets to compensate for 5% of the resulting greenhouse gas emissions, or
    d. Improve performance by 5% (i.e., reduce electricity use intensity and/or the associated greenhouse gas emissions intensity by 5%).
2. For all other greenhouse gas emissions sources (including all scope 1/direct and other scope 2/indirect emissions):
    a. Use eligible sources of bioenergy, achieving the bioenergy credit for 5% of total greenhouse gas emissions,
    b. Purchase carbon offsets to compensate for 5% of the resulting greenhouse gas emissions,
    c. Invest in on-site emissions reductions projects (must be of an equivalent value to carbon offsets compensating for 5% of emissions), or
    d. Improve performance by 5% (i.e., reduce greenhouse gas emissions intensity by 5%).

For the Silver level:

1. For electricity (including purchased electricity resulting in scope 2 emissions and on-site renewable electricity):
    a. Procure or produce renewable electricity to match 20% of the electricity used (Note: Renewable electricity that is part of a utility's default offer receives credit only if there is no voluntary renewable electricity market in the applicable market region),
    b. Purchase carbon offsets to compensate for 20% of the resulting greenhouse gas emissions,
    c. Provide financial support (valued at 2x the cost of renewable electricity attribute certificates or other voluntary purchase option matching 20% of the electricity used) to a climate-relevant public policy initiative,
    d. Improve performance by 20% (i.e., reduce electricity use intensity and/or greenhouse gas emissions intensity by 20%) and reduce absolute emissions per science-based targets, or
    e. Improve performance by up to 10% and meet the remainder of the 20% target via the other accepted method(s).
2. For all other greenhouse gas emissions sources (including all scope 1/direct and other scope 2/indirect emissions):
    a. Use eligible sources of bioenergy, achieving the bioenergy credit for 20% of total greenhouse gas emissions,
    b. Purchase carbon offsets to compensate for 20% of greenhouse gas emissions,
    c. Invest in on-site emissions reductions projects, for example, purchase more energy efficient equipment (must be of an equivalent value to carbon offsets compensating for 20% of emissions),
    d. Improve performance by 20% (i.e., reduce greenhouse gas emissions intensity by 20%) and reduce absolute emissions per science-based targets, or
    e. Improve performance by up to 10% and meet the remainder of the 20% target via the other accepted method(s).

Alternative to #1 and #2: Achieve the embodied emissions target required at the Gold level (see Section 6.8 Addressing Embodied Greenhouse Gas Emissions for further detail).

For the Gold level,

1. For electricity (including purchased electricity resulting in scope 2 emissions and on-site renewable electricity):
    a. Procure or produce renewable electricity to match 50% of the electricity used, producing at least half of the 50% (i.e., 25% of the total electricity used) on site and/or procuring half through long-term power purchase agreements (PPAs) supporting new renewable electricity installations (Note: Renewable electricity that is part of a utility's default offer receives credit for the other 25% only if there is no voluntary renewable electricity market in the applicable market region),
    b. Procure renewable electricity to match 100% of the electricity used at all final manufacturing stage facilities (Note: This is a facility level requirement rather than a final manufacturing stage requirement),
    c. Purchase carbon offsets to compensate for 50% of the resulting greenhouse gas emissions,

   d. Provide financial support (valued at 2x the cost of renewable electricity attribute certificates or other voluntary purchase option matching 25% of the electricity used) to a climate-relevant public policy initiative and meet the remainder of the 50% target (25%) via the other accepted method(s) (Note: This option may not be used as an alternative to achieving the on-site or PPA requirements), or
   e. Improve performance by up to 12.5% (i.e., reduce electricity use intensity and/or the associated greenhouse gas emissions intensity by 12.5%) and meet the remainder of the 50% target via the other accepted method(s).
2. For all other greenhouse gas emissions sources (including all scope 1/direct and other scope 2/indirect emissions):
   a. Use eligible sources of bioenergy, achieving the bioenergy credit for 50% of total greenhouse gas emissions,
   b. Purchase carbon offsets to compensate for 50% of greenhouse gas emissions, or
   c. Improve performance by up to 12.5% (i.e., reduce greenhouse gas emissions intensity by 12.5%) and meet the remainder of the 50% target via other accepted method(s).

For the Platinum level:

1. Procure or produce > 100% of the electricity used, producing the electricity on site and/or procuring through long-term power purchase agreements supporting new renewable electricity installations,
2. Use eligible sources of bioenergy for other on-site energy demands (if any) (Note: Other energy sources (e.g., hydrogen) will be considered on a case-by-case basis), and
3. Purchase carbon offsets to compensate for > 100% of greenhouse gas emissions from non-energy sources and/or from bioenergy receiving partial credit (if any).

Note: The Platinum level goal is to fully electrify, use renewable electricity for total energy demand, and to use carbon offsets only to address any emissions from non-energy sources. However, if the physical infrastructure and/or the political situation do not allow for this, exceptions may be made on a case-by-case basis, allowing for the use of carbon offsets to address greenhouse gas emissions resulting from purchased electricity and/or burning of fuels on site.

Further Explanation

The targets in this section of the standard apply to using renewable electricity and addressing greenhouse gas emissions for the final manufacturing stage of the certified product at a minimum (with several exceptions as noted in the standard above). A recommended alternative to applying the targets to the final manufacturing stage is to apply the targets to final manufacturing facility(ies). The targets are: 5% for Bronze, 20% for Silver, 50% for Gold, and >100% for Platinum.

There are a range of actions and outcomes that the targets may be applied to as follows:

- Renewable electricity procurement
- On-site renewable electricity production and use
- Performance improvements (i.e., greenhouse gas intensity reduction)
- Absolute emissions reductions
- Use of eligible sources of bioenergy

- Purchase of carbon offsets
- Financial donations to climate-relevant public policy initiatives
- Investment in on-site emissions reduction projects (e.g., purchase of more efficient equipment)

In general, the accepted methods of achieving the targets are increasingly limited as the achievement level increases. For the Platinum level, only long-term renewable electricity procurement and on-site renewable electricity production receive credit, and carbon offsets are accepted in a limited number of scenarios. As noted above, the Platinum level goal is to fully electrify and use renewable electricity for total energy demand in final manufacturing.

There are separate targets applicable to (1) electricity, including purchased electricity and on-site renewable electricity, and (2) greenhouse gas emissions from other sources. One or more of the methods listed above may be applied toward achieving the targets. For example, if the renewable electricity target for a given achievement level has been partially met, then one or more of the other accepted methods may be used to achieve the remainder of the target.

Example: A product is manufactured using both electricity and natural gas and the goal is to certify at the Silver level. On-site solar panels provide 15% of the electricity used and the remainder is purchased from a utility. Carbon offsets are purchased in an amount equivalent to the greenhouse gas emissions attributable to 5% of total electricity used and to match 20% of the greenhouse gas emissions that result from burning the natural gas. This allows for achieving the Silver level.

The sub-sections that follow provide additional information on achieving the targets. Note that there is not a separate sub-section for the options to provide financial support to a climate relevant public policy initiative (available at the Bronze, Silver and Gold levels) or invest in emissions reductions equipment (available at the Bronze and Silver levels). See the Required Documentation sections in the 'Meeting the Renewable Electricity Targets' and 'Meeting the Carbon Offset Targets' sub-sections respectively for information on these two options.

Meeting the Renewable Electricity Targets

For the Bronze and Silver levels and for half (i.e., 50%) of the Gold level target (or for 100% of the Gold target if using the 100% renewable electricity procurement alternative per the sub-section titled Renewable Electricity and Greenhouse Gas Emissions Targets above):

1. Renewable electricity may be:
    a. Produced on site,
    b. Procured from a utility or other provider (e.g., through a utility's optional green power offering, or through direct power purchase agreements), and/or
    c. Procured via unbundled renewable energy attribute certificates that support new (≤15 years) renewable electricity installations (e.g., Renewable Energy Certificates (RECs) or Guarantees of Origin (GOs)). Note: "Unbundled" refers to renewable energy attributes that are sold separately from the renewable electricity itself.
2. The electricity must be from one or more of the following sources:
    a. Solar,
    b. Wind,

c. Geothermal,
d. Non-impoundment hydropower, or hydropower certified to a C2CPII-recognized renewable (hydro) electricity standard, or
e. Eligible biofuels (see Accounting for Bioenergy and Applying the Bioenergy Credit section below).

Other renewable sources (e.g., wave and tidal energy) will be evaluated on a case-by-case basis.

3. Renewable electricity (as defined in #2a-e) that is part of a utility's default offer may receive credit toward achieving the renewable electricity targets only if there is no voluntary renewable electricity market in the applicable market region. (Note: An alternative option, including for cases where there is a voluntary renewable electricity market, is to convert the amount of purchased electricity to greenhouse gas emissions and to meet the offset target instead – which does give credit for using renewable electricity present on the grid through that electricity's effect on the emissions rate. See section titled Meeting the Carbon Offset Targets below for further information).
4. Double counting of renewable energy attributes must not occur.
    a. Renewable energy attribute certificates must be retained by the applicant or canceled on the applicant's behalf in all cases.
    b. If procuring unbundled renewable energy attribute certificates outside of a regulated tracking system that controls for double counting, a qualified third party must verify that double counting has not occurred.
5. The generation or consumption of the renewable electricity may not be used to meet any regulatory requirements. Note: In regions with a cap and trade program and where a legal framework and process exists for reducing the cap to support emissions reductions claims associated with voluntary renewable electricity purchases, participation in the process to reduce the cap is required (e.g., for voluntary renewable energy attribute certificates generated in U.S. states with a cap and trade program and voluntary renewable energy set aside accounts, an appropriate amount of allowances must also be retired).

Further Explanation

This section of the standard is applicable to meeting the renewable electricity targets described in requirements #1.a (for the Bronze and Silver levels) and #1.a and 1.b (for the Gold level) in the sub-section titled 'Renewable Electricity and Greenhouse Gas Emissions Targets' above. Note that a wider range of renewable electricity purchasing options are available for achieving the targets at the Bronze and Silver levels and for half of the Gold target compared to the options available for achieving the other half of the target for Gold level and Platinum level. This includes credit for purchase of renewable electricity attributes certificates and purchase of renewable electricity from utilities or though other short-term purchase agreements.

Procuring Unbundled Renewable Energy Attribute Certificates

Renewable energy attribute certificates (i.e., Renewable Energy Certificates (RECs) or Guarantees of Origin (GOs)) are contractual instruments used in the energy sector to convey information about energy generation to other entities involved in the sale, distribution, consumption, or regulation of electricity. When these certificates are sold separately from the energy itself, the attributes and the energy are 'unbundled'. This

results in situations where those who are actually using renewable energy are not able to claim use because the renewable attributes have been sold to others. In regions where attribute certificates are employed, care must be taken to ensure that inaccurate claims of renewable electricity use are not made.

When purchasing RECs or GOs, the quality criteria for contractual instruments defined by the Greenhouse Gas Protocol Scope 2 Guidance must be followed (see Table 7.1 page 60 of the Scope 2 Guidance). This includes a requirement that contractual instruments "**Be sourced from the same market in which the reporting entity's electricity-consuming operations are located and to which the instrument is applied.**" For example, this means that RECs generated in the United States may not be employed to achieve the renewable electricity targets for a manufacturing facility located in Asia.

As noted in the standard, to receive credit towards achieving the renewable electricity targets, unbundled renewable energy attribute certificates must support new (≤ 15 years) renewable electricity installations and one or more of the accepted types of renewable electricity (per requirements #2a-e).

Renewable electricity attribute certificates typically have a validity period (i.e., Guarantees of Origin are valid for one year). Any certificate that does not indicate a period of validity will be considered valid for one year. Therefore, to the degree possible, consumption of non-renewable energy in a specific calendar year should be matched with production via the renewable energy attribute certificates in the same calendar year. **Any excess energy attribute certificates that are purchased for the purposes of achieving the renewable electricity targets may be banked for up to one year** to compensate for non-renewable electricity use. This means that it will be necessary to verify adequate coverage of attribute certificates for the prior year at recertification. This is in alignment with best practice. Note: This is an important change from Version 3.1of the Cradle to Cradle Certified Product Standard, which allowed for banking of energy attribute certificates for longer time periods.

Note that some evidence suggests that purchase of voluntary energy attribute certificates on a short term or single purchase basis does not help to increase the demand for renewable electricity, as is the goal (see for example Brander et al., 2018). Therefore, recommended best practice is to strive to eventually meet the renewable electricity targets completely through onsite renewable electricity production, or if that is not possible, then through long-term power purchase agreements with local, new, generators (as required for the Gold and Platinum levels).

Alternative to Purchasing Renewable Energy Attribute Certificates (RECs, GOs): Financial Support of a Climate-relevant Public Policy Initiative

As noted in the sub-section titled Renewable Electricity and Greenhouse Gas Emissions Targets, financial support of a climate-relevant public policy initiative receives credit as an alternative to procuring renewable energy attribute certificates for achieving the Bronze, Silver, and half of the Gold level renewable electricity targets. The financial support must be twice (i.e., 2x) the cost of procuring renewable energy attribute certificates for achieving the applicable target. Please refer to the standard text and the Required Documentation section below for additional information.

Procuring Renewable Electricity from a Utility

As noted in the standard, *Renewable electricity (as defined in #2a-e) that is part of a utility's default offer may receive credit toward achieving the renewable electricity targets only if there is no voluntary renewable electricity*

market in the applicable market region. This means, for example, that **in Europe and the United States (where voluntary markets do exist), it may not be possible to claim the percentage of renewable electricity noted on a utility bill.** To ensure that the proper amount is claimed, the utility must provide an energy attribute certificate cancellation statement or other official documentation indicating the amount of renewable energy attribute certificates that were cancelled on the applicant's behalf in support of a renewable electricity use claim. Note also that the sources of renewable electricity that receive credit are per requirements #2a-e.

In regions that do not have voluntary renewable electricity markets, applicants may claim the average percentage of renewable electricity available on their grid, or if grid average data are not available, in the country. When determining what amount may be claimed, note that the percentage of renewable electricity generated by a utility or in a certain region may be different from what is actually delivered to customers (e.g., if there is trading and transfer of electricity between regions). When voluntary electricity markets and associated energy attribute certificate trading systems do not exist, it is recommended to select other methods of achieving the targets (i.e., other than taking credit for the average grid mix), such as investment in on-site renewables and/or purchase of carbon offsets.

Note: If claiming the average amount of renewable electricity as allowed outside of regions with voluntary markets (as explained above), only the percentage of the total may be claimed (i.e., the total kWh of renewable electricity received may not be allocated only to a certified product group because this would result in falsely high renewable claims for the product group compared to the reality at the facility overall). For example, if 20% of the default electricity mix is renewable and 1000 kwh are used to manufacture the certified product, then 200 kwh may be counted as renewable.

Other Procurement Options

In addition to purchase of unbundled renewable energy attribute certificates and procurement of renewable energy from a utility as discussed above, all of the following scenarios are relevant to this section and must meet the requirements as stated to receive credit at the Bronze level, Silver level, and for half of the Gold level target:

- Purchasing from a competitive supplier in deregulated markets,
- Purchasing through a certified Community Choice Aggregation (CCA) or other certified community renewables programs,
- Direct purchases such as Power Purchase Agreements (PPAs), and
- Virtual Power Purchase Agreements (VPPAs).

Note that additional guidance on claiming on-site generated renewable electricity and electricity procured via direct and virtual power purchase agreements is included in the next Further Explanation box.

Receiving Credit for Impoundment Hydroelectricity (Requirement #2)

Impoundment hydropower must be certified to a C2CPII-recognized renewable (hydro) electricity standard to be counted towards the renewable electricity targets. Currently recognized renewable electricity certification programs that also certify some hydroelectricity are:

- EKOenergy in the European Union – *provisionally recognized through 31 December 2022; pending review*

- Green-e® certified in the United States and Canada – *provisionally recognized through 31 December 2022; pending review*

Additional programs may be recognized and subsequently added to this list. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition.

Avoiding Double Counting: Retaining and/or Cancelling Energy Attribute Certificates (Requirements #4)

Regardless of how energy is produced and/or procured, the standard requires that double counting be avoided as follows:

a. *Renewable energy attribute certificates must be retained by the applicant or cancelled on the applicant's behalf in all cases.*

b. *If procuring unbundled renewable energy attribute certificates outside of a regulated tracking system that controls for double counting, a qualified third party must verify that double counting has not occurred.*

Third-party certified renewable electricity (e.g., Green-e® certified in the United States and Canada or EKOenergy in the European Union) is highly recommended as a means of ensuring that double counting is avoided.

Qualified third parties are defined as auditing firms with a history of providing energy verification and auditing services and with expertise in electricity markets, energy attribute tracking, and accounting.

Regulatory Requirements (Requirement #5)

Regarding the requirement that: *The generation or consumption of the renewable electricity may not be used to meet any regulatory requirements.* In general, this means that if it is required by law to produce the renewable electricity then it may not be counted towards achieving the targets. The reasons for this are that Cradle to Cradle Certified aims to go beyond regulations – starting where regulations leave off, and this will likely lead to double counting, with both the applicant and the government claiming the same renewable electricity.

Regarding the requirement, *In regions with a cap and trade program and where a legal framework and process exists for reducing the cap to support emissions reductions claims associated with voluntary renewable electricity purchases, participation in the process to reduce the cap is required (e.g., for voluntary renewable energy attribute certificates generated in U.S. states with a cap and trade program and voluntary renewable energy set aside accounts, an appropriate amount of allowances must also be retired):* The purpose of such a mechanism is to improve the potential for renewable energy attribute certificate purchases to reduce greenhouse gas emissions (via reducing the existing cap on carbon emissions). In the United States, the use of Green-e® certified RECs will ensure this requirement has been met. In the European Union, this requirement does not apply (i.e., such a mechanism is not in place).

For the remaining half (i.e., 50%) of the Gold target (unless using the 100% renewable electricity procurement alternative per the sub-section above titled Renewable Electricity and Offset Targets) and for the Platinum level target:

1. The renewable electricity must be:
    a. Produced and consumed on site to the extent feasible, and/or
    b. Procured through long-term (≥ 15 years) power purchase agreements that support new (≤15 years) renewable electricity installations (Note: Virtual power purchase agreements are accepted. Other procurement options meeting the intent of the requirement will be considered on a case-by-case basis.)
2. The electricity must be from one or more of the following sources:
    a. Solar,
    b. Wind,
    c. Geothermal,
    d. Non-impoundment hydropower, or hydropower certified to a C2CPII-recognized renewable (hydro) electricity standard, or
    e. Eligible biofuels (see Accounting for Bioenergy and Applying the Bioenergy Credit section below).

    Other renewable sources (e.g., wave and tidal energy) will be evaluated on a case-by-case basis.
3. Power purchase agreements must support renewable electricity generation that occurs:
    a. In the same grid region as the applicant's facility(ies), or
    b. In a grid region with higher emissions rates than the region where the applicant's facility(ies) are located.
4. Double counting of renewable energy attributes and/or use for regulatory compliance must not occur (per #4 and #5 of the preceding section).

Further Explanation

This section of the standard is applicable to meeting the renewable electricity targets described in requirements #1.a (for the Gold level) and #1 (for the Platinum level) in the sub-section titled 'Renewable Electricity and Greenhouse Gas Emissions Targets' above. The methods in this section may also be applied towards achieving the renewable electricity targets for the Bronze level, Silver level, and the other half of the Gold level target. For example, the methods may be applied in cases when the entire Gold level target has not yet been achieved (e.g., a site with 5% on-site renewable electricity has achieved the Bronze level target.)

For the Gold and Platinum levels of certification, applicants are required to demonstrate commitment to directly using and/or supporting high quality renewable electricity over the long term. The available options for achieving the renewable electricity targets in this section of the standard reflect this goal.

On-site Renewable Electricity

To receive credit for on-site produced renewable electricity, the standard requires that the electricity must be *produced and consumed on site to the extent feasible*. This applies to scenarios where a facility produces electricity on site and is also connected to the electricity grid. Net metering is commonly employed, allowing for utility customers with on-site renewable electricity to sell any excess electricity produced to the utility. Best practice is to monitor electricity production and use to optimize and maximize the use of renewable electricity produced on site. Note that the sources of renewable electricity that receive credit are per requirements #2a-e.

Renewable energy attributes generated from on-site installations and retained/retired by the applicant may be banked for up to one year to account for purchases of non-renewable electricity from the grid that may be necessary due to fluctuations in on-site energy production (e.g., with changing day length and weather) and use. These energy attribute certificates may count as on-site produced electricity.

Power Purchase Agreements

No additional guidance on this purchase option is provided. Please refer to the standard text and Required Documentation sections for information.

Avoiding Double Counting: Retaining and/or Cancelling Energy Attribute Certificates (Requirement #4)

Attribute certificates associated with renewable electricity produced on site and procured via power purchase agreements must be retained and cancelled to support renewable electricity claims and avoid double counting. Refer to Requirements #4 and #5 applicable to the Bronze and Silver level targets and half of the Gold level target within this standard sub-section (Meeting the Renewable Electricity Targets) for additional information.

References

Guide to Purchasing Green Power, (United States Environmental Protection Agency, September 2018)

Required Documentation

If Using Renewable Energy Attribute Certificates (RECs or GOs) to Meet the Targets

- Renewable Energy Attribute Certificate (REC or GO) or other official documentation that indicates:
  - Date of purchase,
  - Validity period,
  - MWh purchased,
  - Identity of generator, and
  - Renewable electricity source (e.g., wind, solar).
- Documentation indicating the age of the generator if this is not included on the certificate (must be ≤ 15 years). Note: In the United States and Canada, assurance that new installations are supported may be achieved via use of Green-e® certified Renewable Energy Certificates (RECs).
- Guarantee that the renewable energy attributes associated with the electricity delivered to the applicant can be claimed by the applicant and are not being claimed or counted elsewhere by any other party. Notes: In the European Union, this requirement is assumed to be met when Guarantees of Origin (GOs) are employed. In the United States and Canada, if Green-e® certified RECs are employed this requirement has been met.

- A description of the system through which the renewable energy is being tracked, identifying the entity tracking the attributes, describing how attributes are being tracked and how double counting is prevented. Notes: In the European Union, this requirement is assumed to be met when Guarantees of Origin (GOs) are employed. In the United States and Canada, if Green-e certified RECs are employed this requirement has been met.
- For facilities located in the United States and Canada: Evidence that an appropriate amount of allowances have been retired from voluntary renewable energy set aside accounts. Note: This may be achieved via use of Green-e® certified RECs.
- C2CPII Clean Air & Climate Protection form with tables 1a and 1b completed.

If Using Utility Delivered Renewable Electricity to Meet the Targets

For regions with a voluntary renewable electricity market (e.g., European Union, United States):

- European Union: Guarantee of Origin cancellation statement as provided by the utility indicating the amount of GOs (MWh) cancelled on the applicant's behalf and the renewable electricity sources (e.g., solar, wind)
  OR

  All regions (including the United States): Energy attribute certificate cancellation statement or other official documentation provided by the utility, indicating:
  - The amount of renewable energy attribute certificates (MWh) that were cancelled on the applicant's behalf (preferred), or the specific percentage of renewable energy in the mix delivered to the applicant.
  - Renewable electricity sources (e.g., solar, wind).
  - Guarantee that the renewable energy attributes associated with the electricity delivered to the applicant can be claimed by the applicant and are not being claimed or counted elsewhere by any other party. Note: In the United States, if Green-e® certified RECs are provided this requirement has been met.
  - A description of the system through which the renewable energy is being tracked, identifying the entity tracking the attributes, describing how attributes are being tracked and how double counting is prevented. Note: In the United States, if Green-e® certified RECs are provided this requirement has been met.
- C2CPII Clean Air & Climate Protection form with table 1a completed.

For regions where there is no voluntary renewable electricity market:

- Documentation and references used for determining that there is no voluntary renewable electricity market in the applicable region and that the applicant's utility has only one electricity mix option available.
- Documentation and references used for determining the average percentage of renewable electricity available on the applicable grid or in the country where the facility is located.
- C2CPII Clean Air & Climate Protection form with table 1a completed.

If Using On-site Renewable Electricity to Meet the Targets

- Description and photos of energy installation including evidence of sources (e.g., solar, wind).
- Evidence of the total annual on-site production (e.g., meter readouts or utility bills).
- Evidence of renewable energy attribute certificate retention and cancellation (if applicable, e.g., in the European Union and United States).
- For the Gold level, evidence that the renewable electricity is consumed on site to the extent feasible. For example, documented analysis of renewable electricity production and on-site use demonstrating efforts to optimize use.
- C2CPII Clean Air & Climate Protection form with table 1a completed.

If Using Power Purchase Agreements (Direct or Virtual) to Meet the Targets

- Fully executed contract between facility owner and energy provider that indicates:
  - Contract length (For the Gold level, must be ≥ 15 years),
  - Location of the generator,
  - Age of generator (For the Gold level, must be ≤ 15 years)
  - Amount of electricity that is/will be purchased (MWh),
  - Sources or electricity (e.g., wind, solar).
- Evidence of renewable energy attribute certificate retention and cancelation (if applicable, e.g., in the European Union and United States) or contract terms stating that the generator is transferring claims to the renewable electricity attributes to the buyer (i.e., that the generator will not sell or otherwise provide the renewable attributes to other parties).
- Gold level:
  - Evidence that the generator is in the same grid region as the final manufacturing facility (e.g., official grid region map with locations of generator and facility marked), or
  - For virtual power purchase agreements, indication of the emissions rates for the grid region where the facility is located and for the grid to which the generators is connected. Include references used.
- C2CPII Clean Air & Climate Protection form with table 1a (for direct PPAs) or 1a and 1b (for virtual PPAs) completed.

Impoundment Hydroelectricity (For All Types of Procurement and Use Listed Above)

- Certificate from a C2CPII-recognized renewable (hydro) electricity standard indicating total MWh of certified hydroelectricity that has been purchased. Note that all other documentation requirements listed above apply, as applicable, depending on how the electricity is procured.

Alternative to Purchasing Renewable Energy Attribute Certificates: Financial Support of a Climate-relevant Public Policy Initiative

- Cost estimate for RECs (United States and Canada) or GOs (European Union). This estimation method may be used for other regions as well.

- Receipt or similar indicating donation amount and date (amount must be 2x the cost estimate).
- Description of the initiative, including link to initiative website if available.
- C2CPII Clean Air & Climate Protection form with tables 1a and 1d completed.

Meeting the Carbon Offset Targets

Carbon offsets may be used to address both direct and indirect greenhouse gas emissions. For example, this includes emissions produced on site from burning fuels and emissions resulting from the generation of purchased electricity or steam off site.

Exception: Carbon offsets may not be used to address emissions attributable to purchased electricity in countries where the nuclear power share is > 10%.

To claim and apply carbon offsets toward the offset target(s), the following conditions must be met:

1. Offsets must be sourced from projects certified to a C2CPII-recognized offset project certification program that aims to ensure that:
    a. The associated greenhouse gas reductions or removals are additional, accurately estimated, permanent, and not double counted.
    b. Offset projects operate in compliance with local laws.
2. The offsets must be purchased voluntarily (and not for compliance purposes).
3. If using carbon offsets to address emissions attributable to the use of purchased electricity (i.e., scope 2 emissions): Emissions attributable to the purchased electricity must be calculated using residual emissions factors if available, or grid average emissions factors if not.

Further Explanation

This section of the standard is applicable to using carbon offsets to achieve the targets for addressing greenhouse gas emissions described in the sub-section above titled 'Renewable Electricity and Greenhouse Gas Emissions Targets'. Carbon offsets may be employed to address emissions attributable to both purchased energy that was generated off-site (i.e., scope 2 emission) and emissions that occur directly at final manufacturing facilities (i.e., scope 1 emissions, for example, that result when fuels are burned on site). Purchase of carbon offsets to address emissions from these energy sources is an option through the Gold level of certification. For the Platinum level, carbon offsets may only be employed to address emissions from non-energy sources and/or emissions resulting from the use of bioenergy receiving partial credit (see Bioenergy section below for additional information).

As noted in this section of the standard, *Offsets must be sourced from projects certified to a C2CPII-recognized offset project certification program*. C2CPII-recognized offset certification programs are as follows:

- American Carbon Registry – *provisionally recognized through 31 December 2022; pending review*
- Clean Development Mechanism – *provisionally recognized through 31 December 2022; pending review*
- Climate Action Reserve – *provisionally recognized through 31 December 2022; pending review*
- The Gold Standard
- Verified Carbon Standard – *provisionally recognized through 31 December 2022; pending review*

Offsets must be purchased voluntarily (and not for compliance purposes). Participation in a cap and trade program as required by law does not receive credit. Applicants are encouraged to select offset projects that also support and protect ecosystems, biodiversity, and local communities (i.e., REDD+ or similar).

Additional programs may be recognized and subsequently added to this list. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition.

Using Carbon Offsets to Address Emissions from Purchased Electricity: Nuclear Power Considerations

As noted in the standard: *Carbon offsets may not be used to address emissions attributable to purchased electricity in countries where the nuclear power share is > 10%.* The reason for this restriction is that Cradle to Cradle Certified supports the use of renewable energy. Nuclear power is not renewable and is also associated with risks of catastrophic accidents and generation of highly hazardous waste – although it is associated with low to zero greenhouse gas emissions. This restriction ensures that action will be taken in support of increasing the availability of renewable electricity in locations where there is a high percentage of nuclear in the mix. Without this restriction, the requirements to use renewables and/or purchase offsets could be completely or partially avoided by using offsets to compensate for emissions attributable to nuclear generated power. The C2CPII Clean Air & Climate Protection form provides information on the percent nuclear share by country for determining where this restriction applies. The current list of countries with > 10% nuclear power are: Armenia, Belgium, Bulgaria, Canada, Czech Republic, Finland, Germany, Hungary, Korea (South), Romania, Russia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan, United Kingdom, United States. This list is based on 2019 data from world-nuclear.org. If more recent factors become available, they may be employed.

Alternative to Purchasing Carbon Offsets: Investment in On-site Emissions Reductions Projects (Bronze and Silver levels)

As noted in the sub-section titled Renewable Electricity and Greenhouse Gas Emissions Targets, investments in on-site emissions reductions projects receive credit as an alternative to purchasing carbon offsets for achieving the Bronze and Silver level targets. The investment must be of equivalent value to a carbon offset purchase for achieving the applicable target (i.e., 5% for the Bronze level, and 20% for the Silver level). Please refer to the standard text and the Required Documentation section below for additional information.

References

Broekhoff, D., Gillenwater, M., Colbert-Sangree, T., and Cage, P. 2019. "Securing Climate Benefit: A Guide to Using Carbon Offsets." Stockholm Environment Institute & Greenhouse Gas Management Institute. Offsetguide.org/pdf-download

Required Documentation

Carbon Offsets

- Offset certificates indicating date of purchase, amount purchased (tCO2e), offset standard, and project(s)

supported (e.g., project numbers)

- C2CPII Clean Air & Climate Protection form with tables 2a and 2d completed and, if offsetting emissions from purchased electricity, tables 1a and 1c completed
- If offsets are employed for addressing emissions attributable to purchased electricity:
  - Indication of the percent nuclear share in the region and references used if different from those available in the C2CPII Clean Air & Climate Protection form
  - References for emissions factors employed if different from those provided in the C2CPII Clean Air & Climate Protection form

Alternative to Purchasing Carbon Offsets: Investment in On-site Emissions Reductions Projects (Bronze and Silver levels)

- Cost estimate for carbon offsets
- Evidence of investment amount and date (e.g., receipts for purchase of new equipment or for payment to contractors for retrofit)
- Description of the project and how it will contribute to reduced emissions
- C2CPII Clean Air & Climate Protection form with tables 2a and 2e completed

Accounting for Bioenergy and Achieving the Bioenergy Credit

If bioenergy is produced on site (including use of biofuels), the greenhouse gas emissions attributable to the bioenergy must be added to the total CO_2e subject to the offset targets.

If the bioenergy is produced from eligible fuels, the bioenergy credit may also be subtracted from the amount of offsets required to reach a given target. The bioenergy credit = (the carbon dioxide combustion emissions of the eligible biofuel) x (the bioenergy credit multiplier for the eligible fuel source type). In addition to receiving the bioenergy emissions credit for the use of eligible biofuels, electric bioenergy produced on site from these fuels may also be counted toward the renewable electricity target.

Eligible fuels are solid, liquid, or gaseous forms of fuel sourced from organic and renewable materials that would otherwise be categorized as waste as defined by the most recent version of the Green-e® Renewable Energy Standard for Canada and the United States.

The bioenergy credit multipliers by eligible fuel source type are as follows (see the Definitions section for a description of the approach used to define these multipliers):

1. Agricultural crop residue that is unmerchantable as food and other similar rapidly renewable waste material: 0.63
2. Animal and other organic waste (e.g., food scraps), landfill gas, and wastewater methane: 1
3. Woody waste: 0.57

To receive the bioenergy credit, the applicant must retain all rights to the environmental attributes associated with the bioenergy. Emissions reductions attributes may not be sold, registered, or claimed by others.

Bioenergy must be produced on site and any biofuels must be used directly to receive the bioenergy credit

with the following exception: For the Bronze and Silver levels, “green-gas” certificates may be employed to compensate for natural gas obtained through the standard gas grid. New (≤15 years) biogas installations within the same market region must be supported. Carbon offsets supporting bioenergy installations receive credit as described above in the section titled Meeting the Carbon Offset Targets.

Further Explanation

Bioenergy, including biofuels, are often considered to be carbon neutral. However, this is not necessarily the case in the near term given the time period over which biomass needs to grow back, especially for slower growing plants like trees. Burning biomass and biobased fuels also produces other types of air emissions (in addition to greenhouse gases) that can contribute to reduced air quality. In addition, if land is used to grow biomass for energy production, there may be competition with land use for growing food. Pressure to grow biomass for energy production could also result in the conversion of natural areas to agriculture. For these reasons, Cradle to Cradle Certified only gives credit to bioenergy (including biofuels) that are produced from bio-based ‘waste’ materials. In addition, the use of woody waste for energy production receives only partial credit. Emissions from bioenergy and biofuels that do not receive credit (i.e., ineligible sources) must be treated in the same way as all other greenhouse gas emissions for the purpose of achieving the targets set out in the sub-section of the standard titled ‘Renewable Electricity and Greenhouse Gas Emissions Targets’. In other words, if carbon offsets will be used to address greenhouse gas emissions (as allowed through the Gold level), and bioenergy that cannot be verified to be produced from eligible waste sources is used, the greenhouse gas emissions attributable to use of the bioenergy must be added to the emissions from any other sources, and this total is used to calculate the percentage of carbon offsets required.

Eligible Sources

Only the waste fuel types that are listed in the Center for Resource Solutions, Green-e Renewable Energy Standard for Canada and the United States may receive the bioenergy credit. Note that this reference also includes some fuel types that do not receive credit and instead must be treated in the same way as using fossil fuel-based energy (i.e., energy crops).

Calculating the Bioenergy Credit

Example calculation and explanation for a scenario where landfill gas (or wastewater treatment gas) and natural gas are used for the final manufacturing stage of the product:

- Bioenergy credit = (amount of landfill gas used * CO_2 emissions factor for landfill gas) x multiplier for landfill gas. Note: The emissions factor used for the eligible fuel must be for CO_2 only and may not include other greenhouse gases such as methane or nitrous oxide emissions. The rationale for this is that the multipliers used to calculate the bioenergy credit are based on estimates of the net atmospheric biogenic CO_2 contribution expected to occur (and on the other hand, expected not to occur) from burning biobased fuels at a stationary source. When burning these fuels, carbon dioxide plus small amounts of methane and nitrous oxide are released. The carbon dioxide can be taken up again by plants, but the methane and nitrous oxide cannot. Therefore, credit is not given for the

methane and nitrous oxide portions of the greenhouse gas emissions resulting from these fuel types. Although this rationale is less directly relevant to the landfill gas and similar scenarios, the same method has been applied.

- Multiplier for landfill gas = 1
- Total emissions = (amount of natural gas used * CO_2e emissions factor for natural gas) + (amount of landfill gas used * CO_2e emissions factor for landfill gas)
- Offsets required to achieve the Gold level target of 50% = (total emissions * 50%) – (bioenergy credit). If this value is negative, no offsets are required. If this value is positive, this is the amount of offsets that must be purchased.
- In other words, if aiming to achieve the Gold level, and (the bioenergy credit ÷ total emissions from all sources) * 100 > 50%, then carbon offsets will not have to be purchased (i.e., the Gold level has been achieved).

This means that if landfill gas or similar is the only fuel used in the final manufacturing stage, then it will not be necessary to purchase carbon offsets to achieve the Gold level. For the Platinum level, only a very small amount of carbon offsets will have to be purchased to account for the small portion of the emissions that are methane and nitrous oxide, and also to achieve the > 100% requirement.

Biogas/Green-gas Certificates

Certificates that do not indicate a period of validity will be considered valid for one year. Certificates may be banked for up to one year after purchase to match non-renewable gas use on site.

Required Documentation

- Receipts, meter readouts, or similar evidence for verifying the amount and type of eligible fuel purchased and used on an annual basis (provide data for the prior two years)
- Reference to the applicable requirement numbers in the Green-e Renewable Energy Standard for Canada and the United States (most recent version) and explanation regarding how it can be verified that the bioenergy or biofuel is from an eligible source
- References for emissions factors if different from those provided in the C2CPII Clean Air & Climate Protection form
- C2CPII Clean Air & Climate Protection form with table 2b completed
- If employing biogas/green-gas certificates (as allowed for the Bronze and Silver levels):
  - Certificate or other official documentation from the biogas generator indicating date of purchase, validity period, total amount purchased, source of biogas (e.g., anerobic digestion of municipal waste biomass), and generator identity including location and age of gas generating installation
  - Evidence that the generator is in the same gas grid region as the final manufacturing facility (e.g., official grid region map with locations of generator and facility marked)

- Guarantee by the generator that the renewable energy attributes associated with biogas can be claimed by the applicant and are not being claimed or counted elsewhere by any other party
- A description of the system through which the biogas is being tracked, identifying the entity tracking the attributes, describing how attributes are being tracked and how double counting is prevented

Achieving the Performance Improvement Credit

The renewable electricity and/or greenhouse gas emissions targets may be reduced when performance improvement(s) resulting from energy conservation and efficiency projects have been demonstrated and verified by a qualified third party. The performance improvement credit may be applied to (1) purchased electricity in terms of kWh or equivalent and direct emissions separately, or (2) combined scope 1 and 2 emissions. In general, the renewable electricity and offset targets may be reduced by one percentage point for each percent of normalized performance improvement achieved, within the following limits:

1. For Bronze level: The 5% renewable electricity and/or greenhouse gas emissions targets may be reduced by up to five percentage points (100% of the targets). If performance improvement(s) of 5% has been achieved, renewable electricity, carbon offsets, and/or other methods of achieving the targets are not required.
2. For Silver level: The 20% renewable electricity and/or greenhouse gas emissions targets may be reduced by up to 10 percentage points (50% of the targets). If the maximum performance improvement credit of 10% has been achieved, only 10% of electricity must be renewably sourced and only 10% of greenhouse gas emissions must be offset or addressed via the other allowable methods. Alternative: If, for the applicant company, absolute emissions reductions are achieved in line with the Science Based Targets Initiative's (SBTI) well below 2°C or 1.5°C scenarios, the 20% renewable electricity and/or offset targets may be reduced by up to 20 percentage points (100% of the targets). Targets must be verified by SBTI and absolute reductions in line with the targets must be realized over the prior certification period. In this case, if performance improvement(s) of 20% or more has been achieved, renewable electricity, carbon offsets and/or other methods of achieving the targets are not required.
3. For Gold level: The 50% renewable electricity and/or greenhouse gas emissions targets may be reduced by up to 12.5 percentage points (25% of the targets). If the maximum performance improvement credit of 12.5% has been achieved, only 37.5% of electricity must be renewably sourced and only 37.5% of greenhouse gas emissions must be offset or addressed via the other allowable methods.
4. The performance improvement credit may not be used toward fulfillment of the Platinum level targets.

The performance improvement credit may be applied when all of the following conditions are met:

1. Performance improvement is achieved at a facility that is part of the product's final manufacturing stage.
2. The product is allocated a share of overall facility energy use and emissions proportional to its share in the facility's overall production. (This is required prior to determining the amount of carbon offsets and/or renewable electricity necessary to meet the remainder of the target(s)).

3. Performance improvements are determined using a baseline year of no more than 10 years prior to certification or recertification (as applicable).
4. Performance improvements from baseline to reporting year must be determined and normalized per an approved method and verified by a qualified third party with expertise in energy performance measurement and verification.
    a. The International Performance Measurement and Verification Protocol (IPMVP), Method C (i.e., the whole facility method), or similar methods based on ISO 50015 and ISO 50047, are accepted.
5. The verifier must report performance improvement(s) in the appropriate quantities depending on how the remainder of the targets will be met as follows:
    a. Performance improvement must be reported separately for electricity and all other greenhouse gas emissions sources (required if meeting renewable electricity and greenhouse gas emissions targets separately); or,
    b. Total performance improvement for all energy sources combined must be converted to and reported as percentage of CO_2e savings achieved (i.e., avoided emissions).
6. The reporting year for the performance improvement verification report must be within one year of the certification issue date. Verification must be repeated upon each recertification.
7. The applicant must retain all rights to the environmental attributes associated with the performance improvement.

Further Explanation

Scope of the Performance Improvement Credit (Requirements #1-2)

Performance improvement [must be] achieved at the facility that is part of the product's final manufacturing stage per requirement #1. This means that company level performance improvements that are not relevant to the manufacturing stage facilities where the product is made do not receive credit. However, if there are multiple final manufacturing facilities and performance improvements have been achieved at several or all of these facilities, the total improvement at all facilities combined may be employed in calculating the credit. Alternatively, the credit may be applied to just some of the facilities where the product is made with other means of achieving the targets applied at the remaining facilities. If this alternative option is employed, then performance improvements must have been achieved at each facility to which the credit is applied.

Per requirement #2: *The product [must be] allocated a share of overall facility energy use and emissions proportional to its share in the facility's overall production. (This is required prior to determining the amount of carbon offsets and/or renewable electricity necessary to meet the remainder of the target(s)).* Energy conservation and efficiency (C&E) projects and performance improvement estimates usually occur and apply at the facility level. Conversely, the default for Cradle to Cradle is for energy and emissions to be reported for (and targets applied to) the product, excluding non-attributable facility-level energy use and emissions. This requirement means that when applying the performance improvement credit to product allocated energy use and emissions, the scope for the energy and/or emission numbers that the targets are based on has to match the scope used in the performance improvement calculations. In other words, if performance improvement percentages are determined at the facility level, and the remainder of the targets will be met based on product allocated energy use and emissions, the product must also be allocated a share of overall facility energy use and emissions proportional to its share in the facility's overall production (e.g., energy used to heat the

building that may otherwise be considered non-attributable to the product). An alternative is to apply both the targets and the performance improvement credit to facility level energy use and emissions, thereby avoiding the need to allocate to the final manufacturing stage all together.

Baseline (Requirement #3)

Per requirement #3: *Performance improvements are determined using a baseline year of no more than 10 years prior to certification or recertification (as applicable).* This means that if efficiency improvements were made more than 10 years ago, a facility is not eligible to receive the performance improvement credit. This also means that if the baseline is set at 10 years ago, it will have to be adjusted at recertification to claim the performance improvement credit again.

Methods and Verification (Requirement #4)

Per requirement #4, performance improvements must be determined per an approved method and verified by a qualified third party with expertise in energy performance measurement and verification. This means that applicants may carry out the estimates themselves, but the method used and result achieved must be verified by a qualified third party to ensure accuracy and conformance with the International Performance Measurement and Verification Protocol (IPMVP) Method C or similar.

Qualified parties are defined as association of energy engineers with IPMVP accreditation or superior energy performance verification bodies.

Methods and Verification References (Requirement #4)

- Association of Energy Engineers (AEE) and AEE directory
- International Performance Measurement and Verification Protocol (IPMVP)
- Superior Energy Performance (SEP) 50001
- SEP 50001 Verification Bodies

How to Report and Apply the Performance Improvement (Requirements #5 and #6)

How the performance improvements are required to be reported and applied depends on how the remainder of the targets (if any) will be achieved.

Method #5a (i.e., performance improvement is reported separately for electricity and all other greenhouse gas emissions sources) must be selected when an applicant would like to purchase energy attribute certificates (RECs or GOs) or use on-site renewables to meet the remainder of a renewable electricity target (i.e., the portion of the target that has not been met via the performance improvement credit) while using offsets to address other emissions. If using method #5a, energy performance improvement must be converted to % CO_2e savings for all energy sources except for purchased electricity and on-site renewables. Note that other emissions sources include purchased heat.

Method #5a is also required for facilities located in a region with a cap and trade program (i.e., in the European Union and some states in the United States). The reason for this is that within a cap and trade system that

regulates the power generation sector, reductions in purchased electricity use due to conservation and efficiency (C&E) measures will not further reduce scope 2 emissions (i.e., the emissions resulting from the purchased electricity) beyond the cap. In this case, it is not appropriate to convert C&E savings into greenhouse gas emissions savings for purchased electricity. Note that it is also allowable to only calculate and apply the performance improvement credit to direct emissions, and to meet the renewable electricity targets and targets for any other type of purchased energy through other means.

If using method #5b (i.e., performance improvement is reported for all energy sources combined), total improvement for all sources (scope 1 and 2) must be converted to and reported as total % CO_2e savings. In this case, offsets may be used to address the remainder of the target (if any) within the constraints indicated by the standard. Emissions from bioenergy must be included in the total emissions estimates. However, if applicable, the bioenergy credit may also be applied (see the Bioenergy section above for further information). Again, it is also allowable to only calculate and apply the performance improvement credit to direct emissions and to meet the renewable electricity targets and targets for any other type of purchased energy through other means.

In all cases, if the total required target for the desired achievement level cannot be achieved completely through the performance improvement credit, then the other acceptable means of meeting the targets for that level may be applied to the remainder. For example, if a performance improvement of 8% has been achieved for direct emissions, the remainder of the Silver target (12%) may be achieved by using carbon offsets to compensate for 12% of greenhouse gas emissions.

Finally, as noted in requirement #6: *The reporting year for the performance improvement verification report must be within one year of the certification issue date. Verification must be repeated upon each recertification.*

Avoiding Double Counting – Retaining Rights to Attributes (Requirement #7)

As noted in the standard: *The applicant must retain all rights to the environmental attributes associated with the performance improvement.* This means, for example, that if carbon offsets are produced and sold from the emissions reductions resulting from the performance improvements, then the performance improvement credit may not be claimed.

Required Documentation

- Verification report provided by a qualified third-party verifier that describes the methods used (e.g., IPMVP Method C) and includes reporting per Requirement #5a or b (as applicable). Report must have been generated in the past year and demonstrate that the baseline year is no more than 10 years prior.
- Name and qualifications of the third-party verifier.
- Explanation of scope of the performance improvements (per requirement #1-2) and how the improvement will be applied towards achieving the Cradle to Cradle Certified targets.
- A statement signed by the facility owner indicating that the company is retaining all rights to the environmental attributes associated with the performance improvements made.
- For the Silver level, if employing the option to reduce the Silver target by more than 10 percentage points through verified performance improvements:

- Evidence of the applicant company having achieved absolute emissions reductions in line with the Science Based Targets Initiative's (SBTI) well below 2°C or 1.5°C scenarios.
- Evidence that the absolute reductions target(s) achieved have been verified by SBTI and have been realized over the prior certification period (e.g., SBTI verification report).

6.5 Energy Efficiency During Product Use

Intended Outcome(s)

Manufacturers are incentivized to make energy efficient products and product users are able to identify and select products that perform efficiently.

Applicable Achievement Level(s)

Bronze

Requirement(s)

For products that use energy during the use phase (e.g., appliances) or that greatly impact the energy efficiency of buildings (e.g., windows, insulation), obtain a certification and/or label using a C2CPII-recognized energy efficiency standard, labeling program, or similar, if available.

C2CPII-recognized efficiency standards and labels must allow users to identify products with above-average performance (e.g., EU Energy Label and EnergyStar in the U.S.).

Certification or labeling is required if a relevant certification or label is available in the region(s) where the product is sold.

Further Explanation

Products that greatly impact the energy efficiency of buildings that are subject to this requirement currently include: windows, doors, insulation, and reflective roofing.

The European Union Energy Label and United States Environmental Protection Agency/Department of Energy program EnergyStar are currently recognized by C2CPII for the purposes of these requirements. Additional certification programs may be recognized and subsequently added to this list. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition.

Required Documentation

- Certificate or label applicable to the certified product
- If the product uses energy and/or impacts the energy use of buildings, evidence of research conducted to determine that there is not an applicable certification or label available in the region(s) where the product is sold, including explanation and references used.

6.6 Transparency

Intended Outcome(s)

Greenhouse gas emissions data are available to stakeholders, demonstrating the manufacturer's commitment to protecting the climate.

Applicable Achievement Level(s)

Bronze and Gold

Requirement(s)

Bronze level: Make greenhouse gas emissions data for the applicant company, all final manufacturing stage facilities, or the final manufacturing stage of the product available to stakeholders.

Gold level: Make embodied greenhouse gas emissions data for the product available to stakeholders. For construction products and building materials used to construct primary building elements (i.e., product types for which life cycle assessment is common practice), make an Environmental Product Declaration available.

For the Bronze level, scope 1 and scope 2 emissions must be reported separately.

Further Explanation

Refer to standard Section 6.2 for guidance on how to calculate scope 1 and 2 emissions. For guidance on best practices applicable to reporting scope 2 emissions, refer to the Greenhouse Gas Protocol Scope 2 Guidance.

Required Documentation

Bronze level

- Link to website and/or report (e.g., sustainability report) where the required data have been made available.

Gold level

- Link to website and/or report (e.g., sustainability report) where embodied greenhouse gas emissions data have been made available. For construction products and building materials (per the list in standard Section 6.2), link to where the Environmental Product Declaration has been made available.

6.7 Using Blowing Agents with Low or No Global Warming Potential

Intended Outcome(s)

Blowing agents used in the product's manufacturing and supply chain do not contribute to climate change or depletion of the ozone layer.

Applicable Achievement Level(s)

Gold

Requirement(s)

For blowing agents used to manufacture foam materials, use blowing agents with low to no global warming potential (GWP) and no ozone depletion potential (ODP).

Blowing agents with a RED or GREY hazard rating in the Climatic Relevance endpoint (as defined by the C2CPII Material Health Assessment Methodology) must not be used. This is required regardless of whether or not the blowing agent remains within the final product and regardless of whether the blowing agent is used during the final manufacturing stage or in the supply chain.

Exemption

Blowing agents used to manufacture foam materials if the foam material makes up < 1% of the product by weight.

Further Explanation

As noted, this requirement applies specifically to blown foam materials. Some blowing agents have a high global warming potential and/or ozone depletion potential. Selecting foams that use preferable blowing agents is best practice and required for the Gold level. Refer to the Cradle to Cradle Certified Material Health Assessment Methodology for the definition of a RED or GREY hazard for the Climatic Relevance endpoint.

If foam is purchased rather than produced and blown as part of the final manufacturing stage, it is recommended to collect data regarding the chemical composition of any blowing agents used while collecting data for the Material Health category requirements. (Otherwise, this information will have to be collected separately for the purposes of this Clean Air & Climate Protection requirement.)

Note that in the case that blowing agents are used in final manufacturing, the associated greenhouse gas emissions must also be added to total emissions per requirements in Section 6.2 Quantifying Electricity Use and Emissions, beginning at the Bronze level. Per Section 6.2 all greenhouse gases must be included in the quantification. This also includes refrigerants and other non-energy related emissions.

References:

Substitutes in Foam Blowing Agents (Significant New Alternatives Policy (SNAP), US EPA)

Required Documentation

- Bill of materials (as provided for the Material Health requirements) indicating the percentage by weight of the foam within the product overall
- Assessment rating(s) of blowing agent(s) used as determined by a Cradle to Cradle Certified Material Health assessor

6.8 Addressing Embodied Greenhouse Gas Emissions

Intended Outcome(s)

Offsetting or reducing embodied GHG emissions has demonstrably decreased the proportion of climate-changing greenhouse gases attributable to manufacturing of the product.

Applicable Achievement Level(s)

Gold and Platinum

Requirement(s)

Gold level: Offset or otherwise address 25% of embodied greenhouse gas emissions attributable to the product from resource extraction through final manufacturing or through end of use.

Platinum level: Offset or otherwise address 100% of embodied greenhouse gas emissions attributable to the product from resource extraction through final manufacturing or through end of use.

At a minimum, a cradle to gate scope including emissions attributable to the final manufacturing stage must be employed.

Embodied greenhouse gas emissions may be addressed through a variety of methods, including but not limited to, the purchase of carbon offsets, projects with suppliers, product redesign, and savings during the use phase.

Reduction in embodied greenhouse gas emissions per functional unit receives credit when compared to a baseline of no more than 10 years prior to certification or recertification (as applicable).

Above average performance (lower embodied emissions per functional unit) receives credit when compared to an industry-wide third-party verified benchmark, if available. An industry-wide generic EPD published in the past five years may be used as the benchmark. Otherwise, the performance of a sample of similar products may be used for comparison.

Qualified third-party verification of the percentage addressed is required if meeting the targets through methods other than offset purchase.

Further Explanation

The embodied emissions targets apply to cradle to gate emissions at a minimum (i.e., *resource extraction through final manufacturing*). However, it is highly recommended to include the entire life cycle through end of use, including product cycling. See Section 6.2 Quantifying Electricity use and Greenhouse Gas Emissions for additional requirements regarding how embodied emissions must be quantified and verified.

The targets in this section (25% and 100% for the Silver and Gold levels, respectively) apply to total annual emissions over the certification period of two years. Therefore, it will be necessary to calculate annual emissions from the per unit values determined per the quantification requirements in Section 6.2.

If using carbon offsets to address embodied emissions, the offsets must be certified to a C2CPII-recognized offset standard (see Section 6.4 guidance for additional information).

As noted in the standard, *Qualified third-party verification of the percentage addressed is required if meeting*

the targets through methods other than offset purchase. In other words, this is required to receive credit for emissions reductions resulting from projects with suppliers, product redesign, and savings during the use phase (that may also be the result of design decisions or be tied to how the product is used – for example to insulate a building which results in lower building energy use). As noted, *reductions in embodied greenhouse gas emissions per functional unit receives credit.* Functional units are defined per the applicable Product Category Rule(s). Note that the functional unit may include more than the certified product itself.

Qualified third parties are defined as life cycle assessment (LCA) practitioners with demonstrated experience conducting life cycle assessments per ISO 14040.

Required Documentation

- Explanation, rationale, and calculations for how total annual embodied emissions have been quantified, referring to the embodied emissions quantified and required documentation provided per Section 6.2
- If using offsets to address embodied emissions, offset certificates indicating date of purchase, amount purchased (tCO2e), offset standard, and project(s) supported (e.g., project numbers)
- If not using offsets to address embodied emissions, verification report from a qualified third party explaining how, and demonstrating that, the applicable target has been achieved
- Name and qualifications of third-party verifier

7 // Water & Soil Stewardship Requirements

Category Intent

Water and soil are treated as precious and shared resources. Watersheds and soil ecosystems are protected, and clean water and healthy soils are available to people and all other organisms.

Requirements Summary

To achieve a desired level within the category, the requirements at all lower levels must also be met.

Bronze	Local and product relevant water and soil issues are characterized. (Required for final manufacturing stage facilities and select tier 1 suppliers of key materials.)
	Final manufacturing facilities comply with water quality regulations or guidelines (i.e., permits, international guidelines, or industry best practice).
	Product relevant chemicals entering effluent or sludge comply with the relevant restrictions on the Core Restricted Substances List (RSL). (Required for final manufacturing stage.)
	Water use at final manufacturing stage facilities is quantified.
	Adequate drinking water, sanitation, and hygiene are provided (final manufacturing stage facilities only).
	A strategy for achieving the Silver level water and soil conservation requirements has been developed. For facilities using high volumes of water in stressed locations, the strategy includes water use reduction targets. Progress is reported at recertification.
Silver	Manufacturing facilities of tier 1 suppliers comply with water quality regulations or guidelines (i.e., compliance with permits, international guidelines, or industry best practice). (Required for tier 1 suppliers of key materials associated with pollutant intense processes.)
	The Bronze level water and soil conservation strategy has been implemented including: At least one conservation technology or best practice at facilities expected to have the greatest water- or soil-related impacts. (Required for final manufacturing facilities with high volume processes in stressed locations and facilities with pollutant intense processes.) One additional action to conserve water and/or soil either at final manufacturing facilities or in the supply chain. (Required when there are any facilities with high volume or pollutant intense processes and/or in stressed locations, or key materials in scope.)
	Product relevant process chemicals entering effluent and sludge are defined and assessed.
	Product relevant effluent and sludge does not contain recognized PBTs, vPvBs, or EU CLP Cat.1 and 2 CMRs, or substances causing an equivalent level of concern, or exposure via effluent and sludge is unlikely or expected to be negligible. (Required for final manufacturing stage.)
	Water use data are made available to stakeholders.
	A strategy for achieving the Gold level water and soil conservation requirements has been developed. Progress is reported at recertification.

Gold	The Silver level water and soil conservation strategy has been implemented including: Conservation technologies and best practices at facilities expected to have the greatest water- and/or soil-related impacts. (Required for all final manufacturing facilities with high volume or pollutant intense processes and/or in stressed locations.) Actions to conserve water and/or soil in the supply chain, including the use of certified materials, working as part of multi-stakeholder group(s), and/or working directly with suppliers to implement water and soil stewardship requirements and address the processes of concern. (Required for key materials in scope.)
	Product relevant chemicals in effluent and sludge are assessed and optimized (i.e., none are x-assessed or grey-rated). (Required for the final manufacturing stage and for key materials where pollutant intense processes occur at tier 1, or at any tier for leather, metal finishing, pulp/paper and textiles.)
	A positive impact project that addresses local and/or product relevant water and/or soil issues has been implemented.
Platinum	Water quality data are made available to stakeholders.
	Impact of positive impact project demonstrated.
	For final manufacturing stage facilities: A comprehensive effluent and sludge quality management system has been established, and Effluent and sludge produced as a result of all manufacturing processes used at the facility are optimized.

7.1 Characterizing Local and Product Relevant Water & Soil Issues

Intended Outcome(s)

Through the assessment and understanding of water- and soil-related impacts attributable to the product, including local water availability and quality issues relevant to the product's manufacturing facilities, opportunities to address the impacts are identified.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Characterize local and product relevant water and soil issues.

For all final manufacturing stage facilities:

1. Determine the basin/catchment/watershed name.
2. Identify risks to water quantity (including baseline water stress) and water quality, and risk of unimproved or no access to drinking water and sanitation as defined by the most recent version of the World Resources Institute Aqueduct database or equivalent.

3. If a catchment level plan is available, obtain, review, and determine how the plan is relevant to the site. This must include a determination of whether a groundwater abstraction cap (i.e., a regulatory limit on total withdrawals) based on water resource availability has been set, and if so, the cap's relevance to the site.
4. Describe effluent and sludge treatment process(es).
5. If third-party treatment facilities are employed, identify the provider(s) and describe any issues with their ability to adequately treat effluent received from the facility.
6. Identify any known issues with source and/or receiving water contamination (e.g., due to the use of reclaimed water) or high concentrations of naturally occurring hazardous substances.
7. Describe any known issues with soil contamination, erosion, or other types of degradation at the site.
8. Determine if the facility is potentially impacting any sensitive ecosystems, protected areas, or similar.

For the product: Identify the use cycle stage(s) (also commonly referred to as "life cycle" stages) responsible for the majority of water quantity and quality related impacts. Describe the impacts of concern.

For facilities of tier 1 suppliers using high volume or pollutant intense processes to produce key materials that make up ≥ 25% of the product by weight or by cost, or for all tier 1 suppliers:

1. Determine the basin/catchment/watershed name.
2. Identify risks to water quantity (including baseline water stress) and water quality, and risk of unimproved or no access to drinking water and sanitation as defined by the most recent version of the World Resources Institute Aqueduct database or equivalent.

Further Explanation

The purpose of this section of the standard is to heighten knowledge and awareness of water and soil related issues relevant to final manufacturing facilities and to the product more generally. This knowledge may inform selection of a Water & Soil Stewardship Positive Impact Project (see Section 7.9). In addition, some of the information collected per the requirements in this section define what is required in other sections. For example, the water stress levels identified in this section, in combination with data on how much water is currently used at each final manufacturing facility (per Section 7.3), inform where water use reduction targets must be set and best practices implemented.

Characterizing Water and Soil Issues for Final Manufacturing Facility Locations (Requirements #1-8)

The requirements in this section apply to all final manufacturing facility locations. Note: The standard requirements are repeated below in italics and guidance is provided in regular font.

1. *Determine the basin/catchment/watershed name*.
   Suggested references for identifying the basin/catchment/watershed name:
   - Aqueduct, World Resources Institute,
   - Interactive Database of the World's River Basins, CEO Water Mandate,
   - United States: Surf Your Watershed, US EPA
2. *Identify risks to water quantity (including baseline water stress) and water quality, and risk of unimproved*

or no access to drinking water and sanitation as defined by the most recent version of the World Resources Institute Aqueduct database or equivalent.

The preferred reference for identifying risks is the World Resources Institute's Aqueduct Water Risk Atlas. At a minimum, the following metrics must be reported as "low", "low to medium", "medium to high", "high", "extremely high", or "no data":

- Physical risk (quantity)
  - Water stress
    Note: This metric is also referred to as Baseline Water Stress and is used to determine which requirements in Section 7.6 Water and Soil Conservation must be met.
  - Flood Risk
- Physical Risk (quality)
- Regulatory & Reputational Risk
  - Unimproved/No Drinking Water
  - Unimproved/No Sanitation

    Note: These metrics are referenced in the Section 7.4 Providing Drinking Water, Sanitation and Hygiene verification requirements. They measure the percentage of population without access to improved drinking water and sanitation. Higher values indicate areas where people have less access.
- Projected change in water stress (scenario: business as usual, 2030)

3. *If a catchment level plan is available, obtain, review, and determine how the plan is relevant to the site. This must include a determination of whether a groundwater abstraction cap (i.e., a regulatory limit on total withdrawals) based on water resource availability has been set, and if so, the cap's relevance to the site.*

   Catchment level management plans may be available from local or state level regulatory bodies and/or from non-governmental organizations operating in the relevant region. It will be necessary to research the availability of catchment plans for each applicant and manufacturing location because there currently is not a single resource that aggregates this information.

4. *Describe effluent and sludge treatment process(es).*

   If effluent is treated on-site, the description must include provision of technical documentation for any on-site treatment equipment and indication of treatment capacity. This, in combination with water audit data, may be used (as part of the verification process) as a check on whether or not sufficient treatment capacity is available.

5. *If third-party treatment facilities are employed, identify the provider(s) and describe any issues with their ability to adequately treat effluent received from the facility.*

   The name and location of the treatment provider(s) for both effluent and sludge must be indicated. In some regions there are publicly available databases that may be useful for determining if there are issues with adequate treatment of effluent (e.g., in the European Union, Urban Waste Water Treatment Directive: Dissemination Platform (UWWTD), and in the United States, Environmental Protection Agency, Enforcement and Protection Online (EPA ECHO). Note that this topic is also relevant to the requirements in Section 7.2 Effluent Quality.

6. *Identify any known issues with source and/or receiving water contamination (e.g., due to the use of reclaimed water) or high concentrations of naturally occurring hazardous substances.*
   - This is an important consideration if there are issues with meeting effluent limitations as required in Section 7.2. If the source water is contaminated, the applicant may wish (if allowed by permits) to adjust for this to demonstrate compliance with the effluent quality requirements in Section 7.2.
   - This information is also relevant and useful to the product inventory required for Material Health for products that contain water (i.e., if water used as a product input is contaminated and contaminants are expected to be present above the inventory threshold for Material Health, then contaminants must be included in the Material Health assessments).
   - If there are known issues with contamination of source water, and tap water is provided to employees for drinking, this is important to consider for the Section 7.4 requirements to provide drinking water to all employees. Publicly available information on this issue that is more detailed than that provided in Aqueduct (per #2 above) exists in some locations (e.g., the monitoring and reporting required per the European Union's Drinking Water Directive and The United States Environmental Protection Agency's Safe Drinking Water Information System (SDWIS)).
7. *Describe any known issues with soil contamination, erosion, or other types of degradation at the site.*
   Suggested references for identifying issues (a non-exhaustive list):
   - European Union references:
     - European Soil Data Centre
   - United States references:
     - US EPA, Cleanups in My Community Maps, Toxic Release Inventory (TRI), and
     - Phase 1 Environmental Site Assessment guidance (available through the US EPA Brownfields All Appropriate Inquiries site, several individual US states, and also per ASTM E1527).
8. *Determine if the facility is potentially impacting any sensitive ecosystems, protected areas, or similar.*

   A sensitive ecosystem is defined as an ecosystem that supports high species diversity and/or endemic species that is at risk due to land use and other pressures (e.g., ecosystem remnants).

   Suggested references (a non-exhaustive list):
   - Ramsar listed wetlands
   - International Union for Conservation of Nature (IUCN) Red List of Ecosystems
   - IUCN World Database on Protected Areas

Characterizing Water and Soil Issues for the Product and Suppliers

For the product: Identify the use cycle stage(s) responsible for the majority of water quantity and quality related impacts. Describe the impacts of concern.

Indicate the life cycle stage(s), type of impact(s), and provide supporting reference(s). Include a description of the issues of concern for the particular product type. For example, for products made from biological materials that require irrigation and chemical inputs in the growing stage, the majority of impacts are likely due to

agricultural production. The response to this question may be based on information available for the product and industry in general (e.g., per life cycle assessments conducted on similar products or for the product's primary inputs).

For facilities of tier 1 suppliers using high volume or pollutant intense processes to produce key materials that make up ≥ 25% of the product by weight or by cost, or for all tier 1 suppliers:

1. *Determine the basin/catchment/watershed name.*
2. *Identify risks to water quantity (including baseline water stress) and water quality, and risk of unimproved or no access to drinking water and sanitation as defined by the most recent version of the World Resources Institute Aqueduct database or equivalent.*

The references noted above for final manufacturing facilities (for requirements #1-2) may be applied to tier 1 suppliers of key materials. Tier 1 suppliers are defined as suppliers to the final manufacturing stage, including in cases where the applicant is not the final manufacturer (e.g., if the applicant is a brand that uses contract manufacturing, the direct suppliers of the contract manufacturer that provide input materials to manufacture the certified product are tier 1). The final manufacturing stage is defined in the *Methodology for Applying the Final Manufacturing Stage Requirements in the Cradle to Cradle Certified® Product Standard*.

Key materials are defined below. Note that the requirement pertains to *suppliers using high-volume or pollutant intense processes.* This means that if it can be demonstrated that tier 1 suppliers do not carry out any high-volume and/or pollutant intense processes (as listed in the *Cradle to Cradle Certified® Water & Soil Stewardship – Key Materials* reference document), then the requirement does not apply – even if they are tier 1 and produce key materials that make up ≥ 25% of the product by weight or by cost. Refer to the Key Materials guidance below for additional information on how to identify key materials in scope.

Key Materials

A key material is defined as a material that is typically produced using a high-volume water use process or a pollutant intense process (see *Cradle to Cradle Certified® Water & Soil Stewardship – Key Materials* reference document for the list of applicable materials and processes).

The key materials in scope for the Water & Soil Stewardship requirements must be determined at the generic material level (e.g., if several aluminum parts are used, the total weight of aluminum applies). If there are no key materials present at ≥ 25% when aggregated by generic material type, but the sum of all key materials is ≥ 25%, the requirements for key materials must be applied to the key materials representing the highest weight or cost fractions of the product until < 25% of the product includes key materials to which the requirements have not been applied. If the 25% threshold is met when using only weight or only cost, then the metric that results in meeting the 25% threshold must be used.

Alternative: Water and soil conservation (quantity and quality) impact hot spots, identified based on conducting a life cycle assessment per ISO 14040, may be used instead of key materials that make up ≥ 25% of the product by weight or by cost for all Water & Soil Stewardship requirements applying to key materials. The assessment must be verified by a qualified third party.

Further Explanation

Identifying Key Materials and Associated Processes in Scope

Key materials are listed in the *Cradle to Cradle Certified® Water & Soil Stewardship – Key Materials* reference document, which may be found on C2CPII's website. As noted in the standard, *a key material is defined as a material that is typically produced using a high-volume water use process or a pollutant intense process*. These processes of concern may be occurring at any tier of the supply chain. For example, a garment made from cotton has a key material (i.e., cotton) that is typically produced using high-volume and pollutant intense processes that occur during cotton production. Cotton production may be several tiers removed from the final apparel manufacturer. All wet processing steps associated with production of the garment are also considered typically high volume and pollutant intense. This includes wet processing that occurs during both yarn and textile production.

The steps for identifying key materials that are in scope are as follows:

1. Review the *Cradle to Cradle Certified® Water & Soil Stewardship – Key Materials* reference document (Key Materials column only) and identify the key materials that the product contains. If the product does not contain any of the materials listed, then the next steps in this list do not apply. In addition, any requirement pertaining to key materials in the other sections of the Water & Soil Stewardship category of the standard are not applicable to the product. However, note that nearly all products will contain at least one key material.
2. As noted in the standard, *the key materials in scope for the Water & Soil Stewardship requirements must be determined at the generic material level (e.g., if several aluminum parts are used, the total weight of aluminum applies).* Therefore, the next step is to sum the percentages, either by weight or by cost, of all key materials of the same generic type***** within the product. **Once this is done, any key materials present at ≥ 25% of the product by weight or by cost are in scope.** Note that if there are any key materials identified using the weight option, key materials do not have to be identified using the cost option (and vice versa). Applicants are encouraged to select the option that will allow them to most effectively influence and positively impact water relevant issues in the supply chain. **For many products, this will be the last step necessary for identifying key materials in scope**; however, note the following requirements:
    - If there are no key materials present at ≥ 25% using the option that was selected initially (i.e., weight or cost), then the other method must be checked as well. Any key materials determined to be present at ≥ 25% based on the alternative approach are in scope.
    - If there are still no key materials present at ≥ 25% when using either the weight or cost approach, then the total percentage of all key materials in the product (regardless of the percentage of any individual generic material type) must be determined. This may also be done by either weight or cost initially.
    - If the total percentage of all key materials is ≥ 25%, then the key materials representing the highest weight or cost fractions of the product must be selected as 'in scope' until < 25% of the product includes key materials that will be out of scope. For example, if a product contains three key materials each present at 10% (total 30%), one of these materials must be selected as 'in scope', resulting in 20% of the product with key materials that are out of scope.

- If the total percentage of all key materials is < 25% when determined based on weight and cost, then there are no key materials in scope (with one exception as described in the next bullet). This means that any requirement pertaining to key materials in the other sections of the Water & Soil Stewardship category of the standard do not apply to the product.
- For products that only have key materials in scope when water weight is excluded from the key materials determination (as described in the bullets above), applicants must select at least one key material (based on identifying key materials with water weight excluded) as in scope.

3. For each of the key materials determined to be in scope, review the manufacturing, extractive, and environmental processes of concern (column two of the *Cradle to Cradle Certified® Water & Soil Stewardship – Key Materials* reference document). The following are important to consider at this stage:
   - As noted previously, the processes of concern may occur at any, and at more than one, tier of the supply chain for a given material. For example, if the product is apparel made from ≥ 25% cotton, then wet textile processing occurring at any tier and cotton production will be in scope. If the product is made from a virgin aluminum part making up ≥ 25%, then primary aluminum production processes and bauxite mining will be in scope. If the product is made from virgin fossil hydrocarbon derived polymer(s) making up ≥ 25%, the primary polymer production and oil extraction processes will be in scope.
   - All processes associated with primary production and extraction (i.e., primary production of plastics, crops, material from grazing species, primary metal production, mined materials, oil and gas, and wood) may be considered as avoided if recycled (rather than virgin) material is used. In these cases, the product contains a key material but the processes of concern are not directly attributable to this use phase of the product. In this case, all requirements pertaining to key materials throughout the Water & Soil Stewardship category do not apply – as long as the recycled content verification requirements (i.e., chain of custody documentation) are met per standard Section 5.4 Increasing Demand: Incorporating Cycled and/or Renewable Content and per the associated guidance.
   - Note that all of the processes listed in the Key Materials reference document are typically of concern for these key materials. Demonstrating that the processes of concern do not occur is one method of achieving the requirements pertaining to key materials. If it is possible to demonstrate that in fact the processes do not occur in the specific supply chain of the certified product, then requirements pertaining to key materials throughout the Water & Soil Stewardship category effectively do not apply.

When applying requirements pertaining to key materials in other sections of the standard note that:

- For key materials sourced from more than one supplier, all suppliers are within scope.
- For a key material that is produced by a supplier at more than one facility, all facilities are within scope unless it can be determined that the material is consistently sourced from only certain supplier facilities.
- The following exception applies: In a few cases the final manufacturing stage definition already includes supplier(s) to the manufacturing facility(ies) responsible for final production. For example, the final manufacturing stage for apparel includes textile dyeing which is often carried out by suppliers to the final cut and sew facility. For cases where the final manufacturing stage definition already includes

suppliers to a final production facility, the Water & Soil Stewardship requirements applying to tier 1 suppliers to final manufacturing may be applied only to the suppliers representing the largest share of production. In an example case where there are several suppliers to final production included in the final manufacturing stage, the one supplier providing the highest percentage of material to the final production facility(ies) would be selected. Then, the suppliers to this facility would be in scope for any requirement applying to tier 1 to the final manufacturing stage.

*** Generic material type** is defined as the general class a homogeneous material belongs to. The generic material type is the common term that would be used to describe a material in commerce. Examples of generic material types include aluminum, polyethylene, steel, cotton, and medium-density fiberboard.

Alternative for Identifying Key Materials and Issues in Scope

The standard provides the following alternative to identifying key materials and associated issues in scope: *Water and soil conservation (quantity and quality) impact hot spots, identified based on conducting a life cycle assessment per ISO 14040, may be used instead of key materials that make up ≥ 25% of the product by weight or by cost for all Water & Soil Stewardship requirements applying to key materials. The assessment must be verified by a qualified third party.* For additional information on conducting a hot spot analysis, see standard Section 4.9 Optimizing Chemistry in the Supply Chain. Qualified third parties are defined as life cycle assessment (LCA) practitioners with demonstrated experience conducting LCAs per ISO 14040.

Required Documentation

- A C2CPII Water & Soil Stewardship form for each final manufacturing stage facility (the form is provided to applicants by their Cradle to Cradle Certified assessor). The form includes fields for reporting all of the required information for final manufacturing facilities and tier 1 suppliers.
- If employing an alternative equivalent method of characterizing the water stress level, a description of the method used, references, and rationale for using the alternative, including a comparison of results to stress levels determined per the preferred reference (WRI Aqueduct).
- List of key materials for the product including a bill of materials demonstrating how the key materials were identified. For any tier 1 suppliers of key materials, location, watershed, and risk levels for the required metrics. The Water & Soil Stewardship form also provides a location for determining and reporting this information. Other formats are also accepted.
- If employing the alternative method of identifying key materials: Required documentation for hot spot analysis per standard Section 4.9 Optimizing Chemistry in the Supply Chain, summary of water and soil related hot spots identified, and qualifications of the individual verifying the results.

7.2 Effluent Quality Compliance

Intended Outcome(s)

Final manufacturing stage and select supplier facilities are in compliance with regulatory and/or industry best practice effluent limitations.

Applicable Achievement Level(s)

Bronze and Silver

Requirement(s)

Bronze level: For the final manufacturing stage, treat effluent (either on or off site) prior to discharge to the environment and adhere to effluent quality regulations or guidelines.

Silver level: For select tier 1 supplier facilities, treat effluent (either on or off site) prior to discharge to the environment and adhere to effluent quality regulations or guidelines.

Facilities discharging effluent directly to surface or groundwater must comply with the corresponding regional regulatory (if any), international, or industry best practice effluent quality guidelines for direct discharge. (Note: Facilities discharging via a sewer system that does not route to an effluent treatment facility with at least secondary treatment capabilities or equivalent are discharging directly to surface or groundwater for the purposes of this requirement.)

Bronze level

For final manufacturing stage facilities meeting this requirement based on regulatory compliance, the parameters addressed in the permit must also be consistent with leading regulations, international guidelines, or industry best practice. Leading regulations are defined as those that include a functioning mechanism through which water quality-based limits are set.

Final manufacturing stage facilities discharging process effluent to an off-site, independently operated effluent treatment facility (e.g., publicly owned treatment works, central effluent treatment plant, or wastewater treatment plant) with at least secondary treatment must:

1. Comply with required pretreatment limits, if any, and
2. Demonstrate that the treatment facility is treating the effluent received to quality standards in line with the corresponding regional regulatory (if any) or international guidelines.
   OR
   Comply with regional regulatory (if any), international, or industry best practice effluent quality guidelines for direct discharge.

Silver level

Select tier 1 supplier facilities discharging process effluent to an off-site, independently operated effluent treatment facility (e.g., publicly owned treatment works, central effluent treatment plant, or wastewater treatment plant) with at least secondary treatment must comply with required pretreatment limits, if any.

The “select” tier 1 supplier facilities in scope are those using pollutant intense processes to produce key materials (per the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials* reference document) that make up ≥ 25% of the product by weight or by cost.

Effluent testing

When effluent must be tested for verification purposes, sampling and testing must be conducted according to the methods specified by regulatory permits, the off-site, independently operated effluent treatment facility, and/or other guidelines as relevant. The analytical laboratory conducting the tests must be accredited or certified for the specific analysis per ISO 17025, NALEP, or equivalent.

Further Explanation

Bronze Level

Determining if a Final Manufacturing Facility is Subject to the Bronze Level Requirements

The Bronze level requirements in this section apply to the product's final manufacturing facilities, not only to processes and effluent discharged as a result of manufacturing the certified product(s). This means that in some cases, manufacturing facilities will be subject to these requirements when the process to produce the certified product is dry.

The requirements in this section do not apply to final manufacturing facilities that (1) do not discharge any manufacturing process effluent, AND (2) depend on independently operated treatment facilities to manage other effluent types (e.g., effluent from toilets and sinks). However, all facilities that discharge effluent to the environment directly (i.e., that do not rely on independently operated treatment facilities), including those that discharge only sanitary effluent (i.e., effluent from toilets and sinks), are subject to the requirements in this section.

Direct discharge is defined as follows: *Effluent is discharged to surface or ground water instead of to an externally owned and operated wastewater/effluent treatment facility.* As noted in the standard, *Facilities discharging via a sewer system that does not route to an effluent treatment facility with at least secondary treatment capabilities or equivalent are discharging directly to surface or ground water for the purposes of this requirement.* Secondary treatment is defined as processes that employ aerobic or anaerobic microorganisms and result in decanted effluents and separated sludge containing microbial mass together with pollutants. (This definition is per the European Environment Agency.)

For final manufacturing facilities that are not subject to the Bronze level requirements in this section, a signed statement and evidence that the facility is out of scope are required. Refer to the Required Documentation box below for additional information.

Determining What is Required for Final Manufacturing Facilities In Scope

For final manufacturing facilities that are subject to the Bronze level requirements, what specifically must be done depends on whether or not the manufacturing facility (1) is in a region with leading regulations, (2) discharges directly to surface or ground water (as defined above), and (3) relies on an independently operated effluent treatment facility to treat process effluent. The guidance that follows is categorized according to these three factors. The following definition of "leading regulations" applies:

Leading Regulations: *Leading regulations are defined as those that include a functioning mechanism through which water quality-based limits are set.* Water-quality based limits are permitted limits for individual facilities that have been set based on what is protective of the quality of the receiving water. This is in contrast to technology-based limits that are set based on what is economically and/or otherwise technically feasible. An exhaustive list of locations with functioning mechanisms through which water quality-based limits are set has not been developed. However, such mechanisms do exist in the European Union and United States. Therefore, **it may currently be assumed that facilities in the European Union, United Kingdom, Switzerland, and the United States are subject to leading regulations.** This means that in these locations, the parameters addressed in the permits are by definition *consistent with leading regulations* as required. Other regions may be added to this list upon consultation with and pre-approval from C2CPII.

Requirements for Final Manufacturing Facilities with Direct Discharge that are in Regions with "Leading Regulations"

As noted above, facilities in the European Union, United Kingdom, Switzerland, and the United States are currently assumed to be subject to leading regulations. For facilities with direct discharge in this category, it must be demonstrated that the facility is in compliance with its permitted limits.

Definition of Compliance: Compliance means that the manufacturing facility is adhering to the limitations required by the permit. This must be true currently and for the two years prior to certification. Compliance is more specifically defined per the applicable regulations. If the permitting authority allows minor exceedances (e.g., exceedances of a certain frequency and amount may be allowed without corrective action required and/or violations may be otherwise categorized as major and minor), such exceedances are also accepted for the purposes of Cradle to Cradle Certified. For example, in the United States, facilities with 'significant noncompliance' have significant exceedances of effluent limits, which, per the United States Environmental Protection Agency, can cause harm to human health and the environment, or failure to submit reports, which can mask serious deficiencies. Therefore, facilities in the United States must not have had a significant noncompliance in the two years prior to certification unless it is demonstrated that this issue has been resolved (see the final sub-section in this Further Explanation box titled When Final Manufacturing Facilities are not in Compliance for additional information).

To determine if a facility is in compliance, effluent test results, summarized as required by the permitting authority, must be compared to what is allowed according to the permit. Permits and test results must be provided by the manufacturer. Alternatively, the compliance status of manufacturing facilities may be demonstrated based on publicly available information (e.g., through the Enforcement and Compliance History Online (ECHO) database in the United States).

Requirement for Final Manufacturing Facilities with Direct Discharge in Other Regions (i.e. Without 'Leading Regulations')

For facilities in this category, it must be demonstrated that the facility is in compliance with its permitted limits and that the *parameters addressed in the permit are consistent with leading regulations, international guidelines, or industry best practice.* If the parameters are not consistent, additional work is required as described noted below.

Definition of Compliance: Compliance means that the manufacturing facility is adhering to the limitations required by its permit and/or leading regulations, international guidelines, or industry best practice. This must be true currently and for the two years prior to certification. Compliance is more specifically defined per the applicable regulations, guidelines, or best practices. For example, the International Finance Corporation (IFC) guidelines note that "effluent limits should be achieved, without dilution, at least 95 percent of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours."

To determine if a facility in in compliance, effluent test results, summarized as required by the permitting authority or other guidelines (as applicable), must be compared to the allowable limits.

Determining Parameter Consistency with Leading Regulations:

To determine whether or not the parameters included in existing permits* for direct discharge are consistent

with leading regulations, international guidelines, or industry best practice:

- Select a set of guidelines from the references listed below that are relevant to the industry and effluent produced.
- If guidelines specific to the industry are not available, reference effluent quality guidelines for an industry sector with analogous processes and effluents (this aligns with the International Finance Corporation's (IFC) approach).
- Compare the existing permits to these guidelines. The permits must include limitations on all parameters and specific chemical substances that are included in the selected set of comparative guidelines to be considered consistent.
- If any parameters or substances are missing from the permits, the applicant must identify appropriate limits for the additional parameters and/or substances per the international or industry best practice guidelines and demonstrate adherence to these limits via effluent testing as described below.

*If permits do not exist and the facility is directly discharging to surface or ground water, the same steps apply.

International and Industry Best Practice Effluent Quality Guidelines

International and industry best practice effluent quality guidelines include the following:

- International Finance Corporation (IFC) (refer to the set of guidelines for the relevant industry)
- For cases where only cooling water is discharged, parameters and limits in the IFC's General Wastewater and Ambient Water Quality guidelines (see link above)
- European Union - Best Available Techniques Reference document (BREFs)
- United States - Environmental Protection Agency's Industrial Effluent Guidelines
- Zero Discharge of Hazardous Chemicals (ZDHC) Wastewater Guidelines

Analytical Testing Requirements: The standard requires: *When effluent must be tested for verification purposes, sampling and testing must be conducted according to the methods specified by regulatory permits, the off-site, independently operated effluent treatment facility, and/or other guidelines as relevant. The analytical laboratory conducting the tests must be accredited or certified for the specific analysis per ISO 17025, NALEP, or equivalent.* If it is necessary to develop an appropriate testing protocol based on other guidelines, the testing frequency, sampling methods, and test methods described in the ZDHC Wastewater Guidelines may be applied. These methods were developed for the textile industry but may be applied to other industries as well. These guidelines include an allowance and method to adjust post-treatment pollutant concentrations by incoming concentrations of contaminants to account for cases where source water is already contaminated for reasons outside of the manufacturer's control. ZDHC specifies a testing frequency of twice per year. Additional test methods for priority pollutants (beyond those indicated by ZDHC) may be found in the relevant regulatory documentation. For example, in the European Union Directive 2008/105/EC.

Confirming that Treatment Capacity is Sufficient for Compliance

For manufacturing facilities in this category (i.e., with direct discharge and in regions without leading regulations), **discharge volume must be compared to the capacity of the on-site treatment equipment to determine if it is likely that the facility is consistently treating all effluent prior to discharge**. Note that reporting on this information is required as part of the Bronze level requirements in Section 7.3 Quantifying Water Use. If it is necessary to treat all effluent prior to discharge in order to plausibly meet the required

effluent limitations, and treatment capacity is less than discharge volume, then the issue must be resolved prior to certification.

Requirements for Final Manufacturing Facilities Using Independently Operated Treatment Facilities to Treat Process Effluent

The following are required for all final manufacturing facilities in this category (regardless of location):

1. *Comply with required pretreatment limits, if any, and*
2. *Demonstrate that the treatment facility is treating the effluent received to quality standards in line with the corresponding regional regulatory (if any) or international guidelines.*

Complying with required pretreatment limits, if any (Requirement #1):

This means that it must be demonstrated that the final manufacturing facility is complying with any pretreatment limits that it is subject to (e.g., as assigned to it by the independently operated treatment facility).

Definition of Compliance: Compliance means that the facility is adhering to the pretreatment limitations required by the permit. This must be true currently and for the two years prior to certification. Effluent test results, summarized as required by the permitting authority, must be compared to the permit to determine if exceedances have occurred. Alternatively, the compliance status of manufacturing facilities may be demonstrated based on publicly available information. If the permitting authority allows minor exceedances (e.g., exceedances may be limited by number, frequency, and percentage of operating time or otherwise be categorized as of high vs. low concern), such exceedances are also accepted for the purposes of Cradle to Cradle Certified.

Demonstrating that the treatment facility is treating the effluent received to quality standards in line with the corresponding regional regulatory (if any) or international guidelines (Requirement #2):

In addition to complying with any pretreatment limits per requirement #1, the applicant is required to determine whether or not the independently operated treatment facility is complying with its own permits. If yes, the requirement has been met. If not, additional action is required as described below. Note that this topic is also addressed in Section 7.1 Characterizing Local and Product Relevant Water and Soil Issues.

Definition of Compliance: Compliance means that the independently operated treatment facility is adhering to the permitted limits. This must be true currently and for the two years prior to certification. If the permitting authority allows minor exceedances (e.g., exceedances of a certain frequency and amount may be allowed without corrective action required and/or violations may be otherwise categorized as major/minor or high vs. low concern), such exceedances are also accepted for the purposes of Cradle to Cradle Certified.

To determine if an independently operated treatment facility is in compliance, effluent test results, summarized as required by the permitting authority, must be compared to what is allowed according to the permit. Permits and test results must be provided by the treatment facility. Alternatively, in some locations, the compliance status of independently operated treatment facilities may be determined based on publicly available information. For example, in the United States, compliance information is available through Enforcement and Compliance History Online (ECHO), and in the European Union, via the Urban Waste Water Treatment Directive: Dissemination Platform (UWWTD). Note that statements of compliance without supporting evidence will not be accepted.

Table - Summary of Requirements for Final Manufacturing Facilities in Scope

Final manufacturing facility location type	Discharges process and/or sanitary effluent directly to surface or ground water (i.e., direct discharge)	Discharges process effluent to an independently operated effluent treatment facility with at least secondary treatment
Region with leading regulations (e.g., EU, US)	• Manufacturing facility complies with permitted limits.	• Manufacturing facility complies with permitted pretreatment limits, if any. • Independently operated treatment facility complies with permitted limits. If the independently operated treatment facility does not hold a permit, it complies with international guidelines.
Region without leading regulations	• Manufacturing facility complies with permitted limits. • Parameters included in the permit are the same as the parameters in a comparative set of best practice guidelines (if not, additional parameters are added as needed).	

When Final Manufacturing Facilities are Not in Compliance with Permitted Pretreatment or Direct Discharge Limits (As Applicable)

Products manufactured in facilities that are not in compliance as defined in the guidance above are not eligible for certification unless it can be demonstrated that the issues resulting in non-compliance have been corrected. If this is demonstrated, non-compliances that have occurred in the prior two years are acceptable.

When Independently Operated Treatment Facilities are Not in Compliance

If an independently operated treatment facility is not complying with its permitted limits or with international guidelines, the standard requires that the final manufacturing stage facility compensate for this by complying *with regional regulatory (if any), international, or industry best practice effluent quality guidelines for direct discharge* itself. International and industry best practice effluent guidelines are defined per the list above (refer to list titled International and Industry Best Practice Effluent Quality Guidelines).

When this is required, manufacturing facilities must adhere to direct discharge limits applicable to the specific parameters or individual substances for which the independently operated treatment facility is out of compliance, or must otherwise demonstrate that their effluent is not contributing to the issues causing non-compliance of the treatment facility. For example, if the independently operated treatment facility is exceeding its permitted limits for zinc only and the manufacturing facility demonstrates, via effluent testing and/or process descriptions, that it does not discharge any zinc (or discharges an amount that is consistent with direct discharge limits), the requirement has been met. Otherwise, products manufactured in facilities that discharge process effluent to independently operated treatment facilities that are not in compliance (as defined above – see sub-section titled Requirements for Final Manufacturing Facilities Using Independently Operated Treatment Facilities to Treat Process Effluent) are not eligible for certification, unless it can be demonstrated that the issues resulting in non-compliance at the treatment facility have been corrected. If this is demonstrated, non-compliances that have occurred in the prior two years are acceptable.

Further Explanation

Silver Level

For the Silver level, the following is required: *For select tier 1 supplier facilities, treat effluent (either on or off site)*

prior to discharge to the environment and adhere to effluent quality regulations or guidelines. Facilities discharging effluent directly to surface or groundwater must comply with the corresponding regional regulatory (if any), international, or industry best practice effluent quality guidelines for direct discharge. (Note: Facilities discharging via a sewer system that does not route to an effluent treatment facility with at least secondary treatment capabilities or equivalent are discharging directly to surface or groundwater for the purposes of this requirement.)

This means that select tier 1 supplier facilities with direct discharge must meet the same requirements as described for final manufacturing facilities at the Bronze level. This includes the more detailed requirements applicable to facilities in regions without leading regulations. Tier 1 suppliers are defined as direct suppliers to the final manufacturing stage of the certified product. The final manufacturing stage is defined in the *Methodology for Applying the Final Manufacturing Stage Requirements in the Cradle to Cradle Certified® Product Standard*.

The standard further specifies that: *Select tier 1 supplier facilities discharging process effluent to an off-site, independently operated effluent treatment facility (e.g., publicly owned treatment works, central effluent treatment plant, or wastewater treatment plant) with at least secondary treatment must comply with required pretreatment limits, if any.* Compliance means that the facility is adhering to the pretreatment limitations as required by the permit. This must be true currently and for the two years prior to certification. Effluent test results, as required by the permitting authority, must be compared to the permit to determine if exceedances have occurred. Alternatively, the compliance status of manufacturing facilities may be demonstrated based on publicly available information. If the permitting authority allows minor exceedances (e.g., exceedances may be limited by number, frequency, and percentage of operating time or otherwise be categorized of high vs. low concern), such exceedances are also accepted for the purposes of Cradle to Cradle Certified. **Determination of the compliance status of independently operated treatment facilities is not required for tier 1 supplier facilities.**

As noted in the standard: *The "select" tier 1 supplier facilities in scope are those using pollutant intense processes to produce key materials (per the Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials reference document) that make up ≥ 25% of the product by weight or by cost.* The methods for identifying key materials are described in the guidance to Section 7.1. The requirements for Silver level in this section (Section 7.2) apply to key materials determined to be in scope per Section 7.1. In addition, they only apply if the pollutant intense processes listed in the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials reference document* are also occurring at tier 1 supplier facilities.

Required Documentation

Bronze level

For all facilities: A signed statement from the applicant or final manufacturer stating that the facility or facilities at which the product is manufactured (1) is/are not required to hold discharge permits, or (2) is/are in compliance with the corresponding regional regulatory (if any), international, or industry best practice effluent quality guidelines (as applicable), and have been in compliance for the prior two years.

For facilities that are not subject to the requirements in this section: A description of how this was determined

and any applicable supporting evidence (e.g., process flow diagrams, photos of the facility, and/or reference to a manufacturing site visit conducted for the purposes of Cradle to Cradle certification).

For facilities subject to the requirements in this section, the following (as applicable):

- A copy of the discharge permit(s) including treatment or pretreatment limitations, and/or other quality guidelines employed (either in place of permits or used to determine consistency) as relevant.
- Effluent test results for conventional quality parameters and any individual substances as required by the permits or other guidelines. Test results are to be summarized as required by the permitting authority, centralized treatment plant, or other guideline, as relevant. At a minimum, biannual testing is required (i.e., two times per year). For the initial certification provide two sets of test data from the prior year at a minimum. For recertification, provide four sets of test data (i.e., two per year for the prior two-year certification cycle).
- For facilities discharging directly to surface or ground water that are in locations without leading regulations, evidence of on-site treatment facility capacity and discharge volume (e.g., description of system design, technical manuals and specifications, and meter read outs of amounts discharged).
- When it is necessary to *demonstrate that the* (off-site) *treatment facility is treating the effluent received to quality standards in line with the corresponding regional regulatory (if any) or international guidelines,* the same methods of verification indicated above in the first two bullets apply (i.e., permitted limits or other quality guidelines employed and effluent test results must be provided). Alternatively, if compliance information for off-site treatment facilities is publicly available, a printout or screenshot of the data demonstrating regulatory compliance for the off-site facility will be accepted.
- If guidelines other than those indicated by permits are used, and guidelines specific to the industry are not available: Provide the rationale for selecting the comparative guidelines including a description of how the processes and effluents are analogous to the relevant industry.
- If following the ZDHC wastewater guidelines, the documentation required by ZDHC.

Silver Level

- In cases where there are no select tier 1 suppliers in scope for this requirement, a description of how this was determined or other evidence.
- For cases where a supplier provides a key material in scope (as determined per Section 7.1), but uses an alternate process for the pollutant intense process(es) noted in the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials reference document*, a process flow diagram, process description, and/or photo(s) of supplier facilities to demonstrate that this is the case.

OR, the following (as applicable):

- For any select tier 1 suppliers in scope with direct discharge, documentation as described in the bulleted list above for Bronze level.
- For any select tier 1 suppliers in scope that are required to comply with pretreatment limits, a copy of the pretreatment limitation requirements/permit and test results summarized as required by the permitting authority, centralized treatment plant, or other guideline, as relevant.

7.3 Quantifying Water Use

Intended Outcome(s)

Water withdrawals, discharge, and consumption at facilities manufacturing the product(s) are quantified, creating a baseline against which reductions can be measured, and helping to identify areas for improvement.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Quantify annual water withdrawals, discharge, and consumption for all final manufacturing stage facilities.

Data must be collected on the following and the data sources indicated:

1. Withdrawals by source and water type,
2. Discharges by receiving body/destination,
3. Capacity of on-site treatment equipment,
4. Consumption by source,
5. Total amount and percentage of water recycled and reused.

Facilities that withdraw or purchase ≥ 100,000 m^3 of water per year are considered as having high-volume processes.

Further Explanation

The requirements in this section apply to all final manufacturing stage facilities, including those that only use water for hygienic purposes (toilets, hand washing) and/or in kitchens. Data are to be collected at the facility level (i.e., not only for the certified product).

Facilities with High-volume Processes

Whether or not a facility uses high-volume processes is an important distinction because it affects what is required in other sections of the Water & Soil Stewardship category.

As noted in the standard, *facilities that withdraw or purchase ≥ 100,000 m^3 of water per year are considered as having high-volume processes*. This is regardless of whether or not they use any of the high-volume processes listed in the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials reference document*. For facilities that do use processes listed as high volume in the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials reference document*, but that use less than 100,000 m^3 of water per year (as determined per the requirements in this section), the facility is not considered to have a high-volume process for the purposes of this standard. As noted above, this is a facility level requirement. This means that designation as a facility with high-volume processes applies even if the processes contributing to this designation are unrelated to the certified product.

References:

- Global Reporting Initiative, GRI 303: Water and Effluents
- CDP Water

Required Documentation

- C2CPII Water & Soil Stewardship Form for each final manufacturing stage facility. Other reporting formats are acceptable as long as all of the required data points are included and data are provided for each final manufacturing stage facility individually.
- Water utility bills and and/or meter readouts as supporting evidence of the data provided.
- For facilities with on-site treatment, a description of the design and capacity of the system and an explanation regarding how it can be verified that capacity is sufficient given discharge volume. There is a space for reporting this information in the C2CPII Water & Soil Stewardship Form. For facilities in regions without 'leading regulations' (per Section 7.2), include evidence of on-site effluent treatment capacity (e.g., system design specifications and technical manuals).

7.4 Providing Drinking Water, Sanitation, and Hygiene

Intended Outcome(s)

Access to drinking water, sanitation, and hygiene is treated as a basic requirement at the facilities where the product is manufactured.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Provide potable drinking water, adequate sanitation, and hygiene to all workers at all final manufacturing stage facilities.

The following conditions must be met:

1. Potable water must be dispensed using a clean and accessible method.
2. An adequate number of toilets per employee must be provided as required by local regulations or international guidelines if local regulations do not exist. The applicant must ensure that sewered and/or portable toilets:
    a. Provide privacy at all times (i.e., may be locked from the inside).
    b. Are separate for each gender. Alternatively, toilet facilities will not be occupied by more than one employee at a time, can be locked from the inside, and contain at least one toilet.
    c. If portable toilets are provided, they must be vented and equipped with lighting.
    d. Are accessible to all employees including disabled people and people with reduced mobility wherever current employees require such accommodations.

3. Handwashing facilities must be located at or adjacent to each toilet facility and must be equipped with one of the following:
    a. Running water and soap.
    b. Waterless skin-cleansing agents capable of disinfecting the skin or neutralizing the contaminants to which the employee may be exposed.
4. A sanitary method of drying hands after washing must be provided.
5. The applicant must establish and implement a maintenance and cleaning schedule with the goal of ensuring that each toilet and handwashing area is maintained in a clean, sanitary, and serviceable condition (including provision of toilet paper or other hygienic option).
6. Reasonable access to drinking water, sanitation, and hygiene facilities must be provided (i.e., either freely accessible at any time as needed by employees or, at a minimum, readily available upon request).

Further Explanation

The requirements in this section apply to all final manufacturing stage facilities. Note that provision of drinking water, sanitation, and hygiene (WASH) is also addressed in the Social Fairness category. Provision of WASH must be included in the Section 8.2 Human Rights Policy. The policy sets the foundation for many of the other Social Fairness requirements, including those to monitor and verify performance on policy implementation (Section 8.3). The result is that provision of WASH will be verified by a qualified third party at the Bronze level in cases where a final manufacturing facility is in a de facto high-risk location (as defined per the Social Fairness category). Note also that WASH must be included in supplier codes of conduct at the Gold level (per Section 8.6 Management Systems).

Definitions

Adequate Number of Toilets: Requirement #2 specifies that an adequate number of toilets must be provided. If local regulations do not specify this, the following references may be employed for determining what is adequate.

How Many Toilets Should a Workplace Have? (UK Health and Safety Executive)

Occupational Health and Safety Standards, Sanitation (United States Department of Labor)

Toilet Accessibility: Requirement #2d states that *toilets must be accessible to all employees including disabled people and people with reduced mobility wherever current employees require such accommodations*. A person of reduced mobility is defined as "any person whose mobility…is reduced due to any physical disability (sensory or affecting mobility, whether permanent or temporary), intellectual disability or impairment, or any other cause of disability, or age,…" per Regulation (EC) No 1107/2006

Sanitary methods of drying hands: This includes provision of air dryers or paper towels. An example of an unsanitary method is provision of a hand towel intended to be used by multiple people prior to washing.

Verification Requirements

The level of verification required in this section of the standard (Section 7.4) depends on the risk level for access to water and sanitation (indicators that must be reported as part of the Characterize Local and

Product Relevant Issues requirements in Section 7.1) as follows:

- **For final manufacturing stage facilities in locations with low risk on access –** It may generally be assumed that local regulations are sufficiently addressing the issue in these regions with the following exceptions:
  - Final manufacturing stage facilities in the agricultural sector must be considered high risk regardless of the risk level on *access to water*.
  - If tap water is provided for drinking and local data indicate that tap water is contaminated, verification of provision of clean drinking water as required for high-risk sites (see below) is required regardless of risk level on *access to water*. Note: One of the topics included in the Characterize Local and Product Relevant Issues (Section 7.1) requirements is to identify any known issues with source and/or receiving water contamination or high concentrations of naturally occurring hazardous substances. This topic is relevant to the issue of tap water contamination and will help to inform whether or not testing of tap water used for drinking is required.
- **For final manufacturing stage facilities in locations with low to medium, medium to high, high, or extremely high risk on access (and for the agricultural sector regardless of risk level) –** If a qualified third party is required to generate social performance data per the Social Fairness verification requirements (Section 8.3), provision of drinking water, sanitation, and hygiene (WASH) will be included in the list of priority issues to be investigated. In this case, provision of WASH will be verified as part of the Social Fairness requirements and no further action is required for the purposes of the Water & Soil Stewardship category. Otherwise, the Cradle to Cradle Certified assessor will examine facilities and verify that the WASH requirements have been met when conducting the manufacturing site visit (required for the Bronze level).
- **For final manufacturing stage facilities in locations with medium to high, high, or extremely high risk on access to drinking water –** Quarterly testing of drinking water is required to demonstrate that clean drinking water is provided. Either local or the World Health Organization's (WHO) parameters and limits must be met (see Annex 3, Table A3.3 in the linked reference). Testing may be contracted by the applicant, or if water is purchased and provided within sealed containers, by the drinking water provider.

References

Guidelines for Drinking-water Quality, 4th edition, incorporating the 1st addendum (WHO, 2017). See Annex 3, Table A3.3
WASH@Work: A Self-Training Handbook (ILO, 2016)

Required Documentation

- For final manufacturing stage facilities in locations with low risk on access, no additional documentation is required beyond what is already specified per the Social Fairness category Section 8.3 Monitor and Verify Performance.

- For final manufacturing stage facilities in locations with low to medium, medium to high, high, or extremely high risk on access (and for the agricultural sector regardless of risk level), the following must be provided:
  - Photographs or videos within the facility of toilets, hand washing areas, and method(s) of providing drinking water – For sites that the Cradle to Cradle Certified assessor will not visit (see site visit requirements in the Appendix of this guidance document), it must be possible to link the photos to the facility (e.g., photos must include GPS coordinates or other locational information, or a series of photographs lead from areas of the facility that are identifiable as being owned by the applicant company to the WASH area). Toilets and sinks must appear to be clean in the photos.
  - Maintenance and cleaning schedules printed on company letterhead.

  Exception: If WASH has been verified by a qualified third party per the Social Fairness Bronze level requirements, no additional documentation is required beyond what is listed in Section 8.3 Monitor and Verify Performance.
- For final manufacturing stage facilities in locations with medium to high, high, or extremely high risk on access to drinking water (or for any location where tap water is provided and there is a history of unsafe tap water), drinking water test results conducted on a quarterly basis and indication of laboratory qualifications.

7.5 Water & Soil Stewardship Strategy

Intended Outcome(s)

A water and soil stewardship strategy is developed, providing an actionable pathway toward operating in a manner that protects water and soil resources.

Applicable Achievement Level(s)

Bronze and Silver

Requirement(s)

Bronze level: Develop a strategy for achieving the Silver level water and soil conservation requirements and report on progress made toward achieving the strategy at each recertification.

Silver level: Develop a strategy for achieving the Gold level water and soil conservation requirements and report on progress made toward achieving the strategy at each recertification.

For the Bronze level, the strategy must be designed with the aim of eventually achieving the Silver level as described in Section 7.6 Water and Soil Conservation.

For final manufacturing stage facilities with high volume processes that are also in medium to high stress locations, the strategy must also include quantitative water use reduction targets, informed by the Quantifying Water Use requirements (Section 7.3), including:

1. Near-term (defined as 0-2 years) and mid-term (defined as 2-20 years) targets.
2. Proposed activities and method(s) for reaching each target.

3. Base year(s) and target year(s) must be indicated.
4. A report of progress made toward meeting the targets that were set at the last certification including percent reductions in use and increases in percent recycling achieved (not applicable for initial certification).

For the Silver level, the strategy must be designed with the aim of eventually achieving the Gold level as described in Section 7.6 Water and Soil Conservation.

All strategies must include specific goal(s) and associated timelines for implementation.

Further Explanation

Determining What to Include in the Strategy

The required strategy applies to final manufacturing stage facilities overall (i.e., not only to the processes used to manufacture the certified product) and to key materials in scope (as determined per Section 7.1 and applicable specifically to the product). However, note that the strategy may be developed by the applicant company, including in cases where the applicant company is different from the company that owns the final manufacturing facility(ies).

It is necessary to review Section 7.6 Water and Soil Conservation prior to developing a strategy to understand what must be included in the strategy. As part of this, it will be necessary to consider if any final manufacturing facilities are high volume (as determined per Section 7.3), in stressed locations (as determined per Section 7.1 and 7.6), or use pollutant intense processes (using the approach described for Key Materials in Section 7.1, but applied to final manufacturing facilities rather than suppliers in this case). Additional guidance for identifying facilities in scope for this requirement is provided in Section 7.6.

As noted above, the requirements apply to the facility. This means that even if the certified product does not require any water use, but the facility overall is considered to be a high-volume facility (per Section 7.3), requirements pertaining to high-volume facilities in this Section (7.5) and in Section 7.6 Water & Soil Conservation must be met. In addition, if production of the certified product does not include pollutant intense processes, but such processes do occur at the final manufacturing stage facilities, then requirements pertaining to facilities with pollutant intense processes in this Section (7.5) and in Section 7.6 Water & Soil Conservation must be met.

Setting Targets for Facilities with High-volume Processes in Stressed Locations

Note that the requirement to set targets to reduce water use for facilities of this type is unique to this section of the standard (i.e., this is not referenced in Section 7.6 Water and Soil Conservation). When setting targets, it is recommended that mid-term targets be set at no more than 15 years out from the current date and that the *projected change in water stress* metric (per Section 7.1) be used to inform the ambition of the targets and prioritize actions.

Developing a Strategy for Issues Occurring in the Supply Chain

The methods of achieving the Gold level requirements applicable to key materials in scope (and the associated suppliers) as described in Section 7.6 Water and Soil Conservation should be reviewed when developing the

strategy. In addition, it is important to note that the use of recycled material is a method of avoiding the need to address high-volume and pollutant intense processes associated with initial resource extraction or raw material production. For example, for a product that is 100% metal, if it can be demonstrated that > 75% is recycled content, then the requirements to address high-volume and pollutant intense processes associated with metal ore mining and primary metal production will not apply.

In the case of an opaque supply chain, the strategy could include elements that align with similar requirements in the Social Fairness category (Section 8.3, Gold level) as follows: (1) Undertake a traceability exercise with the goal of tracking the material from the direct supplier through all stages of processing to initial production or extraction (or work to identify a supply chain that can be traced), (2) Establish how to mitigate the negative impacts, and/or (3) Participate in a stakeholder initiative actively working to address the issues.

Required Documentation

- List of final manufacturing stage facilities and indication if they are high volume, pollutant intense, and/or in a stressed location (this may be provided via the Water & Soil Stewardship forms and Assessment Summary Form).
- A documented strategy that includes all required points applicable to the desired achievement level per this section (7.5) and per Section 7.6 Water and Soil Conservation. All strategies must include specific goal(s) and associated timelines for implementation.
- At recertification, a progress report.

7.6 Water & Soil Conservation

Intended Outcome(s)

Conservation technologies and best practices are increasingly being implemented to reduce water use and/or improve effluent and/or soil quality where there are known issues.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Implement at least one conservation technology or best practice at all final manufacturing stage facilities with high volume processes in stressed locations and/or with pollutant intense processes, and take at least one additional action to conserve water and/or soil at final manufacturing stage facilities or in the supply chain.

Gold level:

1. Implement conservation technologies or best practices at all final manufacturing stage facilities with high volume or pollutant intense processes, and/or in stressed locations.
2. For key materials that make up ≥ 25% of the product by weight or by cost, take action to conserve water and/or soil in the supply chain.

Silver Level

For final manufacturing stage facilities with high volume processes in medium to high stress locations, at least one technology or best practice leading to water use reductions must be implemented, and

For final manufacturing stage facilities with pollutant intense processes, at least one technology or best practice leading to improved effluent quality must be implemented, and

One of the Gold level requirements must also be implemented for at least one final manufacturing stage facility or for one key material that makes up ≥ 25% of the product by weight or by cost. (Required unless there are no final manufacturing stage facilities or key materials in scope for the Gold level requirements.)

High-volume and pollutant intense processes by material type are listed in the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials* reference document. Stress level is defined using the baseline water stress metric first referenced in Section 7.1. Other methods of identifying stress level may be considered on a case-by-case basis.

Gold Level

For final manufacturing stage facilities with high volume processes in medium to high stress locations, technologies or best practices leading to the maximum feasible water use reductions must be implemented, and

For final manufacturing stage facilities with high volume processes in low stress locations, at least one technology or best practice leading to water use reductions must be implemented, and

For final manufacturing stage facilities in high stress locations without high volume processes, at least one technology or best practice leading to water use reductions must be implemented, and

For final manufacturing stage facilities with pollutant intense processes, technologies or best practices leading to the maximum feasible improvement in effluent quality must be implemented.

Further Explanation

Identifying Final Manufacturing Facilities Subject to these Requirements

The Silver and Gold levels require that technologies or best practices leading to water use reductions and/or improved effluent quality be implemented at final manufacturing facilities that use a high volume of water and/or use pollutant intense processes. The level of action required depends on achievement level and, for water use reductions, the level of water stress. As noted in the Strategy section (7.5), these requirements apply at the facility level, which means that there may be cases where action is required even though production of the certified product does not directly contribute to the issue of concern.

The facility types listed below are subject to the requirements in this section of the standard:

Facilities with High-volume Processes – The amount of water withdrawn and purchased by final manufacturing facilities was determined per the requirements in Section 7.3 Quantifying Water Use. As noted in Section 7.3, final manufacturing facilities that withdraw or purchase ≥ 100,000 m^3 of water per year are considered as having high-volume processes.

Facilities in Water Stressed Locations – The water stress level for all final manufacturing facilities was determined per the requirements in Section 7.1 Characterizing Local and Product Relevant Water and Soil Issues. The stress levels noted in the requirements are defined as follows:

- Low stress locations are defined as locations with a baseline water stress risk level of low or low to medium per WRI's Aqueduct database.
- Medium to high stress locations are defined as locations with a baseline water stress risk level of medium to high, high, or extremely high per WRI's Aqueduct database.
- High stress locations are defined as locations with a baseline water stress risk level of high or extremely high per WRI's Aqueduct database.
- If no data are available for a given location in WRI's Aqueduct database, data for adjacent areas may be used to infer risk level. Alternate data sources should also be explored, if available, to make a determination regarding risk level.

Facilities with Pollutant Intense Processes – Final manufacturing stage facilities producing materials associated with pollutant intense processes are defined as facilities that produce one or more of the materials listed in the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials reference document* using one or more of the listed pollutant intense processes.

Implementing Technologies and Best Practices to Reduce Water Use and Pollution

A non-exhaustive list of suggested best practices and technologies may be found in a table at the end of the Water & Soil Stewardship section of this guidance document. The sections relevant to water in the European Union's Reference Documents on Best Available Techniques will also be of use if available for the applicable industry.

For the Gold level, facilities with high-volume processes in medium to high stress locations and facilities with pollutant intense processes are required to implement technologies and best practices leading to the maximum feasible water use reductions and effluent quality improvements, respectively.

Maximum feasible means that there are no technologies available, excluding emerging/novel techniques that are not yet commercially developed, that would reduce water use or improve quality (as required) more than what has been implemented. It is understood that maximum feasible water use reductions and quality improvements may be tied and that trade-offs may exist. When both pollutant intense and high-volume processes exist, effluent quality and water use must be optimized simultaneously.

For facilities with pollutant intense processes, one method for achieving the Gold level is to demonstrate that the United States Environmental Protection Agency's New Source Performance Standards (NSPS) are being met.

Note that prior work to reduce water use and improve effluent quality may receive credit (i.e., new actions are not necessarily required for the purposes of Cradle to Cradle certification).

For key materials that make up ≥ 25% of the product by weight or by cost:

1. For forest and agricultural raw materials (excluding untraceable commodity type agriculturally

derived material, e.g., ethanol):

a. The material must be certified to a C2CPII-recognized standard that addresses the processes of concern (per the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials* reference document) or an equivalent alternative to certification must be in place.
b. Alternatively, for the Gold level (i.e., not an option for the Platinum level), the following are required:
    i. An explanation of the limitation(s) preventing the incorporation of the required percentage(s) of certified material and how, based on these limitation(s), the amount of certified material currently used represents the maximum that is currently feasible.
    ii. The explanation must be reported publicly.
    iii. A strategy for addressing the identified limitation(s) and increasing the amount of certified material over time must be developed. The strategy must include discrete objectives and an associated timeline.
    iv. For recertification:
        1. The applicant must demonstrate progress toward achieving the objectives.
        2. A description of progress made must be reported publicly.

Further Explanation

The requirements in this section apply to the key materials in scope as determined per Section 7.1

Using C2CPII-recognized Certifications for Forest and Agricultural Raw Materials

The following forest and agricultural raw materials are associated with high-volume and/or pollutant intense processes and are the subject of these requirements.

- Crops: The *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials* reference document indicates that cotton, maize/corn, soy, and sugarcane must be considered as typically grown using high-volume processes (i.e., irrigation). In addition, all crops are flagged as potentially associated with the following pollutant intense (including soil erosion related) processes:
    - Pesticide and fertilizer use and associated chemical runoff to surface water.
    - Deforestation and other unmanaged/poorly managed land conversion to agriculture.
    - Excessive tilling and associated soil erosion and siltation of surface water.
- Wood: Wood is associated with pollutant intense processes during production. These processes include deforestation, soil erosion and runoff as a result of poor forest management, and pesticide and fertilizer use.
- Animal material: Leather, wool, and other materials sourced from ungulates/grazing species (e.g., cashmere) are associated with pollutant intense processes occurring during livestock production and farming, including the potential for land degradation, soil erosion, and pollutant run-off.

For the Gold level, the goal is to use forest and agricultural materials that are certified to a C2CPII-recognized standard, or an equivalent alternative, that addresses these concerns. Currently recognized certification programs are listed below.

- Cotton*: Better Cotton Initiative (BCI)
- Wood: Forest Stewardship Council (FSC)
- Palm oil: Roundtable on Sustainable Palm Oil (RSPO)
- Cotton and other crops: Global Organic Textile Standard (GOTS) – *provisionally recognized through 31 December 2022; pending review*

Additional programs may be recognized and added to this list. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition. The Appendix also lists requirements for 'alternative equivalent to certification'. If it is not possible to use certified material or an equivalent alternative to certification, the option described in Requirement #1b may be applied. In this case the limitation(s) identified will be publicly reported via the C2CPII Version 4.0 certification report.

* Note: Cotton sourced from certain locations is also associated with a high risk of child labor and/or forced labor. To address this concern, any cotton sourced from a de facto high-risk location (as defined for Gold level in Social Fairness Section 8.3) must be certified to a standard that also addresses child labor. Organic standards (e.g., India organic regulation, China organic regulation) do not sufficiently address child and forced labor issues during the cotton production phase where these issues are high risk. See Social Fairness Sections 8.1 and 8.3 for additional information.

The requirements in this section apply specifically to the raw material production phase. It may also be necessary to address additional processes that are used in manufacturing steps occurring after raw material production. For example, in the case of leather, wet processing steps (e.g., tanning) are also high volume and pollutant intense per the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials* reference document. To address wet processing steps, applicants may choose from the options described in the next section of the standard (i.e., Requirement #2a-c).

2. For other material types:
    a. A C2CPII-recognized certification or alternative that addresses the processes of concern must be in place (the alternative described in 1b above may be applied), or
    b. The applicant must be actively involved with a multi-stakeholder group working to address the processes of concern, or
    c. The applicant must work directly with suppliers of key materials to implement the Water and Soil Stewardship requirements (per the Alternative for Key Materials section below).

Alternative for Key Materials: Working with Suppliers to Implement Water and Soil Stewardship Requirements

The following receives credit as an alternative to using certified materials, implementing alternatives, or working with a multi-stakeholder working group to address water- and soil-related issues of concern:

For the Gold level, suppliers of key materials must fulfill the following requirements:

1. Local and Product Relevant Water and Soil Issues must be characterized (per Section 7.1).
2. For supplier facilities producing key materials associated with high volume processes and located in medium to high stress locations: At least one technology or best practice leading to water use reductions must be implemented.

3. For supplier facilities producing key materials associated with pollutant intense processes:
    a. The Effluent Quality Compliance requirements must be fulfilled (per Section 7.2), and
    b. At least one technology or best practice leading to improved water and/or soil quality must be implemented.

Required Documentation

To receive credit for implementing a water conservation best practice or technology, the following must be provided:

- A description of the practice or technology.
- Evidence that the best practice or technology has or can be expected to lead to either water use reductions and/or quality improvements as relevant. The evidence provided may:
    - Be direct evidence that applies specifically to the site (e.g., test data demonstrating reduced release of pollutants before and after a best practice was implemented), and/or
    - Be generally applicable (e.g., a comparative estimate of water use reduction that can be expected based on the technical documentation for new equipment compared to that of older equipment that has been replaced.)
- An estimate/indication of the percentage of total effluent and/or water use (as relevant) that the best practice will affect.
- Proof of implementation (e.g., receipts of purchase and installation for new equipment).

To receive credit for implementing the maximum feasible improvements (Gold level):

- Description of all best practices and technologies that are employed at the facility.
- Argument and rationale demonstrating that these practices are the maximum feasible including supporting references.

To receive credit for the use of certified materials, the program certificate and proof of purchase must be provided. Or, if unable to achieve this requirement, an explanation of the limitation(s) and a strategy for addressing the identified limitation(s). Note that these limitation(s) are required to be publicly reported via the C2CPII certification report.

To receive credit for working with a multi-stakeholder group to address issues and processes of concern:

- Description of group participants (e.g., participant list and/or stakeholder types).
- Evidence of the issues the partnership seeks to address.
- Documentation describing the terms and understandings between the company and collaboration partners.
- Documentation of outputs from the collaborative activity.

To receive credit for working directly with suppliers to implement Water & Soil Stewardship Requirements, the same documentation is required of suppliers as for final manufacturing facilities. See Sections 7.1, 7.2, and 7.6 for additional information.

7.7 Assessing and Optimizing Product Relevant Chemicals in Effluent and Sludge

Intended Outcome(s)

Chemicals entering receiving waters and soils as a result of product manufacturing have been intentionally selected based on their preferred safety attributes.

- At the Bronze level, in alignment with leading regulations that aim to protect human health and the environment, the release of well-known toxic chemicals is avoided.
- At the Silver level, chemicals classified as carcinogenic, mutagenic, or reproductive toxicants (CMRs) are not used, or, if these substances are present, exposure to them is unlikely or expected to be negligible. In addition, persistent, bioaccumulative, and toxic (PBTs) or very persistent and very bioaccumulative (vPvBs) substances are not used. The product also does not contain substances that cause an equivalent level of concern or exposure to them is unlikely or expected to be negligible.
- At the Gold level, chemicals used are compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology. Exposure to hazardous chemicals via product relevant effluent and sludge is unlikely or expected to be negligible.

Applicable Achievement Level(s)

Bronze, Silver, and Gold

Requirement(s)

Bronze level: All product relevant chemicals entering effluent or sludge during the final manufacturing stage comply with the relevant restrictions on the Core Restricted Substances List (RSL).

Silver level:

Define and assess product relevant process chemicals entering effluent or sludge during the final manufacturing stage and develop a strategy for optimization.

- Ensure that any product relevant chemicals (including product relevant process chemicals) released with effluent or sludge during the final manufacturing stage:
  - Are not classified or listed as known or suspected to cause cancer, birth defects, genetic damage, reproductive harm (CMRs), or cause an equivalent level of concern, or, if these substances are released, that exposure is unlikely or expected to be negligible, and
  - Are not listed as persistent, bioaccumulative, and toxic (PBTs), very persistent and very bioaccumulative (vPvBs).

Gold level:

- Define and assess all product relevant chemicals entering effluent or sludge during the final manufacturing stage and at select supplier facilities.
- Ensure that any product relevant chemicals released with effluent or sludge during the final manufacturing stage or at select supplier facilities are compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology, allowing only a, b, and c assessed chemicals within effluent and sludge.

For the Bronze level,

1. Product relevant chemicals are defined as intentional product inputs and process chemicals (including single chemicals and chemical mixtures, as well as known contaminants) used to manufacture the product. (Note: Process chemicals are further defined in the Definitions section).
2. All product relevant chemicals that enter or potentially enter the effluent are in scope.
3. If applicable, restriction thresholds apply to the chemical mixtures as received from the supplier.

For the Silver level,

1. For process chemical formulations, all substances present at 1000 ppm (0.1%) or above within the formulation are subject to review. Substances may be grey-rated due to missing toxicity information and otherwise must have received an abc-x rating.
2. CMRs are defined as substances that have received a harmonized classification of Category 1 or 2 in one or more of the CMR endpoints as listed within the EU's Classification, Labelling and Packaging regulation (CLP) Annex VI, or are CMR substances listed on the REACH Candidate list of Substances of Very High Concern (SVHC) for Authorisation (including those on Annex XIV). PBTs, vPvBs, and substances causing an equivalent level of concern are defined per the REACH Candidate list of Substances of Very High Concern (SVHC) for Authorisation (including those on Annex XIV).

For the Gold level, the "select" suppliers in scope are those meeting both of the following conditions:

1. Tier 1 suppliers to the final manufacturing stage and suppliers that carry out pollutant intense processes associated with the following material types regardless of tier: leather, metal finishes, pulp and paper, and textiles, and
2. Suppliers that produce key materials using pollutant intense processes for materials that make up ≥ 25% of the product by weight or by cost.

Further Explanation

The requirements in this section of the standard apply to the certified product and not to the entire facility where the product is made. For Bronze and Silver levels, the final manufacturing stage of the certified product is in scope. For Gold level, processes occurring in the supply chain are also in scope in some cases. This is described below. The requirements in this section align closely with those in the Material Health category. See Material Health Section 4.1 Restricted Substances List and 4.6 Using Optimized Materials for additional information. Important differences are noted here.

Identifying Product Relevant Chemicals Entering Effluent and Sludge (Final Manufacturing Stage)

As noted in the standard:

1. *Product relevant chemicals are defined as intentional product inputs and process chemicals (including single chemicals and chemical mixtures, as well as known contaminants) used to manufacture the product. (Note: Process chemicals are further defined in the Definitions section).*
2. *All product relevant chemicals that enter or potentially enter the effluent are in scope.*

This means that the requirements apply to substances that are already subject to review per the Material Health category plus any additional process chemicals that do not remain in the final product above subject to review levels but have some potential to enter the effluent and sludge. All chemicals with the potential to

enter effluent and sludge during the process must be included in the scope. In general, unless water only comes into contact with the product at a point when chemicals within the product are unavailable for release (e.g., they are reacted into the material matrix), it must be assumed that there is potential for chemicals within the product to enter effluent and sludge. **See the Definitions section of the standard for a definition of a process chemical.**

Bronze Level: Restricted Substance List (RSL) Compliance (Final Manufacturing Stage)

For chemicals with potential to enter the effluent and sludge that are subject to review per the Material Health category, compliance with the restricted substances list is already addressed via the Material Health requirements. Therefore, the only additional requirement for Water & Soil Stewardship is to confirm that any process chemicals used during the final manufacturing stage that are also released or potentially released with effluent and sludge are in compliance with the Core RSL (i.e., the section of the RSL applicable to all product types). As noted in the standard, *restriction thresholds apply to the chemical mixtures as received from the supplier.* For single chemical substances, those listed on the RSL may not be used as process chemicals.

Silver Level: Confirming that CMRs and SVHCs are not released with effluent and sludge (Final Manufacturing Stage)

For chemicals with the potential to enter the effluent and sludge that are also subject to review per the Material Health category, confirming that CMRs and SVHCs are not released with effluent and sludge is already addressed via the Material Health requirements. This will have been achieved by either collecting supplier declarations stating these substances are not present in the product's materials or via material health assessments that consider (among other things) the toxicity of the chemical in the context of release to the environment, if applicable. Therefore, the only additional requirement for Water & Soil Stewardship is to confirm that any process chemicals used during the final manufacturing stage that are also released or potentially released with effluent and sludge are not CMRs or SVHCs.

There are two important distinctions for the Water & Soil Stewardship category:

1. The first is that process chemicals released to effluent and sludge must be assessed at the Silver level. This means that for process chemicals released to effluent and sludge during the final manufacturing stage, supplier CMR and SVHC declarations alone are not accepted. Instead, full material disclosure must be obtained for these process chemicals and a material health assessment rating must be assigned. The following exception applies: *Substances may be grey-rated due to missing toxicity information.* This means that substances may be 'grey' due to lack of toxicity data on any hazard endpoint, but they may not be 'grey' due to missing composition information (note: 'grey' is an assessment designation that is defined per the Cradle to Cradle Certified Material Health Assessment Methodology). This will allow a Material Health assessor to confirm that CMRs and SVHCs are not released.
2. Secondly, it is important to note that: *For process chemical formulations, all substances present at 1000 ppm (0.1%) or above within the formulation are subject to review.* This is a higher subject to review limit than the default for substances in the product's materials, which is 100 ppm (0.01%) in most cases. See the Definitions section for a definition of process chemical.

Assessing Chemicals in Effluent and Sludge

Assessing chemicals in effluent and sludge is required at the Silver level as noted above for process chemicals, and for the Gold level where certain pollutant intense processes within the supply chain are also in scope. In addition, this is required in the Material Health category requirements for chemicals subject to review in the product that are also released to effluent and sludge (in increasing percentages of the product by weight, i.e., 75% Bronze, 95% Silver, 100% Gold).

Note that assessments must be carried out on the reacted form of the parent chemical in any case where chemical reactions are known to occur within the effluent that result in the formation of more hazardous substances (e.g., dioxins may form in pulp mill effluent especially when elemental chlorine bleaching is used).

See the Material Health Methodology (in particular the methods for assessing effluent and sludge) for further information on how to assess chemicals in this context. In brief, regarding exposure, if a closed loop system is in place this may allow for chemicals with RED and grey hazard ratings to receive a c-assessment. However, if hazardous substances are disposed of with effluent or sludge when the system is periodically flushed or cleaned, or if hazardous substances are within the sludge and it is not handled appropriately, a c-assessment will not be possible. Appropriate handling of sludge is defined based on the Material Health Assessment Methodology. If a chemical can be c-assessed in the context of sludge, the sludge by definition is handled adequately or appropriately.

Gold Level: Using Optimized Chemistry (Final Manufacturing Stage and Select Suppliers)

The Gold level requirement is to: *Ensure that any product relevant chemicals released with effluent or sludge during the final manufacturing stage or at select supplier facilities are compatible with human and environmental health according to the Cradle to Cradle Certified Material Health Assessment Methodology, allowing only a, b, and c assessed chemicals within effluent and sludge*. As noted above, the Cradle to Cradle Certified Material Health Assessment Methodology is used to assess chemicals in effluent and sludge for the purposes of the Water & Soil Stewardship category.

An important distinction for the Gold level in the Water & Soil Stewardship category is the scope, which includes 'select suppliers'. Those in scope are *suppliers that produce key materials using pollutant intense processes for materials that make up ≥ 25% of the product by weight or by cost.* These are the key materials in scope as identified in Section 7.1. For the purposes of the requirements in this section, this is further narrowed down to *tier 1 suppliers to the final manufacturing stage and suppliers that carry out pollutant intense processes associated with the following material types regardless of tier: leather, metal finishes, pulp and paper, and textiles*. For example, this means that for an apparel product, it is required to assess all chemicals released to effluent and sludge during any wet processing of the textile(s) used that occurs after the raw material production or extraction stage, including wet processing of fiber, yarn, and the textile itself.

Required Assessment Ratings for Specific Materials and Substances

The substances listed below will always be x-assessed if released with effluent or sludge (however, see note below regarding bleaching chemistry). For the substances listed below that are x-CMR (per the Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation), PBT, vPvB, or equivalent concern (i.e.,

SVHCs), and are discharged with effluent during the final manufacturing stage of the product, the product is limited to the Bronze level. If the substance is released in the supply chain by a 'select supplier' in scope for the Gold level, the product is limited to the Silver level. Substances that are x-assessed but are non-CMR and not a SVHC may be used at the Silver level.

- Chrome plating, use of chrome VI: x-CMR.
- Leather tanning, use and/or formation of chrome VI: x-CMR
- Biological and biologically-derived fibers
  - Elemental chlorine bleaching: x-CMR (due to the likely formation of dioxins and other issues) unless shown otherwise.
  - Elemental chlorine free (ECF) bleaching based on chlorine dioxide or similar: x-assessed due to the formation of organohalogens in effluent and sludge. It is allowable to assume no CMRs or SVHCs for the purposes of the Silver level. However, for the Gold level, this must be demonstrated as noted below.

Note regarding assessment of bleaching chemistry

It is highly unlikely that a process using ECF bleaching will achieve the Gold level in the Water & Soil Stewardship category because organohalogenated substances will be present in effluent and sludge when using the typical ECF process, and per the Material Health Assessment Methodology, all organohalogens must be x-assessed due to life cycle concerns. The Material Health Assessment Methodology has an allowance for determining that substances in effluent are below safe limits (thereby allowing for c-assessment if so); however, because a wide range of substances with a range of toxicity concerns can potentially form in effluent when using ECF bleaching, safe limits may not be easily determined. Another option is to demonstrate that any problematic substances (in this case Adsorbable Organic Halides (AOX) as a substance group and dioxins) are below detection in effluent and, assuming AOX is also in sludge, that sludge is handled appropriately. Refer to the Material Health Assessment Methodology for additional information. Note that the sludge handling method that would allow for a c-assessment per the current methodology (assuming AOX is present) is one where the sludge is kept in a closed system of nutrient recovery and re-used without exposure concerns.

If effluent produced from a bleaching process will be tested with the aim of achieving a c-assessment, it must, at a minimum, be tested for AOX and the most toxic dioxin congener (2,3,7,8-TCDD). The required detection limits for effluent are as follows, unless permit limits are lower, in which case those take precedence:

- AOX: 20 ppb. This is the detection limit for United States Environmental Protection Agency test method 1650, required for use in demonstrating compliance with the United States effluent guidelines for pulp and paper. Note that in the European Union, there are several possible test methods with ISO 9562 being common. The detection limit for ISO 9562 is 10 ppb.
- 2,3,7,8-TCDD: 10 pg/L. This is based on the United States Environmental Protection Agency test method 1613.

Required Documentation

Please refer to the Required Documentation in the Material Health Sections 4.1 Restricted Substances List Compliance, 4.3 Material and Chemical Inventory, and 4.4 Assessing Chemicals and Materials. The same requirements apply to Water & Soil Stewardship Section 7.7.

7.8 Transparency

Intended Outcome(s)

Water use and effluent quality data for final manufacturing stage facilities are available to stakeholders, demonstrating the manufacturer's commitment to water stewardship.

Applicable Achievement Level(s)

Silver and Platinum

Requirement(s)

Silver level: Make water use data for final manufacturing stage facilities available to stakeholders.

Platinum level: Make effluent quality data for the final manufacturing stage facilities available to stakeholders.

The data must include:

1. For the Silver and Platinum levels, withdrawals by source and stress level, consumption, and discharge by level of treatment and destination.
2. For the Platinum level, effluent quality test reports as required for verification of the Effluent Quality Compliance requirements (see Section 7.2).

Further Explanation

The Silver level transparency requirements apply to all final manufacturing facilities, including those that only use water for sanitary and hygienic purposes (e.g., toilets and sinks). The data required for achieving the Silver level transparency requirements will have already been collected per the requirements in Section 7.1 Characterizing Local and Product Relevant Water & Soil Issues (i.e., water stress level data) and 7.3 Quantifying Water Use.

The Platinum level requirements apply to all final manufacturing facilities except the facilities that are not required to comply with the requirements in Section 7.2 Effluent Quality Compliance, which are the facilities that do not release any process effluent and depend on independently owned treatment plants to treat all other effluent (e.g., effluent produced from toilets and sinks). The data required for achieving the Platinum level transparency requirements will have been collected per the requirements in Section 7.2 Effluent Quality Compliance.

Required Documentation

Silver and Platinum levels:

- Evidence of public disclosure of the required data (e.g., a link to the applicant's website, sustainability report that includes the required data disclosure, or a report prepared per GRI 303-Water).

7.9 Positive Impact Project

Intended Outcome(s)

Water and/or soil quality, water quantity, or the health of aquatic and/or soil ecosystems within the catchment(s) where the manufacturer, employees, customers, and/or suppliers are located is improved through initiation or participation in a collaborative project.

Applicable Achievement Level(s)

Gold and Platinum

Requirement(s)

Gold level: Implement a project that will positively impact local and/or product relevant water or soil issues.

Platinum level: Demonstrate the impact of the positive impact project using quantitative metric(s).

The project must:

1. Reach beyond the final manufacturing stage facility and into the value chain and/or local community and aim to positively impact aquatic and/or soil ecosystems, local communities, water and/or soil quality and/or water quantity within the catchment(s) where the manufacturer, employees, customers, and/or suppliers are located.
2. Include direct involvement by company employees and/or senior management.
3. Address one or more of the issues identified in the Characterize Local and Product Relevant Water and Soil Issues requirement (Section 7.1) or otherwise be material to the applicant company.

Further Explanation

The requirements in this section apply to the applicant company.

Selecting a Positive Impact Project

Applicants are highly encouraged to select positive impact projects that focus on issues identified in the Characterize Local and Product Relevant Water and Soil Issues requirement (Section 7.1). If the project selected focuses on an issue separate from those identified in Section 7.1 (i.e., otherwise material to the company as permitted in requirement #3), the applicant must provide an explanation of how this issue was chosen and the explanation must demonstrate that the project is relevant to at least one stakeholder group (e.g., employees, local communities, customers, suppliers, other species, or entire ecosystems).

Example projects include:

- Participation in collective action projects, if any are occurring locally. May include partnering with NGOs

(e.g., WWF) focusing on water issues

- Participation in water stewardship industry initiatives (e.g., working to innovate solutions to product relevant water issues such as microfiber pollution for synthetic textiles)
- Participating in a local wetland restoration project
- Working with local conservation organization(s) to advocate for increased protection of upstream forest cover (which is relevant to preserving water quality)
- Providing drinking water and/or sanitation to the local community when there is lack of access

Actions that occur only once (e.g., a single volunteer engagement) will not receive credit. Once implemented, the project must be ongoing with actions occurring regularly (annually at a minimum). The project must go beyond simply making donations unless it is demonstrated that donations occur annually, are ≥1% of certified product profits, and employees have provided input on the project(s) to support (e.g., 1% For the Planet).

Selecting Key Performance Indicators

See the Social Fairness category Section 8.8 Silver level for guidance on selecting key performance indicators. This guidance also applies to the Water & Soil Stewardship category.

Incorporating Employee Input

See the Social Fairness category Section 8.8 Silver level for guidance on incorporating employee input. This Guidance also applies to the Water & Soil Stewardship category.

Platinum Level: Assessing and Demonstrating Impact

See the Social Fairness category Section 8.8 Gold level for guidance on demonstrating impact. This guidance also applies to the Water & Soil Stewardship category.

Required Documentation

Gold Level:

- Description of which issue(s) or opportunity(ies) are addressed that the applicant company identified from the Section 7.1 Characterizing Local and Product Relevant Water & Soil Issues. If the project focuses on an issue separate from those identified in Section 7.1, an explanation of how this issue was chosen – which must include relevance to at least one stakeholder group, or other species.
- Description of measurable outcomes that are planned for the project, and one or more KPIs that will be tracked before, during, and after the project to demonstrate improvement/change/impact.
- Documentation of employee input received and/or employee engagement process. This could include email communication, meeting notes, or survey responses, etc.

Platinum Level:

- Impact assessment report, including tracking of defined KPI(s) developed at the Gold level, and evaluation of progress since project initiation. The report must demonstrate positive impact via evaluation of the defined KPI(s).

7.10 Optimizing Effluent and Sludge Quality at the Facility Level

Intended Outcome(s)

Effluent and sludge at final manufacturing facilities are managed with the aim of protecting local water quality and ecosystem health.

Applicable Achievement Level(s)

Platinum

Requirement(s)

For the final manufacturing stage facilities:

- Establish a comprehensive effluent and sludge quality management system, and
- Optimize the effluent and sludge produced as a result of all manufacturing processes used at the facility.

The following are in scope:

1. Effluent and sludge produced as a result of all manufacturing processes at the facility.
2. Non-manufacturing effluent and sludge (e.g., from water used in toilets, kitchen areas) unless treated by an off-site, independently operated effluent treatment facility.
3. All chemicals with potential to enter effluent and sludge including, but not limited to:
    a. process chemicals,
    b. intentional product inputs,
    c. chemicals used to treat and clean cooling systems,
    d. chemicals used to treat the effluent, and
    e. custodial/cleaning chemicals used in the manufacturing area.

Managing Effluent and Sludge Quality

The comprehensive effluent quality management system must:

1. Be informed by an understanding of:
    a. The hazardous substances (defined as substances with RED hazard(s) per the Material Health Assessment Methodology) used intentionally and unintentionally by the facility and the industry. This must be determined based on a comprehensive review of safety data sheets and the relevant literature on chemicals of known and emerging concern, both regulated and non-regulated. (Note: This is different from the chemical inventory required for materials and products in the Material Health category.)
    b. Local and catchment level water quality issues that are relevant to the facility, surrounding

ecosystem, and community, including the quality of source and receiving waters, and the health of receiving ecosystems, determined per the Characterize Local and Product Relevant Water Issues requirement (Section 7.1) and communication with non-governmental organizations (NGOs) working on local water issues and/or local water authorities.

2. Include comprehensive methods for avoiding the intentional and unintentional use, and subsequent introduction, of hazardous substances to the environment via effluent and sludge. The methods must address all chemicals in scope and may include but are not limited to:
    a. Use of third-party certified and optimized input formulations and materials,
    b. Analytical testing of purchased formulations to screen for hazardous contaminants, and
    c. Adherence to industry best practice manufacturing restricted substances lists.
3. Include qualified third-party verification that processes and procedures for on-site treatment facility operation (if any) and water quality management are in place and functioning.
4. Monitor conventional water quality parameters (e.g., pH, total suspended solids, biochemical oxygen demand), and for the release of hazardous substances relevant to the industry and facility. The following are required:
    a. Effluent as it leaves the facility must be tested for all substances of concern identified per the required research (per #1).
    b. Best practices must be used to collect samples.
    c. Testing must be conducted at least two times per year.
    d. Laboratories conducting the tests must be ISO 17025 accredited.

Optimizing Effluent and Sludge Quality

1. For conventional water quality parameters, facility(ies) releasing effluent directly to surface or groundwater (defined in Section 7.2) must comply with the more stringent of the limitations indicated by either their permits or as follows:
    a. pH: 6-9
    b. Biological Oxygen Demand (BOD): 25 mg/L
    c. Chemical Oxygen Demand (COD): 100 mg/L
    d. Total Suspended Solids (TSS): 30 mg/L
    e. Ammonia (as N): 10 mg/L
    f. Total nitrogen: 10 mg/L
    g. Total phosphorus: 2.0 mg/L
    h. Temperature: < 3 °C increase
    i. Color: 7 m^{-1} (436 nm; yellow) 5 m^{-1} (525 nm; red) 3 m^{-1} (620 nm; blue)
    j. Oil and grease: 10 mg/L
    k. Coliform: 400 bacteria/100 ml

    Applicants who would be required to comply with effluent limits more stringent than what is indicated by their permits may alternatively publicly disclose an explanation of the conditions and/or trade-offs preventing the facility from meeting the more stringent limits.

    These effluent limits are the most stringent of those listed for multi-brand consortia or for the benchmark countries (if not included in multi-brand consortia list) per Zero Discharge of Hazardous

Chemicals Programme, Textile Industry Wastewater Discharge Quality Standards Literature Review REV1, 2015. https://www.roadmaptozero.com/fileadmin/pdf/WastewaterQualityGuidelineLitReview.pdf

2. Hazardous substances identified per the required research (per the Effluent and Sludge Quality Management section #1) must not be x-assessed in effluent or sludge (per the Material Health Assessment Methodology section on assessment of effluent and sludge).

Receiving water is defined as the ultimate receiving water in the case of off-site, independently operated effluent treatment facilities.

Further Explanation

Effluent and Chemicals in Scope

Facilities that have completely dry or closed loop systems in place, do not discharge any manufacturing process effluent or sludge, and depend on independently operated treatment facilities to treat non-process effluent (i.e., from toilets and sinks) are not subject to the requirements in this section (with verification).

The requirements in this section apply to effluent and sludge discharged from final manufacturing stage facilities, not only to the effluent produced as a result of producing the certified product. Essentially any chemical used on-site with potential to enter effluent and sludge is in scope.

Managing Effluent and Sludge Quality

In addition to the requirements themselves, the following additional information and guidance is provided:

Requirement #1a:

- Review all safety data sheets (SDSs) for chemicals and chemical mixtures in scope (as defined in #1-3, including #3a-e). Compile a list of chemicals with associated RED hazards as listed on all SDSs and as defined by the Material Health Assessment Methodology.
- To identify contaminants of emerging concern that may be relevant to the industry, review governmental and academic publications (see for example). Examples of contaminants of emerging concern include certain pesticides, pharmaceuticals, PFASs, phthalates, flame retardants, and siloxanes.
- Another approach for identifying hazardous chemicals that are in use by the industry and therefore potentially present in purchased formulations (even if not listed on SDSs, which may be incomplete or inaccurate), is to review current and prior uses of substances on the REACH annex XVII and the Candidate List of Substances of Very High Concern for chemicals relevant to the industry. This information can be found in REACH Annex XV restriction reports and dossiers. This approach is most relevant to regions where regulations are lagging.

Requirement #2: For example, this may include the use of Cradle to Cradle Certified materials and formulations, ZDHC MRSL compliance formulations, or the use of ChemIQ, a testing protocol developed by VF Corp.

Requirement #3: Staff that are operating any on-site treatment plants must be appropriately trained and qualified. If the facility has ISO 14001 or equivalent and the system includes processes and procedures for managing effluent, this may receive credit (however, this will have to be determined on a case-by-case basis

because ISO 14001 certification does not always explicitly address water quality).

Requirement #4

Testing and sampling methods required by the ZDHC Wastewater Guidelines are recommended. Also see the Cradle to Cradle Certified Material Health Assessment Methodology for additional methods.

If it can be determined that a substance is typically removed from the liquid effluent by wastewater treatment processes then it may not be necessary to test for that substance on an ongoing basis. To determine if a chemical is likely to be removed by wastewater treatment processes, the Material Health Assessment Methodology for assessing effluent and sludge may be applied. The following reference may be useful for this purpose: EU Wide Monitoring Survey on Waste Water Treatment Plant Effluents, 2012, (download link).

Optimizing Effluent and Sludge Quality

As noted, *hazardous substances identified per the required research (per the Effluent and Sludge Quality Management section #1) must not be x-assessed in effluent or sludge (per the Material Health Assessment Methodology section on assessment of effluent and sludge).* This means that if hazardous substances are identified per the required research, that a Material Health Assessment Body is required to conduct the assessment work to determine whether or not the identified substances are x-assessed.

Required Documentation

- If relevant, evidence that the facility is not subject to these requirements (e.g., photos and diagrams of a fully closed loop water system and description of the process for cleaning the system including how any waste/sludge is handled, and/or photos and diagrams showing that water is otherwise only used for sanitary and hygienic purposes with effluent sent to an independently operated treatment facility).
- Research report including:
  - A list of hazardous chemicals relevant to the industry, facility, local ecosystem, and community, in the context of water.
  - Indication of which of these chemicals can and cannot be removed by the treatment methods employed.
  - List of references.
- Description of the methods used to control input chemistry.
- Evidence of third-party verification of effluent quality management system.
- If effluent is treated on site, evidence of relevant staff training and qualifications for operating treatment plant.
- Effluent test data, methods, and lab qualifications.
- For any hazardous substances identified, assessment results demonstrating that the substance is not x-assessed in the context of effluent and sludge.

Further Explanation

Table - Water & Soil Stewardship Example Conservation Technologies and Best Practices

The following are example conservation technologies and best practices for fulfilling the Water & Soil Stewardship requirements in standard Section 7.6 Water & Soil Conservation. These are applicable for cases where one best practice or technology is required. These examples were selected based on their potential to have medium to high impact on improving quality and/or reducing water use as noted. Some of the listed practices will also positively impact soils (e.g., see rows for crops).

Impact type	Material	Process or sub-material	Technologies and Best Practices	References
Quality	Several	wastewater treatment	Use reverse osmosis, ultrafiltration and/or nanofiltration to treat process water.	
Quality	Several	wastewater treatment	Use constructed wetland to treat process water.	Constructed Wetlands (US EPA)
Quality	Wood/ timber	sawmill	Divert stormwater around storage areas with vegetated swales, and/or berms.	Industrial Stormwater Factsheet: Timber (US EPA)
Quality & Quantity	Chemicals	ammonia production	Recycle steam condensate, process, and scrubbing waters to reduce the amount of chemicals released to the environment (air and water emissions) and the original amount of chemicals added to process water.	Best Available Techniques Reference Documents (European Commission)
Quality	Chemicals	soap manufacturing	Utilize wastewater treatment with flow balancing, first reaction stage (denitrification – NO3 to N2 – in a stirrer tank where the external carbon source is added), second reaction stage (degradation of residual organics in a stirrer tank by addition of small amounts of nitrate), and separation (the activated sludge is returned to the first reaction stage) to remove nitrates and phosphates from effluent water.	Best Available Techniques Reference Documents (European Commission)
Quality	Metal finishes	Plating line	Install an ultrafiltration system for recovery of degreasers and oil for reuse to minimize BOD loading to wastewater.	
Quality & Quantity	Metal finishes	Plating line	Install a closed loop system with filtration, ion exchange, and electrolytic recovery.	
Quality	Metal finishes	Plating line	Transition to using base alloys that do not have to be plated (e.g., stainless steel).	
Quality	Metal finishes	Cleaning	Use mechanical mixing, agitation, and air blowing in plating and rinsing processes to reduce amount of chemicals needed in rinse baths.	California Department of Water Resources
Quantity	Metal finishes	Cleaning	Utilize multiple tanks and countercurrent rinsing (rinse parts in dirtier water in the beginning of the process and move to more clean water at the end of the process) for parts to reduce the risk of contamination and need to dump entire rinse tanks of water.	California Department of Water Resources
Quality & Quantity	Metal finishes	Cleaning	Utilize a dragout control method. Dragout occurs when processed parts are removed from one tank and transferred to another, contaminating the rinse.	California Department of Water Resources

Quality	Mined & extracted materials	Acid and metalliferous drainage	Leading practice for the prevention and treatment of acid and metalliferous drainage includes identification, characterization, scheduling, transport, segregation, selective placement, co-disposal and sometimes blending of sulfidic and carbonate-bearing materials, as well as an appropriate level of monitoring.	Preventing Acid and Metalliferous Drainage (Australian Government, 2016)
Quantity	Several	Boiler	Minimize boiler blowdown: Install a conductivity controller that can continuously measure the conductivity of the cooling tower water and that will initiate blowdown only when the conductivity set point is exceeded or have blowdowns scheduled by volume of use, not time of use.	California Department of Water Resources
Quantity	Several	Boiler	Maximize boiler condensate return via pipe loops that return cooled, condensed stream to reduce the amount of new boiler water (saving treatment energy, water, and chemicals).	California Department of Water Resources
Quantity	Several	Cleaning equipment	Install Clean In Place (CIP) technology for pipes and tanks rather than taking apart the system and soaking for cleaning.	California Department of Water Resources
Quantity	Wood/ timber, pulp & paper	Debarking	Transfer from water intensive water pressure debarking process to mechanical bark stripping processes.	
Quantity	Pulp & paper	Debarking	Transfer from water intensive water pressure debarking process to mechanical bark stripping processes.	
Quality	Pulp & paper	Pulping	Move from chemical pulping processes that require water rinses and release wastewater higher in BOD and chemical contaminants to a mechanical pulping process.	Pulp and Paper Mills Pollution Prevention and Abatement Handbook (World Bank)
Quantity	Several	Cooling	• Utilize recycled water for cooling water and eliminate one pass cooling systems (exception to elimination of one pass cooling: use water for another purpose after cooling (e.g., irrigation). • Increase number of cycles for which water is used in cooling tower. • Use an air-cooled condenser system as opposed to a water-cooled condenser or cooling system. • Capture rainwater on site and use for cooling water (if allowed by regulations). • Use a cooling tower or chilled water loop instead of once through cooling for water-cooled rectifiers. • Conversion of evaporative cooling towers to dry cooling towers eliminates evaporation and reduces water losses.	Catalogue of Good Practices in Water Use Efficiency (Water Resources Group, 2012) Alliance for Water Efficiency
Quantity	Cement	Kiln	Use dry process kilns instead of wet process kilns.	Cement Sustainability Initiative (WBCSD, 2018)
Quantity	Cement	Slurry thinning	Use chemical thinners (water reducing ad-mixtures) to thin slurry and reduce water use.	

Quantity	Semi-conductors	Rinsing	Use filters to produce pure water – Optimize pre-treatment for RO, to minimize the amount of reject water, through the use of activated carbon filtration to produce high-quality DI water and increased water recovery.	California Department of Water Resources
Quality & Quantity	Crops	Management	• Conversion to organic practices (when water conservation issues are included in a certification counts as both Quality & Conservation best practice). • Install drip irrigation. • Use terracing and/or contour buffer triples to control overland flow. • Use grassed waterways for flow control. • Edge-of-field buffering and filtering. • Cover cropping. • Fallow high-slope lands. • Any technique that reduces runoff and increases infiltration and retention by soils and sub-surface geology (recommended techniques to achieve this vary by region).	
Quality	Crops	Management	• Conversion to IPM practices. • Use application methods to reduce runoff/infiltration (e.g., subsurface injection, plowed under, timing to avoid rainfall). • Test soil nutrients and adjust application to agronomic rates to minimize nitrogen and phosphorous loss at origin. • Use less soluble fertilizer sources (chemical, manure, pre-application treatment). • Protect wellhead to minimize direct flow to groundwater. • Install and maintain impoundments to trap sediment, nitrogen, and phosphorous.	
Quantity	Crops	Management	Manage water use by monitoring crop life cycle and when water deficit benefits formation of fruit or boll vs leaf formation.	
Quality & Quantity	Chemicals	Handling of process water and condensate	Recycle condensate, process and scrubbing waters, to enable the use of more efficient scrubbing liquids to reduce the amount of water treatment needed, the amount of chemicals released to the environment (air and water emissions), and the amount of chemicals added to process water.	Best Available Techniques Reference Documents (European Commission)
Quality & Quantity	Pulp & paper	Debarking	Transfer from water intensive water pressure debarking process to mechanical bark stripping processes.	
Quality & Quantity	Pulp & paper	Pulp washing	Switch from conventional pulp washing (which consumes huge quantity of water because it is a batch process) to continuous countercurrent processes.	

Quality	Mined & extracted materials	Tailings	Implementation of a risk-based approach, critical controls, engineer-of-record and independent review of tailings storage facilities. ICMM guidance focuses on governance to reduce risk of tailings dam failure and hence uncontrolled release.	MAC Guide to the Management of Tailings (Mining Association of Canada, 2017)
Quality	Chemicals	Solvents, plastics	Closed systems for solvent use and recovery of residual solvents. Using gas-phase polymerization processes for polyethylene and polypropylene in fluidized beds or continuous-flow stirred-bed reactors (to avoid using solvents).	
Quantity	Textiles	Dyeing	Use low impact dyes. Low impact dyes are defined as dyes that: (1) Have a high absorption rate (>70%), (2) Require less rinsing compared to conventional dyeing processes (results in at least a 20% reduction in water compared to alternatives), and (3) Do not contain toxic metal mordants, toxic metal chromophores, or other highly toxic chemicals (i.e., not x assessed as defined by the Cradle to Cradle Material Health methodology). For low impact reactive dyes, 50% less salt and soda ash are needed for fixation when compared to conventional reactive dyes. For polyester, select disperse dyes that are used in water free dyeing equipment.	Cattermole Consulting (2018)
Quantity	Several	Maintenance	Develop a schedule including timelines that regularly checks and fixes plumbing water leaks. The first round of checking and fixing must have occurred to receive credit. Scheduled checks must occur bi-annually at a minimum to receive credit.	Clean by Design (NRDC, 2015)
Quality & Quantity	Several	Process water	Full recirculation of process water, with makeup water added to account for evaporation.	
Quality & Quantity	Plastics	Process water	Use gas-phase polymerization processes for polyethylene and polypropylene in fluidized beds or continuous-flow stirred-bed reactors (to avoid using solvents, which pollute and have higher energy costs to recover solvent/dry the polymer); closed systems for solvent use and recovery of residual solvents.	
Quality	Textiles	Management	Conformance with the Zero Discharge of Hazardous Chemicals (ZDHC) wastewater guidelines (progressive or aspirational limits).	
Quality	Textiles	Management	Conformance with the Zero Discharge of Hazardous Chemicals (ZDHC) Manufacturing Restricted Substance List (MRSL) at the facility level.	

8 // Social Fairness Requirements

Category Intent

Companies are committed to upholding human rights and applying fair and equitable business practices.

Requirements Summary

To achieve a desired level within the category, the requirements at all lower levels must also be met.

Bronze	Human rights risks are assessed for the applicant company, final manufacturing stage, and direct suppliers to the final manufacturing stage (tier 1). Progress is made on assessing risks beyond tier 1 (i.e., tier 2 and beyond).
	A human rights policy based on international human rights standards and an understanding of the company's risk areas is in place.
	A strategy for implementing the human rights policy is developed. At recertification, progress toward achieving the strategy is measured.
	For the applicant company and final manufacturing stage facilities, performance against the human rights policy is measured and corrective actions for select issues (e.g., child labor, forced labor) are complete. Corrective actions are planned for any other poor performance issues and, at recertification, progress is demonstrated.
	Company executives demonstrate commitment and support for establishing, promoting, maintaining, and improving a culture of social fairness.
Silver	Social audit performance data are requested from tier 1 suppliers in high-risk locations. At recertification, progress is made on supply chain data collection and corrective actions, if needed. Corrective actions for select issues (e.g., child labor, forced labor) are complete.
	Management systems support the implementation and oversight of the human rights policy within company operations.
	A grievance mechanism permits company employees and other stakeholders to obtain redress for negative human rights impacts.
	The company has implemented a positive social impact project that measurably improves the lives of employees, the local community, or a social aspect of the value chain.
	The company uses open and transparent governance and reporting, making information on how human rights risks are managed and adverse impacts are addressed publicly available.

Gold	Human rights risks are assessed for the product's components and raw materials (regardless of tier).
	Materials associated with high risk of child or forced labor or support of conflict are certified to a C2CPII-recognized certification program or an equivalent alternative is in place. If a certification program is not available, a traceability exercise is conducted upon recertification.
	Responsible sourcing management systems support the implementation and oversight of the policy within the product's supply chain.
	A grievance mechanism permits contract manufacturer employees and other stakeholders to obtain redress for negative human rights impacts.
	An assessment has been conducted to determine the impact of the positive impact project using quantitative metric(s). Measurable progress is demonstrated at recertification.
	The company incorporates stakeholder engagement and feedback into human rights risk management. Stakeholder feedback informs strategy and operations.
Platinum	The company is collaborating to develop and scale solutions to an intractable social issue within the value chain of the product.
	The company fosters a diverse, inclusive, and engaged work environment in which social fairness operates as a core part of recruitment, training, remuneration, performance evaluation, and incentive structures.

8.1 Assessing Risks and Opportunities

Intended Outcome(s)

Opportunities for improvement are identified and understood as a result of an assessment of human rights risks.

Applicable Achievement Level(s)

Bronze and Gold

Requirement(s)

Bronze level:

- Assess human rights risks and identify opportunities for improvement for the applicant company, including all final manufacturing stage facilities, and tier 1 suppliers. (Note: Tier 1 suppliers are defined as suppliers to the final manufacturing stage, including in cases where the applicant is using contract manufacturing.)
- Demonstrate ongoing efforts to improve visibility and assess risks within the certified product's supply chain (i.e., beyond tier 1).

Gold level: Assess human rights risks and identify opportunities for improvement associated with the product's components and raw materials (regardless of supply chain tier).

For the Bronze level, the risk and opportunity assessment must include:

1. A company level risk assessment based on conducting desk research, at a minimum, to identify:

a. Known and likely human rights risks associated with the applicant company's own operations, final manufacturing stage facilities, the product's supply chain, product cycling, relevant communities, potentially affected groups, and other relevant stakeholders.
b. Well-known risks associated with the applicant's industry/sector and country(ies) of operation.

2. A tier 1 supplier risk assessment based on knowledge of supplier industry/sector and locations to identify high-risk supplier facilities including those in:
   a. Industries/sectors associated with a high risk of human rights violations or other negative human rights impacts.
   b. Locations that are reputed to have conflict, corruption, widespread human rights violations, and/or weak governance.
   c. De facto high-risk locations, defined as countries that fall below the 65% percentile when taking an average of the six World Bank Worldwide Governance Indicators.

Further Explanation

Definition of Human Rights

Human rights are rights inherent to all human beings, regardless of race, sex, nationality, ethnicity, language, religion, or any other status. Human rights include the right to life and liberty, freedom from slavery and torture, freedom of opinion and expression, the right to work and education, and many more. Everyone is entitled to these rights, without discrimination (https://www.un.org/en/global-issues/human-rights). Internationally recognized human rights are defined in the International Bill of Human Rights (which includes the Universal Declaration of Human Rights, codified through the International Covenant on Civil and Political Rights and the International Covenant on Economic, Social and Cultural Rights), as well as the eight International Labor Organization (ILO) Core Conventions set out in the Declaration on Fundamental Principles and Rights at Work.

The ILO Core Conventions are:

1. Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)
2. Right to Organise and Collective Bargaining Convention, 1949 (No. 98)
3. Forced Labour Convention, 1930 (No. 29) and its 2014 Protocol
4. Abolition of Forced Labour Convention, 1957 (No. 105)
5. Minimum Age Convention, 1973 (No. 138)
6. Worst Forms of Child Labour Convention, 1999 (No. 182)
7. Equal Remuneration Convention, 1951 (No. 100)
8. Discrimination (Employment and Occupation) Convention, 1958 (No. 111)

Additional information on human rights is included in Section 8.2 Human Rights Policy.

Identifying Human Rights Risks (Requirements #1-2)

The first step in conducting the risk assessment is to **identify (1) what human rights and (2) whose human rights** may be negatively impacted by the applicant company. The list of human rights that every company is

required to include in their human rights policy (per Section 8.2 Human Rights Policy) are human rights that the manufacturing sector commonly impacts. This means that the human rights risks identified as part of the risk assessment are likely to include some (if not all) of the issues that are also required to be included in the policy. However, **businesses can have an impact on nearly the entire spectrum of internationally recognized human rights.** Therefore, additional human rights (beyond those required for inclusion in the policy) may also be identified through the required research.

All of the following must be included in the scope of the research to identify risks: The applicant company's own (direct) operations, final manufacturing stage facilities (which may be contract manufacturing), the product's supply chain, product cycling, relevant communities, potentially affected groups, and other relevant stakeholders. Location and industry are important (and required) to consider when conducting the research. This is because certain industries and locations are associated with higher risk to human rights than others.

The risks identified are expected to **include both actual and potential impacts on human rights and focus on risk to people**. This is in alignment with the UN Guiding Principles on Business and Human Rights (UNGPs) and related –. Risk to people means a focus on the impacts a business can have on employees, workers in the value chain, local communities, and consumers, and it includes vulnerable and "hard to see" populations such as women, minorities, migrants, and others. It is important to note that risk to people is the primary focus of a human rights risk assessment, although increasingly risk to people and risk to business are aligned.

The risk assessment may be conducted based purely on desk research. It is expected that information be obtained from a variety of information sources. References may include government, private, academic, and civil society sources. Best practice includes risk inputs that include geographic, geo-political, issue-based, emerging topics, stakeholder-informed, and both quantitative and qualitative resources. Examples include the Walk Free Foundation Global Slavery Index, UN Human Development Index, ILO Fatal Injuries Index, Transparency International Corruption Perceptions Index, World Bank Rule of Law Index, among other resources. Applicants can also utilize databases and/or other information sources in combination with supplier location data, such as Maplecroft, Social Hotspots Database, ELEVATE EiQ, Intertek Inlight, or British Standards Institution SCREEN, among others.

Tier 1 (and Beyond) Supplier Risk Assessment: Tier 1 suppliers are defined as direct suppliers to the final manufacturing stage of the certified product. The tier 1 risk assessment (per requirement #2 above) is a sub-set of the company-level risk assessment discussed above. **This portion of the risk assessment requires identifying all tier 1 suppliers and at least some tier 2 (or beyond) suppliers specific to the product by industry/sector (#2a) and location (#2b), and using this information to systematically identify human rights risks (see next paragraph for more information regarding assessing risks in tier 2 and beyond)**. In addition, efforts to identify risks beyond tier 1 must also be demonstrated. Under Version 3.1 of the standard, the Social Hotspots Database (SHDB) was commonly used for a similar requirement. The SHDB may be used for Version 4.0 as well. Other references are also accepted, as long as they provide a means of identifying industries/sectors and locations associated with a high risk of human rights violations or other negative impacts, as well as locations reputed to have conflict, corruption, and weak governance. The allowance for some flexibility in how this research is conducted and references used is balanced by #2c, which is that **certain locations are always identified as high risk** (see de facto high-risk locations below). Finally, although the standard includes these specific research requirements applicable to tier 1 and beyond, note that the entire

supply chain of the applicant company must still be considered in the risk assessment. However, this may be done more generally than what is required per #2 for the supply chain of the product.

Ongoing Efforts to improve visibility and assess risks within the product's supply chain (i.e., beyond tier 1) must also be demonstrated for the Bronze level and at each recertification. For the initial certification, this means that at least some information regarding tier 2 (or beyond) and the associated risks must be obtained. The same methods as those used for tier 1 apply. This information (along with the tier 1 information) is also subject to requirements #3-6 in this section of the standard. Additional information on this topic is included in a separate 'Further Information' box below.

De Facto High-risk Locations

The following locations are de facto high risk:

Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bahrain, Bangladesh, Belarus, Belize, Benin, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Chad, China, Colombia, Comoros, Congo, Dem. Republic, Congo, Republic, Côte d'Ivoire, Cuba, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, Arab Republic, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, Gambia, The, Georgia, Ghana, Greece, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran, Islamic Republic, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Korea, Dem. Republic, Kosovo, Kuwait, Kyrgyz Republic, Lao PDR, Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mexico, Micronesia, Fed. Sts., Moldova, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, North Macedonia, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Puerto Rico, Qatar, Romania, Russian Federation, Rwanda, São Tomé and Principe, Saudi Arabia, Senegal, Serbia, Sierra Leone, Solomon Islands, Somalia, South Africa, South Sudan, Sri Lanka, Sudan, Suriname, Swaziland, Syrian Arab Republic, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Tuvalu, Uganda, Ukraine, Uzbekistan, Vanuatu, Venezuela, RB, Vietnam, West Bank and Gaza, Yemen, Republic, Zambia, Zimbabwe.*

The risk assessment must identify specific issues. If a risk assessment fails to identify any issues and is submitted for certification, it will not be accepted. If an applicant concludes that there is not a single issue of high importance to employees or to other stakeholders throughout the value chain, the applicant will be required, at a minimum, to examine more thoroughly the employment and community issues in the headquarters location.

*The approach for identifying de facto high-risk locations for Cradle to Cradle Certified is based on the Social Accountability International (SAI) method of identifying locations that require enhanced auditing procedures. The SAI approach is in turn based on the World Bank's Worldwide Governance Indicators. The list above is based on the most recent list of indicators available at the time of writing this guidance (2019).

References

Declaration on Fundamental Principles and Rights at Work (United Nations, 1998)

International Bill of Human Rights (United Nations, 1948)

The Corporate Responsibility to Respect Human Rights: An Interpretive Guide (United Nations, 2012)

Worldwide Governance Indicators (World Bank, 2019)

3. Identification of human rights due diligence best practices to address the risks.
4. Information regarding the impact and importance of identified risks as defined by affected stakeholders, including employees of the applicant company.
5. Prioritization of the risks and opportunities for improvement identified. At a minimum, the following must be prioritized:
    a. Well-known industry risks,
    b. Human rights violations, and
    c. Issues where the applicant has substantial leverage to make improvements.
6. Testing the results of the assessment with internal audience(s) to validate the outcome.

Further Explanation

Identifying Human Rights Due Diligence Best Practices (Requirement #3)

Once the full set of human rights risks have been identified as described in the box above (requirements #1-2), the next step is to identify due diligence best practices for addressing the risks. These may be practices that are already in place, planned for future implementation, or that have just been identified as part of the research conducted for Cradle to Cradle certification.

Due diligence is generally defined as **the care that a reasonable person and/or organization exercises to avoid harm to others**. Human rights due diligence aims to prevent and mitigate potential human rights impact(s) in which an enterprise might be involved. The United Nations Guiding Principles on Business and Human Rights (UNGPs) defines human rights due diligence (HRDD) as a) assessing risks, b) managing risks/impacts, c) tracking effectiveness, and d) communicating how impacts are addressed. HRDD is built into Cradle to Cradle Certified as described below. Therefore, the due diligence best practices identified may generally include actions that also allow for achieving higher levels of certification. Other more specific and targeted approaches will also be relevant, depending on the actual and potential risks identified in the assessment.

a. ***Assessing risks*** – This aspect of HRDD is addressed through the other requirements in this section of the standard (i.e., through #1-2, the requirement to demonstrate ongoing efforts to identify risks beyond tier 1, and the Gold level requirement to identify high-risk raw materials and components).

b. ***Managing risks/impacts*** – This is addressed via Section 8.3 Monitor and Verify Performance as well as Section 8.6 Management Systems for direct operations, final manufacturing, and tier 1.

c. ***Tracking effectiveness*** – This requires identifying metrics and/or milestones to track the effectiveness of actions taken as part of managing risks and impacts. Tracking effectiveness requires asking and answering the question: did the actions taken to manage risks and impacts work? This is one aspect of standard Section 8.4 Strategy for Policy Implementation. It is also tied to the Section 8.3 Monitor and Verify Performance requirements, which require measuring performance over time as well as taking corrective actions as needed.

d. ***Communicating*** how impacts are being addressed – This includes both internal and external

communication. External communication is a requirement of standard Section 8.9 Transparency and Stakeholder Engagement. Examples of how and where companies may already be communicating this information externally include Modern Slavery Act Statements and Corporate Social Responsibility Reports.

Example of due diligence practices: A human rights policy or code may be used as a tool to identify risks (i.e., the policy sets expectations and provides the list of issues that will be tracked and managed), while audit reports and corrective action plans may be employed as a means of both managing and tracking human rights policy/code violations over time if combined with method(s) of measuring effectiveness and a tracking system.

Collecting Information Regarding the Impact and Importance of Risks as defined by affected stakeholders, including employees of the applicant company (#4): This type of information is ideally gathered directly in consultation with stakeholders, including employees, but may also be gathered indirectly from publicly available information (e.g., labor organizations/trade unions, human rights watch groups and defenders, and grassroots organizations). The information obtained on the impact and importance of risks may help to refine the risk assessment (requirements #1-2) and inform prioritization (requirement #5) as described below.

Prioritizing Risks (Requirement #5)

Cradle to Cradle Certified requires that the following types of risks be prioritized for action, at a minimum: Well-known industry risks, human rights violations, and issues where the applicant has substantial leverage to make improvements. More generally, prioritization is to be done per the UNGPs, which expect an organization to review all potential impacts based primarily on severity. Severity is defined by how grave, widespread, or difficult to remedy the impact would be: "Severity of impacts will be judged by their scale, scope, and irremediable character." The UN's Corporate Responsibility to Respect Human Rights Interpretive Guide further explains: "This means that its gravity and the number of individuals that are or will be affected (for instance, from the delayed effects of environmental harm) will both be relevant considerations. 'Irremediability' is the third relevant factor, used here to mean any limits on the ability to restore those affected to a situation at least the same as, or equivalent to, their situation before the adverse impact."

Per UN Guiding Principles Reporting Framework: "An understanding of a company's salient human rights issues is built on a process by which the company:

- identifies the full range of human rights that could potentially be negatively impacted by its activities or through its business relationships:
  - involving all relevant functions and units across the business;
  - informed by the perspectives of those who may be negatively impacted;
- **prioritizes** potential negative impacts for attention:
  - primarily based on their potential severity, as defined in the UN Guiding Principles, namely:
    - **how grave** the impact would be;
    - **how widespread** the impact would be;
    - **how hard** it would be to put right the resulting harm;

    - secondarily based on their **likelihood**, retaining due attention to high-severity, low-likelihood impacts;
- engages with internal and external stakeholders to explain its conclusions and check whether any considerations have been missed."

Testing the Results of the Risk Assessment (Requirement #6)

Cradle to Cradle Certified requires the results of the risk assessment (at a minimum) to be tested with internal audiences. This may (for example) be done through an internal survey to gather input and reactions to the assessment and identify any gaps. Internal audiences must include a representative sample of company employees from various business units and functions (e.g., sustainability, marketing, legal, procurement, human resources, finance, audit, operations, etc.), including managerial and non-managerial roles. Employee representatives can also be included such as trade unions or other representatives.

While not a requirement, it is good practice to also test the results of the risk assessment with external stakeholders. The UNGPs expect that businesses engage with affected stakeholders and/or their representatives. The following definitions are provided.

- **Affected stakeholders** can include employees, contract workers, workers in the supply chain, and community members or groups located where the applicant company operates or its products are produced. Stakeholder representatives are groups that represent affected persons, which can include unions, employee or worker committees, and community groups. Affected stakeholders can be either internal or external stakeholders.
- **Internal stakeholders** are typically anyone employed directly by the company and contract employees.
- **External stakeholders** can include suppliers, communities, buyers, investors, civil society organizations, customers, and end-users of products.

Additional Guidance: Obtaining a Deeper Understanding of Human Rights Issues

Most human rights issues are complex and require deeper understanding, as outlined in the ILO Core Conventions or other explanatory resources provided in this User Guidance. Companies looking to deepen their knowledge and management approach are encouraged to conduct further research and/or engage with peer companies, respected industry initiatives, and other stakeholders. Some examples include:

- Further research into understanding ***drivers of forced labor*** – for example, the ILO has defined 11 indicators of forced labor, which include abuse of vulnerability, deception, restriction of movement, isolation, physical and sexual violence, intimidation and threats, retention of identity documents, withholding of wages, debt bondage, abusive working and living conditions, and excessive overtime. See ILO Indicators of Forced Labour.
- Calculating and implementing a ***living wage*** – A living wage goes beyond the legal minimum wage. The Global Living Wage Coalition (GLWC) defines a living wage as "remuneration received for a standard workweek by a worker in a particular place sufficient to afford a decent standard of living for the worker and her or his family. Elements of a decent standard of living include food, water, housing, education,

health care, transportation, clothing, and other essential needs including provision for unexpected events." At the time of writing this User Guidance, there was no single agreed upon method of defining living wage, and therefore its implementation varies. The GLWC has a series of case studies on its website of how to calculate and implement a living wage. Note that it is a requirement for all companies with Cradle to Cradle Certified product(s) to commit to providing a living wage in the human rights policy (see Section 8.2). Implementing a living wage is a requirement for Platinum level certification (see Section 8.11).

- Considering the nuances of ***freedom of association and collective bargaining*** in locations where the relevant ILO Core Conventions C087 and C098 (respectively) have not been ratified – this applies to countries such as Bahrain, Oman, Qatar, Saudi Arabia, United Arab Emirates – where trade unions are banned completely; and in China and Vietnam, where unions are government controlled and not independent. If ILO member states have not ratified either of these Core Conventions, they are still bound to uphold freedom of association and the right to collective bargaining through the 1998 ILO Declaration on Fundamental Principles and Rights at Work. The Sedex Supplier Workbook provides practical guidance on situations where country law prohibits or limits workers' rights to freedom of association and to bargain collectively; in these scenarios, "companies must make sure that their practices do not prevent workers from forming or joining legally acceptable worker organisations. For example, companies must not pressure workers to join a company-controlled organisation in place of an organisation created by and controlled by workers." See also the ILO list of ratifying countries by Convention.
- Understanding ***excessive overtime*** – Working hours are a fundamental component of safe and humane working conditions. Weekly rest and paid annual leave are expected as a normal part of working agreements, typically required by national and local law, and must be provided to employees as part of their benefits. The first ever ILO Convention (CO1) in 1919 focused on working hours, stipulating a maximum of 48 hours per working week (typically 8 hours per day, for 6 days). While this convention was initially written for industry, ILO Convention 30 makes it clear the expectation applies to Commerce and Office environments as well. ILO Convention 14 stipulates workers are entitled to at least one rest day – which is defined as a continuous period of at least 24 hours each week. Overtime is the number of hours worked beyond the maximum allowed by week (8 hours per day), or 48 hours per week. National laws can vary from international standards. Peak production periods also show that many suppliers do not adhere to these expectations on a continuous basis.

References

The Corporate Responsibility to Respect Human Rights - An Interpretive Guide (United Nations, 2012)

Guiding Principles on Business and Human Rights (United Nations, 2011)

Human Rights Due Diligence in High Risk Circumstances: Practical Strategies for Businesses (Shift, March 2015)

OECD Due Diligence Guidance for Responsible Business Conduct (OECD, 2018)

UN Guiding Principles Assurance Guidance (Shift and Mazars, 2017)

UN Guiding Principles Reporting Framework with Implementation Guidance (Shift and Mazars, 2015)

Ongoing efforts to improve visibility and assess risks within the product's supply chain based on increasing knowledge of tier 2 (and eventually beyond tier 2) supplier industry/sector(s) and location(s) as described in #2 above for tier 1 must be demonstrated. If new risks are identified, #3-6 above also apply. For supplier locations that have not yet been identified, if there is a chance that the location is high risk, then it must be considered de facto high risk until shown otherwise. Identification of the locations of these potentially high-risk suppliers must be prioritized.

Further Explanation

Ongoing Efforts to Improve Visibility and Assess Risks

As noted previously, ongoing efforts to improve visibility and assess risks within the product's supply chain (i.e., beyond tier 1) must also be demonstrated for the Bronze level and at each recertification. For the initial certification, this means that at least some information regarding tier 2 (or beyond) and the associated risks must be obtained. The same methods as those used for tier 1 apply. This information (along with the tier 1 information) is also subject to requirements #3-6 in this section of the standard. Ongoing efforts are required until the entire supply chain has been mapped, to the degree possible.

An applicant company's risk assessment must be updated at each recertification (i.e., every two years), and the results must be used to determine if any changes to the policy, policy implementation, or risk assessment are needed. This might be the result of emerging issues that have arisen since the policy was created or last risk assessment was conducted. For supply chain risks, the applicant must review at a minimum if its supplier locations have changed, and if so then risk assessment for those suppliers must be updated. In addition, if updates have been made to the data sources used, then it will also be necessary to update the results (e.g., the US Department of Labor reference required for identifying materials associated with a high risk of child labor or forced labor at the Gold level as described below is updated every year).

Gold level: Assess human rights risks and identify opportunities for improvement associated with the product's components and raw materials (regardless of supply chain tier).

For the Gold level, high-risk components and raw materials must be identified, including the following de facto high-risk items:

1. Materials and components from source countries where there is reason to believe that child labor or forced labor is involved, and
2. Tin, tantalum, tungsten, and gold from conflict-affected and high-risk areas.
3. If new risks are identified, #3-6 above also apply.

Further Explanation

The information that must be obtained for Gold level is considered a more detailed subset of the overall risk assessment described above for the Bronze level. Once this information is obtained, it must also be incorporated into the process of identifying due diligence best practices though testing of results (i.e., requirements #3-6 described for the Bronze level in the section above).

Identifying Materials and Components that are De Facto High-risk for Child and/or Forced Labor

For determination of *Materials and Components from source countries where there is reason to believe that child labor or forced labor is involved,* the most recent version of the US Department of Labor's List of Goods Produced with Child Labor or Forced Labor must be used. This resource is updated annually in the spring and available on the US Department of Labor's website.

Identifying Tin, Tantalum, Tungsten, and Gold from Conflict-affected and High-risk Areas

Determination of *Tin, tantalum, tungsten, and gold from conflict-affected and high-risk areas* must be based on the most recent version of the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (Note: The OECD does not provide a country-specific list, but it does require particular due diligence processes).

The OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas has a specific *Supplement on Tin, Tantalum and Tungsten* which is the appropriate reference material. It states that companies are recommended to "establish a system of internal control over the minerals in their possession (chain of custody or traceability) and establish on-the-ground assessment teams, which may be set up jointly through cooperation among upstream companies while retaining individual responsibility, for generating and sharing verifiable, reliable, up-to-date information on the qualitative circumstances of mineral extraction, trade, handling and export from conflict-affected and high-risk areas". The Supplement is meant to apply to actors operating in a conflict-affected and high-risk area, or potentially supplying or using tin, tantalum, or tungsten from a conflict-affected or high-risk area. It defines the following red flags to trigger use of the OECD due diligence standards and processes:

"Red flag locations of mineral origin and transit:

- The minerals originate from or have been transported via a conflict-affected or high-risk area.
- The minerals are claimed to originate from a country that has limited known reserves, likely resources or expected production levels of the mineral in question (i.e., the declared volumes of mineral from that country are out of keeping with its known reserves or expected production levels).
- The minerals are claimed to originate from a country in which minerals from conflict-affected or high-risk areas are known to transit.

Supplier red flags:

- The company's suppliers or other known upstream companies have shareholder or other interests in companies that supply minerals from or operate in one of the above-mentioned red flag locations of mineral origin and transit.
- The company's suppliers' or other known upstream companies are known to have sourced minerals from a red flag location of mineral origin and transit in the last 12 months."

The OECD defines upstream companies as inclusive of artisanal or small-scale producing enterprises, and not individuals or informal working groups of artisanal miners.

Identifying Other High-risk Components and Raw Materials

In addition to the de facto high-risk components and materials as identified per the guidance above, the standard requires that *high-risk components and raw materials must be identified* more generally. This aspect of

the risk assessment may be conducted based purely on desk research. References may include government, private, academic, and civil society sources. Best practice includes risk inputs that include geographic, geo-political, issue-based, emerging topics, stakeholder-informed, and both quantitative and qualitative resources.

References

List of Goods Produced with Child Labor or Forced Labor (US Department of Labor, 2020)

OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (OECD, 2016)

Supplement on Tin, Tantalum and Tungsten, OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas. (OECD, 2016)

Required Documentation

Bronze Level

- Description of the applicant's company-level risk assessment methods and results that demonstrates the risk assessment was conducted using the required scope (per requirement #1a-b) and lists any well-known risks associated with the applicant's industry/sector and countries of operation.
- A list of tier 1 suppliers by location and industry/sector and indication of the high-risk issues for each. (Note: Tier 1 refers to direct suppliers to the final manufacturing stage of the product only.)
- List of de facto high-risk locations for applicant company headquarters, final manufacturing stage facilities, and tier 1). Note: This information for tier 1 may be included with the information required in the bullet above. In addition, there is a column that automatically looks up this information in the Bill of Materials form.
- Evidence of efforts to map risks beyond tier 1.
- References used, including any information obtained (either directly or indirectly) from stakeholders.
- List of due diligence best practices that are or could/will be used to address the identified risks.
- Evidence of prioritization and description of methods used; indication that the issues listed in #5a-c have been prioritized, at a minimum. Note that prioritized issues must be included in the strategy required in Section 8.4.
- Evidence that the results of the assessment have been tested, at a minimum, with internal audiences (e.g., internal survey results).

Gold Level

- List of de facto high-risk components and raw materials and source location(s). If source is unknown, this must be specified.
- List of any additional high-risk components and raw materials and source location(s). If source is unknown, this must be specified. List of references used.

- Evidence that any additional risks identified for the Gold level have also achieved the Bronze level requirements #3-6 (i.e., the last four bullets in the Requirement Documentation section above for the Bronze level).

8.2 Human Rights Policy

Intended Outcome(s)

The applicant is formally committed to respecting and upholding human rights as defined by international standards.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Commit to respect human rights, as enshrined in municipal law and internationally recognized human rights standards, through company policy.

The policy must:

1. Establish human rights expectations for the applicant company, the supply chain, communities, potentially affected groups, and other relevant stakeholders.
2. Include the company's commitment to support the following (Note: These are the expectations that must be established and are referred to as "required policy elements" in other sections of the standard):
    a. Elimination of discrimination with respect to employment and occupation including, but not limited to, ethnicity-, race- and gender-based discrimination,
    b. Elimination of harassment and abuse,
    c. Elimination of all forms of forced or compulsory labor, or activities that are known to lead to forced labor (e.g., human trafficking),
    d. The abolition of child labor and adequate protections for workers above the legal working age and below age 18,
    e. Prevention of excessive working hours,
    f. Freedom of association and collective bargaining,
    g. Safe and healthy work, including:
        i. Access to water, sanitation, and hygiene (WASH),
        ii. Emergency preparation and response,
        iii. Hazardous materials handling procedures,
        iv. Management systems that address health and safety risks, and
        v. Appropriate building construction, electrical, and fire safety,
    h. Provision of the legal minimum wage and all legally mandated benefits including employer contributions for social security benefits and services,
    i. Aspirations for the provision of a living wage that covers the necessities for life as defined in its

local context (e.g., food, water, housing, health care, education, clothing, transportation, child care, discretionary income),

j. Fair and ethical business practices, including anti-corruption/bribery. (Note: In practice, this may be part of a human rights policy or, more commonly, a separate company policy or code.),

k. Additional priority issues identified in the risk assessment (per Section 8.1), if any.

3. Be formally approved and signed by a duly empowered officer of the applicant company or by the board of directors.

The policy must be guided by the eight Fundamental Conventions of the International Labor Organization and the United Nations Guiding Principles on Business and Human Rights, as well as the International Bill of Human Rights. Where national law and these international human rights standards differ, the applicant must follow the higher standard; where they are in conflict, the applicant must seek to respect internationally recognized human rights to the greatest extent possible.

Further Explanation

Committing to Respect Human Rights

The Foundational Principles of UN Guiding Principles on Business and Human Rights (UNGPs) stipulate that **businesses are expected to respect human rights**, meaning that they should avoid infringing on the human rights of others and should address adverse human rights impacts in which they are involved. The *Corporate Responsibility to Respect* human rights, according to the UNGPs, sets expectations with staff and business partners for the business to have responsibility for human rights in its own operations and throughout the value chain. This applies to all locations where the business has operations or business relationships, including relationships throughout the supply chain and includes actual and potential negative human rights impacts on communities, potentially affected groups, and other relevant stakeholders. While suppliers and other entities are also responsible for respecting human rights, a business must set expectations for all actors connected to its business operations, products and services.

The *Responsibility to Respect* human rights applies to all businesses, regardless of their size, sector, operational context, ownership and structure.

It is common for corporations to create a human rights policy, human rights statement, and/or responsible sourcing policy for their entire entity, and then cascade those expectations through business relationships. Human rights policies and/or codes of conduct typically stipulate an entity's commitment to respect particular human rights, and stipulate the prohibition of certain human rights infringements. Setting expectations with suppliers typically takes the form of a code of conduct, which suppliers are required to comply with as part of business terms. Often, suppliers may not have their own human rights policies – but their commitments are manifested in their agreement to comply with buyers' codes of conduct.

Cradle to Cradle Certified requires that all of the 'required policy elements' be explicitly included in company policy. It must be clear in the policy that these expectations apply not only to the supply chain but to the company as a whole, communities, potentially affected groups, and other relevant stakeholders. One common pitfall is for companies to comprehensively require commitment to respect human rights in a supplier code while failing to commit to the same set of issues at the corporate level. The purpose of requiring explicit and direct commitment to all points in the human rights policy section at the company level is to ensure that it is clear to all stakeholders, including suppliers and employees, what the company is committed

to and how human rights are defined. Finally, note that companies that have signed the UN Global Compact (UNGC) will still be required to meet the Section 8.2 Human Rights Policy requirements. The UNGC requires signatories to commit to 10 Principles. The content of these principles is aligned with the international expectations defined in the ILO Fundamental Conventions and UNGPs; however, they are a high-level commitment and not entirely the same.

References

United Nations Guiding Principles on Business and Human Rights (United Nations, 2011)

International Bill of Human Rights (United Nations, 1996)

Fundamental Conventions of the International Labor Organization

ILO Conventions (Full List)

How Businesses Impact Human Rights (UNGP Reporting Framework, 2015)

Sedex Supplier Workbook: Chapter 1.3: Freedom of Association and Collective Bargaining (Sedex and Verite, 2014)

Required Documentation

Bronze Level

The applicant company's policy document(s) that:

- Set expectations for the company and value chain (i.e., supply chain, communities, potentially affected groups, and other relevant stakeholders).
- Explicitly include the company's commitments to all of the required policy elements.
- Include a commitment to adhering to all local and state laws covering human rights.
- Define human rights per, and explicitly reference, the eight Fundamental Conventions of the International Labor Organization, the United Nations Guiding Principles on Business and Human Rights, and the International Bill of Human Rights.
- Explicitly specify that where national law and these international human rights standards differ, the higher standard will/must be followed; and where they are in conflict, the applicant (or supplier or business partner) will seek to respect internationally recognized human rights to the greatest extent possible.
- Are signed by a duly empowered officer of the applicant company or by the board of directors.

8.3 Monitor and Verify Performance

Intended Outcome(s)

Performance on upholding human rights is monitored and verified, ensuring that corrective actions are taken when poor performance is identified and increasing the level of assurance that risks to human rights are addressed.

Applicable Achievement Level(s)

Bronze, Silver, and Gold

Requirement(s)

Bronze level: For the applicant company and final manufacturing stage facilities, measure performance against the human rights policy and confirm the completion of corrective actions associated with issues of high concern including child labor, forced labor, corruption/bribery, and immediate threats to life and safety. For any other poor performance issues, plan corrective actions and, at recertification, demonstrate progress on addressing the issues.

Silver level: Request data measuring performance against the human rights policy from all high-risk tier 1 suppliers. At recertification, demonstrate continued efforts to obtain performance data and evidence of tracking corrective actions that may be necessary at tier 1 supplier locations.

Gold level: For components and raw materials associated with high risk of child labor, forced labor, or support of conflict, specify or certify to a C2CPII-recognized certification (if available) or equivalent that includes performance requirements aligned with the human rights policy.

For the Bronze level:

1. Performance data must be generated and verified by a qualified party.
2. If identified, the following issues of high concern must be resolved prior to certification or recertification
    a. Child labor,
    b. Forced labor,
    c. Corruption/bribery,
    d. Unauthorized subcontracting,
    e. Missing or deficient permits (i.e., business license, building permit, and environmental permit(s) if required by local regulations),
    f. Any immediate threat to life or safety (e.g., poor fire safety, structural safety hazard), and
    g. Denial of access to the facility, workers, or files.

Further Explanation

Measuring Performance

The Bronze level requirement to measure performance **applies to the applicant company and to all final manufacturing stage facilities.**

Applicant companies are expected to identify and track quantitative metrics to measure performance on the required policy elements listed in Section 8.2, including high-risk issues identified per the risk assessment in Section 8.1 and thereby also included in the policy. In addition, performance must be measured on points #2a-g, defined in this section (Section 8.3). **The specific metrics and indicators used to monitor and measure performance are determined by the applicant company.**

When selecting indicators, consider the UN Guiding Principles Assurance Guidance, which outlines

expectations that: "The company has relevant qualitative and/or quantitative indicators that it uses to assess how effectively it is addressing actual and potential human rights impacts, and which:

- Are capable of providing valid insights into how effectively the company is addressing human rights impacts.
- Are capable of being reliably measured or assessed.
- Are placed in context* where this is necessary to interpret how effectively the company is addressing its human rights impacts.
- Include indicators that reflect stakeholder perceptions."

*Regarding context: this means that the performance indicators selected must be appropriate to the local and national context for racial, ethnic, religious, and economically disadvantaged minorities (i.e., the specific categories of minority or vulnerable groups being tracked will vary according to locality).

For verification purposes, evidence must be presented to demonstrate that the company's and final manufacturing facility(ies)' performance data is capable of satisfying individual performance measurement requirements (i.e., for each required policy element). This is described in the Required Documentation section and detailed in the Assessment Summary Form. Information on utilizing other third-party standards to measure and verify performance is provided at the end of this 'Further Information' box. For final manufacturing facilities in high-risk locations in particular, the use of other standards is a recommended approach for achieving the requirements in this section.

Who may Generate Performance Data

As noted above, performance data must be generated for both the applicant company and, more specifically, for all final manufacturing facility locations. The standard indicates that *performance data must be generated and verified by a qualified party*. Who is considered qualified depends on the risk level of the applicant's headquarters and final manufacturing facility(ies) locations per the table below. For applicant headquarters and final manufacturing facilities located in de facto low-risk locations, the applicant may generate their own performance data without specific qualifications required, although use of a qualified auditor is encouraged. **For de facto high-risk locations, a qualified third-party auditor or qualified internal auditor is required.**

Table – Who is permitted to generate performance data for the company and for final manufacturing facilities (including contract manufacturing) depends on location risk level as noted. The same approach applies for data collection from tier 1 suppliers to the final manufacturing stage of the certified products (as required for Silver level).		**Who is permitted to generate data**			
Applicant location type	**Final manufacturing facility (including contract manufacturing/supplier) location type**	**Applicant**	**Contract manufacturer/ Supplier**	**Qualified internal auditor**	**Qualified third-party auditor**
Applicant headquarters, low risk*	n/a (i.e., for company level data generation)	x	n/a	x	x
	Applicant owned, low risk	x		x	x
	Applicant owned, high risk			x	x
	Contract manufacturing/supplier, low risk	x	x	x	x
	Contract manufacturing/supplier, high risk			x	x
Applicant headquarters, high risk*	n/a (i.e., for company level data generation)		n/a		x
	Applicant owned, low risk				x
	Applicant owned, high risk				x
	Contract manufacturing/supplier, low risk		x	x	x
	Contract manufacturing/supplier, high risk			x	x

**Location risk level is defined per Section 8.1 #2c, (i.e., de facto high-risk locations are countries that fall below the 65th percentile when taking an average of the six World Bank Worldwide Governance Indicators). A list of de facto high-risk locations is provided in this User Guidance under Section 8.1 Assessing Risks and Opportunities.*

Qualified third party and qualified internal auditors are defined as follows:

- ***Qualified third-party auditor:*** An individual employed by a third-party social audit or social compliance firm possessing valid social audit credentials such as certification from the Association of Professional Social Compliance Auditors (APSCA). Qualified third-party auditors are not permitted to provide other services to the applicant company, as this constitutes a conflict of interest. Note: See section on using third-party standards below. The auditors for currently recognized third-party standards meet this requirement.
- ***Qualified internal auditor:*** An individual employed directly by the applicant company, who meets all of the following criteria:
  - Employed in a dedicated social compliance auditor role.
  - Possesses an accepted social audit credential (e.g., APSCA).
  - At least three years of social auditing experience.

Confirming that Corrective Actions have been Completed for Issues of High Concern

Once performance has been measured as required for Bronze level, corrective actions are required as follows:

confirm the completion of corrective actions associated with issues of high concern including child labor, forced labor, corruption/bribery, and immediate threats to life and safety. This means that if child labor, forced labor, corruption/bribery, immediate threats to life and safety, or any of the other issues listed in #2a-g in this section are identified when measuring performance, the company must demonstrate that corrective actions have been taken and the issue has been resolved prior to certification.

Note that corrective actions are commonly tracked in a Corrective Action Plan (CAP). CAPs are developed to document necessary improvement and track actions taken. CAPs are commonly developed as a required summary of non-compliances in factory audit reports. They are often documented in a spreadsheet to outline specific issues identified and track relevant progress thereafter. For applicants utilizing third-party auditors to measure performance, this is where to look to confirm that corrective actions have been taken on the issues noted above and the applicable corrective action plan closed (see below for additional information).

Developing Corrective Action Plans (CAPs) and Demonstrating Progress (for Other Issues)

Once performance has been measured, corrective action plans must be developed per the following requirement: *For any other poor performance issues, plan corrective actions and, at recertification, demonstrate progress on addressing the issues.* 'Other poor performance issues' refers to performance on the required policy elements, other than those identified as 'issues of high concern'. For example, this includes poor performance on discrimination, working hours, freedom of association, wages, and health and safety concerns that do not constitute immediate threats.

Criteria for a Credible Corrective Action Plan (CAP)

All CAPs are required to include the following elements:

- Reference to requirement
- Reference to local or national law violated (if relevant)
- Description of the issue/violation/non-compliance
- Supporting evidence
- Perceived root cause (this could be based on cost, lack of awareness, management system failure, industry norm, physical site limitation, training deficit, government limitation, customer requirement or lack of oversight, etc.)
- Recommendation for improvement OR Agreed upon corrective action to take
- Management comments
- Person responsible (assigned and identified in the document)
- Specific action/improvement plan
- Timeline for completion
- Management sign-off

Demonstrating Progress: Completion/Closure of CAPs

The expectation is for CAPs to be closed within the time allotted for completion (e.g., 30-90 days is common).

However, evidence of closure may be provided upon recertification, in particular if an audit was conducted just prior to certification and the time for completion has not yet occurred. If an issue is not resolved at recertification, the reason provided must be adequate – e.g., root cause of discrimination may be based on decades-long practices embedded in country cultural practices, etc. In these scenarios, while remediation is not required for the first round of recertification, progress towards remediation is required.

Utilizing Third-party Standards to Measure Performance

Companies may utilize a variety of other tools and standards to define metrics and/or measure performance at the corporate and facility level. However, be aware that not all standards have the same focus and/or level of detail – including details related to the issues contained in requirements for the human rights policy (Section 8.2) and issues of high concern listed in requirements #2 a-g of this section.

For the Applicant Company: Currently there are no third-party standards recognized as equivalent to Cradle to Cradle Certified for the purposes of achieving the Section 8.3 Monitoring and Verification requirements. Information regarding the similarities and differences between Cradle to Cradle Certified and some other similar corporate-level standards (e.g., SAC Higg BRM, the Global Reporting Initiative, and B Corp), is available from C2CPII. Companies using these systems must still provide all of the required evidence for achieving the Monitoring and Verification requirements as described in the Required Documentation box below and the Assessment Summary Form.

For Final Manufacturing Facilities: Cradle to Cradle Certified has been compared to the following facility level standards: the Social and Labor Convergence Project (SLCP), Social Accountability International SA8000, and Sedex Members Ethical Trade Audit (SMETA). A full comparison summary of these standards to the Cradle to Cradle Certified Social Farness requirements is available from C2CPII. For facilities certified to one of these standards, many of the Section 8.3 Monitor and Verify Performance requirements for the Bronze level (including use of a qualified auditor as required for de facto high-risk locations) will have been met (see list of gaps below). For manufacturing facilities holding one of the certifications listed above that also fully constitute the applicant company (e.g., if there is one final manufacturing facility that is SA8000 certified and no external offices or headquarters that were excluded from the SA8000 audit), then additional Cradle to Cradle Certified Social Fairness requirements will have also been met. See the *Certification Preparation Tool for facility-level standards* for additional information in this case.

The following gaps exist (i.e., the following Cradle to Cradle Certified requirements are not covered by the third-party standard):

- SLCP (1.3): Denial of access to the facility, workers, or files. (Note: If identified, this issue of high concern must be resolved prior to Cradle to Cradle certification).
- SA8000 (2014): Corruption/bribery (Note: If identified, this issue of high concern must be resolved prior to Cradle to Cradle certification).
- SMETA (v6.1, May 2019): Health and safety including: (i) Access to water, sanitation, and hygiene (WASH), (ii) Emergency preparation and response, (iii) hazardous materials handling procedures, (iv) management systems that address health and safety risks, (v) appropriate building construction, electrical, and fire safety.

When employing one of the standards listed above to measure performance at a facility, the following are required:

1. For Cradle to Cradle requirements that are not covered within the standard used (as noted above), individual answers/responses and comments must be provided in the Assessment Summary Form where applicable.
2. The certificate and report that resulted from use of the other standard must be submitted.
3. All violations and/or "non-compliances" identified in the reports and the associated corrective action plans (CAPs) must be reviewed to ensure that issues of high concern as defined per Cradle to Cradle Certified have been resolved, and that credible CAPs (as defined in guidance above) have been created for other issues. Note that non-compliances with a third-party standard is not necessarily the same as non-compliance with the Cradle to Cradle Certified requirements.

For example, if an SA8000 report is available for a final manufacturing facility, it must be verified that the report is valid within the certification period and that CAPs have been established for any non-compliance violations cited in the SA8000 audit report. In addition, the applicant company and/or applicable supplier must separately respond to how the requirements to (1) measure performance on implementing fair and ethical business practices, including anti-corruption/bribery and to (2) resolve any issues with corruption/bribery (if identified), have been achieved.

Required Documentation

Bronze Level

- Evidence that performance has been measured for the applicant company and all final manufacturing stage facilities on the required policy elements (Section 8.2 Human Rights Policy, #2a-j) and issues of high concern (Section 8.3 #2a-g). See **detailed evidence/documentation requirements*** following this bulleted list appliable to these points.
- For final manufacturing stage facilities, if employing third-party standard(s) for achieving this requirement: Certificate(s), audit report(s), corrective action plan(s) and evidence of gap closure (see guidance above). In this case the detailed evidence/documentation requirements noted in the bullet above is not directly required because this will have been covered/examined as part of the third-party audit.
- For the applicant company and all final manufacturing stage facilities in de facto high-risk locations, evidence of qualifications of the third party of internal auditor generating the performance data (i.e., name and credentials).
- For the applicant company and all final manufacturing stage facilities, evidence of corrective actions taken (for issues of high concern) or corrective action plans (for other issues).
- Recertification: Evidence of corrective action plan closure and/or progress.

***The following evidence is required** for each policy element (Section 8.2 Human Rights Policy #2a-j) to demonstrate that performance has been measured for the applicant company and all final manufacturing stage facilities:

a) Discrimination:

- Written policies and procedures that document anti-discrimination commitment, regardless of gender, race, religion, age, disability, sexual orientation, nationality, marital status, political opinion, social group, ethnic origin or medical status. This should include statements that characteristics of an individual shall not be the basis of decisions regarding any employment decision for hiring, job assignment, bonus, allowance, compensation, and discipline, and that these decisions shall be based solely on and discipline shall be made solely based on education, training, and demonstrated skills or abilities.

b) Harassment and abuse:

- Written policies and procedures that document the applicant has committed to ensuring its workplace or any workplaces associated with the product cycle is free of sexual harassment, and that sexual harassment is not tolerated.

  Definitions of harassment and abuse include: (1) Any form of – or threat of – physical violence, including slaps, pushes or other forms of physical contact as a means to maintain labor discipline is not utilized. (2) Any form of verbal violence, including screaming, yelling, or the use of threatening, demeaning, or insulting language, as a means to maintain labor discipline is not utilized.

c) Forced or compulsory labor: See section below relevant to issues of high concern.

d) Child labor: See section below relevant to issues of high concern.

e) Excessive working hours:

- Written policies and procedures regarding hours of work and requirements for overtime, including policy and documentation for overtime hours within allowable limits under applicable laws or agreements, whichever is stricter. Documentation of an established mechanism to determine, monitor and control the overtime hours of employees. For example, time and attendance records.
- Documentation of all legally required time and attendance records are complete, accurate and up to date. These records should be maintained by employer for at least 12 months, or longer if required by law. Data shows that regular working hours for all employees are within allowable limits under applicable laws or agreements, whichever is stricter and that all employees are provided with at least one day off (24 hours) in every 7-day period.

f) Freedom of association and collective bargaining:

- Written policies and procedures that the applicant respects freedom of association and collective bargaining, and that discrimination, harassment, intimidation, interference, or retaliation for efforts to freely associate or bargain collectively is not tolerated.
- Where a collective bargaining agreement (CBA) is in place, documentation for existing or past CBAs are provided as evidence that these records are kept on file.
- Where freedom of association and the right to collective bargaining are restricted by law, evidence that employees are free to join (or not join) legal employee organizations without interference and there is not refusal to recognize such organizations. This could be documented in a policy statement and records of existing employee organizations in existence.

g) **Safe and healthy work:** Documentation of compliance with applicable laws and regulations governing the work environment, including the following:

i. **Access to water, sanitation and hygiene (WASH):** Copies of past health and safety reports, preferably conducted by an internal audit or third-party audit firm, to identify any type of health and safety violations. This must include evidence that:

- There are sufficient number of toilets consistent with local law per floor and gender; when local law requirement does not exist, the employer should have at least one toilet for every 25 for both male and female employees respectively (recommendation of World Health Organization [WHO]).
- Toilets are maintained clean and provide appropriate privacy (stalls with doors).
- Employees have access to clean water for washing within nearby proximity to toilets.

ii. **Emergency preparedness and response:** Copies of past health and safety reports, preferably conducted by an internal audit or third-party audit firm, to identify any type of health and safety violations. This must include evidence of/that:

- Compliance with all applicable laws and regulations governing 'Emergency Preparedness'.
- There are sufficient numbers of emergency exits at the workplace (production floors, office areas, warehouse, etc.).
- Emergency exits are clearly marked with illuminated exit signs.
- Emergency exits are accessible and free from obstruction during working hours (including overtime).
- Emergency exits are unlocked during working hours (including overtime).
- Fire escape and main exits are discharged directly to the exterior of building.
- Fire and emergency evacuation plans are prominently posted on every floor and work area as well as near exits and stairways.
- Aisles, stairs and passageways are kept clear at all times.
- Evacuation drills are conducted regularly, at least once per year or more often where required by law.

iii. **Hazardous materials handling procedures:** Copies of past health and safety reports, preferably conducted by an internal audit or third-party audit firm, to identify any type of health and safety violations. This must include evidence of/that:

- Compliance with all applicable laws and regulations governing 'Chemical and Hazardous Substances'.
- An inventory of chemical and hazardous substances used in the workplace is maintained.
- Chemicals used at the workplace are registered for the intended used when applicable. All local safety standards and applicable laws are adhered to.
- Material safety data sheets (MSDSs) are prominently posted in both storage and use zones, and maintained in languages understood by workers.

- Chemicals and hazardous substances are properly labelled as per label instructions of local safety standard and MSDSs are maintained.
- There are functioning emergency eyewash station and/or showers provided where corrosive chemicals or high volumes of solvents are handled and used.
- Employees who are involved in handling, clean-up and disposal of chemicals and hazardous substances received regular training on emergency response plans and actions (with training records maintained).

iv. **Management systems that address health and safety risks:** Copies of past health and safety reports, preferably conducted by an internal audit or third-party audit firm, to identify any type of health and safety violations. This must include evidence of/that:

- There is a designated management representative responsible for health and safety as per legal requirements.
- Appropriate training is provided for managers on how to implement the health and safety management system.
- There is a system to identify and monitor laws, regulations and customer requirements that apply to the workplace. The most current version(s) of applicable laws, regulations, and customer requirements for health and safety management systems (if any) must be provided.

v. **Appropriate building construction, electrical, and fire safety:** Copies of past health and safety reports, preferably conducted by an internal audit or third-party audit firm, to identify any type of health and safety violations. This must include evidence of/that:

- Compliance with all applicable laws and regulations governing 'Building Safety', 'Electrical Safety', and 'Fire Safety'.
- There are no indications of possible structural collapse on the interior or exterior of buildings, such as large visible cracks or sagging in walls and floors.
- All legally required building or construction certificates/reports/permits are current and available for review.
- Building inspections are conducted on a regular basis as per standard of practice or country law.
- Where required by law, maximum occupancy signage is clearly posted within each room, near each entrance. Maximum occupancy is within building permit requirements.
- There are sufficient protections for building roof and floor opening preventing falls and accidents.
- Electrical equipment has appropriate safety warning labels.
- Electrical panels/control panels/distribution boards are easily accessible/unblocked.
- Electrical wires and outlets are in safe conditions (e.g., no unprotected wires, etc.).
- High voltage areas and generator areas are restricted to authorized personnel only.
- The workplace has a qualified professional (electrician, hired or outsourced) to maintain electrical system on regular basis.
- The employer follows local law and fire safety standards to have a suitable fire detection and emergency alarm system covering the facility.

- If applicable, emergency alarm system is clearly designated (visible signs), unobstructed, and audible throughout the entire workplace. The system is inspected regularly and tested in coordination with fire drills.
- The facility maintains all fire safety certificates, licenses and inspection records as legally required.
- Fire extinguishers shall be sufficient in numbers as legally required and maintained in good condition.

h) Legal minimum wage and all legally mandated benefits including employer contributions for social security benefits and services:

- Written policies and procedures regarding wages are to be paid at least at minimum wage or industry wage as agreed with a collective bargaining agreement, whichever is higher. Policies and procedures regarding that overtime hours are paid at a premium as legally required or by contractual agreement, whichever is higher. Policies and procedures that commit the applicant to provide all legally mandated benefits to eligible workers, and that employees are paid correctly for all legally paid time off.
- Documentation of all legally required payroll documents, journals and reports are provided, complete, accurate and up to date. These records should be maintained by employer for at least 12 months, or longer if required by law. They should include correct and accurately calculated legal withholds in employee pay records, such as taxes, social security, pension, or healthcare from employee wages as required by law.

i) Living wage: This is aspirational at Bronze level and is therefore recommended for inclusion in performance measurement, but not required. See Section 8.11 for additional information.

j) Fair and ethical business practices, including anti-corruption/bribery: See section below relevant to issues of high concern.

k) Additional priority issues identified in the risk assessment (if any): Documentation will vary by issue.

***The following evidence is required** per issue of high concern (Section 8.3 Monitoring & Verification #2a-g):

a) Child labor: Written copy of its age verification procedures; a description of training procedures for staff responsible for hiring; a review of randomly selected employee files to verify age was appropriately verified with a government issued ID.

b) Forced or compulsory labor: Sample of employee contracts to show they include all legally required employment terms. Assessors will request at least 20% of contracts to be checked for facilities with under 100 workers; for facilities with more than 100 workers, at least 20 files must be checked. Note: If recruitment fees are identified or have been in the past, third-party documentation indicating fees were fully repaid to workers must be provided.

c) Corruption/bribery: Written policies and procedures that document its commitment to the anti-corruption and bribery process, including documented consequences for violating the policy. Copies of training content and training schedules to ensure all employees understand the policies and procedures. Existence of whistleblowing channels to support reporting issues.

d) Unauthorized subcontracting: Written policies, procedures, and records that require disclosure and

tracking of subcontractors to customers as part of the customer's approval process. Examples include emails to customers requesting permission to subcontract.

e) **Missing or deficient permits** (i.e., business license, building permit, and environmental permit(s) if required by local regulations): All valid permits required by local regulations. If there is a delayed permit due to longer governmental review periods, the applicant must provide documentation verifying it has requested the permit.

f) **Any immediate threat to life or safety** (e.g., poor fire safety, structural safety hazard): Copies of past health and safety reports, preferably conducted by an internal audit or third-party audit firm, to identify any type of health and safety violations. This must include evidence that:

- There are no indications of possible structural collapse on the interior or exterior of buildings, such as large visible cracks or sagging in walls and floors.
- There are sufficient numbers of emergency exits at the facility (production floors, office areas, warehouse, etc.).
- Emergency exits are unlocked during working hours (including overtime).
- The facility maintains all fire safety certificates, licenses and inspection records as legally required.
- Appropriate, functioning Personal Protective Equipment (PPE) is provided to workers free of charge.
  Specialized machinery and equipment have all required and up-to-date licenses/permits (forklift, cargo lift, boiler, compressor, etc.)
- Specialized equipment operators (forklift, cargo lift, boiler, electrician, hot work [e.g., welding], etc.) are licensed where legally required and trained in safety operating procedures.
- Points of operation and other potentially dangerous parts are operated with proper machine guards and safety features.
- Compliance with all applicable laws and regulations governing employee protection and machine safety.

Documentation of actions taken to correct violations recorded, and whether those corrective action plans have been completed.

g) **Denial of access to the facility, workers, or files:** Written policies that document the company's commitment to transparency and maintaining all appropriate documentation for review by its customers (for contract manufacturers/suppliers) and/or qualified parties (i.e., the social auditors required to conduct the performance evaluation for high-risk locations). Documentation of communication regarding these expectations. For applicants and facilities in low-risk locations, providing access to a Cradle to Cradle Certified assessment body serves as sufficient evidence.

Silver level: Request data measuring performance against the human rights policy from all high-risk tier 1 suppliers. At recertification, demonstrate continued efforts to obtain performance data and evidence of tracking corrective actions that may be necessary at tier 1 supplier locations.

For the Silver level:

1. Social audit performance data must be requested from all high-risk tier 1 suppliers providing components and materials that are subject to review (as defined in Material Health Section 4.3), including all de facto high-risk suppliers (as defined in Section 8.1).
2. If data are outdated or not available, the applicant must arrange for a social audit to be conducted.
3. Audits must be performed by qualified personnel with a social audit credential and no conflicts of interest related to the supplier.
4. Data must be generated within the past 24 months.
5. If identified, the following issues of high concern must be resolved prior to certification or recertification,
    a. Child labor,
    b. Forced labor,
    c. Corruption/bribery,
    d. Unauthorized subcontracting,
    e. Missing or deficient permits (i.e., business license, building permit, and environmental permit(s) if required by local regulations),
    f. Any immediate threat to life or safety (e.g., poor fire safety, structural safety hazard), and
    g. Denial of access to the facility, workers, or files.
6. Corrective actions must be planned or ongoing for any other poor performance issues identified. At recertification, the applicant must demonstrate progress on:
    a. Encouraging suppliers to complete corrective actions,
    b. Tracking whether timelines are adhered to, and
    c. Taking steps to suspend or terminate relationships with suppliers that fail to make progress on remediation.
7. At recertification, progress must be demonstrated on requesting social audit data from additional high-risk suppliers, if any, identified through the supplier risk assessment. For suppliers that continually fail to provide data, the applicant must take remedial actions (i.e., steps to suspend or terminate the relationship) after a maximum of two years.

Further Explanation

Requesting Performance Data from High-risk Tier 1 Suppliers

The Silver level requires that applicants request performance data for all high-risk tier 1 suppliers. At a minimum, data must be requested from tier 1 suppliers that are in de facto high-risk locations as defined in Section 8.1. Tier 1 suppliers are defined as direct suppliers to the final manufacturing stage of the product (i.e., this requirement applies only to the supply chain of the certified product; however, note that tier 1 may be tier 2 for the applicant company in cases where contract manufacturing is carrying out the final manufacturing stage of the product).

Performance data for tier 1 suppliers may be generated through a new social audit or provided from existing information that was recently generated for the supplier's facility by a qualified party. The same requirements for generation of performance data as described for Bronze level apply, including the requirements for use of other third-party standards (e.g., SLCP, SA8000, or SMETA).

When requesting performance data from tier 1 suppliers, it will be necessary to specify that:

- Performance must be measured on the required policy elements (per Section 8.1) and the issues of high concern per this section (Section 8.3).
- For any poor performance issue identified, corrective action plans are required.
- The data must have been generated in the past 24 months.
- The data must be generated by a qualified third party (i.e., a third-party APSCA auditor that does not provide any other paid services to the supplier*).
- The request could be met via certification to a third-party standard (e.g., SA8000, SLCP, SMETA), including via provision of a certificate and audit report that may already be available.

*See definition of a qualified third-party auditor and the table defining who is permitted to generate performance data in the Further Explanation box above (Section 8.3 Bronze level). The same requirements apply for Silver level. Note that there is also an option for the data to be generated by a qualified internal auditor for all applicants (regardless of locational risk level for corporate headquarters), if such an auditor is available. In this case, the request to the supplier would be to allow the applicant company's qualified internal auditor to conduct an audit rather than requesting the data as listed above.

When Social Audit Performance Information for High-risk tier 1 Suppliers is not Available

Where applicant companies do not initially have access to social audit performance information, the Silver level can still be achieved as long as data have been requested. Upon learning that data are not available or are outdated, a social audit by a qualified party must be arranged. Qualified parties must not have a conflict of interest related to the supplier. Conflicts of interest include other paid services provided to the supplier such as separate engagement already taking place in the form of corrective action management, in-factory training, or other support.

Demonstrating Progress

For recertification it is required that applicants *demonstrate continued efforts to obtain performance data and* [provide] *evidence of tracking corrective actions that may be necessary*.

For recertification, it is expected that the performance data requested at the time of the prior certification will have been obtained. In addition, where corrective actions were found to be necessary based on the data received, the applicant company is expected to encourage and track completion of corrective actions. In addition, if any additional high-risk suppliers have been identified since the prior certification, data must have been requested from these additional suppliers. For cases where data has not yet been obtained, progress is also defined as having scheduled a date on which an audit will be conducted in the near future, or suppliers having provided self-assessment questionnaires. However, if a supplier has not provided the requested information within one certification cycle (a two-year period), the applicant company must take steps to suspend or terminate relevant high-risk tier 1 supplier relationships – this is a sign of lack of trust and transparency between the buyer and manufacturer and does not indicate responsible supply chain management.

Required Documentation

Silver Level (minimum for initial certification):

- Evidence of communication requests to all tier 1 suppliers in de facto high-risk locations (e.g., emails or other formally documented communication) and supplier responses. Reminder: Tier 1 is defined as the direct suppliers to the final manufacturing stage of the certified product.

Once data have been received (this may occur for the initial Silver level certification or for recertification), the same evidence as is required for the Bronze level (i.e., for the company and final manufacturing facility performance measurement), is also required for tier 1 suppliers as follows:

- Evidence that performance has been measured on the required policy elements (Section 8.2 Human Rights Policy, #2a-j) and issues of high concern (Section 8.3 #2a-g) within the past 24 months. See detailed evidence/documentation requirements* in the Bronze level "Further Information" box.
- If employing third-party standard(s): Certificate(s), audit report(s), corrective action plan(s) and evidence of gap closure (see the Bronze level "Further Information" box for guidance). In this case the list of documentation required per the bullet above is not directly required because this will have been covered/examined as part of the third-party audit.
- Evidence of qualifications of the qualified third part(ies) or internal auditor generating the performance data (i.e., name and credentials of auditor).
- Evidence of corrective actions taken (for issues of high concern) or corrective action plans (for other issues).

Silver Level Recertification:

- Evidence of progress on obtaining social audit data from suppliers (e.g., social audit reports that have been obtained over the past two years or self-assessment questionnaires submitted by suppliers). Note: Provision of a self-assessment questionnaire counts as progress only once.
- Evidence of corrective action plan (CAP) tracking by the applicant as well as CAP closures and/or other progress. For example, signed and closed CAP report(s) and copies of communications encouraging suppliers to adhere to timelines and take correction actions.
- If any suppliers have failed to make progress on providing data or on corrective actions: Evidence of the applicant company's written policy or criteria for suspending or terminating relationships with suppliers and evidence of action taken if/when this situation has arisen. This may include email communications to suppliers about warnings, timelines, and updates to contract terms to suspend or terminate relationships.

Gold level: For components and raw materials associated with high risk of child labor, forced labor, or support of conflict, specify or certify to a C2CPII-recognized certification (if available) or equivalent that includes performance requirements aligned with the human rights policy.

For the Gold level:

1. A C2CPII-recognized certification or an equivalent alternative to certification is required for all de facto high-risk components and raw materials subject to review (as defined for Material Health), if a C2CPII-recognized certification exists and certified material is available.
2. At recertification, if a C2CPII-recognized certification does not exist, or certified material is not available, and the applicant has not been able to institute an alternative, the applicant must:
    a. Undertake a traceability exercise with the goal of tracking the material from the direct supplier through all stages of processing to initial production or extraction,
    b. Establish how to mitigate the negative human rights impacts, and
    c. Participate in a stakeholder initiative actively working to address the issues.

Further Explanation

Utilizing C2CPII-recognized Certifications (or Equivalent) for High-risk Components and Raw Materials

For components and raw materials associated with high risk of child labor, forced labor, or support of conflict, a C2CPII-recognized certification (if available) or equivalent that includes performance requirements aligned with the human rights policy is required. High-risk components and raw materials are defined in Section 8.1 (Gold level).

C2CPII-recognized certifications for the purposes of this requirement are certifications that address the required human rights policy elements and also meet the C2CPII certification program requirements (per Appendix 2 in this guidance). The following certifications are currently recognized:

- Better Cotton Initiative (BCI) - C2CPII-recognized when Level 3 volume claims can be/are made (which are allowable when volume fees are paid). See the BCI Claims Framework.
- Fairtrade International
- Fair Trade Certified (USA)
- Forest Stewardship Council (FSC)

Additional programs may be recognized and added to this list. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition.

Note that certified organic does not ensure that human rights issues are adequately addressed, and therefore is not listed here. This is because organic standards are defined regionally, primarily address the environmental and chemical use aspects of production, and depend primarily on local law and enforcement of human rights. As noted in previous sections, it is important to understand if local labor laws do not align with international human rights standards, and/or if local labor laws lack adequate enforcement to ensure respect for human rights in relevant jurisdictions.

Equivalent alternatives to certification also receive credit, but are not required. Equivalent alternatives must address the required human rights policy elements and meet the relevant C2CPII program requirements for equivalents (per Appendix 2 in this guidance). Qualified third-party verification is required, or the applicant must demonstrate legitimate grounds for an alternative method of verification (such as community-based verification). Please refer to Appendix 2 for additional information.

When an Applicable Certification Does Not Exist (or Material is Unavailable)

If an applicable certification does not exist or certified material is otherwise not available (e.g., because supply is low), and an equivalent has not been implemented, applicants are required to undertake a traceability exercise, establish a plan for mitigating the negative human rights impact, and participate in an applicable stakeholder initiative working to address the issue(s) of concern. Mitigation plans may be similar to corrective actions taken with suppliers elsewhere in the supply chain and/or related to the responsible sourcing management system identified in Section 8.6. Additionally, it is important to note that the purpose of the traceability exercise is to determine which supplier lots and serial numbers were used in finished products, and how the applicant has tracked and traced raw materials from the origin through delivery to the supplier to customer, and all stages in between.

Required Documentation

Gold Level

- Valid C2CPII-recognized certificate(s) or equivalent for all de facto high-risk components and raw materials subject for review within the product (this applies to the supply chain of the certified product only).

OR

- Evidence of research conducted to determine that an applicable certification does not exist, or evidence of attempts to obtain certified material that were not fruitful (e.g., email communications with potential suppliers).

Gold Level Recertification (if an Applicable Certification Does Not Exist, or Certified Material is Not Available):

- Evidence that an equivalent alternative is in place or that #2a-c have been implemented. See Appendix 2 in this User Guidance for the evidence required for eligible alternatives to certification. Otherwise, the following are required:
  - Description of the traceability exercise, including supplier communication and results.
  - Description of what is required to fully mitigate the negative human rights impacts identified, and plans for how the applicant company is working to mitigate those impacts. This may include reference to management decisions, management systems, responsible sourcing plans, and/or corrective action plans.
  - Membership details for the stakeholder initiative, including link to public references to the applicant's membership status and a payment slip indicating that member dues are current.

8.4 Strategy for Policy Implementation

Intended Outcome(s)

A framework for monitoring and measuring progress toward achievement of social performance targets and for identifying areas for improvement is established.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Bronze level: Develop a strategy for implementing the human rights policy and report on implementation progress at each recertification.

The strategy must:

1. Address priority risks and opportunities (per Section 8.1).
2. Include specific time-bound performance and impact objectives to guide decision making.
3. Define the scope of implementation.
4. Define the company's human, technical, and material resource allocation for implementation.

For recertification, performance data must be collected and analyzed to measure progress toward achieving social targets and objectives, and identify areas for improvement. For any areas of poor performance identified, methods of improving outcomes must be identified and evaluated, and the strategy refined accordingly.

Further Explanation

The Social Fairness strategy is expected to reflect the commitments made in the human rights policy and demonstrate how the company will operationalize these commitments. This entails developing a framework for implementing the policy, defining the scope of implementation, identifying accountable parties and designated resources within the business, and a sound measurement system.

Priority Risks and Opportunities (Requirement #1): At a minimum, the strategy is expected to focus on the priorities determined per the Risk Assessment (see Section 8.1).

Time-bound Performance and Impact Objectives (Requirement #2): The specific objectives and related targets included in the strategy will depend on the priority action areas identified in #1. Performance objectives and related targets will, in many cases, be contained in the human rights policy itself (see Section 8.2) – for instance, targets of zero tolerance apply to the commitment to prohibit child labor or forced labor; there are other areas where targets can focus on reducing negative impacts, such as root cause analysis of excessive working hours to credibly working to prevent this occurrence; or targets that communicate expectations and track efforts to manage emerging opportunities, like implementing a living wage in the supply chain.

Scope of Implementation (Requirement #3): This is a requirement to define the geographies and tier(s) of the applicant's operations and supply chain that are addressed by the strategy.

Defining Resources (Requirement #4): The human, technical, and materials resource allocation to support the plan's implementation must be defined. It is best practice to also define the financial resources allocated (or spend) for effective implementation. Examples of business units and staff that are typically involved in implementation include Procurement, Purchasing, Sourcing, Risk Management, Internal Audit, Compliance, Supply Chain, Operations, Sustainability, Corporate Responsibility, Legal, Human Resources, Product Development, Product Design, Planning, and Quality Assurance.

Resource allocation could, for example, include a description of relevant business units and staff experience

assigned to implementation, agreements with external stakeholders or service providers who are or will be engaged to support implementation efforts, or a training plan and budget for supplier capacity building.

Preparing for Recertification: The framework for implementing the policy is required to identify how implementation will be monitored and measured. Measurement must include performance metrics to evaluate existing processes and outcomes, and define improvement areas. This is in preparation for achieving the recertification requirements that *performance data must be collected and analyzed to measure progress toward achieving social targets and objectives*.

Recertification: *For any areas of poor performance identified, methods of improving outcomes must be identified and evaluated, and the strategy refined accordingly.* Examples of evaluation methods that can be used include:

- Management reviews at appropriate intervals
- Industry or competitor benchmarking
- Obtaining feedback from internal and/or external stakeholders

Required Documentation

Bronze Level

- The applicant company's strategy that includes the required points #1-4.
- Description of how implementation will be monitored and measured.

Bronze Level Recertification

- Evidence of performance data analysis specific to the defined objectives in the original strategy.
- List of areas of poor performance identified from the analysis conducted (if any).
- Description of plans to improve performance outcomes, and description of how the plan is selected/developed and evaluated.
- Description of how the strategy has been updated to incorporate the need to improve poor performance.

8.5 Demonstrating Commitment

Intended Outcome(s)

A culture of social fairness that prioritizes human rights and the application of responsible business practices to all stakeholders is established, promoted, and improved by company leadership.

Applicable Achievement Level(s)

Bronze

Requirement(s)

Demonstrate commitment and support for establishing and maintaining a culture whereby employees and business partners are able to achieve high levels of social performance.

The applicant's leadership team (i.e., C-level executive and/or Board of Directors) must demonstrate commitment and support by:

1. Communicating the company's social aspirations and values, strategy for upholding human rights, and significance of respect for human rights to the success of the company internally and/or externally.
2. Defining a position to actively lead on human rights, oversee implementation of the strategy, and drive continuous improvement efforts.
3. Ensuring there are defined procedures for escalating human rights risks and identified impacts to the executive team.

Further Explanation

Importance of Demonstrating Commitment

According to the UN Guiding Principles on Business and Human Rights, companies are expected to express their commitment to meet their responsibility to respect human rights by ensuring their human rights policy:

a. Is approved at the most senior level of the business enterprise;

b. Is informed by relevant internal and/or external expertise;

c. Stipulates the enterprise's human rights expectations of personnel, business partners and other parties directly linked to its operations, products or services;

d. Is publicly available and communicated internally and externally to all personnel, business partners and other relevant parties;

e. Is reflected in operational policies and procedures necessary.

Communicating the company's position to respect human rights internally and externally shows that the company takes this commitment seriously and is accountable for its implementation.

It is important for a senior executive to have ultimate oversight for the applicant's commitment to ensure there is accountability for its implementation.

Who is Expected to Demonstrate Commitment

The applicant's leadership team (i.e., C-level executive and/or Board of Directors) must demonstrate commitment. In practice, positions with this responsibility can include:

- Board Director or Executive that has accountability for human rights (e.g., Head of Sustainability), Human Rights Committee, or member of Executive team with accountability for People, Supply Chain, Compliance, etc., such as Chief People Officer and/or Chief Procurement Officer.
- Business Unit functional head that has accountability and responsibility for human rights. This could be a leader within Procurement, Purchasing, Sourcing, Risk Management, Internal Audit, Compliance, Supply Chain, Operations, Sustainability, Corporate Responsibility, Legal, Human Resources, etc.

Creating accountability means instilling ownership through all levels and functions within the organization,

and defined procedures to support implementation of the policy – including revision of existing procedures if necessary.

Demonstrating Commitment

Communicating (Requirement #1): For the Bronze level, communication of the company's social aspirations, values, and strategy may be either internal or external. This may include, for example, sustainability reports and/or signed policy documents. See Required Documentation section for additional examples.

Defining a Position to Actively Lead on Human Rights (Requirement #2): The position often has responsibility for the human rights management plan, internal and/or external progress reporting on implementation efforts, and/or KPIs to measure and assess progress. The designated position to lead on human rights may be full time or part time as appropriate and feasible for company size.

Procedures for Escalating Risks and Impacts (Requirement #3): In assigning roles and responsibilities, the senior executive is expected to also have accountability for human rights risks and identified impacts that have been escalated to the executive team. Examples of escalation procedures can include internal monitoring and reporting procedures, employee hotlines, grievance mechanisms and/or procedures maintained by Internal Audit, Ethics, or Risk Management departments. The escalation process should be included in training for key roles responsible for implementing the policy and demonstrating the organization's commitment to respect human rights.

References:

UN Guiding Principles on Business and Human Rights, see Principle 16 (United Nations, 2011)

The Corporate Responsibility to Respect Human Rights: An Interpretive Guide, see p. 26. (United Nations, 2012)

Doing Business with Respect for Human Rights, see Chapter 3.2. (Shift, Oxfam, Global Compact Netherlands, 2016)

Required Documentation

Bronze Level

- Evidence that the applicant company is *Communicating the company's social aspirations and values, strategy for upholding human rights, and significance of respect for human rights to the success of the company internally and/or externally*. May include one or more of the following:
  - A human rights policy document with executive level signature that is publicly available and/or circulated internally to all employees,
  - A company press release on this topic,
  - A Modern Slavery Act Statement,
  - A sustainability report that includes a section on human rights, and/or
  - A transcript from a public speech given by a C-suite representative.

- Description of the designated position to lead on human rights.
- Defined processes and procedures for escalating and reviewing human rights risks and identified impacts by the executive team.

8.6 Management Systems

Intended Outcome(s)

A management system for people and procedures is in place, ensuring that necessary corrective actions are taken, actions are effective, and that performance on protecting human rights is ultimately improved.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Implement a management system that supports achievement of the human rights policy commitments within company operations.

Gold level: Implement a responsible sourcing management system that supports achievement of the human rights policy commitments within the product's supply chain.

For the Silver level, the management system must include the following elements:

1. Designated staff with social compliance responsibilities.
2. Designated oversight function and process.
3. Business procedures that support implementation of the human rights policy within the company's workplace and across corporate functions and different levels of management.
4. Education for staff with social-related duties on human rights principles.
5. Internal communication and employee involvement.
6. Procedures to measure and evaluate workplace activities against the human rights policy.
7. Policies and procedures for the prompt implementation of corrective and preventive actions within the company's workforce.

For recertification at the Silver or Gold level, the policy, procedures, practices and/or programs must be reviewed to identify deficiencies and implement changes (if needed) that will lead to improved performance. Remedial activities (if needed) must be underway and seek to identify and address root causes. (Note: This applies to the company-level management system at the Silver level and also to the responsible sourcing management system at the Gold level.)

Further Explanation

Consider the following when implementing a management system that supports achievement of the human rights policy commitments within company operations:

Elements of a Credible Human Rights Management System for Company Operations

To implement a management system that supports implementation of the human rights policy within a company's own operations, the policy must be embedded into the organization's business processes. This includes senior accountability and oversight, staff involvement throughout all functions and levels of management and related training, internal communication, and monitoring processes.

A Credible Management System has the Following Components:

- Defined roles and responsibilities for implementation
- Shared ownership throughout the organization, including different functional responsibility and geographic responsibility where relevant for adequate implementation
- Required training to ensure staff with responsibilities have adequate knowledge of human rights and details contained in the policy
- Procedures that document how human rights are expected to be integrated into the company's operations
- Framework for reviewing the effectiveness of implementation. This can include required review of documentation and tracking of KPIs to measure progress against internal or publicly made goals
- Regular review of compliance with the policy, including compliance with legal requirements, emerging expectations in locations of operation and/or as compared to peers or best practices identified, and adequacy of company performance to meet stated commitments
- Stated commitment for regular review/continuous improvement based on findings

CSR Europe's Blueprint for Embedding Human Rights in Key Company Functions outlines six essential elements for embedding human rights into a company. Additional information is provided here to outline key expectations for implementation.

1. ***Cross-functional coordination and leadership***. Assign accountability throughout all senior levels of the company and identify all business functions with responsibility to implement the policy. Define responsibilities in writing to ensure clarity and ownership.

2. ***Shared responsibility***. Includes all departments and functions that would have responsibilities for activities or business relationships that could be connected to human rights risks. This can include the following examples:

    - *Senior management*: Leads senior-level accountability, review and decision-making. Involved in setting targets, incentives, and disincentives; fostering a culture that respects human rights from the top; and managing necessary change management.
    - *Human resources*: Helps embed human rights in relevant processes, such as recruitment, hiring, training, performance appraisal and dismissal. See Section 8.11 for additional detail.
    - *Procurement/Sourcing*: Ensures social fairness criteria are integrated into sourcing criteria and decisions. Can exercise influence with suppliers to minimize negative impacts on human rights and/or enhance positive impacts on social fairness. (This is a Gold level requirement in this section.)
    - *CSR/sustainability*: Provides substantive expertise for the embedding phase on specific human rights policy elements or social fairness implementation criteria; can support design and implementation of staff training.

- *Middle management*: Day-to-day responsibilities for implementing policy requirements and business procedures, which can include management of corrective actions where necessary.
- *Communications*: Supports roll out of human rights policy coordination, informing staff of important developments, and disseminating key policies and commitments.

3. Operational guidance and training. Training focuses on the human rights policy commitment and the key issues and topics embedded within it per Section 8.2. A focus is also on building understanding of specific human rights issues, internal roles and expectations for management, and how to escalate issues. It is expected to be tailored to individual roles and be supported by senior management. Section 8.11 has additional details about employee training, engagement, and involvement.

4. Two-way communication. This occurs between management and operational staff, to ensure challenges are identified and course of action for addressing such challenges are reviewed and approved.

5. Performance goals for staff to align incentives. Ensure relevant staff have human rights or social fairness goals included in their annual performance evaluations. More information about this criteria is detailed in Section 8.11.

6. Regular analysis of performance. Maintain an inventory of internal policies and procedures for implementing the human rights policy, including identification of individuals responsible and support for annual reviews to determine where improvements are needed. Determine corrective and preventative actions in relevant areas of the business and ensure individuals are accountable for addressing root causes of negative human rights impacts to prevent reoccurrence.

A Note Regarding Grievance Mechanisms

Note that grievance mechanisms (covered in Section 8.7) are a means of identifying adverse impacts and providing remedy. Grievance mechanisms could be considered as one aspect of a human rights management system. However, management systems should be designed such that a company is able to avoid infringing on human rights and having adverse impacts, therefore also avoiding the need for remedy to begin with.

Developing Business Procedures (Requirements #3, 6, and 7)

The following are required:

- Requirement #3: *Procedures that support implementation of the human rights policy within the company's workplace and across corporate functions and different levels of management.*
- Requirement #6: *Procedures to measure and evaluate workplace activities against the human rights policy.*
- Requirement #7: *Policies and procedures for the prompt implementation of corrective and preventive actions within the company's workforce.*

A procedure is a standard way of doing something and includes detailed step-by-step instructions. Generic examples of procedures used in management systems are widely available through ISO management system support offerings. Manufacturers are often most familiar with standard operating procedures applicable to quality management and/or health and safety. A generic outline of a procedure may be found in the IFC-ESMS Toolkit.

Business Procedures that Support Implementation of the Human Rights Policy (Requirement #3) may be specifically focused on human rights issues. However, human rights are also expected to be integrated into and aligned with business procedures more generally with the goal of preventing the business from having an adverse impact on human rights. For example, part of a hiring procedure will include checking the identification, including the age, of an applicant to ensure that they are old enough to work as defined per local and/or international law. Some more nuanced examples are provided by the UN Guiding Principles Implementation Guide: "For instance, if a construction company rewards operational staff purely on their speed in building new infrastructure and without regard to whether they harm communities in doing so, it is likely to incentivize behaviours that lead to adverse human rights impact. If an Internet company's staff automatically defer to every Government request for information about users, regardless of the human rights implications, it runs the risk of being involved in any human rights abuses that result." Additional examples and guidance may be found in the set of Environmental and Social Management System Implementation Handbook & Toolkit documents available through Social Accountability International's resource library.

Procedures to Measure and Evaluate Workplace Activities Against the Human Rights Policy (Requirement #6)

- Procedures to measure and evaluate activities against the human rights policy may include definitions of performance indicators and how those are tracked and evaluated. Relevant indicators may include (for example) number of accidents, average working hours and wages paid, or number of workers trained on health and safety. This requirement ties back to the requirements to monitor performance (Section 8.3). The difference is that the focus of this section (Section 8.6) is on the existence of a consistent measurement and evaluation procedure as part of a comprehensive management system, where for the Bronze level, the requirements focus on the performance itself at a particular point in time.
- One aspect of the procedures to evaluate activities against the human rights policy is the procedure for conducting a management review described for recertification below.

Procedures for the Prompt Implementation of Corrective Actions (Requirement #7): Corrective action plans (CAPs) are explained in the guidance to Section 8.3. Refer to Section 8.3 for a description of credible corrective action plans. It is recommended that a procedure for prompt implementation of corrective and preventative actions includes all of the elements of a credible CAP (e.g., inclusion of a timeline for closure). A generic outline of a procedure may be found in the IFC-ESMS Toolkit.

Recertification

Management System Review: For recertification at the Silver level, an internal management review of the system must have been conducted. Note that annual reviews are considered best practice. The system's effectiveness on implementing the policy is expected to be reviewed. Best practice is to also include a review of compliance with all relevant laws. Management review is often accomplished via a management review meeting. A possible agenda for a management review meeting (per the SA8000 and IFC Toolkits referenced below): (1) Review progress on strategy and action plans, (2) Review progress on any improvement plans or remedial activities, (3) Review compliance with labor laws and regulations, (4) Review social performance, (5) Discuss possible adjustments to risk assessment, (6) Prioritize activity for the next three, six and 12 months, and (7) Review and approve needed resources by senior management.

Remedial Activities: The standard requires that *remedial activities (if needed) must be underway and seek to identify and address root causes*. The remedial activities referred to in the requirement are actions to address any issues with the effectiveness of the management system that may have been identified during the management review. This means that the management system review must be conducted far enough in advance of recertification for remedial activities (if needed) to be initiated. A root cause is the core issue or highest level cause of a problem. It is the core reason for a cause and effect chain reaction that may have occurred, ultimately leading to a specific problematic outcome(s).

References

Blueprint for Embedding Human Rights in Key Company Functions (CSR Europe, 2016)

Environmental and Social Management System Implementation Handbook & Toolkits (Social Accountability International and International Finance Corporation, 2014-2020).

Required Documentation

Silver Level

The following information is required in order to demonstrate that the management system for the applicant company's own operations has been implemented. The numbers below align with the individual requirement numbers in this section.

1. Internal organizational charts and/or descriptions of the functions, business units, or staff responsible for social compliance, and job descriptions for relevant staff.
2. Description of who and what processes create accountability for social compliance and policy implementation. For example, this might include oversight by a Chief Procurement Officer or Human Rights lead, with support from a cross functional committee of business units such as Sourcing, Compliance, Sustainability, Product Development, Design, Legal, Human Resources, etc. It could alternatively be a particular leader of the social compliance organization and description of the process by which social compliance is managed within the company's own operations.
3. Detailed information about how the policy is integrated into the organization – this may be through written procedures, description of processes, reference to several standard operating procedures, and/ or intra-department collaboration for managing the policy implementation or processes.

   Written procedures must reference the human rights policy and social compliance program as part of defined ways of working. A procedure must include details about responsibilities of different functions (such as Sourcing, Compliance, Sustainability, Product Development, Design, Legal, Human Resources, etc.) and levels of management (managers, directors, business leaders).
4. Examples of any internal human rights training for individuals with social-related duties. Provide examples of training materials and a training log to show completion of training.
5. Internal communication to employees about the company's human rights commitments and activities.

Examples include announcements about the policy, reference in an employee handbook, internal emails announcing progress on goals, etc.

6. Key performance indicators or example progress reports to evaluate the effectiveness of implementation plans and the management system. This may include documentation for processes to review compliance with the human rights policy and also compliance with local laws. If third-party assessments of activities and/or reports have been conducted by an external stakeholder, provide this information to document supporting implementation of different activities.
7. Written policies and procedures that outline requirements for implementation of corrective and preventive actions if risks and/or impacts are identified.

Silver Level Recertification

Evidence that the design and effectiveness of the management system (policies, practices, and programs) have been reviewed to identify deficiencies/changes required for improved performance. Regular internal management reviews (annual review is recommended) of the social compliance system, where documentation is written records from management review meetings. This must include evidence that improvements identified in the previous review are underway.

Gold level: Implement a responsible sourcing management system that supports achievement of the human rights policy commitments within the product's supply chain.

For the Gold level, the responsible sourcing management system must include the following elements:

1. Designated staff with ethical sourcing responsibilities.
2. Designated oversight function and process.
3. Procedures to communicate to suppliers the company's human rights policy and any associated ethical sourcing business processes.
4. Supplier contractual requirements for human rights policy compliance and monitoring (e.g., supplier codes of conduct if defined as a contractual term). Contracts must require suppliers to extend social compliance expectations to their suppliers.
5. Evaluation of new suppliers prior to the awarding of contracts to determine if the supplier can meet requirements.
6. Policies and procedures for the prompt implementation of corrective and preventive actions.
7. Education for sourcing and/or procurement team(s) on responsible sourcing and/or human rights principles.
8. Business procedures for identifying and documenting the cause and resolution of human rights issues and/or impacts in the supply chain that arise as a result of audits/reviews or concerns raised by employees or other third parties.

For recertification at the Silver or Gold level, the policy, procedures, practices and/or programs must be reviewed to identify deficiencies and implement changes (if needed) that will lead to improved performance. Remedial activities (if needed) must be underway and seek to identify and address root causes. (Note: This applies to the company-level management system at the Silver level and also to the responsible sourcing management system at the Gold level.)

Further Explanation

Consider the following when implementing a responsible sourcing management system:

Elements of a Credible Human Rights Management System for the Supply Chain

Requirements at the Gold level are similar to the Silver level, with specific focus on responsible sourcing management systems to be applied throughout the supply chain.

This includes the same essential elements for embedding human rights, such as the following:

- Management communicates the importance of responsible sourcing throughout the company
- The Chief Procurement Officer (or other relevant sourcing leader) is involved in management review and decisions to implement the company's human rights policy within its supply chain management
- Job descriptions for sourcing managers include collaboration with compliance staff and business partners on responsible sourcing inputs
- Specialized training is developed for staff with key roles responsible for implementing within the supply chain (e.g., responsible purchasing practices for procurement and merchants; training on specific human rights risks related to key sourcing markets)
- Annual performance reviews include accountability and key performance indicators for staff carrying out responsible sourcing practices
- Supplier performance evaluation is utilized to drive compliance and corrective action where necessary. See Silver level (above) and Section 8.3 for more details.

Applicants are expected to communicate their human rights policy commitment to all business partners, including suppliers, and cascade implementation responsibilities to business relationships throughout the value chain. Communication can take the form of providing business partners with copies of the policy commitment and keeping records of communication with suppliers that promote responsible business practices.

Often, setting expectations with suppliers takes the form of communicating a Responsible Sourcing Policy or Code of Conduct, which suppliers are required to comply with as part of business terms. See Section 8.2 for additional context. It is a Cradle to Cradle Certified requirement to ensure supplier contracts extend social compliance expectations to suppliers – this is commonly manifested in the supplier posting a Code of Conduct in facilities.

Embedding the Code of Conduct or similar human rights policy expectations in an actual business contract is different than required posting of the Code of Conduct in a supplier facility. Cradle to Cradle certification requires inclusion of supplier social compliance expectations in contract terms to ensure that an applicant's

suppliers implement the company's expectations, and that these terms include penalty or termination clauses for upholding social compliance expectations where necessary. Including this term in the actual supplier contract demonstrates its importance and signals social compliance is expected be treated on par with traditional business metrics such as cost, quality, on-time-delivery, etc. These expectations should be added to new business agreements before signed, and can be incorporated into existing supplier terms during an onboarding process and/or in the cycle of contract renewal.

Once a supplier has received communication about social compliance expectations and committed to uphold these expectations through its contractual terms, monitoring of performance in the form of social compliance audits is conducted at 3-, 6-, 12-, or 24-month intervals depending on the buyer's specifications or requirements of the particular standard or certification used. The Gold level also specifies evaluation of new suppliers to confirm compliance prior to awarding contracts. This ensures the buyer understands the risks present for the supplier prior to orders being placed. Section 8.3 has detailed information about monitoring and verification. Monitoring results may show minor or major violations with the buyer's human rights expectations, which are expected to be remediated by the supplier and measured in corrective action plans over time. The supplier must also work to improve its performance and build capacity to prevent these violations in the future.

Responsible sourcing practices define responsibilities for the buyer, including functions such as Procurement, Purchasing, Sourcing, Design, Production, Planning, and Contract Management (e.g., Legal), among others. A company is expected to implement internal education about responsible sourcing practices and impacts on suppliers. This can include building knowledge about the following:

1. Performance pressures, as buyers feel pressure to meet production goals and tight margins which in turn can put pressure on suppliers to deliver faster and cheaper;
2. Competing priorities, as buyers frequently prioritize price, quality, and delivery above all else when rewarding or penalizing suppliers;
3. Unequal power that buyers hold over suppliers when it comes to financial and negotiating terms. Suppliers commonly feel pressure to make their customers happy in any circumstance for fear of losing business.

A company can inadvertently create negative impacts on the people who are employed by suppliers through its purchasing practices, and this should be prevented. For instance, a rush order, last minute design change, or reduced price can lead to longer working hours for less pay and in unsafe conditions or falsified records to hide unauthorized subcontracting or other violations with the buyer's human rights policy or Code of Conduct. Even simple changes a buyer makes, like a color or material change, can create a major difference in manufacturing requirement. When buyers make order changes, it is best practice for these changes to be accompanied by altered pricing or timeline shifts, especially in the midst or at the end of a production cycle. Without such treatment, minor changes can provide perverse incentives for a supplier to violate human rights commitments in order to meet other contract terms. Instead, it is important for buyers to consider how to integrate social compliance into traditional business metrics to prevent such occurrence. Buyers can also consider the impact of creating incentives for suppliers to manage social and labor issues responsibly – such as reduced social monitoring, rewards and recognition, future orders, and more favorable contract terms for suppliers who have strong social performance and continued improvement.

References

Blueprint for Embedding Human Rights in Key Company Functions (CSR Europe, 2016)

The Corporate Responsibility to Respect Human Rights: An Interpretive Guide (United Nations, 2012)

Doing Business with Respect for Human Rights, see Chapter 3.2. (Shift, Oxfam, Global Compact Netherlands, 2016)

Responsible Sourcing Management Model (ELEVATE, 2019)

Step-by-Step Guide to Reviewing and Improving Purchasing Practices (Ethical Trade Initiative, 2010)

Required Documentation

Gold Level

The following information is required in order to demonstrate that the applicant company's responsible sourcing management system has been implemented. The numbers below align with the individual requirement numbers in this section.

1. Internal organizational charts and/or descriptions of the functions, business units, or staff responsible for social compliance and Job descriptions for relevant staff. Must include details about which function and staff have responsibility for ethical sourcing (e.g., procurement, sustainability).
2. Description of who and what processes create accountability for social compliance in the product's supply chain. This might include oversight by a Chief Procurement Officer or Human Rights lead, with support from a cross functional committee of business units such as Sourcing, Compliance, Sustainability, Product Development, Design, Legal, Human Resources, etc. It could alternatively be a particular leader of the social compliance organization and description of the process by which social compliance is integrated into sourcing decisions and regular supplier reviews.
3. Written procedures and supplier requirements or guidance materials that set expectations for supplier compliance with the human rights policy. This may include the supplier code of conduct, and documentation in the form of steps for communication and adherence, such as emails or contract terms that specify required compliance.
4. A supplier contract template and/or excerpts of a valid supplier contract that include language requiring suppliers adhere to the applicant's ethical sourcing requirements as a condition of business, and setting expectations for their suppliers to do the same. This could include a supplier code of conduct if the supplier is required to sign this as a contractual term. It is best practice to stipulate that suppliers will be monitored for social compliance.
5. Written procedures and/or guidance that stipulates how new suppliers are evaluated to determine if the supplier meets the applicant's responsible sourcing and/or social compliance requirements. Written procedures and/or guidance that explain how evaluation of social compliance is included in decisions to award contracts to new suppliers.
6. Written policies and procedures requiring corrective and preventive actions for suppliers if non-compliances are identified in their production facilities. Credible corrective action plans define

timelines for expected corrective actions, which may relate to the severity of the non-compliance.

7. Description of the training and/or a sample of training or education materials that explain key human rights issues and applicant procedures for sourcing and procurement team(s) to incorporate into their everyday activities to achieve responsible sourcing goals.
8. Written procedures for identifying and documenting human rights issues and/or impacts raised by employees or third parties. This could include escalation and/or remediation processes, including identification of issues and corrective actions in audit reports in the supply chain.

Gold Level Recertification

Evidence that the design and effectiveness of the management system (policies, practices, and programs) have been reviewed to identify deficiencies/changes required for improved performance. This may include regular internal management reviews (annual review is recommended) of the responsible sourcing system, where documentation is written records from management review meetings. This must include evidence that improvements identified in the previous review are underway.

8.7 Grievance Mechanisms

Intended Outcome(s)

A mechanism is in place by which employees, customers, suppliers, and other stakeholders may safely report negative effects of business activities and operations and other social fairness concerns to the company in order to obtain redress for those impacts.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Provide a grievance mechanism that permits company employees and other stakeholders to obtain redress for negative human rights impacts. For any contract final manufacturing stage facilities, request that a grievance mechanism be made available.

Gold level: For contract final manufacturing stage facilities, ensure that a grievance mechanism is available that permits employees and other stakeholders to obtain redress for negative human rights impacts.

For the Silver and Gold levels, the applicant company must have a grievance mechanism for company employees and other stakeholders that:

1. Is supported by a non-retaliation policy.
2. Is capable of addressing the risks and potential adverse impacts on people.
3. Addresses concerns promptly, using an understandable and transparent process based on local best practices that is readily accessible by any affected stakeholder.
4. Provides feedback to those concerned, without their risking retribution.
5. Includes informing direct employees about the mechanism at the time of hire.
6. Does not impede or preclude access to judicial or administrative remedies that might be available

under law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.

7. Includes written records and periodic reviews to identify and make necessary improvements.

For the Gold level, the grievance mechanism may be provided by the contract manufacturer or by the applicant.

Further Explanation

About Grievance Mechanisms

For the Silver and/or Gold levels, the grievance mechanism(s) must be in place, functioning, and effective.

The UN Guiding Principles on Business and Human Rights (UNGPs) expect companies to implement operational grievance mechanisms for employees, non-employees, and communities that can be negatively affected by a company's operations and business activities. Businesses are expected to be able to receive, process, and provide adequate response or remedy to grievances raised. This includes defining procedures for:

1. Workers and individuals to file grievances,
2. Management investigations of grievances submitted by workers and non-workers to make remedy decisions,
3. Management communication of the outcomes after the investigation, and
4. Documenting and maintaining outcomes.

Grievance mechanisms can take many forms, including a suggestion box, talking to a supervisor or Human Resources staff person, internal hotlines, external hotlines, union or worker committees, or other forms. Grievance mechanism hotlines operated by an outside third party are an acceptable option that may be implemented by the applicant and/or contract manufacturer for cases where a functioning mechanism is not available.

Grievance mechanisms are only effective if workers know about, trust, and are confident using them.

Within a properly functioning grievance mechanism, a non-retaliation policy must ensure confidentiality or anonymity of the individual who raised the grievance and ensure he or she is protected from retribution (direct or indirect). Additionally, any person(s) bringing a complaint must be informed about the resolution of the investigation and any corrective action taken.

Cradle to Cradle Certified requires that grievance mechanisms be capable of addressing the risks and potential adverse impacts on people. The UNGPs outline eight criteria for effectiveness of grievance mechanisms, which have been summarized by Ergon Associates in their white paper "Access to Remedy – operational grievance mechanisms" for the Ethical Trading Initiative as the following:

1. Legitimate: *Fair and trustworthy*
2. Accessible: *To all those they are designed for*
3. Predictable: *In terms of process and available outcomes*

4. Equitable: *Meaning fair and equal access to information, advice and expertise for both stakeholders raising a grievance as well as those managing the process*
5. Transparent: *About the process and progress of responding to grievances*
6. Compatible: *With internationally recognised human rights standards and local laws*
7. A source of continuous learning: *For organisations to improve its system to best support its stakeholders' needs*
8. Based on engagement with stakeholders: *With the affected stakeholders, and relevant experts when necessary*

Grievance procedures are often utilized as part of remedy required when negative human rights impacts occur. The concept of remedy aims to restore individuals or groups that have been harmed to the situation they would have been in had the impact not occurred. Accordingly, grievance procedures should reflect the size and scale of company operations and the needs of its workers and the communities affected by its business operations.

A mechanism may be non-functioning if:

- There are no grievances reported in the prior 12 months
- There are no documented follow-up actions taken in response to grievance reports made
- Actions taken are or appear to be insufficient to resolve the case

If there are no cases recorded within 12 months of grievance procedure operation, then it must be assumed that the process is non-functioning. In this case, to achieve the Silver level, the applicant must assess the problem, identify barriers to effective functioning (if any), and take action to correct the issue(s). At the Gold level, this may require intervention with the contract manufacturer (as relevant).

References

UN Guiding Principles on Business and Human Rights (United Nations, 2011)

Access to Remedy – operational grievance mechanisms (Ergon Associates for the Ethical Trading Initiative, 2017)

Required Documentation

Silver Level

Documentation of a company's own grievance mechanism available to employees and other stakeholders that meets all points below. If any contract manufacturers are used for the final manufacturing stage of the product, evidence that the applicant has requested that they provide a grievance mechanism of their own (e.g., copy of email communication to the supplier).

Gold Level

Documentation of an existing grievance mechanism available to employees and other stakeholders at contract

final manufacturing facilities (if any) that meets all points below. The mechanism may be provided by the applicant company or by the contract manufacturer. If provided by the applicant, evidence of communication to all contract manufacturer employees and stakeholders that the mechanism is available for their use is required.

The numbers below align with the individual requirement numbers in this section.

1. A non-retaliation policy that is either freestanding or incorporated into another policy. The non-retaliation policy must ensure confidentiality or anonymity of the individual who raised the grievance and ensure he or she is protected from retribution (direct or indirect).
2. Documentation that the grievance mechanism is legitimate, predictable, and rights compatible as follows:
   - Evidence that the grievance mechanism is used by the intended audience, as demonstrated in a log of complaints received.
   - Description of the process by which a worker submits a grievance, and the process by which management reviews, makes decisions, communicates outcomes, and provides remedy (where relevant) about the grievance.
   - Evidence that grievances are evaluated in alignment with human rights definitions and internationally recognized standards (e.g., the UN Declaration of Human Rights and ILO Conventions), as well as with local labor laws.
3. Documentation of a transparent process that is visible and understandable to all stakeholders and grievance procedures that include a defined timeline for responses to occur, including:
   - Evidence that communication about the mechanism is provided in a language and format that is easily understood by intended users, including local language or dissemination verbally (where illiterate workers or stakeholders are present).
   - Evidence that parties raising grievances are informed about progress.
   - Evidence of regular communication about the overall mechanism's performance to build confidence in its use.
4. Examples of how the applicant has engaged individuals who have used the mechanism to provide feedback/outcomes from the review. If the applicant does not have an example, they must provide procedures of how it would respond in the event an issue is raised.
5. Evidence of communication(s) provided to employees informing them about the grievance mechanism when they are hired. For example, information about the mechanism that is included in new hire training, an employee handbook, or on facility posters.
6. Written policy(ies) that document the applicant's grievance mechanism is not a substitute for existing judicial or arbitration procedures or a substitute for resources provided through collective agreements.
7. Evidence that written records are kept and of the review process for complaints, concerns, or suggestions received, including:
   - Usage statistics for the grievance mechanism to demonstrate that records are maintained and reviewed. This may include data such as the number of complaints filed and types of complaints or

topics on which complaints are made, a log of outcomes after evaluation of complaints, and what remedy has been provided.

- Documentation of procedures for assessing the grievance mechanisms' effectiveness and processes to make improvements.

8.8 Positive Impact Project

Intended Outcome(s)

Positive impact on a social issue of significant importance to the company and/or value chain of the product.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Implement a positive impact project that measurably improves the lives of employees, the local community, or a social aspect within the value chain of the product.

Gold level: Conduct an assessment to determine the impact of the positive impact project using quantitative metric(s).

For the Silver level, the following are required:

1. The applicant must invest in a social impact project that involves issues or opportunities that were identified in the risk assessment process (per Section 8.1) or that are otherwise material to the company.
2. The project goal(s) must be supported by one or more key performance indicators that are tracked before, during, and after the project.
3. Project selection must incorporate employee input.

For the Gold level, an impact assessment must be performed based on the defined key performance indicator(s). For recertification, measurable progress must be demonstrated.

Further Explanation

A positive social impact project is a project implemented, often through community investment or community development efforts, where an applicant is engaged in activities to help address wider issues affecting people – including employees – in the communities where the applicant does business or its products are made. Positive social impact projects can vary widely. For example, they may focus on access to drinking water and sanitation, accessible childcare and education in the supply chain, employees volunteering with at-risk youth, or reducing local food insecurity through community gardening.

Selecting a Positive Social Impact Project

Applicants are highly encouraged to select positive impact projects that focus on human rights and other social issues rather than environmental issues, which are already addressed by the other Cradle to Cradle Certified program categories. Projects focusing on environmental issues are only eligible if the applicant can show a

clear connection to the risk assessment conducted per Section 8.1, or otherwise demonstrate the project will contribute to respecting the rights of people and/or benefit those people or their communities. If the project selected focuses on an issue separate from those identified in the human rights risk assessment process (i.e., 'otherwise material to the company' as permitted in requirement #1), the applicant must provide an explanation of how this issue was chosen and the explanation must demonstrate the project is relevant to at least one stakeholder group (as defined in Section 8.1).

Ensuring a focus on respecting human rights in the selection of the positive social impact project is consistent with the UN Guiding Principles prioritization of salient human rights risks, which focus on risk to people, as compared to material issues which focus on risk to the business – although increasingly salience and materiality are related. Definitions of salient human rights are provided in Section 8.1. The UN Guiding Principles Reporting Framework Resources: Salient Human Rights Issues states that using 'salience' means change from being a resource drain on companies to being an investment in putting in place processes that enable the company to manage key risks to people.

Selecting Key Performance Indicator(s)

One or more Key Performance Indicators (KPIs) must be selected and tracked before, after, and during the project. It is important to understand the difference between inputs, outputs, and impacts. The Business for Societal Impact (B4SI) Framework defines these different types of indicators as follows. Because focus is on measurable improvement of the lives of employees, the local community, or a social aspect within the value chain of the product, it is recommended to focus on impact indicators if there is only one KPI for the project.

- ***Inputs: what is contributed***, e.g., financial or in-kind initiative focused on issues such as education, health, economic development, environment, arts and culture, social welfare, etc., in a specific location
- ***Outputs: what happens***, e.g., number of individuals or communities supported, employees involved, suppliers reached, stakeholders engaged, etc.
- ***Impacts: what change occurs***, e.g., depth of impact on people, behavior or attitude change, quality of life improvement or well-being change, etc.

Incorporating Employee Input

Incorporating employee input into the project is a minimum requirement. Involving employees in additional aspects of the project is highly encouraged. For example:

- The project's design has included involvement of the applicant company and/or supplier employees (as relevant) through a documented needs assessment process
- Employees have provided feedback on program design elements
- Employees participate in project governance
- If a trade union is established at relevant facility(ies), the trade union has been consulted in the project design and involved in project implementation

It is best practice to also engage with external stakeholders – particularly those community members that the positive social impact project is meant to serve, including disadvantaged and/or vulnerable groups.

This process can include stakeholder mapping (see Section 8.8) to identify groups that are interested in or affected by the applicant's activities. Project planning and implementation are expected to be inclusive, considering multiple perspectives and paying particular attention to vulnerable groups or those that may be underrepresented in the most visible community groups.

Gold Level: Assessing Impact

Impact assessment of the positive impact project is required for the Gold level and for recertification at the Gold level. The impact assessment must draw on the KPI(s) that were developed for the Silver level to evaluate and measure progress since project initiation.

It is recommended that projects be monitored periodically against KPIs, at the beginning, midterm, or several interim points, and at the end of the project. Regular monitoring and evaluation ensure projects can be adjusted as needed based on local contexts to ensure objectives are achieved. It is common for positive social impact projects to be slightly adjusted to reflect local realities. The monitoring process can also include community members in participatory evaluation – this is an important way to drive inclusiveness and also ensure feedback from local stakeholders is incorporated.

The impact assessment must focus on outcomes. For example, if an applicant implements a training for small scale producers that results in an increased number of qualified workers to perform skill-based work, neither the training or the number of workers are KPIs that show the impact of the project. In this case, the impact was improved productivity, capacity, logistics, and market efficiency of the producer's operations, which increased profits and the ability to support their families.

Gold Level Recertification: Demonstrating Progress

For recertification at the Gold level, measurable progress must be demonstrated by the impact assessment (i.e., the assessment must demonstrate positive impact). Best practice is to demonstrate impact using an impact KPI.

References:

UN Guiding Principles Reporting Framework: Salient Human Rights Issues (UNGP Reporting Framework, 2015)

Business for Societal Impact (B4SI) Guidance Manual (Corporate Citizenship, 2020)

World Bank Community Driven Development

Required Documentation

Silver Level

- Description of which issue(s) or opportunity(ies) are addressed that the applicant company identified from the risk assessment process. If the project focuses on an issue separate from those identified in the risk assessment process, an explanation of how this issue was chosen - which must include relevance to at least one stakeholder group (as defined in 8.1).

- Description of measurable outcomes that are planned for the project, and one or more KPIs that is being tracked, before, during, and after the project to demonstrate improvement/change.
- Documentation of employee input received and/or employee engagement process. This could include email communication, meeting notes, survey responses, etc.

Gold Level

- Impact assessment report, including tracking of defined KPI(s) developed at the Silver level, and evaluation of progress since project initiation.

Gold Level Recertification

- An updated impact report that demonstrates positive impact via evaluation of the defined KPI(s).

8.9 Transparency and Stakeholder Engagement

Intended Outcome(s)

The applicant company is held accountable for any negative human rights impacts, encouraging ever improving performance.

Applicable Achievement Level(s)

Silver and Gold

Requirement(s)

Silver level: Use open and transparent governance and reporting, making information on how human rights risks are managed and adverse impacts are addressed publicly available.

Gold level: Incorporate stakeholder engagement and feedback into human rights risk management, using it to shape company strategy and operations.

For the Silver level, the applicant must make the following information publicly available:

1. The human rights policy, objectives, and progress toward achieving objectives (i.e., activities and outcomes),
2. A description of adverse impacts on human rights and how they are addressed, and
3. Sourcing information including number of suppliers by geographic location. Required for the final manufacturing stage, direct suppliers to the final manufacturing stage, and suppliers of high-risk components and raw materials (when such information becomes available or at a minimum for the Gold level when identified as required per Section 8.1).

For the Gold level, the applicant must have a robust process for accepting or soliciting, and responding to, stakeholder feedback. Input from stakeholders must be regularly obtained and used to shape the strategy for implementing the human rights policy, management systems, and related operations.

Further Explanation

Silver Level: Transparency

The UN Guiding Principles on Business and Human Rights expect a human rights policy statement be publicly available, and communicated actively to entities with which the enterprise has contractual relationships;

others directly linked to its operations, which may include State security forces; investors; and, in the case of operations with significant human rights risks, to the potentially affected stakeholders.

Under both the UNGPs and the OECD Guidance for Responsible Business Conduct, companies are expected to communicate about their efforts to prevent and address human rights risks as part of their due diligence process. That means communicating with:

- Internal stakeholders, including executives and business units that are involved in assessing and managing human rights risks; and
- External stakeholders, including affected groups, civil society organizations, local communities, topic experts, investors, and anybody else who might be interested in or concerned about your human rights impacts.

Wherever and whenever an applicant identifies a human rights risk (see Section 8.1), it is expected to communicate with potentially affected stakeholders to explain how it is addressing the risk. In this communication, it is important to consider literacy, language, and cultural communication barriers.

Transparency on Adverse Impacts and How They are Addressed

For the Silver level requirement #2, the applicant is required to make information about adverse impacts on human rights that are connected to its business activities publicly available. **The applicant must disclose how it is connected** – e.g., whether it has caused, contributed to, or is linked to – the adverse impact.

The UNGPs define a company's connection to adverse impacts on human rights as follows:
This designation informs its responsibility for providing remediation for the adverse impact.

How a Company is Connected	Definition	Action Required
Cause	Causes an impact through its own activities	• Cease the activity that caused the impact • Provide remedy • Take steps to prevent impact from recurring
Contribution	Contributes to an impact either directly or through some outside entity (government, business or other)	• Cease activity and avoid contribution • Provide remedy • Use leverage to mitigate any remaining impact to the greatest extent possible
Linkage	A company's operations, products, or services are linked to a negative human rights impact through a business relationship (or series of relationships)	• Has forward-looking responsibility to prevent the impact from recurring • No explicit responsibility to provide remedy but can choose to do so

Transparency on Sourcing

For requirement #3 when applying for the Silver level, applicants must make sourcing location(s) publicly available. At a minimum, this must include information about the locations of final manufacturing stage facilities and tier 1 suppliers (i.e., direct suppliers to the final manducating stage of the product). This information may be aggregated at the country level.

For requirement #3 when applying for the Gold level, information regarding the locations of suppliers of high-risk components and raw materials (as defined in Section 8.1) must also be made publicly available. Where sourcing locations of potentially high-risk components and raw materials are unknown, this must also be disclosed.

Gold Level: Stakeholder Engagement and Feedback

Stakeholder feedback may come from investors, suppliers, other business partners, civil society, employees, workers within the supply chain, or community members and locally affected populations – and may be both positive and negative. Feedback may be received through formal and/or informal channels (in contrast to grievance mechanisms, which must be through formal defined processes).

For organizations new to stakeholder engagement, the AccountAbility Stakeholder Engagement Standard AA1000SES provides credible step-by-step guidance focused on steps to plan, prepare, engage, and review/ improve.

AA1000SES advises organizations plan for stakeholder engagement by first conducting stakeholder mapping to have a clear understanding who relevant stakeholders are and how they can engage with the organization. This includes understanding the following of individual and organizational stakeholders:

- "knowledge of the issues associated with the purpose and scope of the engagement;
- expectations of the engagement;
- existing relationship with the organisation (close or distant; formal or informal; positive or negative);
- dependence on the organisation,
- willingness to engage;
- level of influence;
- type (civil society, government, consumer, etc.);
- cultural context;
- geographical scale of operation;
- capacity to engage (e.g., language barriers, IT literacy, disability);
- legitimacy and representation; and
- relationships with other stakeholders."

AA1000SES states that mapping can be "based on any of the criteria used to characterise the stakeholders, per above, and should focus on determining which groups and individual representatives are most important to engage with in relation to the purpose and scope of the engagement. Some considerations include evaluating stakeholder's influence vs. willingness to engage, type of stakeholder vs. level of influence, or capacity to

engage and knowledge of issues against expectations. Setting clear criteria for mapping stakeholders better enables the owners of the engagement to steer the engagement away from being driven by non-strategic considerations such as the 'noisiest' stakeholders, the short-term focus of the media, or the comfort zone of managers. While initial profiling and mapping may take place without the systematic involvement of stakeholders, as engagement takes place and practice matures, relevant stakeholders should be involved in this process and outcomes adjusted accordingly."

Note that stakeholder feedback policies are required as part of ISO 9001. Certification to ISO 9001 may be used to demonstrate compliance with the stakeholder feedback portion of this requirement.

References

AccountAbility Stakeholder Engagement Standard AA1000 SES (AccountAbility, 2015)

ISO 9001 (ISO, 2015)

OECD Guidance for Responsible Business Conduct (OECD, 2018)

UN Guiding Principles on Business and Human Rights (United Nations, 2011)

Required Documentation

All or some of the information required may, for example, be published in the applicant company's Sustainability Report, website, Human Rights Report, or Modern Slavery Act statement. Provide links to all relevant documents/information.

Silver Level

Evidence that the applicant company makes the following information publicly available must be provided.

- The human rights policy, objectives, and activities.
- A description of adverse impacts on human rights connected to the company's business activities and how they are addressed. Note that adverse impacts can reflect the issues found in the risk assessment or human rights policy (see Section 8.1 and 8.2) and may include adverse impacts that are reported through monitoring, verification, or corrective actions taken (see Section 8.3); or uncovered through grievance mechanisms (see Section 8.7). The publicly available information must include how the company is connected – e.g., whether it has caused, contributed, or is linked – to the adverse impact.
- The number of final manufacturing and tier 1 suppliers by country.

Gold Level

- Evidence that the applicant company makes the following information publicly available: The number of suppliers of high-risk components and raw materials by country, or disclosure that the location(s) is/are unknown (as relevant).
- A written process in place at the applicant company for accepting or soliciting, and responding to, stakeholder feedback. This could be a defined process and/or disclosed in an external document.

8.10 Collaborating to Solve Social Issues

Intended Outcome(s)

Industry-wide progress is made toward solving social issues that are widely recognized as being difficult and complex.

Applicable Achievement Level(s)

Platinum

Requirement(s)

Collaborate to develop and scale solutions to an intractable social issue within the value chain of the product.

Collaboration must be with a multi-stakeholder program or consortium working on a common goal to comprehensively address a social issue. The applicant must actively participate for the full certification period. The initiative selected must:

1. Support implementation of the company's social strategy and policy.
2. Aim to drive progress within an industry or across multiple industries.
3. Ensure that ground rules for the partnership allow for adequate voice for all participants.
4. Include ongoing assessment of partnership impact.

Further Explanation

Multi-stakeholder programs or multi-stakeholder initiatives bring together businesses, governments, civil society, and/or other stakeholders to address issues of mutual concern. They do this through collective action, creating new market frameworks, serving as intermediaries, and overall focus on collaboration to address social (and environmental) issues. Their efforts can focus on advocacy, trade, public policy, new business incentives, certification schemes, supply chain alignment, agreements with worker organizations, and other topics at national, regional, or sector levels.

It is important to consider the objectives of multi-stakeholder initiatives in the purpose of solving a problem. Credible multi-stakeholder initiatives have well-established program governance, membership criteria, participation qualifications, and requirements for implementation. Many also require fees and can offer resources for engagement and to support the initiative's objectives and outcomes. Best practice is for multi-stakeholder initiatives to publicly communicate these elements. According to the World Economic Forum on Corporate Citizenship, there are seven success factors for effective partnership:

1. Openness, transparency, and clear communication to build trust and mutual understanding,
2. Clarity of roles, responsibilities, goals and "ground rules",
3. Commitment of core organizational competencies,
4. Application of the same professional rigor and discipline focused on achieving targets and deliverables that would be applied to governing, managing and evaluating other types of business alliances,
5. Respect for differences in approach, competence, time frames and objectives of different partners,
6. Focus on achieving mutual benefit in a manner that enables the partners to meet their own objectives as well as common goals, and

7. Understanding the needs of local partners and beneficiaries, with a focus on building their own capacity and capability rather than creating dependence.

It is insufficient for the applicant to simply sign on to an initiative; rather, there must be evidence of active participation and ongoing effort.

Participation in a multi-stakeholder initiative may include providing technical expertise, enrolling suppliers as participants in the initiative, participating in advocacy work or public campaigns, or other efforts that result in implementation of a program. Participation may also include financial support. Financial support may be cash, grants, in-kind products/services, or staff secondment.

Applicants must demonstrate efforts to implement solutions and/or initiatives developed through the multi-stakeholder initiative or program into their own operations or value-chain as applicable. In the case where that is not yet available, applicants are expected to advocate with appropriate stakeholders for systemic changes to be made.

References:

Partnering for Success: Business Perspectives on Multi-stakeholder Partnerships (World Economic Forum on Corporate Citizenship, 2005).

Increasing the effectiveness of multi- stakeholder initiatives through active collaboration (World Bank Group, 2014)

Leadership, Accountability and Partnership: Critical Trends and Issues in Corporate Social Responsibility (The Corporate Social Responsibility Initiative, Kennedy School of Government, 2004)

Required Documentation

Platinum Level

- Evidence of the applicant company's participation in the multi-stakeholder program, including timeline or dates of the participation. For example, a link to a list of members and/or a member certificate in the form of an approval for participation by the multi-stakeholder program.
- A description of the initiative and how it aligns with the applicant's social fairness strategy and policy.
- Evidence that the initiative involves at least one industry and is aiming to make progress on a shared social issue.
- Documentation of the initiative's bylaws or governance process that indicates how decisions are made.
- Project plans and/or applicant documentation indicating that a review of the program and activities occurs regularly. This documentation may be generated by the applicant to review the effectiveness of the program and its participation there within, or it may be generated by the multi-stakeholder program and distributed to participants.

If any of the required documentation is not publicly available from the multi-stakeholder initiative, the applicant must acquire documentation from the initiative, signed by a staff member. Signature by email is accepted.

8.11 Fostering a Culture of Social Fairness

Intended Outcome(s)

Socially fair business practices in its governance and management approach are applied by the applicant company. This is reflected by a diverse, inclusive, and engaged workforce and through training, remuneration, and payment of a living wage.

Applicable Achievement Level(s)

Platinum

Requirement(s)

Foster a diverse, inclusive, and engaged work environment in which social fairness operates as a core part of recruitment, training, remuneration, performance evaluation, and incentive structures.

The following are required:

1. Hiring and promotion processes must be evaluated and amended, if needed, to promote inclusivity and equal opportunity.
2. Access to training on key social issues (i.e., those included in the policy or identified per the risk assessment) must be provided to all executives and employees.
3. Awareness training on diversity and inclusion, gender equality, and anti-discrimination must be provided to all staff.
4. Social performance indicators must include ethnicity-, race-, sex- and age-disaggregated data on hiring, compensation, promotion, demotion, training and mentoring for employees of all levels. Exception: If applicable local laws do not permit collection of all or a portion of the required data, the pertinent portion of the requirement is waived.
5. Data must be evaluated for pay equity, including a comparison of the average wages by ethnicity, race, and gender for work of equal value, and the ratio of the compensation of the CEO or equivalent to the median and average wage of a full-time worker. The exception noted in #4 applies.
6. Pay equity data must be published externally and made publicly accessible. An explanation of differences that may be realized or quantified over time must be included. The exception noted in #4 applies.
7. Data on violence in the workplace, including gender-based violence, must be documented where it has occurred.
8. Performance assessments of any executives or employees with designated social responsibilities must include consideration of criteria or metrics derived from the human rights policy and strategy.
    a. Social performance results must be considered in compensation packages / incentive plans for top company executives and management with social management or oversight functions (i.e., from C-level executives to business unit and functional heads).
9. Diversity and equal opportunity employment must be included in the organization's social strategy and implementation. The company must:
    a. Conduct an evaluation to understand why differences in representation by ethnicity, race, and gender exist in the boardroom, the workplace, and the first tier of the supply chain.
    b. Develop and implement a plan for remedying any differences that are or may be attributable to unequal opportunity.

c. Investigate, encourage, and promote equal opportunities for women and racial, ethnic, religious, or economically disadvantaged minorities into supervisory and management roles in the workplace, particularly if they are under-represented in such roles.

10. Employees must be paid a living wage. This is defined as being paid sufficiently for a standard workweek (i.e., not including overtime) to afford a decent standard of living for their families, inclusive of: food, water, housing, education, health care, transportation, clothing, and other essential needs including savings for unexpected events and some disposable income.
11. Program(s) must be implemented to regularly engage employees (including other workers on the premises or under the supervision of the company) on the company's social vision and goals, and to identify actions that will help the company to achieve them.

Further Explanation

Hiring and Promotion (Requirement #1)

The standard requires that *hiring and promotion processes be evaluated and amended, if needed, to promote inclusivity and equal opportunity*. This goes beyond having an equal opportunity and/or non-discrimination policy. It means that applicants are actively taking steps to implement such policies. For example, this may include analyzing and amending job description language to ensure it is culturally sensitive and non-discriminatory, recruiting through organizations serving populations that are currently underrepresented and/or taking actions to reduce, and ideally remove, bias from the hiring process (e.g., blind recruitment and resume review).

Training (Requirements #2-3)

Trainings must occur annually at a minimum and focus on the human rights policy commitment and the key issues and topics embedded within it per Section 8.2 – including human rights, diversity and inclusion, gender equality, and anti-discrimination, among other issues identified in the organization's risk assessment process (per Section 8.1). It is recommended that trainings occur at the time of hire and also include details about how the policy is operationalized throughout business operations and partnerships. All employees are expected to understand the policy and know how it applies to their job and daily activities. Formal training may be complemented by coaching, mentoring, or networks for knowledge sharing on social fairness within the company.

Social Performance Indicators and Data Evaluation for Pay Equity (Requirements #4-5)

The standard requires that: *Social performance indicators must include ethnicity-, race-, sex- and age-disaggregated data on hiring, compensation, promotion, demotion, training and mentoring for employees of all levels* (unless local laws do not allow for these data to be collected). The data must be appropriate to the local and national context. This means that the specific categories of minority or vulnerable groups being tracked will vary according to locality.

These data must be evaluated for pay equity. Pay equity means eliminating discrimination in the wage system. The standard requires that the evaluation include *a comparison of the average wages by ethnicity, race, and gender for work of equal value, and the ratio of the compensation of the CEO or equivalent to the median and average wage of a full-time worker.*

Public Disclosure of Pay Equity Data (Requirement #6)

The pay equity data that is collected per requirement #5 must be publicly disclosed. Publishing pay equity data shows the organization's commitment to achieving equitable ratios.

Documenting Violence in the Workplace (Requirement #7)

Data on violence in the workplace, including gender-based violence, must be documented where it has occurred. Gender-based violence is defined as any form of – or threat of – physical violence, including slaps, pushes, or other forms of physical contact as a means to maintain labor discipline, or any form of sexual harassment.

Performance Assessments (Requirement #8)

Performance assessments of any executives or employees with designated social responsibilities must include consideration of criteria or metrics derived from the human rights policy and strategy. In addition*, social performance results must be considered in compensation packages/incentive plans for top company executives and management with social management or oversight functions (i.e., from C-level executives to business unit and functional heads).* Social fairness criteria or metrics must be evaluated in the same manner as traditional performance metrics and hold equal weight in these evaluations. Examples: a Vice President in a management role may be evaluated on resource allocation that supports social fairness objectives, a Human Resources lead responsible for implementing employee programs may be evaluated on the number of trainings that contain social fairness topics, purchasing staff may be evaluated on the successful completion of due diligence procedures, and a legal professional may be evaluated based on the percentage of contracts that require compliance with the organization's human rights policy or code of conduct.

Diversity and Equal Opportunity as Part of Social Strategy and Implementation (Requirement #9)

Diversity and equal opportunity employment must be included in the organization's social strategy and implementation. This includes (a) conducting an evaluation to understand why differences in representation by ethnicity, race, and gender exist in the boardroom, the workplace, and the first tier* of the supply chain, (b) developing and implementing a plan for remedying any differences that are or may be attributable to unequal opportunity and (c) investigating, encouraging and promoting equal opportunities for women and racial, ethnic, religious, or economically disadvantaged minorities into supervisory and management roles in the workplace, particularly if they are under-represented in such roles. An example of how a company could promote equal opportunity is to provide parental leave for both women and men, including when it is not legally obligated to do so, or provide a longer leave period than is legally mandated. This can provide an opportunity for women to not fall behind in their career trajectories because of childcare (a role traditionally reserved for and filled by women). Another example is providing childcare at the workplace and/or providing flexible schedules to employees.

*Note: 'First tier' refers to the direct suppliers of the applicant company, rather than to tier 1 to the final manufacturing stage of the products (i.e., 'first tier' is used differently here than in other sections of the standard).

Living Wage (Requirement #10)

Paying legally mandated wage levels is a standard expectation of remuneration and is required for the Bronze level. For the Platinum level, applicants must also implement a living wage. In many countries, few companies pay a living wage to all employees. It is also quite unusual for companies to have completed the necessary calculations to determine that a living wage is paid, as there is no internationally agreed definition for living wage. Cradle to Cradle Certified requires that applicants provide an explanation and supporting evidence (i.e., supporting wage data and an explanation of how it was determined that a living wage is paid). One commonly used approach that meets the Cradle to Cradle Certified requirement is the Anker Methodology. The Anker Methodology estimates cost of a basic but decent lifestyle for a worker and his/her family in a particular place, and then determines if that estimated living wage is being paid to workers. The methodology requires transparency and detailed documentation and analysis to ensure that the living wage estimate is solid and credible, and requires considering not only gross cash payment, but also deductions from pay, overtime pay, bonuses, and in-kind benefits.

The Global Living Wage Coalition (GLWC) keeps a resource library of living wage calculations and case studies, by industry and country (some are in progress). Current industries include bananas, coffee, floriculture, garments/textiles, manufacturing, seafood processing, tea. Current countries include Bangladesh, Brazil, China, Colombia, Costa Rica, Dominican Republic, Ecuador, Ethiopia, Ghana, Guatemala, India, Kenya, Malawi, Mexico, Nicaragua, Pakistan, South Africa, Sri Lanka, Uganda, Vietnam. For applicants that are not included in these industries or countries, documentation of the alternative methodology used and how it meets the Cradle to Cradle Certified requirements must be provided.

Some standards, such as Social Accountability International (SAI), include living wage in their requirements. SAI is the owner of the SA8000 standard and promotes the Anker Methodology as a founding member of the Global Living Wage Coalition. However, SA8000 requirements for implementing a living wage are not in cadence with Cradle to Cradle Certified requirements, as the SAI timeline is 18-24 months to achieve a living wage while Cradle to Cradle Certified applicants must have already demonstrated achievement of a living wage when applying for Platinum level.

Employee Engagement (Requirement #11)

The standard requires that *Program(s) must be implemented to regularly engage employees (including other workers on the premises or under the supervision of the company) on the company's social vision and goals, and to identify actions that will help the company to achieve them.* This may occur through formal trainings and events, or informally – for example, via town hall meetings, email communication, an associate portal, and/or video messages.

References

Women's Empowerment Principles and Gap Analysis Tool (United Nations, 2020)

Gender Equality in Codes of Conduct Guidance (Business for Social Responsibility, 2017)

Required Documentation

Platinum Level

The following information is required for the applicant company's own operations (although information about the first tier of the applicant's supply chain is required in #9). The numbers below align with the individual requirement numbers in this section.

1. Procedures describing how hiring and promotion processes are evaluated and updated to promote equal opportunity, inclusion, and diversity.
2. Examples of internal human rights training for executives and employees focused on social issues as identified in the risk assessment (Section 8.1) and/or human rights policy (Section 8.2). Provide examples of training materials and a training log to show completion of training. An example of a log is a schedule of training sessions and list of executive and employee participants.
3. Examples of training on diversity, inclusion, gender equality and anti-discrimination as provided to executives and employees. Training KPIs and/or training attendee lists indicating all staff has received this type of training. Attendee lists must indicate the percentage of employees who have participated for the applicant's entire organization.
4. A list of social performance indicators specific to company operations that meet the requirements. If applicable laws prohibit data collection, evidence of legal prohibition (e.g., a link to the legislation or order).
5. A description of the process for collecting and evaluating pay equity data and data sheets with the information collected, including all of the indicator-specified wage comparisons. If applicable laws prohibit data collection, evidence of legal prohibition (e.g., a link to the legislation or order).
6. Evidence of public disclosure of pay equity data (e.g., a link to the web page or report where this information is disclosed). If applicable laws prohibit data collection, evidence of legal prohibition (e.g., a link to the legislation or order).
7. A process to document violence, including gender-based violence, in the workplace and current data as proof that such data are being actively collected.
8. Evidence of inclusion of human rights and/or social responsibility goals in annual performance objectives and assessments for executives and/or employees with designated social responsibilities. Metrics included in performance assessments may include implementation of employee training, risk assessment, sourcing decisions that include social performance evaluation, supplier management, evaluation of supplier non-compliances, etc. Provide a sample of performance reviews to demonstrate that social criteria are included.

   Description of compensation package terms for executives and management with social responsibility oversight, to confirm inclusion of social performance results/criteria. Where there are several executives and/or management team members with these responsibilities, provision of an example (i.e., one or two plan(s)) is sufficient.
9. Internal strategy documents and/or external documents that indicate diversity and equal opportunity employment is included in the organization's social strategy and activities. External documents may include relevant information provided by the applicant in an annual report or sustainability report.

a . Documentation of the process for evaluating differences that exist based on ethnicity, race, and gender. This may include evaluation of cultural norms or other factors. Documentation of recommendations for increasing diversity and equal opportunity where needed.

The applicant must document its understanding of differences based on location, cultural, and legacy contexts in its submission. These factors may differ at each level of the organization – e.g., board room, workplace, and first tier of supply chain; therefore, documentation must clearly identify applicability for different contexts (where the applicant has multiple entities or management processes within an organization). It is not enough to provide a statement that evaluation is considered and/or takes place. Note: In this case, 'first tier' refers to direct suppliers to the applicant company.

b . Documentation of efforts to achieve the diversity strategy. This may include focused recruiting efforts and internal KPIs to measure progress on diversity targets.

c . Documentation of existing demographics in supervisory and management roles to compare to full employee population statistics as baseline information.

Documentation of activities for promotion of minorities in supervisory or management roles, where under-representation exists. Evaluation of the need to create an environment for promoting minorities into supervisory and management roles, which may include an analysis of existing management's willingness to change existing practices. Promotion activities could include developing processes and training provided for minority groups to encourage upward advancement such as training seminars, e-learning modules, mentoring circles and/or programs.

Documentation of planning, training, or programs for upward advancement are required for both the applicant and first tier of the supply chain. Note: In this case 'first tier' refers to direct suppliers to the applicant company, rather than to tier 1 to the final manufacturing stage of the products.

10. Analysis for how a living wage has been calculated and implemented, including supporting evidence (e.g., specific wage data and evaluation of whether wages paid meet criteria for living wage). Documentation must include review of the applicant's lowest paid position compared to the living wage. If the Anker Methodology is not employed, the applicant must provide the following:
    - A detailed explanation regarding how the living wage was calculated and references used.
    - The rationale for using this method rather than the Anker Methodology.
    - A list of other organization(s) that have used and/or support the method that the applicant has submitted.
11. Examples of employee engagement on the applicant company's social vision and a description of how these communications have helped to support the company's social vision and goals.

9 // Packaging for Certified Products

The requirements in this section apply to the packaging of a product seeking certification. At a minimum, the packaging for a product seeking certification is subject to the requirements listed in this section.

Alternatively, packaging may be:

1. Certified as a separate product –– In this case, the product must meet all standard requirements, the same as other products. Note that standard Sections 2.3 and 5 include requirements specific to single-use plastic packaging when certified as a separate product.
2. Assessed separately from the product in the Material Health and Product Circularity categories only –– In this case, the achievement levels for these two categories are assigned to the packaging separately, and are separately stated on the product's certificate and in the Cradle to Cradle Certified Product Registry. If this option is selected, the packaging is not certified in its own right and is not subject to the Clean Air & Climate Protection, Water & Soil Stewardship, or Social Fairness requirements.

Intended Outcome(s)

Product packaging meets high product circularity standards at the entry level of certification, ensuring alignment with the Cradle to Cradle principles for these typically non-circular product types.

Applicable Achievement Level(s)

Bronze

Requirement(s)

For product packaging, design the packaging for cycling, incorporate cycled content, and ensure access to cycling.

The following are required:

1. The primary packaging materials for formulated consumer products that are fast-moving consumer goods, including cosmetics, personal care, and household and industrial/institutional cleaning products, and for any product, packaging materials that are intended to be used with the product or for the application or dispensing of the product (e.g., mascara brush, lipstick tube, or other types of applicators, paper towel or toilet paper cores, tape dispenser, glue stick), must comply with:
    a. The RSL (Section 4.1),
    b. The restriction on organohalogens and functionally related chemicals of concern (Section 4.2), AND two of the following from c, d, e, and f below:
    c. The sum of post-consumer cycled and renewable content must be ≥ 20% or equal to the percentage of cycled and renewable content required for the Silver level per Section 5.4 Increasing Demand.
    d. 90% of the packaging materials by weight meet all cycling requirements below or meet the Silver and Gold level requirements, respectively, in Sections 5.2 Preparing for Active Cycling and 5.5 Material Compatibility for Technical and/or Biological Cycles:
        i. The packaging must be compatible for municipal cycling systems,

ii. Plastic materials must be a type that is commonly recycled or composted via curbside pickup (i.e., PET, HDPE, PP, bioplastics) and the material must be accepted by municipal recycling programs in the region(s) where the product is sold,
iii. Materials that are intended for composting must be fully compostable per a C2CPII-recognized compostability standard consistent with the intended cycling pathway(s), and
iv. Materials that are commonly recyclable (e.g., paper, steel, aluminum) must not contain additives or features that are likely to result in low-value (i.e., low-quality) reprocessed material. Additives that may be present in the recycled content used are out of scope for this determination. Exemption: Glass is exempt from this requirement.

e. The packaging is reusable/refillable, is part of a refill system (e.g., refill pouches), and/or the packaging has a product-specific take-back program.
f. The applicant has demonstrated efforts to reduce the amount or weight of the packaging materials for the certified product or has met the Gold level requirements in Section 5.7 Circular Design Opportunities and Innovation.

2. Any other packaging materials contained in one sales unit as it is offered to the end user or consumer at the point of purchase and not added exclusively for shipping (e.g., a toothpaste box, outer box containing individually wrapped product units), must comply with:
   a. The restriction on organohalogens and functionally related chemicals of concern (Section 4.2), AND one of the following from b, c, d, and e below:
   b. The sum of post-consumer cycled and renewable content must be ≥ 20% or equal to the percentage of cycled and renewable content required for the Silver level per Section 5.4 Increasing Demand.
   c. 90% of the packaging materials by weight meet all cycling requirements below or meet the Silver and Gold level requirements, respectively, in Sections 5.2 Preparing for Active Cycling and 5.5 Material Compatibility for Technical and/or Biological Cycles:
      i. The packaging must be compatible for municipal cycling systems,
      ii. Plastic materials must be a type that is commonly recycled or composted via curbside pickup (i.e., PET, HDPE, PP, bioplastics) and the material must be accepted by municipal recycling programs in the region(s) where the product is sold,
      iii. Materials that are intended for composting must be fully compostable per a C2CPII-recognized compostability standard consistent with the intended cycling pathway(s), and
      iv. Materials that are commonly recyclable (e.g., paper, steel, aluminum) must not contain additives or features that are likely to result in low-value (i.e., low-quality) reprocessed material. Additives that may be present in the recycled content used are out of scope for this determination. Exemption: Glass is exempt from this requirement.
   d. The packaging is reusable/refillable, is part of a refill system (e.g., refill pouches), and/or the packaging has a product-specific take-back program.
   e. The applicant has demonstrated efforts to reduce the amount or weight of the packaging materials for the certified product or has met the Gold level requirements in Section 5.7 Circular Design Opportunities and Innovation.

The following materials are not subject to the packaging requirements:

1. Materials used exclusively for shipping the product, such as a box, pallet, or shrink/plastic wrap, that are not the primary packaging materials that contain, envelop, or hold the product.

2. Packaging materials for products that are sold exclusively as material inputs for other products (rather than being sold to the general public).

Further Explanation

The requirements in this section apply to the packaging of a certified product. **All requirements apply, regardless of the achievement level for the product itself.**

As noted, packaging and other materials used exclusively for shipping the product (e.g., polybags, boxes, pallets) are out of scope. In addition, packaging for products that are sold as inputs to other products is also out of scope.

Complying with the Restricted Substances List (RSL) (Requirement #1.a)

See standard Section 4.1 Restricted Substances List Compliance in the Material Health category for guidance on achieving this requirement.

For materials that do not contain recycled content, declarations from packaging suppliers stating that the packaging does not include restricted substances above the indicated limits are required as evidence of RSL compliance. Declarations must be collected for all packaging components including inks, adhesives, and minor parts such as pumps.

The Restricted Substances List may be found on C2CPII's website and the RSL Declaration is available to Cradle to Cradle Certified assessors. The core restricted substances list (tab titled "All_Products") applies to all packaging materials.

RSL compliance for paper and materials designated for composting

For paper and materials designated for composting, the biological nutrient list also applies. Per the RSL (see the Definitions and Scope tab): *Biological Nutrient Materials – The restrictions on this list apply to BN materials subject to review in any product. For the purpose of this list, BN materials are those that fall under one or more of the following categories: (1) Materials released directly to biosphere as part of their intended use or end of use (liquid formulated products, aerosols, materials designed for composting or other biodegradation pathways, etc.), (2) Materials for which partial or complete release to environment is unavoidable as a part of use or end of use of the product (paint, materials designed to abrade such as brake pads, shoe soles, sliders, etc.), (3) Biological materials (wood, agricultural products, etc.) or biologically derived materials that are commonly regarded as compostable/ biodegradable (paper, cellulose, etc.).*

RSL compliance for materials containing recycled content

For recycled content materials from sources that cannot be fully defined (i.e., post-consumer sources and many pre-consumer sources as well), analytical testing is required to confirm compliance with the RSL. At a minimum, this must include the Bronze level testing requirements per the Recycled Content Materials Assessment Methodology and related list of analytes. Testing frequency is at least once per certification cycle (i.e., at least once every two years). Refer to the Recycled Content Materials Assessment Methodology (linked above) for additional information. Note that Silver level analytical testing is not required unless the packaging will be assessed separately and/or certified separately from the product itself, and the application will be for achievement above the Bronze level.

For materials that are **not** biological nutrients (e.g., plastic packaging), analytical testing must be conducted for the metals included in the table below. The limits listed below apply. Note that these limits apply to total concentration of the metal within the material rather than to leached or migrated amounts.

Chemical Name	Maximum allowable concentration (ppm)
Arsenic and its compounds	1000
Cadmium and its compounds	100
Chromium VI and its compounds	1000
Mercury and its compounds	1000
Lead and its compounds	1000

For biological nutrient materials (e.g., paper), several additional metals and metalloids must be tested for and different limits apply as listed below. For biological nutrient materials, the limits are migration limits per the European Union Toy Safety Directive. However, if testing demonstrates that total concentration for each metal and metalloid is below the limits listed, this is acceptable as well (if the total concentration of a metal in the material is less than a migration limit, it is not possible for the migration limit to be exceeded).

Chemical Name	Maximum allowable concentration (ppm) or amount migrated
Antimony and its compounds	560
Arsenic and its compounds	47
Cadmium and its compounds	17
Chromium, trivalent, and its compounds	460
Chromium, hexavalent, and its compounds	0.2
Cobalt and its compounds	130
Lead and its compounds	160
Mercury and its compounds	94
Nickel and its compounds	930
Selenium and its compounds	460

Complying with the Restriction on Organohalogens and Functionally Related Chemicals of Concern (Requirements #1.b and #2.a)

See standard Section 4.2 Avoidance of Organohalogens and Functionally Related Chemical Classes of Concern in the Material Health category for guidance on achieving this requirement.

For materials that do not contain recycled content, declarations from suppliers stating that the packaging complies with this restriction are accepted as evidence of compliance. This may be achieved via use of the same RSL declaration mentioned above because the RSL itself includes lines relevant to these restrictions. Alternatively, elemental analysis as described below for recycled content may be employed.

For materials containing recycled content from sources that cannot be fully defined, analytical testing is required to confirm compliance with this restriction. Conformance may be determined per elemental analysis. The restriction has been met if the combined elemental concentration of Cl and Br are <1000 ppm and the concentration of F is < 1000ppm. If these limits are exceeded, additional, more focused testing will be

necessary to ensure compliance with these restrictions. Refer to the Recycled Content Materials Assessment Methodology for additional information. Note that analytical testing is not required for the functionally related chemicals of concern (i.e., the organohphosphate ester flame retardants). Rather, RSL declarations alone may be employed for this restriction.

Circularity Requirement Options (Requirements #1.c-f and #2.d-g)

For products within the same group (i.e., that are applying under a single Cradle to Cradle Certified certificate), or for applicants with more than one certificate, individual packaging types may achieve the circularity requirements differently, as long as at least one or two (as applicable for the packaging type) have been achieved.

Achieving the Required Percentage of Post-consumer Recycled and/or Renewable Content (Requirements #1.c and #2.b)

Requirement: *The sum of post-consumer cycled and renewable content must be ≥ 20% or equal to the percentage of cycled and renewable content required for the Silver level per Section 5.4 Increasing Demand.*

The definition of renewable content in the standard Definitions section applies:

Renewable content – Material derived from a living, natural resource (agriculture, aquaculture, or animal- derived) that can be continually replenished. Material must be legally harvested, as defined by exporting and receiving country. If the material is wood, or another material associated with extensive evidence of ecosystem destruction due to land conversion and/or poor management practices, to count as renewable the material must be certified by a C2CPII-recognized program as responsibly sourced. If the material is a biologically derived plastic or liquid formulation, material only counts as renewable if its bio-based content has been quantified using radiocarbon dating or through chain of custody documentation showing derivation from natural resources.

This means that for wood-based paper made from virgin wood pulp to count as renewable it must be certified to a C2CPII-recognized responsible sourcing standard. In other words, for paper made from 100% virgin wood pulp, at least 20% must be responsibly sourced per an applicable standard to achieve this requirement. See standard Section 5.4 Increasing Demand: Incorporating Cycled and Renewable Content for additional information on C2CPII-recognized responsible sourcing standards.

Applicants may achieve these requirements on a per package basis or based on the average amount of post-consumer recycled and renewable content for all Cradle to Cradle certified products over the prior year (for new certifications) or prior two years (for recertifications). If meeting the requirement based on the average, a signed commitment to tracking and maintaining compliance over the next two years is also required. If employing this approach, the methods employed to demonstrate compliance with the California packaging law must be applied.

For this requirement (Section 9), the amounts of post-consumer recycled and renewable content may be verified via a declaration from the applicant. Verification per chain of custody documentation, either as part of the Cradle to Cradle certification process or via use of a C2CPII-recognized cycled content certification, is recommended. See the Required Documentation section below for additional information on chain of custody.

Achieving this requirement per Section 5.4: As noted in the standard, an alternative to achieving ≥ 20% post-

consumer recycled or renewable content is to achieve the Silver level requirements per Section 5.4. Refer to the reference document titled *Cradle to Cradle Certified® Required Percentages of Cycled and Renewable Content by Product and Material Type* (see the Packaging & Single Use Products tab) for Silver level requirements by material type. However, note that in most cases the required percentages for packaging as listed in this document will be greater than 20%. In other words, it will usually be less difficult to achieve the sum of post-consumer cycled and renewable content must be ≥ 20% than to achieve the required percentages per the Required Percentages of Cycled and Renewable Content by Product and Material Type reference document. In addition, the Product Circularity section of the standard requires that: *For commonly recycled biological and biologically derived materials, renewable content counts half as much as recycled content toward meeting the required cycled and/or renewable content percentages*. If meeting the percentages in the Required Percentages of Cycled and Renewable Content by Product and Material Type reference document rather than the 20%, this requirement also applies.

Achieving the Compatibility Requirements (Requirements #1.d and #2.c)

Requirements: *90% of the packaging materials by weight meet all cycling requirements below or meet the Silver and Gold level requirements, respectively, in Sections 5.2 Preparing for Active Cycling and 5.5 Material Compatibility for Technical and/or Biological Cycles*:

i. *The packaging must be compatible for municipal cycling systems.* Refer to the guidance for standard Section 5.5 Material Compatibility for Technical and/or Biological Cycles (see Section 5.5. Bronze level requirement #3) for a list of compatibility requirements by material type.

ii. *Plastic materials must be a type that is commonly recycled or composted via curbside pickup (i.e., PET, HDPE, PP, bioplastics) and the material must be accepted by municipal recycling programs in the region(s) where the product is sold.* This means that only PET, HDPE, PP and bioplastics are eligible to meet this requirement.

iii. *Materials that are intended for composting must be fully compostable per a C2CPII-recognized compostability standard consistent with the intended cycling pathway(s).* Refer to the guidance for standard Section 5.5 Material Compatibility for Technical and/or Biological Cycles (see Section 5.5. Bronze level requirement #4.c) for a list of C2CPII-recognized compostability standards.

iv. *Materials that are commonly recyclable (e.g., paper, steel, aluminum) must not contain additives or features that are likely to result in low-value (i.e., low-quality) reprocessed material. Additives that may be present in the recycled content used are out of scope for this determination. Exemption: Glass is exempt from this requirement.* Refer to the guidance for standard Section 5.5 Material Compatibility for Technical and/or Biological Cycles (Gold level high-value cycling requirements) for a list of additives and features that likely result in low-value reprocessed material.

Refill/Reuse and Product Specific Take-back Program (Requirements #1.e and #2.d)

No additional guidance is provided. Refer to Required Documentation section below.

Weight Reduction (Requirements #1.f and #2.e)

Requirement: *The applicant has demonstrated efforts to reduce the amount or weight of the packaging materials*

for the certified product or has met the Gold level requirements in Section 5.7 Circular Design Opportunities and Innovation. Paraphrasing from standard Section 5.7 Circular Design Opportunities and Innovation, weight reductions receive credit when they have led to at least a 10% decrease in material weight compared to packaging used for the same or a similar product type, or for packaging that requires at least 10% less material than the average package of the same type and function. Refer to Container Compliance Options: Rigid Plastic Packaging Container (RPPC) Program (CalRecycle) for additional guidance and calculation methods.

Refer to Section 5.7 Circular Design Opportunities and Innovation for design opportunities and innovations that also receive credit (i.e., as alternatives to weight reduction).

Required Documentation

- Description of product packaging and if/how it fits into the categories of packaging types subject to the requirements (i.e., primary packaging materials for formulated consumer products that are fast-moving consumer goods, packaging materials that are intended to be used with the product or for the application or dispensing of the product, or other packaging materials contained in one sales unit as it is offered to the end user or consumer at the point of purchase and not added exclusively for shipping).

For compliance with the restricted substances list, organohalogen, and functionally related chemicals of concern requirements (requirements #1.a and b applicable to packaging of fast moving consumer goods and packaging intended to remain with the product during use):

- RSL declarations for all packaging components/materials
- If using recycled content materials, analytical test results (i.e., for the metals, metalloids for biological nutrients, Cl, Br, and F)

For compliance with the organohalogen and functionally related chemicals of concern restriction ONLY (requirement #2.a):

- Supplier declarations (the RSL declaration, or a simplified declaration applicable only to the Section 4.2 restrictions may be employed)
- If using recycled content, analytical test results (i.e., for Cl, Br, and F)

For compliance with the post-consumer recycled and renewable content requirements (requirements #1.c and #2.b):

- C2CPII Bill of Materials Form (or similar) for the packaging with the columns applicable to use of cycled and renewable content (Section 5.4) complete.
- Signed declaration from the applicant stating the percentage of post-consumer and recycled content in the packaging, source(s) of renewable content, and explaining how the percentages have been verified by the applicant. Recommended: Chain of custody documentation (per the Product Circularity Section 5.4, Required Documentation) or C2CPII-recognized recycled content certification certificate.
- Explanation regarding how any renewable content meets the definition of renewable per the standard Definitions section. For wood-based packaging such as virgin wood-based paper, C2CPII-recognized program certificate and evidence of purchase.

- If achieving this requirement based on averages, data and calculations demonstrating how the average has been ≥ 20% over the prior year (for new certifications) or prior two years (for recertifications) and signed commitment to maintaining this percentage over the next two years at a minimum.

For compliance with the compatibility requirements (requirements #1.d and #2.c):

- C2CPII Bill of Materials Form (or similar) for the packaging with the columns applicable to compatibility (Section 5.5) complete.
- Explanation regarding how each of the requirements has been achieved. Referring to the applicable sections of the Product Circularity guidance (i.e., Section 5.5 Bronze and Gold levels).

For compliance with the reusable/refillable or part of take-back program requirement (requirements #1.e and #2.d):

- Photos of packaging and explanation of how the refill or reuse system functions and is communicated to customers (e.g., links to relevant website and/or photos of this information as included on the packaging itself)

and/or,

- Description of the product-specific take-back program, partnerships involved (if any), and evidence regarding how the program is communicated to customers (e.g., links to relevant website and/or photos of this information as included on the packaging itself).

For compliance with the weight reduction or other design opportunity requirements (requirements #1.f and #2.e):

- Description of the weight reducing design and how it has enabled the use of less material. Data and calculations showing how the product weight changed and over what time period.

or

- Required documentation per Section 5.7 Circular Design Opportunities and Innovation if a different opportunity is selected.

10 // Animal Welfare Requirements

Several animal material types may not be used in certified products (see eligibility restrictions in the User Guidance). The requirements in this section apply to animal materials and substances derived from animal materials that are eligible for certification. The eligible materials and substances to which the requirements in this section apply are:

1. By-products of meat production and fishing (e.g., leather, sheepskin, down, fish skin - excluding fur), or
2. Material sourced from animals that do not have to be killed or live-plucked in order to harvest the material (e.g., sheep's wool).

For substances derived from by-products (e.g., substances derived from fat, skin, bone): The requirements in this section apply only if these substances are inextricably tied to the product's core functionality (e.g., products made entirely from gelatin, collagen, chondroitin, squid ink, or tallow, and products containing these substances, if tied to core functionality).

Note: These requirements do not apply to material from invertebrates for which clear evidence of sentience does not exist.

Intended Outcome(s)

The welfare of the animals is protected during all production phases when material from animals is used in a certified product.

Applicable Achievement Level(s)

Bronze and Silver

Requirement(s)

Bronze level: For products containing animal material, commit to protecting animal welfare through company policy. Develop a strategy and plan for implementing a mechanism that aims to ensure adherence to the policy and demonstrate progress toward implementing the policy and mechanism.

Silver level: Use materials and substances certified to a C2CPII-recognized animal welfare certification program, or equivalent alternative.

For the Bronze level, the applicant must have a policy in place that forbids animal abuse at all facilities where the animals are raised and/or slaughtered (including any facilities in the supply chain), and during transport. The policy must:

1. Address the five freedoms:
    a. Freedom from hunger and thirst
    b. Freedom from discomfort
    c. Freedom from pain, injury, and disease
    d. Freedom to express normal behavior
    e. Freedom from fear and distress
2. Prohibit specific practices of high concern for the animal-derived material type in question (e.g., mulesing of sheep).

3. Include provisions to immediately address cases where it becomes known that animal abuse is occurring (e.g., a provision to immediately cease doing business with affected suppliers until the issue is resolved).

The planned mechanism for implementing the policy must include:

1. Regular on-site surveillance of all relevant facilities by individuals knowledgeable of animal health and welfare issues to verify implementation of the policy.
2. A method of tracking material from farm to certified product in any case where the farm is not the final manufacturing stage.

For the Silver level:

1. The animal welfare certification or alternative must address all required points of the policy (per the Bronze level requirements) and include regular site surveillance of all relevant facilities by third-party auditors knowledgeable of animal health and welfare issues. Regular site surveillance is defined as at least one on-site audit every two years including an allowance for conducting unannounced audits.
2. If using an equivalent alternative to certification, qualified third-party auditors without a conflict of interest (i.e., no other paid services provided to the applicant) must verify equivalency and policy implementation.

Further Explanation

Eligibility

As noted, only by-products of meat production or fishing, and material from animals that do not have to be killed or live plucked to obtain the material, are eligible. In addition, per Section 2.1 of the standard, all fur is ineligible, including when it is a by-product and regardless of whether or not it has been removed from the hide or skin. Material from cephalopods is also ineligible. The animal welfare requirements currently do not apply to silk worms, although production typically does require killing moth larvae, pupae, and adults. A recommended best practice for silk is to specify silk for which moths are allowed to emerge prior to utilizing the cocoons. See Section 2.1 of the standard for additional information on eligibility.

The following material types are commonly understood to be by-products of meat production: Cow leather and hides, sheepskin, and down. However, for any animal material, third-party verification that a material is indeed a by-product may be requested by C2CPII should the application audit surface concerns about whether or not this is the case.

Bronze Level: Welfare Policy

Applicants are required to conduct research into the issues applicable to the animal material(s) used in the product to gain an understanding of the specific issues relevant to ensuring the five freedoms are provided for the animal species used. Practices of high concern must also be investigated. As noted, the policy must apply to animal husbandry and also to practices occurring during transport and in the slaughterhouse, the latter of which are more easily overlooked, as they are often outside the control of the farmer/grower. The policy must explicitly include commitments to ensuring that any practices of high concern identified via the research are avoided. For example, mulesing of sheep (as noted in the standard) is of concern for wool and sheepskin, as is live plucking of birds for down. It is recommended that the policy also commit to ensuring specific husbandry

techniques known to enhance the welfare of the species being used, regardless of whether these techniques are currently required by law or by animal welfare certifications.

It is important to note that the Bronze level of certification is only applicable for up to four years (i.e., two two-year certification periods), after which applicants are required to advance to the Silver level. Refer to standard Section 1.3.3 for additional information.

Silver Level: C2CPII-recognized Welfare Certifications

Currently recognized animal welfare certification programs are as follows:

- Responsible Wool Standard – *provisionally recognized through 31 December 2022; pending review*
- Responsible Down Standard – *provisionally recognized through 31 December 2022; pending review*

Additional programs may be recognized and subsequently added to this list. Refer to Appendix 2 in this guidance document for requirements and the application process for recognition. Appendix 2 also lists requirements for 'alternative equivalents to certification'.

Note that organic certification does not fulfill the Silver level animal welfare requirements.

Required Documentation

Bronze level

- Explanation regarding how it can be ensured that the material is a by-product (if applicable) and, for down, that live plucking does not occur.
- Summary of practices that will enhance animal welfare during all production phases for the species used (farming/growing, transport, slaughter), identification of any issues of high concern, and references used.
- Company policy that includes all required points. This must include a zero tolerance stance for mulesing and live plucking, as applicable.
- Description of the planned mechanism for ensuring policy implementation including required points #1-2 (i.e., surveillance and tracking).
- Procedure for addressing any policy non-compliances identified.

Silver level

- Animal welfare certification certificate.
- If the certification was obtained by a supplier of the applicant, evidence of purchase of the animal material from the certification holder/supplier (e.g., purchase order, receipts).

11 // Private Label Product Requirements

A private label product is a product that is identical in every way to another product that is currently Cradle to Cradle Certified (i.e., the parent product), except for brand name and packaging.

Companies applying for a private label product certification must meet the following requirements:

1. Complete and sign a Private Label Verification Form stating that the product is identical to the certified parent product,
2. If necessary for the achievement level in the Product Circularity category met by the parent product, make a connection to the original equipment manufacturer's or parent product company's take-back program(s) or other cycling initiatives in order for the product to be cycled as intended, and
3. Unless meeting all standard requirements per the option below, disclose that the certification is a private label certification. (C2CPII will indicate which certifications are private label product certifications on the Cradle to Cradle Certified Product Registry and on Cradle to Cradle Certified certificates.)

All other program requirements will have been met by the parent product company rather than by the private label company.

If a company does not wish to disclose that the product has a private label certification, the product and company must meet all standard requirements (although the majority will have already been met by the manufacturer and parent company). This will include:

- The company-level Social Fairness requirements, and
- The company-level Environmental Policy and Management requirements unless already met by the final manufacturing stage.

For further information about private label certifications, see the Policy for Certification of Private Label Products within the Cradle to Cradle Certified® Certification Scheme.

Required Documentation

- C2CPII Private Label Verification Form
- Explanation regarding how the Product Circularity requirements have been met (e.g., if the original manufacturer has achieved the requirements through a product specific take-back program, describe how the private label product will also be recycled through this pathway)
- Agreement to disclose that the product is a private label on C2CPII's web registry (this may be done on the Private Label Verification Form) or evidence that all applicable company level requirements have been met

12 // Definitions

Anaerobic digestion – The process by which microorganisms biologically decompose material into carbon dioxide, methane, water, inorganic compounds, and/or biomass in an anaerobic environment (absence of oxygen), within a limited time period.

Baseline water stress – Measures the ratio of total water withdrawals to available renewable surface and groundwater supplies. Water withdrawals include domestic, industrial, irrigation, and livestock consumptive and non-consumptive uses. Available renewable water supplies include the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users. - WRI Aqueduct, 2019

Benign minerals – Inorganic salts that contain cations and anions that are considered compatible with or beneficial to biological life processes.

Biodegradable material – A material that can undergo near-complete biological decomposition into carbon dioxide, water, inorganic compounds, and biomass in a natural medium (soil, water, or anaerobic environments) within a limited time period, thereby efficiently returning nutrients from the material back to the earth.

Bioenergy credit multiplier – A unitless factor used to calculate the bioenergy credit. The bioenergy credit multiplier is equal to: [1- (adjusted Biogenic Assessment Factor for the eligible fuel)].

Biogenic assessment factor – A unitless factor that represents the net atmospheric biogenic CO2 contribution associated with using a biogenic feedstock at a stationary source, taking into consideration biogenic landscape and process attributes associated with feedstock production, processing, and use at a stationary source, relative to the amount of biogenic feedstock consumed. This term represents a ratio of the net biogenic carbon cycle effects from all stages of the growth, harvest/collection, processing, and use of a biogenic feedstock relative to the carbon content of biogenic feedstock used at the point of assessment and resulting in stack emissions at a stationary source. [Reference: U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Atmospheric Programs, Climate Change Division. Framework for Assessing Biogenic CO2 Emissions from Stationary Sources, November 2014] BAFs modeled using future anticipated baselines developed for fuels most similar to those eligible for credit per the standard were selected. The BAFs were adjusted up by 10% as a conservative approach, or in the case of landfill gas and similar, set to zero rather than giving a credit greater than the carbon dioxide emissions produced.

Biological cycle – The cycle by which materials or parts are released to, and ideally reprocessed in, the environment via composting, biodegradation, nutrient extraction, or other biological metabolic pathways.

Biologically derived material – A material that is a biological material or that was originally derived from a biological material through one or multiple chemical transformations.

Biological material – A material that is extracted from a plant or animal source without significant chemical processing.

Chemical substance (or "substance") – Matter of constant composition best characterized by the entities (molecules, formula units, atoms) it is composed of. Physical properties such as density, refractive index, electric conductivity, melting point, etc., characterize the chemical substance.

Child labor – Work that deprives children of their childhood, their potential, and their dignity, and that is

harmful to physical and mental development. A child is anyone under the age of 18. The minimum working age is 15 years, or statutory school-leaving age, whichever is higher. This age can vary by country. Key References: United Nations Convention on the Rights of the Child, International Labor Organization (ILO) Convention 138 – Minimum Age, ILO Convention 182 – Worst Forms of Child Labor.

Collective bargaining – All negotiations which take place between an employer, a group of employers or one or more employers' organizations, on the one hand, and one or more workers' organizations, on the other, for: (a) determining working conditions and terms of employment; and/or (b) regulating relations between employers and workers; and/or (c) regulating relations between employers or their organizations and a workers' organization or workers' organizations. Key References: International Labor Organization (ILO) Convention 98 – Right to Organize and Collective Bargaining, ILO, ILO C154 - Collective Bargaining Convention.

Component ("Part") – A single functional grouping of contents. A part is an optional categorization to identify a portion of a product that is used modularly. A part will still be comprised of one or more homogeneous materials.

Compostable material – Characteristic of a product, packaging, or associated component that allows it to biodegrade, generating a relatively homogeneous and stable humus-like substance within a limited time period.

Cycling – The processing of material, parts, or whole products toward a new use cycle via a technical or biological cycling pathway that includes at least one of the following: reuse, remanufacturing, refurbishing, recycling, nutrient extraction/anaerobic digestion, composting, or biodegradation.

Cycled content – Material or parts that have been reclaimed, recycled, salvaged, or otherwise captured from a pre-consumer or post-use phase of a previous cycle.

Cycling pathway – A specific method, system, or other means of processing a material at the end of its use phase. Examples include: municipal recycling, home composting, aerobic biodegradation in wastewater (i.e., at municipal treatment plant), take-back and repair/remanufacture by the manufacturer.

Destructive disassembly operations – Disassembly processes that deal with the partial or complete destruction of obstructing components. In these cases, components or irreversible fasteners (e.g., welds) are destroyed using destructive tools such as a hammer, crowbar, or grinder.

Direct discharge – Effluent is discharged to surface or groundwater instead of to an externally owned and operated wastewater/effluent treatment facility.

Discrimination – Unequal treatment, directly or indirectly, on various grounds including race, ethnicity, sex, language, religion, political or other opinion, national or social origin, property, and birth or other status (such as sexual orientation or health status, for example, having HIV/AIDS). Key References: Universal Declaration of Human Rights – Article 2, 7, 23, International Labor Organization (IL) Convention 111 – Discrimination, International Convention on the Elimination of All Forms of Racial Discrimination, International Convention on the Elimination of All Forms of Discrimination against Women.

Diversity – The inclusion of different types of people (such as people of different races or cultures) in a group or organization.

Excessive working hours – Maximum working hours of 8 hours per day, or 48 hours per week. Overtime is the number of hours worked beyond the maximum allowed by week, and international standards limit this to

60 hours per week. Rest days are a continuous period of at least 24 hours each week. National laws can vary from international standards. Key References: International Labor Organization (ILO) Convention 1 – Hours of Work (Industry), ILO Convention 30 – Hours of Work (Commerce, Offices), ILO Convention 116 – Reduction of Hours of Work, ILO Convention 14 – Weekly Rest.

Fast-moving consumer goods – Non-durable consumer products that are purchased frequently, consumed rapidly, and sold quickly at a relatively low cost. Examples include household goods such as cosmetics, personal care, cleaning products, and office supplies.

Final manufacturing stage – The processes that constitute the final manufacturing stage are defined by industry category in the Cradle to Cradle Certified® Methodology for Applying the Final Manufacturing Stage Requirements.

Final manufacturing stage facility – A facility at which final manufacturing stage processes occur. Final manufacturing stage processes are defined in the Cradle to Cradle Certified® Methodology for Applying the Final Manufacturing Stage Requirements.

Forced labor – Situations in which persons are coerced to work through the use of violence or intimidation, or by more subtle means such as accumulated debt, retention of identity papers, or threats of denunciation to immigration authorities. Key References: International Labor Organization (ILO) Convention 29 – Forced Labor and ILO Convention 105 – Abolition of Forced Labor.

Formulated consumer product – A product whose function is determined primarily by its chemical composition (rather than shape, surface, or physical design). Typically, it is a single homogeneous chemical mixture such as a liquid, gel, paste, cream, powder, tablet, or bar.

Freedom of association – The fundamental human right of peaceful assembly and association, including the right to form and to join (or not join) trade unions and other organizations for the protection of their interests. Key References: United Nations Declaration on Human Rights, Articles 20 and 23, International Labor Organization (ILO) Convention 87 – Freedom of Association and the Protection of the Right to Organize, ILO Convention 98 – Right to Organize and Collective Bargaining.

Generic material type – The general class a homogeneous material belongs to. The generic material type is the common term that would be used to describe a material in commerce. Examples of generic material types include: aluminum, polyethylene, steel, cotton, and medium-density fiberboard.

Harassment and abuse – Includes, but is not limited to, violence, corporal punishment, harsh or degrading treatment, sexual or physical harassment, mental, physical, verbal, or sexual abuse. Key References: Universal Declaration of Human Rights, International Covenant on Civil and Political Rights, Declaration on the Protection of all Persons from Being Subjected to Torture and Other Cruel, Inhumane or Degrading Treatment or Punishment, International Labor Organization (ILO) Convention 190 – Violence and Harassment.

High-value cycling – The cycling of high-quality materials as defined by the Gold level requirements for "high-value cycling potential" in Section 5.5.

Homogeneous material (or "material") – A material of uniform composition throughout that cannot be mechanically disjointed, in principle, into different materials. Coatings and finishes such as plating, powder coats, enamels, etc., are considered unique homogeneous materials (see *Cradle to Cradle Certified Methodology for Defining Homogeneous Materials* for details).

Inclusion – The act or practice of including and accommodating people who have historically been excluded.

Intended cycling pathway – See "Cycling pathway."

Intermediate product – A product sold exclusively as an input to be used in another product and not sold to the general public.

Key material – A material that is typically manufactured using a pollutant intense or high-volume water use process (see the *Cradle to Cradle Certified® Water & Soil Stewardship - Key Materials* reference document).

Living wage – The remuneration received for a standard workweek by a worker in a particular place sufficient to afford a decent standard of living for the worker and her or his family. Elements of a decent standard of living include food, water, housing, education, health care, transportation, clothing, and other essential needs including provision for unexpected events. Key References: Global Living Wage Coalition, Anker Methodology.

Long-use phase product – A product with a use phase time that is typically greater than 1 year.

Material – See "Homogeneous material."

Minimum wage – The compensation to be paid to an employee or worker, based on wage levels of individual countries. Nearly all countries have a national body that determines minimum wages nationally, or for sectors or occupations. In most jurisdictions, overtime must be paid at a premium. Wages and premiums vary by country. Key References: International Labor Organization (ILO) Convention 26 - Minimum Wage, ILO Convention 131 - Minimum Wage Calculation, ILO Convention 100 – Equal Remuneration.

Nutrient extraction – Applying biomass conversion processes and equipment to produce low-volume but high-value chemical products.

Rare and endangered species – Any species listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) appendices [Reference: https://www.cites.org/eng/app/index.php] and/or in the International Union for Conservation of Nature (IUCN) Red List as Near Threatened, Vulnerable, or Endangered. [http://www.iucnredlist.org/]

Performance improvement – In the context of energy conservation and efficiency projects, this term refers to the percentage change in energy consumption from a baseline period to a reporting period. Depending on the methodology employed, one or both of these values will be adjusted (i.e., normalized) to account for differences in production, weather, etc., between the baseline and reporting period. This adjustment allows for a comparison of two consumption amounts that correspond to consistent conditions. Note that performance improvements do not necessarily correspond with or lead to total energy use reductions, particularly if production has greatly increased.

Pharmaceutical – A compound manufactured for use as a medicinal drug. This includes any substance or combination of substances presented as having properties for treating or preventing disease; or any substance or combination of substances that may be used in or administered to human beings and/or animals either with a view to restoring, correcting, or modifying physiological functions by exerting a pharmacological, immunological, or metabolic action, or to making a medical diagnosis.

Post-consumer cycled content – Material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose.

Pre-consumer cycled content – Material or parts diverted from the waste stream during a manufacturing process. Material or parts such as rework, regrind, or scrap that are generated in a process and are capable of being reclaimed within the same process that generated it are excluded.

Primary packaging materials – The materials that physically contain, envelop, or hold the certified product, and typically come into direct contact with the product. Any materials or components that are attached to the materials that physically contain, envelop, or hold the certified product (such as inks, adhesives, labels, nozzles, pumps, and caps) are also considered to be part of the primary packaging.

Process chemical – Any substance that comes into direct contact with the product or any of its material constituents during any of the processes that constitute the final manufacturing stage of the product. It is used as an intentional part of any of these processes to fulfill a specific function or achieve a specific effect in the product or any of its material constituents. Within this definition, process chemicals are limited to pure chemical substances and chemical substances present in a mixture at a concentration of 1,000 ppm or above. Mixtures include liquids, sprays, gases, aerosols, solids, etc. The concentration threshold applies to process mixtures directly as received by the supplier and prior to any dilution that may take place at the manufacturing site. This definition does not include maintenance agents for machinery, effluent, or wastewater treatment chemicals, chemicals used in steam boilers, or cleaning agents used for the production area, offices, and/or lavatories. Distilled water, tap water, and ambient air in their unaltered state are excluded from the assessment.

Product – A physical item that can be routinely and individually purchased from the applicant by other entities. A product is composed of one or more components, homogeneous materials, and/or chemical substances. A product may function as a component or material in another product.

Product use phase time – The typical time of use of a product starting at the point the product is received by the user or customer, and ending at the time the product is cycled (this includes refurbishment, remanufacturing, reuse, and recycling, but not repair).

Rapidly renewable – Material derived from a natural resource (agriculture or animal-derived) that has a maximum 10-year regeneration cycle. (Note: This term is used in the Renewable Energy & Climate category while the term “renewable” is used in the Product Circularity category.)

Recycled content – proportion of pre-consumer or post-consumer materials, by mass, of recycled material in a product or packaging.

Recycling – The process by which a material, after serving its intended function, is processed into a new material via mechanical or chemical transformation and then added to a new material formulation in a different context.

Refillable – A characteristic of a product or packaging that can be filled with the same or similar product more than once, in its original form and without additional processing except for specified requirements such as cleaning or washing. Programs must exist to facilitate refilling and reuse to support a refillable claim.

Refurbishing – The process of returning a product to good working condition by replacing or repairing major components that are faulty or close to failure, and making cosmetic changes to update the appearance of a product, such as cleaning, changing fabric, painting, or refinishing.

Remanufacturing – The process of disassembly and recovery at the subassembly or component level.

Functioning, reusable parts are taken out of a used product and rebuilt into a new one. This process includes quality assurance and potential enhancements or changes to the components.

Renewable content – Material derived from a living, natural resource (agriculture, aquaculture, or animal-derived) that can be continually replenished. Material must be legally harvested, as defined by exporting and receiving country. If the material is wood, or another material associated with extensive evidence of ecosystem destruction due to land conversion and/or poor management practices, to count as renewable the material must be certified by a C2CPII-recognized program as responsibly sourced. If the material is a biologically derived plastic or liquid formulation, material only counts as renewable if its bio-based content has been quantified using radiocarbon dating and through chain of custody documentation showing derivation from natural resources.

Responsibly sourced renewable content – Material that is certified by a C2CPII-recognized standard that verifies sustainable, environmentally friendly forest or vegetation management. These recognized standards have criteria that address: 1) Compliance with all applicable laws and regulations of the country in which farming or harvesting operations occur, 2) Operations that respect land rights and land use rights, and are unlikely to cause displacement of food production, 3) Planning, monitoring, management, and continuous impact assessment for the farming and/or harvesting of material, 4) Maintenance, conservation, or enhancement of biodiversity in the forest/vegetation or other ecosystem, 5) Maintenance or enhancement of the productive function of the forest/vegetation or other ecosystem area and efficient use of harvested materials (e.g., rate of harvest does not exceed rate of regrowth in the long term), 6) Maintenance or enhancement of the health and vitality of the forest/vegetation or other ecosystem and its protective systems (soil and water).

Reusable – Characteristic of a product or packaging that has been designed to be used in more than one use cycle for the same purpose for which it was originally conceived.

Separable – The ability of removing one homogeneous material from another one it is physically attached to.

Science-based targets – Targets adopted by companies to reduce greenhouse gas (GHG) emissions that are aligned with the level of decarbonization required to keep global temperature increase below 2 degrees Celsius compared to pre-industrial temperatures, as described in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5). [Reference: sciencebasedtargets.org, accessed 26 September 2018]

Scope 1 emissions – Emissions from operations that are owned or controlled by the reporting (i.e., applicant) company.

Scope 2 emissions – Indirect emissions from the generation of purchased or acquired electricity, steam, heat, or cooling consumed by the reporting (i.e., applicant) company.

Short-use phase product – A product with a use phase time that is typically less than 1 year.

Single-use plastic product – Any disposable plastic product, made wholly or partially from plastic, that is designed to be used only once (i.e., is not reusable or refillable) Note: This definition includes biodegradable plastics.

Stakeholder – An individual who may affect or be affected by an organization's activities. An affected stakeholder in the context of the Social Fairness requirements is an individual whose human rights have been

affected by an enterprise's operations, products, or services.

Substance – See "Chemical substance."

Supply chain – A set of organizations linked by flow(s) of products, services, finances, or information from a source to a customer.

Technical cycle – The cycle by which a product's materials or parts are reprocessed for a new product use cycle via recycling, repair, refurbishment, remanufacturing, or reuse.

Tier 1 supplier – For the purposes of Cradle to Cradle certification, this term refers to direct suppliers to the final manufacturing stage of the product. For cases where the applicant company uses contract manufacturing, tier 1 suppliers are the suppliers of the contract manufacturer.

Value chain – Interlinked value-adding activities that convert inputs into outputs which, in turn, add to the bottom line and help create competitive advantage. A value chain typically consists of inbound distribution or logistics, manufacturing operations, outbound distribution or logistics, marketing and selling, and after-sales service. These activities are supported by purchasing or procurement, research and development, human resource development, and corporate infrastructure (Reference: Businessdictionary.com and https://www.ifm.eng.cam.ac.uk/research/dstools/value-chain-/).

13 // Appendix 1 – Manufacturing Facility Site Visit

Further Explanation

For all levels of certification, a final manufacturing facility site visit(s) must be conducted by a Cradle to Cradle assessment body to verify that the standard requirements have been met.

Frequency

A site visit is required:

- Prior to initial certification (for new Cradle to Cradle Certified products) or at the first renewal after the first certification to Version 4.0 of the standard (for products currently Cradle to Cradle Certified).
- If the manufacturing process changes significantly. This includes, but is not limited to, cases where a process step, as defined in the Final Manufacturing Stage Guidance, is added or removed, a process that was previously dry is altered so that effluent is produced, and/or if there is a major product redesign.
- At least once every four years.

For products certifying to Version 4.0 of the Cradle to Cradle Certified Material Health Certificate Standard, a site visit is recommended prior to initial certification, but is not required. Instead, a site visit is required prior to recertification, at least once every four years following that, and if the manufacturing process changes significantly, as noted above.

Location(s)

At a minimum, a site visit must be conducted at the main final manufacturing facility. Site visits must also be conducted at any additional facilities involved in select manufacturing processes for which chemical exposure concerns are considered exceptionally high (per the Methodology for Applying the Final Manufacturing Stage Requirements). The product, or a representative product for product groups, must be on the production line(s) during the site visit(s).

If there is more than one final manufacturing facility, the “main” facility is defined as the facility that is the most representative of the majority of certified products sold. If there are significant differences in processes between facilities, the assessor must visit sites that are representative of all processes included in the final manufacturing stage.

When there is more than one manufacturing site and data are available regarding the sites’ history of failing regulatory emissions permit limits or of having occupational safety and health violations, the assessor must take this into consideration when selecting sites to visit. In a scenario where such data are available for all sites producing the product(s), and one site has a history of multiple failures, that site should be selected for conducting the visit. However, in cases where such data are not available for all sites producing the product(s), the assessor(s) must use their best judgement regarding which facilities are of greatest risk of material misreporting or being out of compliance with certification requirements in combination with the other rules (above and below for de facto high-risk locations) in deciding which sites must be visited.

References for determination of compliance (a non-exhaustive list):

- China - IPE database http://wwwen.ipe.org.cn/about/about.aspx
- US - OSHA database: https://www.osha.gov/pls/imis/establishment.html#disclaim

In cases where the same processes occur at multiple facilities and there is one or more sites in de facto high-risk locations (defined in Social Fairness Section 8.1):

- Site(s) that are in de facto high-risk locations must be selected over low-risk locations for conducting the site visit.
- If there is more than one site in a de facto high-risk location, the number of high-risk sites that must be visited is equal to the square root of n + 1, where n= the total number of sites in high-risk locations. This results in the following requirements:

# of de facto high-risk sites	# of sites to visit
1	1
2	2
3-6	3
7-12	4
13-20	5

- When it is time to repeat the site visits (based on the required frequency), a different set of sites must be visited until a site visit has been conducted at all facilities in high-risk locations.
- Exception: Sites with ISO 14001, 45001, or similar certifications may be excluded from the total number of sites in high-risk locations when determining the number of site visits necessary (i.e., if all high-risk sites are ISO 14001 certified, one site visit may be sufficient depending on what constitutes the main facility and compliance history, if available).
- Lacking information on sites that have a history of non-compliance, the specific sites selected for the visits must be chosen randomly from the full list of de facto high-risk sites. One simple method of choosing randomly from a numbered list of sites is to use a random number generator to order the sequence of numbers and to then select the numbers (and sites) at the top of the random sequence to visit (up until the required number of sites has been selected based on a sqrt n+1 sample size). https://www.random.org/sequences/

More than one site visit may be necessary for the same facility if applicants choose to certify multiple products over time that are made using different processes. However, if a new product group is certified that is made using a process that was already observed and verified, a new visit will not be necessary as long as the frequency requirements have been met.

Please refer to Social Fairness Section 8.3 Monitor and Verify Performance regarding when and where a third-party social audit is required in addition to the site visit(s) described above.

Required Documentation

- Completed C2CPII Manufacturing Site Visit Checklist (available to C2CPII assessors)

14 // Appendix 2 – Process for Becoming a C2CPII-recognized Program

Further Explanation

C2CPII-recognized Programs

Several requirements in Version 4.0 of the Cradle to Cradle Certified Product Standard reference *C2CPII-recognized* certification programs, standards, or testing methods that may be used to comply with the requirement. A program, standard, or testing method must meet the following requirements to receive C2CPII recognition:

4. The program, standard, or testing method includes the technical requirement(s) and otherwise addresses the issues and intent as defined in the Version 4.0 requirement, and
5. The system administering and developing the certification program/standard or testing method includes the framework and process elements based on the ISEAL Credibility Principles listed in the C2CPII Recognized Program Application Form.

Note: System requirements for recognition are subject to change. Decisions to recognize programs, standards, and testing methods are made in C2CPII's sole discretion.

Note: Programs/standards that do not issue certifications are not eligible for recognition (e.g., ISO 26000 and similar provide guidelines rather than a certification standard).

Exemptions

Certain organizations may be exempt from demonstrating compliance through the application process based on global use and recognition of their respective programs, standards, and testing methods or where C2CPII has directly determined compliance with the C2CPII system requirements (requirement #2 above). Such organizations include:

- National and international standard development organizations (e.g., ISO, OECD, ASTM)
- National, international, and state government entities
- Programs that are ISEAL Code Compliant (isealalliance.org)

Note: Programs with systems supported by ISO/IEC 17065 accreditation or equivalent may be used to demonstrate compliance with the applicable C2CPII system requirements covered by the accreditation scheme.

Provisional C2CPII Recognition

Program, standards, and testing methods recognized in Version 3.1 of the Cradle to Cradle Certified Product Standard have been given provisional recognition for Version 4.0 through 31 December 2022. If it is determined that these programs meet the new Version 4.0 system requirements (requirements #2 above), they will be given full recognition status and the provisional status will be removed.

Applying for C2CPII Recognition

To apply for recognition as a C2CPII-recognized program, the C2CPII Recognized Program Application Form must be completed and submitted to C2CPII. An application processing fee applies. C2CPII staff will review the application to determine if the recognition requirements have been met. If it is determined that the requirements are met, the program, standard, or testing method will be added to the relevant lists(s) of C2CPII-recognized programs for the applicable requirement(s) in this User Guidance document.

Recognition as an Alternative to Certification

Some requirements in Version 4.0 allow for the use of an "alternative to certification" in cases where a certification does not exist for the product type or for other reasons. To receive credit as an alternative to certification, the approach used must meet the same requirements listed above for becoming a C2CPII-recognized certification program or standard. Qualified third-party auditors without a conflict of interest (i.e., no other paid services provided to the applicant) must be used to verify compliance or the applicant must demonstrate legitimate grounds for an alternative method of verification (such as community-based verification). Pre-approval from C2CPII regarding the alternative approach to be used is required. Alternative approaches will be reviewed and accepted on case-by-case basis at C2CPII's sole discretion.

Required Documentation

- Completed C2CPII Recognized Program Application Form

Guidance for the Cradle to Cradle Certified™ Product Standard, Version 3.1

Last Revision: October 2020

COPYRIGHT

TRADEMARK

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

GUIDANCE FOR THE CRADLE TO CRADLE CERTIFIED™ PRODUCT STANDARD, VERSION 3.1 REVISION HISTORY

REVISION DATE	SECTION	TYPE OF CHANGE	AUTHORIZED BY
September 29, 2016	Initial Release		S. Klosterhaus
May 2017	1.3	Clarified requirements in designating materials as either technical or biological nutrients.	S. Klosterhaus
May 2017	2.1	Added definition of what counts as a single product variation.	S. Klosterhaus
May 2017	2.1	Added additional products that are not eligible for certification: specific medical products, certain animal skins or pelts, and unoptimizable materials.	S. Klosterhaus
May 2017	3.1	Bleaching agents added to the scope of plant-based materials as subject to review at any level	S. Klosterhaus
May 2017	3.3	Clarified that, to comply with toxic metal thresholds, averaging results among several batches is permissible for BN materials with post-consumer recycled content	S. Klosterhaus
May 2017	3.4	Corrected to reference in the standard (3.3 instead of 3.1) in regard to the definition of “intentionally added” chemicals.	S. Klosterhaus
May 2017	3.4, 3.6	Clarified that only Cr(VI) be considered for metal plating processes when determining chemicals required for a complete assessment.	S. Klosterhaus
May 2017	3.9	Clarified that TLV/MAK values (i.e. point 3c) take precedent over detection limit (i.e. point 3a) in determining allowable thresholds for VOCs.	S. Klosterhaus
May 2017	3.9	Corrected link to the California Department of Public Health's (CDPH) Standard Method v1.1-2010	S. Klosterhaus
May 2017	4.1	Clarified definition of biodegradability, what materials may be assumed to be biodegradable, and what tests are required to verify biodegradability.	S. Klosterhaus
May 2017	4.1	Clarified definition of how compostability is determined, what materials may be assumed to be compostable.	S. Klosterhaus

May 2017	4.1	Clarified the scope of the definition of recycled content	S. Klosterhaus
May 2017	4.1	Expanded the scope of exempt products to include all wet-applied products.	S. Klosterhaus
May 2017	4.1	Clarified the scope of exempt coatings used on metals in the requirement that wet-applied materials be classified as biological nutrients.	S. Klosterhaus
May 2017	4.2	Clarified when compostability testing is required.	S. Klosterhaus
May 2017	5.3	Updated reference to Green-e national standard, which determines the eligibility of certain renewable fuels.	S. Klosterhaus
May 2017	5.5	Clarified requirement to reflect “embodied emissions” instead of “embodied energy”.	S. Klosterhaus
May 2017	7.4	Added ZQ Merino Wool, and BES 6001 Framework Standard for Responsible Sourcing to list of approved programs. Also, added a specification to the RSPO Palm Oil Certification.	S. Klosterhaus
March 2018	1.3	Clarified requirements in designating materials as technical or biological nutrients**.**	S. Klosterhaus
March 2018	1.3	Clarified the definition of “sealed” as part of the EMC requirements.	S. Klosterhaus
March 2018	2.1	Clarified that products that lead to or include animal abuse are out of scope for certification	S. Klosterhaus
March 2018	6.5	Clarified that GREY ratings due to missing toxicity information are only allowable for the Silver level Water Stewardship requirement.	S. Klosterhaus
March 2018	6.5	Clarified that process chemicals may be assessed as mixtures and assigned material level ratings	S. Klosterhaus
September 2018	2.1 & 7.4	Removed ZQ Merino. (This was mistakenly added at a prior update before it had been fully approved.)	S. Klosterhaus
September 2018	3.5	Added a section that clarifies how to assess bleaching chemistry. This includes introduction of standard detection limits for AOX and the most toxic dioxin.	S. Klosterhaus
September 2018	3.6	Clarified that for the cases listed in this section, percentage assessed must be calculated at the chemical level.	S. Klosterhaus
September 2018	3.9	Clarified scope of VOC testing	S. Klosterhaus
September 2018	4.2	Clarified that a nutrient management strategy is not required for products made of a discrete list of common materials for which recycling infrastructure is readily available in markets for which the product is sold.	S. Klosterhaus

September 2018	5.3	Updated references to recommended offset registries.	S. Klosterhaus
September 2018	6.2	Updated a US reference for characterizing local and business specific water issues.	S. Klosterhaus
March 2019	2.1	Added two compliance paths for addressing animal welfare concerns applicable to wool and similar materials.	S. Klosterhaus
October 2020	3.3	Corrected a typo in the banned list for biological nutrients	S. Klosterhaus
October 2020	3.6	Clarified the allowable methods for determining percentage assessed for products containing materials that are Cradle to Cradle Certified or have a Material Health certificate.	S. Klosterhaus
October 2020	3.8	Clarified that any known CMRs subject to review must be included in the assessment results at the Silver level.	S. Klosterhaus
October 2020	4.1	Clarified that the MR Score for single-material Biological Nutrient products that are dry powders may be determined using the process for wall paints and other wet-applied products.	S. Klosterhaus
October 2020	5.3	Clarified when and what percentage of renewable electricity available on the standard grid may be claimed.	S. Klosterhaus
October 2020	7.4	Added Better Cotton Initiative to the list of recognized standards.	S. Klosterhaus

1 OVERVIEW OF THE GUIDANCE DOCUMENT

1.1 PURPOSE AND CONTENT

The purpose of this document is to serve as guidance to the Cradle to Cradle Certified Product Standard, Version 3.1 (the 'standard'). This guidance provides clarification and further interpretation of the original intent of a number of the requirements in Version 3.1 of the standard document. Information in this document supersedes any conflicting information that may be present in the full standard document.

1.2 SUPPORTING DOCUMENTS

The following documents are to be used in conjunction with this guidance document:

- Cradle to Cradle Certified™ Product Standard, Version 3.1
- Cradle to Cradle Certified™ Material Health Assessment Methodology

- Any additional supporting standard documents and guidance posted on the C2CPII website

Visit the Cradle to Cradle Products Innovation Institute website to download the standard documents and obtain the most current information regarding the product standard (http://www.c2ccertified.org/product_certification/c2ccertified_product_standard).

1.3 DOCUMENT ORGANIZATION

Beginning with Section 2 of this document, guidance is organized following the sections of the original standard document. Section sub-headings without any additional guidance have been omitted from this document.

Effective Material Cycles

Background: The standard delineates what types of products may be considered Biological or Technical Nutrients.

Interpretation: Certain products MUST be designated as biological nutrients. These include

- Any formulated products that are wet-applied by the end-user or consumer, or any coatings, finishes, or liquids applied to biological materials (e.g. wool, bioplastics, cotton, paper, etc.). Exceptions to this rule are coatings intended exclusively for metal materials.
- Materials that, in their intended application, make it either impractical or impossible to cycle via TN cycling pathways (e.g. toilet paper, paper towels, tissues, sanitary napkins, etc.).
- Products such as tires, brake pads, or shoe soles that are intended to abrade in use also must be assessed as biological nutrients (even if they are designed as technical nutrients).

Externally Managed Components (EMCs)

Background: The standard delineates what defines an EMC and the requirements for how they must be assessed. The intent of these requirements is for the supplier to attest that the sub-assembly is a sealed component manufactured in a way that prevents the migration of chemicals and materials from the component.

Interpretation: “Sealed" is intended to mean that the EMC portion of the product is not available for oral, dermal, or inhalation exposure to occur during use or likely unintended use. Use includes any maintenance that may need to occur during use of the product. Any components or materials that are available for exposure to occur, such as the housing, any external wiring, etc. may not be considered part of the EMC and must be assessed per the traditional methodology.

2 OVERVIEW OF THE STANDARD

2.1 PRODUCT SCOPE

Definition of a Product, Product Variation

Background: The standard states that “materials and sub-assemblies can be considered “products” for certification purposes.”

Interpretation: Although the certification covers a wide range of products, including items like materials and sub-assemblies that are not intended for supply to the general public, the general definition of a product as described in the product grouping policy must still be fulfilled: "... any physical item that can be routinely and individually purchased from the applicant by other entities.” Applicants may not certify items which they sell exclusively as parts of other products and not individually.

Additional Product Types Excluded from the Product Scope

Background: The standard presents a list of products that are excluded from certification to “create a threshold to prevent unreasonable products from entering the system and to protect the positive values around products, as well as their usefulness.”

Interpretation: The following product types have been added to this list. They include:

1. Fur, skins, or pelts from vertebrates killed specifically to harvest materials (e.g. fox, mink, beaver, and ermine fur, skin, or pelts). Leather, skins, or pelts from vertebrates used in meat production are allowed (e.g. rabbit fur, cow, and sheep skins obtained during meat production).
2. Products that are comprised of chemicals whose toxicity is intrinsically tied to the product’s core functionality thus rendering the product non-optimizable (e.g. biocides or raw chemicals that are x-assessed in their intended use)

The following product type is also excluded from the product scope because it is intended to have a specific physiological impact and the Cradle to Cradle Certified Material Health Assessment Methodology is not designed for the purpose of evaluating such intentional impacts:

3. Products that are classified as medical products according to the following definition:

    (a) Any substance or combination of substances presented as having properties for treating or preventing disease; or

    (b) Any substance or combination of substances which may be used in or administered to human beings and/or animals either with a view to restoring, correcting, or modifying physiological functions by exerting a pharmacological, immunological or metabolic action, or to making a medical diagnosis. This also includes substances that are marketed for this purpose (even if there is little evidence for medical benefit).

Clarification on products related to animals that are out of scope for certification

Background: The standard presents a list of products that are excluded from certification to “create a threshold to prevent unreasonable products from entering the system and to protect the positive values around products, as well as their usefulness.”

Interpretation: This is intended to include products that lead to or include animal abuse.

All animals used by people are covered by the Treaty of Amsterdam and Treaty of Lisbon statements that animals must be considered as sentient beings. This means that the animals

are not just goods, or products, or possessions, but have some intrinsic value and must be treated accordingly.

Products leading to or including animal abuse include the following in the context of animal material:

1. Material from vertebrates that are raised primarily or only for their fur, skins, pelts, etc. (e.g. fox, mink, beaver, and ermine fur).
2. Material from unsustainable fisheries.

This interpretation applies when the certified product is made entirely of animal material (e.g. a wool yarn), and also when animal material is used as an input to a certified product (e.g. a wool textile may be used as upholstery for a certified furniture product; shark cartilage as an input to a personal care product.)

The following animal-related products may be considered in-scope:

1. Material from animals that do not have to be killed in order to harvest the material (e.g. wool, mohair)
2. Material that is a by-product from the meat industry (e.g. leather, rabbit fur, sheepskin, chicken, duck, and goose feathers)
3. Silk
4. Material that is a by-product of processing Marine Stewardship Council (MSC) certified seafood (i.e. portions of the certified seafood product that are unusable as food).

For in scope materials #1 & #2, the applicant must have a policy in place that forbids animal abuse at all facilities where the animals are raised and/or slaughtered, including facilities in the supply chain, as relevant. The policy must include language that:

1. Addresses the five freedoms.
2. Includes specific positions on any practices of high concern relevant to the material type in question. The following must be addressed as indicated. Additional issues may be added at a later date based on the list of pre-approved certifications below and other applicable references.
    a. Wool: mulesing is unacceptable
    b. Down, angora (rabbit), and mohair (goat): live plucking is unacceptable
    c. Down/feathers: force feeding is unacceptable
    d. Rabbit: small cage size and crowding is of high concern and must be addressed.
    e. Cattle, goat, sheep: Use of electric prods is unacceptable
3. Includes provisions to immediately address cases where it becomes known that animal abuse is occurring, for example, a provision to immediately cease doing business with affected suppliers until the issue is resolved.

In addition, the applicant must demonstrate that a mechanism is in place that aims to ensure adherence to the policy. At a minimum, the mechanism must include:

1. Regular on site surveillance of all relevant facilities by individuals knowledgeable of animal health and welfare issues. During site visits, the responsible individual must check that the five freedoms are being addressed and that there is no evidence of the prohibited practices listed above. Self-declarations from the farm or individuals hired by the farm are not sufficient. The following are acceptable:
    a. Direct visits by the applicant or an intermediary hired by the applicant such as a veterinarian.
    b. Third party audits by approved certification bodies.
2. A method of tracking material from farm to certified product (i.e. a method to track the chain of custody) in any case where the farm is not the final manufacturing stage.

ALTERNATIVE for in scope material types #1 & 2 (i.e. material from animals that do not have to be killed in order to harvest the material and for by-products) that are certified organic: Applicant has a policy in place and is demonstrating continuous improvement towards implementing a monitoring mechanism **and/or** is actively working to influence and improve on how organic agriculture standards address and verify animal welfare. (NOTE: certified organic cannot be assumed to fully address animal welfare concerns. This alternative is provided because Cradle to Cradle Certified encourages the use of organic material and recognizes that it is currently a very high bar to ask for both an organic and a fully functioning mechanism or welfare certification at the Basic level of certification.)

ALTERNATIVE for in scope material type #1 (i.e. material from animals that do not have to be killed in order to harvest the material): Applicant has a policy in place and is demonstrating continuous improvement towards implementing a monitoring mechanism. (NOTE: this option is provided in recognition of the fact that it is currently often impossible to trace wool back to the farm level, and that current certification holders using wool will need additional time to fully comply with this interpretation.)

Although not currently required, existing third-party certification programs that address all of the required points listed above are highly recommended and the preferred method of ensuring that abuse does not occur. If an appropriate certification is in place, proof of certification may be provided instead of documentation demonstrating that a policy and mechanism, as described above, are in place.

Pre-approved certifications:

- Animal Welfare Approved (applies when material coming directly from the farm will be Cradle to Cradle certified. Standards do not include chain of custody requirements.)
- Down Pass 2017
- Global Traceable Down Standard
- IDFL when certifying to one of the approved programs (note: IDFL is a third-party certification body not a standard)
- Responsible Down Standard
- Responsible Wool Standard

3 MATERIAL HEALTH

3.1 GENERIC MATERIAL TYPE AND INPUTS SUBJECT TO REVIEW

Clarifying scope of materials subject to review at any concentration level to include bleaching agents for plant-based materials

Background: The standard states the following materials as subject to review at any concentration: finishes (coatings, plating, paints), blowing agents, textile auxiliaries, paper bleaching agents, and plating chemistry are subject to review at any concentration level when the part these are relevant to is itself present at ≥0.01% in the product.

Interpretation: Included in the list of materials that are subject to review at any concentration are bleaching agents used in processing of plant-based materials such as cotton.

NOTE: Also see section 3.4 below for additional interpretations relevant to materials subject to review at any level.

3.3 DETERMINING ABSENCE OF BANNED LIST CHEMICALS

Determining Toxic Metal Thresholds of BN Materials Containing Post-Consumer Recycled Content

Background: The standard states specific thresholds for toxic metals in BN materials as follows: 2 ppm for cadmium, 90 ppm for lead, 100 ppm for chromium, 1 ppm for mercury, and 10 ppm for arsenic. However, it does not state a method for testing for these thresholds when the BN contains post-consumer recycled content.

Interpretation: Solid BN materials with post-consumer content may comply with toxic metal thresholds by testing for concentrations that are on average, among several batches of product, below the specified toxic-metal thresholds for any given period time where the material is supplied for use in a certified product. This is provided that any exceedances in individual batches are due to variable unintended and unavoidable contamination of the post-consumer recycled content stream.

Correction to the Banned List of Chemicals

Background: The banned list of chemicals for biological nutrients (Table A-2 in the Section 15 Appendix) includes Benzo(g,h,l)perylene (CAS 191-24-2).

Interpretation: The correct spelling is: Benzo(g,h,i)perylene. This has been corrected in the Banned List of Chemicals Form.

3.4 COLLECTION OF MATERIAL COMPOSITION DATA

Chemicals Subject to Review at Any Concentration – Textile Auxiliaries and Leather Tanning Agents

Background: In this section, the standard states that “Chemicals subject to review are limited to intentionally added inputs (see Section 3.1 for definition of intentionally added).”

Interpretation: The standard is referring to the incorrect section. This passage was intended to reference section 3.3 instead.

Background: The standard states that the chemicals subject to review in each material are those present at a concentration ≥ 0.01% (≥ 100 ppm), and those subject to review at any concentration.

Chemicals subject to review at any concentration are: lead, mercury, hexavalent chromium, cadmium, pigments, dyes and other colorants, phthalates, halogenated organics, scarce elements, metal plating agents, textile auxiliaries, blowing agents, and paper bleaching agents. These chemicals are subject to review even if they do not remain in the final product.

Interpretation: The term 'textile auxiliaries' is to be replaced with 'textile dye auxiliaries' here and in other sections of the standard where this concept is discussed. A textile dye auxiliary is any substance used in the dye bath (i.e. during the dying step). A textile auxiliary is defined as any process chemical used during the dyeing or finishing of a textile. Textile auxiliaries that are not dye auxiliaries need only be included in the review if they are present at a concentration ≥ 0.01% (≥ 100 ppm) within the textile material. They will also be considered in the Water Stewardship category at the Silver level if they are present in effluent as part of the product's final manufacturing stage.

Interpretation: Leather-tanning agents shall be added to the list of chemicals subject to review at any concentration.

Chemicals Subject to Review at Any Concentration – Process Chemicals and Chromium in Metal Plating

Background: The standard states that the concentration of process chemicals that include metal plating agents, in addition to textile auxiliaries, blowing agents, and paper bleaching agents, must be collected regardless of the concentration in the material.

Interpretation: When the standard states that "metal plating agents" are subject to review, this is intended to mean that Cr(VI) must be assessed when used as a metal plating agent, regardless of the chrome speciation in the final product. If Cr(VI) is used in the plating process of a material subject to review in a product, this means the product is limited to the Bronze level in Material Health (since Cr(VI) is a CMR).

However, other substances that may be used in the plating process do not have to be assessed if they comprise < 100 ppm of the material in the finished product.

NOTE: Also see section 3.1 above for additional interpretations relevant to materials subject to review at any level.

3.5 MATERIAL ASSESSMENTS

Assessment of Bleaching Chemistry

Background:

1. Bleaching chemistry is subject to review at any level for all biological nutrient materials per the Standard Material Health requirements.
2. When chlorine based bleaching including Elemental Chlorine Free (ECF) bleaching (which is based on chlorine dioxide) are used to manufacture bleached pulp, halogenated organics form and are typically present in effluent above detection limits.
3. Per the Water Stewardship requirements for assessing product relevant chemicals including process chemicals: "If the exposure is via effluent, the assessment must be conducted on the primary hydrolyzed or reacted form of the parent chemical that would appear in the effluent." This is noted in the context of assessing chemicals used during the final manufacturing stage.

4. Halogenated organic substances are always x-assessed when subject to review, including when they are (or are not) in the product and/or when detectible in effluent.
5. Substances with RED hazard flags that are potentially entering the effluent must be below detection in effluent to receive a c-assessment in that context as noted in the Exposure Assessment Methodology.
6. The result: Halogenated organics, typically measured as AOX in pulp & paper effluent, have to be below detection in effluent, otherwise exposure must be assumed plausible and an x-assessment assigned.

Interpretation:

The following applies in all cases, including to bleaching chemicals when subject to review at any level and when bleaching chemistry is assessed for the Material Health and Water Stewardship requirements: If the exposure is via effluent, the assessment must be conducted on the primary hydrolyzed **or final reacted form(s)** of the parent chemical that would appear in the effluent.

In the context of chlorine based bleaching of biological nutrients, it must be assumed that AOX and the most toxic dioxin (2,3,7,8-TCDD) are 'final reacted forms' potentially present in the effluent unless a closed loop system is in place.

If AOX and 2,3,7,8-TCDD are present below detection in effluent at the bleaching plant(s), and exposure is otherwise not plausible based on application of the Exposure Assessment Methodology to all use/life cycle phases, then a c-assessment for chlorine based bleaching agents is possible.

The following detection limits apply unless the applicant's permits require lower limits in which case the permit limits must be used.

- AOX: 20 ppb. This is the detection limit for US EPA test method 1650, required for use in demonstrating compliance with the US effluent guidelines for pulp and paper. Note that in the EU there are several possible test methods with ISO 9562 being common. The detection limit for ISO 9562 is 10 ppb.
- 2,3,7,8-TCDD: 10 pg/L. This is based on the US EPA test method 1613.

3.6 DETERMINING PERCENTAGE ASSESSED

Percentage Assessed at the Chemical Level

Background: The standard requires that materials in a product be assessed using the ABC-X rating system. In most cases, an increasing percent of homogeneous materials by weight must be assessed as certification level increases. However, an increasing percent of chemicals by weight may be used in some cases as detailed below. Exception #2 below is a new interpretation added to the standard via this guidance document.

Interpretation: The total percentage of the product assessed equals the sum of the individual percentages by weight of each homogeneous material (that meet the requirements detailed in the full standard document), with two exceptions as described below. For products in category #1 below, and if applying the exception described in #2, the percentages for each chemical by weight **must** be used in determining the percentage of the product assessed.

1. The product is a single-material product. For this purpose, a product is considered a single-material product if it is composed of:
    a. A single homogeneous material, or
    b. A single homogeneous material that is at least 95% of the final product by weight and 5% or less of other materials that are either a coating, finish, print, paint, ink, other surface treatment, film, or interlayer.
2. The product contains at least one homogeneous material that makes up more than 25% of the product by weight and this material contains one or more GREY substances whose assessment is infeasible due to missing toxicity data or formulation information that the assessor is unable to obtain due to a supplier's refusal to share the information. For a product to qualify for this exception, this homogenous material must itself be at least 95% assessed based on the weight fraction of the individual assessed chemical substances in the material.

Ensuring Absence of CMRs at the Silver Level when Reporting Percentage Assessed at the Chemical Level

Background: If reporting percentage assessed based on the weight of chemicals per one of the exceptions described in the section above and applying at the Silver level, it is necessary to perform additional due diligence to ensure that carcinogens, mutagens, and reproductive toxicants (CMRs) are not present.

Interpretation: In order for a substance to count towards the percentage assessed at the Silver level, it must not be GREY and one of the following is required:

- It is part of a homogenous material in which all of the substances subject to review have been identified (i.e., no GREY ingredients due to lack of formulation data) and none received a single chemical risk score of 'x' as a result of being a CMR (other chemicals may still be GREY due to missing toxicity data and thus not count toward the percentage assessed), OR
- It is part of a homogenous material for which the material supplier or other party with knowledge of the chemical composition of the material has signed a declaration stating that CMRs are not present in the material.

These conditions also apply when the product itself is a single homogenous material. This means that in order for any substances in a single homogenous material product to count towards the percentage assessed at the Silver level, the substance(s) must not be GREY, and either all substances subject to review must be identified, or CMR declarations must be obtained from suppliers of unidentified mixtures.

Determining Percentage Assessed for Products Containing Materials that are Cradle to Cradle Certified or have a Material Health Certificate

Background: The standard requires that materials in a product be assessed using the ABC-X rating system. An increasing percentage of homogeneous materials by weight, or chemicals by weight in the case of single homogenous material products (also see interpretation above), must be assessed as the achievement level increases. In some (but not all) cases, materials that are Cradle to Cradle Certified or have Material Health Certificates may count towards the percentage assessed for another product.

Interpretation: For single homogeneous materials (and any other materials for which percentage assessed has been determined at the chemical level per the interpretation above) that are Cradle to Cradle Certified and/or have a Material Health Certificate:

- If the material is at the Gold level in Material Health, it may be assumed to be 100% C-assessed. Materials at the Gold level in Material Health may be used in products certified at any achievement level.

- If the material is at the Bronze or Silver level in Material Health, it may not be assumed that the material is ABC-X assessed. This is because the percentage assessed requirements are 75% and 95% of chemicals by weight at Bronze and Silver level respectively for single homogeneous materials. This means that an overall ABC-X rating for the material is unlikely to have been assigned. For the material to be counted towards the percentage assessed in another product, it will be necessary to obtain an ABC-X assessment rating applicable to the relevant exposure scenarios (or based only on hazard ratings) from the relevant assessor.

- If the material is at the Bronze level in Material Health, it must also be assumed to contain carcinogens, mutagens, and reproductive toxicants (CMRs) - and therefore may only be used in another Bronze level certified product - unless information to the contrary is obtained.

Percentage Assessed for Biological Nutrients

Background: At the Bronze level and above, complete formulation information needs to have been collected for 100% of BN materials that are released directly into the biosphere as a part of their intended use (e.g., cosmetics, personal care, soaps, detergents, paint, etc.).

Interpretation: Cosmetics, personal care, soaps, detergents, paint, etc., includes all wet applied products and all other liquid products that may be released directly to the biosphere during use.

Determining Percentage Assessed – Process Chemicals and Chromium in Metal Plating

See Section 3.4 above.

3.7 MATERIAL OPTIMIZATION STRATEGY

X and GREY Materials Must be Included in the Strategy

Background: The ‘Standard Requirement’ portion of section 3.7 of the standard states that: ‘A phase-out or optimization strategy has been developed for those materials with an X rating.’

Interpretation: The optimization strategy must also include a plan for phase out or complete assessment of any GREY rated materials or chemicals. This is stated in the Methods portion of section 3.7 of the standard: ‘All X (problematic) and Grey (data missing) materials are to be included in the optimization plan.’

3.8 DETERMINING ABSENCE OF CMR SUBSTANCES

CMRs Subject to Review and Assessment

Background: The standard requires the following at Silver level: “The product has been at least 95% assessed (by weight) using ABC-X ratings.” and “The product does not contain substances known or suspected to cause cancer, birth defects, genetic damage, or reproductive harm (CMRs) in a form that may result in plausible exposure.” Per Section 3.8 of the standard “This requirement shall be interpreted to mean that the 95% or more of the materials in the product that have been assessed as A, B, C, or X do not contain known or suspected CMRs in a form that will result in plausible exposure to humans or the environment during the product scenarios evaluated.” The standard also states that if “a CMR is in a material, or is one of the chemical types that are subject to review at any concentration in the product, it is subject to review.” In addition, "if the assessor determined that plausible exposure to the CMR may occur as a result of its use in the material, the material receives an X assessment and is not permitted for use in a Silver-certified product.”

Interpretation: For the Silver level, if the applicant and/or assessor are aware of a CMR that is subject to review within a material and product, the CMR and the material must be included in the assessment results. If exposure to the CMR is deemed plausible, the product is not eligible for certification at the Silver level. This is true in all cases, including when the CMR is present in a material that would not need to be assessed to achieve the Silver level 95% assessed requirement. In other words, it is not allowable to purposely ‘hide’ CMRs in the last 5% of the product that may remain unassessed at the Silver level.

Ensuring Absence of CMRs at the Silver Level when Reporting Percentage Assessed at the Chemical Level

See Section 3.6 above regarding conditions applying at the Silver level when determining percentage assessed based on the weight of assessed chemicals instead of assessed homogeneous materials.

3.9 VOLATILE ORGANIC CHEMICAL (VOC) EMISSIONS TESTING

Scope

Background: The standard states that a product designed for indoor use, or one that could potentially impact indoor air quality, must meet the Cradle to Cradle Certified™ VOC emissions standards. The intent of the requirement is to ensure that VOCs are not being emitted from products used indoors or products that impact the concentration of VOCs in the indoor environment. Indoor-use products are those with intended or likely unintended use scenarios in interior spaces (i.e., inside a building). Due to the short duration of exposure, consumable indoor products fully designed as biological nutrients (e.g., detergents, personal care products, toilet paper) are not subject to the VOC emissions testing requirement. Furthermore, VOC tests are not required for products that are sold exclusively as material inputs for other products (rather than being sold to the general public).

Interpretation: Testing to demonstrate compliance with the Cradle to Cradle Certified™ VOC emissions standards is required for products that are:

- permanently installed in indoor rooms, e.g. floors, walls, ceilings and insulation material, or
- used to install the above-mentioned products permanently, e.g. adhesives and sealants, or
- permanently applied to surfaces in indoor rooms, e.g. paints and coatings, or
- used as permanent or long-term equipment of indoor rooms, e.g. all kinds of furniture.

Testing is **not required** for products with “intended or likely unintended use scenarios in interior spaces” that are not permanently installed as described in the bullets above (e.g. testing is not required for clothing, bed sheets, towels, kitchenware, etc.)

7-Day Time Point

Background: The standard states that: 'The time point used is 7 days for VOCs and IVOCs'.

Interpretation: The test duration can be longer than 7 days (up to 14 days) but the testing has to either include a measurement or interpolation to the day 7 concentrations (or earlier), which need to meet the thresholds indicated in the standard.

Testing Requirements for Product Groups

Interpretation: For product groups it is acceptable for the assessor to select and have tested a single representative product (for example the one with the highest number of inputs) if it can reasonably be expected that no other product in the group will perform less well.

VOC Emission Limits Related to Whether or Not a TLV or MAK Value is Known for the VOC of Relevance

Background: The standard currently dictates that individual VOCs that would receive an x assessment must be < (0.01) x [the lower of the TLV or MAK value]. It also states that carcinogens, endocrine disruptors, mutagens, reproductive toxins, or teratogens must be below detection limits (detection limits must be < 9.0 µg/m3 for formaldehyde and < 2µg/m3 for all other chemicals). It is, however, unclear which limit (i.e. 0.01xTLV/MAK or detection limit) takes precedence for carcinogens, endocrine disruptors, mutagens, reproductive toxins, or teratogens.

Interpretation:

VOCs that are considered known or suspected carcinogens, endocrine disruptors, mutagens, reproductive toxins, or teratogens, and have no known TLV or MAK value, are restricted to levels below 2 µg/m^3 (detection limits must be < 2µg/m^3). If the TLV or MAK value of an individual VOC that would receive an x assessment (regardless of whether it is a suspected carcinogen, endocrine disruptor, mutagen, reproductive toxin, or teratogen) is known, then it is restricted to levels below (0.01) x [the lower of the TLV or MAK value].

Formaldehyde is still restricted to levels below 9.0 µg/m^3.

Updated Link to California Department of Public Health's (CDPH) Standard Method v1.1-2010

Background: The standard provides a link (in blue) in referencing VOC levels in the following sentence: “The VOCs with established Chronic Reference Exposure Levels (CRELs) listed in the California Department of Public Health's (CDPH) Standard Method v1.1-2010 must be included in emissions testing. CREL values are continuously updated by the California Office of Environmental Health Hazard Assessment (see http://oehha.ca.gov/air/allrels.html).”

Interpretation: The correct, updated link is the following: California Department of Public Health's (CDPH) Standard Method v1.1-2010

4 MATERIAL REUTILIZATION

4.1 MATERIAL REUTILIZATION SCORE

Determination of the Biodegradability of a Chemical or Material Counting Toward the MR Score

Background: The standard currently states that the biodegradability of a chemical or material is determined as follows: The OECD defines the appropriate testing methods for determining ready and inherent biodegradability. The entire material needs to be biodegradable in order to be counted as biodegradable in the Material Reutilization score. If making biodegradability claims for materials that are not commonly known to be biodegradable, testing should be done according to these, or comparable methods. Biodegradability of the material must be considered under the conditions of the material’s intended end-of-use scenario.

Interpretation: For this purpose, commonly known biodegradable substances are defined as: Manufactured items consisting of chemically unmodified natural organic substances with additives that are < 1% by weight and a, b, or c-assessed for the biodegradation or composting exposure scenario may be assumed to be biodegradable. Note that dyeing does not chemically modify a material. Compostable materials (see next section for definition of compostable) may be assumed to be biodegradable as long as the intended end-of-use scenario involves industrial or home composting. However, biodegradable materials may not be assumed to be compostable unless also listed as commonly known to be compostable in the following section.

In order to determine biodegradability of materials not commonly known to be biodegradable, the following certification programs **or the tests that lead to each respective certification** may be used to verify biodegradability (i.e. certification is not necessarily required as long as the relevant test(s) have been carried out and demonstrate that the material is biodegradable). If there are multiple intended end-of-use scenarios, all of those must be addressed by the relevant tests or certification programs.

End-of-Use Environment	Certification Program	Primary Basis (additional relevant tests are listed within program documentation)
Soil	Vinçotte: OK biodegradable SOIL	EN 13432, EN 14995 (adapted for soil conditions)

Freshwater	Vinçotte: OK biodegradable WATER	EN 13432, EN 14995 (adapted for freshwater conditions)
Freshwater	SCS: Biodegradability Standard	OECD 301A-F, OECD 310

Additional biodegradability programs or standards may be added to this list. Requests to add additional programs must include the following:

- A link to the program's website
- A list of the product types within scope
- A summary of any ecotoxicity requirements included
- The relevant end-of-use environment
- The national or international biodegradability standard(s) on which the program is based

Additional tests not necessarily associated with a verified certification program may also be used. These include the following: OECD 306, OECD 311 and OECD 302b.

Determination of the Compostability of a Chemical or Material Counting Toward the MR Score

Background: The standard currently states that a compostable material is a material capable of undergoing biological decomposition in a compost site as part of an available program, such that the material is not visually distinguishable and breaks down into carbon dioxide, water, inorganic compounds, and biomass at a rate consistent with known compostable materials. In addition, the standard states that if making claims on the compostable nature of materials that are not commonly known to be compostable, testing is required according to the appropriate ASTM, ISO, CEN, or DIN standard (e.g., ASTM D6400-04 for plastics).

Interpretation: For this purpose, commonly known to be compostable materials are: Untreated/raw plant and animal matter without additives or colorants. Plain white or brown paper with less than 1% additives that is not colored, coated, shiny, laminated, made with wet strengtheners, or printed with inks is also commonly known to be compostable (see OK Compost's Certification Scheme for "Products made of compostable materials" for some additional exceptions for paper). For commonly known to be biodegradable materials (defined above), proof of biodegradation is not required as part of the compostability tests, but proof of disintegration and compost quality are required. See the relevant compostability standard for further information (OK Compost's Certification Scheme for "Products made of compostable materials" AND Requirements of the EN 13432 Standard).

In order to determine compostability of materials not commonly known to be compostable, the following certification programs or the tests that lead to each respective certification may be used to verify compostability:

End-of-Use Environment	Certification Program	Primary Basis (additional relevant tests are listed within program documentation)

Industrial composting	European Bioplastics: Seedling	EN 13432 (secondarily, ASTM D 6400, EN 14995, ISO 17088)
Industrial composting	DIN-Geprüft: Industrial Compostable	EN 13432 (secondarily, ASTM D 6400, EN 14995, ISO 17088, ISO 18606, AS 4736)
Industrial composting	BPI	ASTM D6400, ASTM D6868
Industrial composting	Vinçotte: OK Compost	EN 13432, EN 14995
Home composting	Vinçotte: OK Compost Home	EN 13432, EN 14995 (adapted for home composting conditions)
Home composting	Association for Organics Recycling: Home Compostable Certification	EN 13432, EN 14995 (adapted for home composting conditions)

Other compostability programs or standards may be added to this list. See the biodegradability section above for requirements to add additional programs to the list.

Scope of the Definition of Recycled Content Toward MR Score

Background: The standard currently defines post-consumer recycled content as “materials that have been collected for recycling after consumer use”

Interpretation: “Recycled content” in this definition is interpreted to include content that comes from reuse, refurbishment or remanufacturing as well as typical recycling collection and processing. Reuse is defined as the use of the same product or material components in a different application or by a different user without the need for reprocessing or improvement. Refurbishment is defined as the renovation or upgrade of a material or product, without the need for part replacement. Remanufacturing is defined as the renovation or upgrade of a material or product in which parts and components are replaced before re-entering the market.

Special Considerations for Calculating the MR Score for Products Containing Water

Background: The standard currently states that with the exception of paints (see next section), water weight must be excluded from the product weight when calculating the Material Reutilization score

Interpretation: This exemption applies more generally to all wet-applied products, not just to paints.

Special Considerations for Calculating the MR Score for Paint and Other Wet-Applied Products: Coatings Used on Metals

Background: The standard currently states that general purpose and wall paints and other wet-applied products must be regarded as Biological Nutrients, and are thus assessed based on

their safety when released into the biosphere (by erosion, washing, leaching, burning, or similar processes) and their biodegradability.

Interpretation: An exception to this rule are coatings intended exclusively for application on metals – those can be classified as Technical Nutrients and do not need to have the MR score calculated as specified for other wet-applied products.

Special Considerations for Calculating the MR Score for Paint and Other Wet-Applied Products: Dry Powders that are Biological Nutrients

Background: The standard provides a process for evaluating the Material Reutilization score for paint and other wet-applied products, which must be assessed as Biological Nutrients. The standard notes that because such products are formulated single-material products, the percent biodegradable is not based on the percent of biodegradable homogeneous materials (as for multiple-material products). Instead, the '% biodegradable content' for the MR score is based on the individual product ingredients. In addition, the percent weight of benign minerals commonly found in surface soils and sediments may be considered 'cyclable'.

Interpretation: The Material Reutilization score for single-material Biological Nutrient products that are dry powders may also be determined using the process for wall paints and other wet-applied products.

4.2 NUTRIENT MANAGEMENT STRATEGY

Evidence for Compostability Required If Composting is Primary End-of-use Strategy

Background: The standard currently states that the method of recovering, reusing, recycling, or composting individual materials within the product and the product overall must be addressed within the nutrient management strategy.

Interpretation: If composting in standard industrial composting facilities or at home is the only or primary end-of-use strategy, then compostability testing related to the intended end-of-use scenario must have been completed for materials that are not commonly known to be compostable to ensure that the strategy is viable. With the exception of some paper as described in section 4.1, chemically modified manufactured items of natural origin containing additives or colorants (e.g. wool and cotton textiles) may not be assumed to be compostable under standard home or industrial composting conditions. However, they may be assumed to be biodegradable in some cases as described in section 4.1 (biodegradability does not ensure compostability).

For products that are commonly known to be biodegradable, but are not commonly known to be compostable and also have not been tested for compostability (or cannot pass composting tests due to the length of time for adequate disintegration or resulting compost quality), the nutrient management strategy may be based on biodegradation and/or recycling. In this case, a strategy that does not depend on existing composting facilities or on home composting will be required.

Alternative Compliance for Reporting a Nutrient Management Strategy for Common Material Types

Background: The standard currently requires that a company complete the development of a "nutrient management" strategy for the product that includes scope, timeline, and budget. Documentation required is a strategy outline and narrative addressing these points.

Interpretation: Recycling infrastructure is widely available in the EU and US for some product and material types. When this is the case, it may be assumed that a nutrient management strategy is already in place. Specifically, this may be assumed when the product is a) a basic material used as an input for recyclable products or b) typically recycled via municipal systems (bottle, can, food tub) with no special disassembly required **AND** is comprised mostly (i.e. labels, fasteners, lids, and other small components may be excluded) of one of the following materials:

- Glass
- Paper
- Aluminum
- Steel
- Polyester Terephthalate [PET] (and not any modified derivatives such as PET-G)
- High Density Polyethylene [HDPE]
- Polypropylene [PP]

A nutrient management strategy, as described by the standard, is required in all other cases.

5 RENEWABLE ENERGY AND CARBON MANAGEMENT

5.1 QUANTIFYING ELECTRICITY USE AND EMISSIONS

Reporting Emissions from On-Site Generated Electricity

Background: The standard requires that two mutually exclusive quantities relevant to the final manufacturing stage of the product be reported: electricity use and greenhouse gas emissions.

Interpretation: Greenhouse gas emissions resulting from production of electricity on-site are to be reported in the greenhouse gas emissions category.

5.3 USING RENEWABLE ELECTRICITY AND ADDRESSING GREENHOUSE GAS EMISSIONS

Claiming the Percentage of Renewable Electricity Available on the Electrical Grid and Allocation to the Applicant Product

Background: The standard states that renewable electricity that is already a standard part of the grid mix does not count toward the requirements to use renewable electricity unless the applicant is participating in a voluntary green pricing program or the applicant has verified that their utility is delivering renewable electricity that may be claimed by the utility customer without

being double-counted elsewhere in the system. The standard also requires that electricity and greenhouse gas emissions be allocated to the applicant product(s).

Interpretation: In locations where there are no voluntary green power pricing programs available and there is only one electricity mix option, the average percentage of renewable electricity on the grid may be counted by the applicant. In locations where voluntary renewable electricity purchasing options do exist, but the applicant is not participating in the voluntary market, the amount of renewable electricity in the residual mix[1] may be counted by the applicant. In these cases (and when there are no other sources of renewable electricity e.g. on-site produced renewable electricity with renewable attributes retained by the applicant), the percentage of renewable electricity used to manufacture the product is the same as the average percentage of renewable electricity available via the standard grid mix or in the residual mix as applicable.

Carry Over of Excess RECs and Offsets

Background: The standard states that "If it is determined that excess offsets or RECs were purchased in the prior year due to use of estimates, the excess may be credited toward the amount to be purchased at the next re-application."

Interpretation: RECs intended for a given certification period may be purchased up to a year prior to the beginning of that certification period. Excess RECs that were originally intended for any given 2-year certification period may be applied to the 2-year certification period following it, but not to any subsequent certification periods.

Updated Reference to Green-e National Standard

Background: The standard states that "Eligibility of renewable fuels for this purpose is determined based on the definitions in Section II.A 5 in Appendix D of the Green-e National Standard. Renewable fuels that are not covered by the types (woody waste, agricultural crop residue, animal and other organic waste, certain energy crops, landfill gas and wastewater methane) and definitions in Section II.A 5 in the Green-e National Standard may be eligible, subject to a case-by-case review by C2CPII.

Interpretation: The link has since changed and is corrected in the above statement.

Updated References to Offset Registries

Background: The standard provides a partial list of recommended offset registries.

- Clean Development Mechanism https://cdm.unfccc.int
- Climate, Community, and Biodiversity http://www.climate-standards.org
- Verified Carbon Standard http://www.vcsprojectdatabase.org/#/home
- Gold Standard https://www.goldstandard.org/
- Green-e Climate (see endorsed program) https://www.green-e.org/

Interpretation: Several web links have changed and are corrected above. The home web page is provided.

[1] https://www.aib-net.org/facts/european-residual-mix
https://www.green-e.org/residual-mix

5.5 ADDRESSING EMBODIED ENERGY USE WITH OFFSETS OR OTHER PROJECTS

All "Embodied Energy" References Should be Changed to "Embodied Emissions"

Background: The current standard requires that "At least 5% of the embodied energy associated with this product from Cradle to Gate is covered by offsets or otherwise addressed (e.g., through projects with suppliers, product re-design, savings during the use phase, etc.)" Two other phrases in this section also contain the term "embodied energy".

Interpretation: References to "embodied energy" within this section should be replaced with reference to "embodied emissions."

6 WATER STEWARDSHIP

6.2 LOCAL AND BUSINESS-SPECIFIC WATER ISSUES

Reporting on Scarcity/Stress Level

Interpretation: To address Required Documentation item #4 of the water issues characterization (scarcity/stress level), applicants may report any reasonable water stress metric (e.g. baseline water stress, annual renewable water supply per person, etc.), from any source (Global Water Tool, Aquaduct, etc.). Applicants may also report risk levels for more than one metric if they choose. Exclusive use of metrics unrelated to water quantity is not permitted, since the intended issue to investigate is scarcity.

Surf Your Watershed Reference No Longer Available

Background: Surf Your Watershed is a suggested reference for characterizing local and business specific water issues in the US. This reference was available on the US Environmental Protection Agency (EPA) website.

Interpretation: Per the US EPA's website, a replacement application is currently in development, with an expected released date of Fall 2018. This EPA site lists other references that may be used in the interim**:** https://www.epa.gov/waterdata/surf-your-watershed

Watershed information can also be found on the US Geological Survey's (USGS), Science In Your Watershed web site https://water.usgs.gov/wsc/map_index.html and water use by state may be found at the USGS National Water Information System site: https://waterdata.usgs.gov/nwis/wu

6.3 WATER STEWARDSHIP INTENTIONS

High Risk Issues

Background: An action plan to address local and business specific water issues that have been identified per standard section 6.2 is required. Specifically, a plan to address high or very high risk/opportunity categories (Social Hotspot Database) and red ratings (WBCSD Global Water Tool) is required.

Interpretation: Applicants are required to provide a positive impact strategy for any "high" risk issues identified, unless the Global Water Tool is used. In the latter case, a strategy will only be required for "extremely high" risks (since the standard only requires a strategy for "red" ratings outputted by the Global Water Tool). To override a reported high risk from a non-Global Water Tool source, an applicant can report a comparable Global Water Tool result and that result must not be red.

Plan to Address Scarcity

Interpretation: For all identified problems except scarcity, a plausible explanation for why an identified issue is unrelated to the activities of the applicant is acceptable in lieu of an action plan to address the issue. An action plan to address high risk on water quantity (i.e. water scarcity) is required in all cases where water is used at the final manufacturing stage facility. For example, if sanitary water is used but the manufacturing process itself does not require any water, an action plan would still be required.

A list of measures that can be implemented to increase efficient use of water can be found in Appendix A of the U.S. EPA Water Conservation Plan Guidelines.

6.4 WATER AUDIT

Alternative to Facility Wide Water Audit

Background: A facility wide water audit is required. The intent of the requirement is to assist manufacturers with understanding the amount of water used to manufacture the product and identify opportunities for reduction in use. A specific list of metrics to report on is detailed in the standard's Methods section and also within a supporting Water Audit form.

Interpretation: Metrics and supporting documentation other than those listed in the standard and supporting Water Audit form are acceptable as long as the outcome of the data collection and analysis meets the intent of the requirement (i.e., to increase the manufacturer's understanding of the amount of water used to manufacture the product). For example, a cradle to gate water use life cycle assessment (LCA) would be accepted in place of a facility wide water audit.

6.5 CHARACTERIZING AND ASSESSING PRODUCT-RELATED PROCESS CHEMICALS IN EFFLUENT

Water Recovery

Background: At the Silver level and above, "Product-related process chemicals in effluent are characterized and assessed, or product-related process chemicals are not discharged to water systems because wastewater is kept flowing in systems of nutrient recovery."

Interpretation: The term 'nutrient recovery' in the requirement above is referring to water recovery as opposed to chemical recovery. Product-related process chemicals present in any effluent that is discharged are required to be optimized. In other words, even if wastewater is treated prior to leaving the facility as effluent, product-related chemicals remaining in the effluent must still be characterized, assessed, and optimized (per standard section 6.7) due to the presence of low concentrations of these chemicals'.

Clarification of permissible ways to assess for process chemicals

Background: If the manufacturing process involves process chemicals with the potential to enter final manufacturing stage effluent, the standard requires complete characterization and assessment of these chemicals. It is mentioned that one method for complete characterization and assessment is assigning a single chemical risk rating (abc-x) for each substance used as product-related process chemical or part of a processing mixture (where grey is only allowed if there is missing toxicity data).

Interpretation: As is the case for any homogeneous material or mixture in a product for the Material Health assessment methodology, process chemicals that are formulated mixtures may also be assessed using material-level ABC-X assessments to meet the requirement of full assessment and characterization of process chemicals. This means that if a chemical is identified in a formulated mixture as x, the whole formulated mixture may count as assessed and X.

Required Documentation

Background: As part of the required documentation for this requirement, the assessor must identify the single chemical risk rating (as a,b,c, or x) for each chemical identified. The single chemical risk rating considers the chemical's hazards and exposure to the chemical via effluent. GREY single chemical risk ratings are permissible if the GREY rating is due to missing toxicity data rather than missing formulation information.

Interpretation: The last sentence of this documentation requirement only applies for the Silver level Water Stewardship requirement, not to the Gold level Water Stewardship requirement described in section 6.7 of the standard. At the Silver level, GREY single chemical risk ratings are permissible if the GREY rating is due to missing toxicity data rather than missing formulation information. At the Gold level, all substances must have received a single chemical risk rating of a, b, or c (GREY is not permissible).

6.6 SUPPLY CHAIN WATER ISSUES AND STRATEGY

Eligible Tier 1 Suppliers

Background: To fulfill the Silver-level supply chain option, applicants must complete one of the three Basic-level water issues investigation options for at least 20% of the tier 1 suppliers.

Interpretation: Only suppliers for which the given investigation option is applicable are eligible to help fulfill the requirement. In other words, only suppliers that have a facility (and are therefore able to complete a water audit) are eligible to contribute toward fulfillment of the water audit option, and only suppliers that have a discharge permit (and therefore can report on whether there was a violation) are eligible to contribute toward the discharge permit option.

7 SOCIAL FAIRNESS

7.4 MATERIAL-SPECIFIC OR ISSUE-SPECIFIC AUDIT

Additions to List of Approved Programs

Background: A material-specific and/or issue-related audit or certification relevant to a minimum of 25% of the product material by weight is required. A list of pre-approved programs is provided in the standard.

Interpretation: The following have been added to the list of approved programs:

1. Certain statewide professional logger certification programs if it can be shown that the material is supplied directly by a currently certified logger (includes: Pro Logger – North Carolina, Master Logger - Kentucky and Tennessee, and SHARP Logger – Virginia).
2. RSPO Certified Sustainable Palm Oil tracked through the Identity Preserved, Segregated or Mass Balance supply chain certification systems.
3. SustainaWOOL™ under the following conditions:
    a. The wool is sourced only from companies/farmers that are designated as having Ceased Mulesing (CM) or source Non Mulesed (NM) wool. Wool from sheep that have received Pain Relief (PR) treatment may not receive credit as mulesing is still used among these companies/farmers.
    b. A National Wool Declaration (NWD) must be provided. This information will have been collected as part of the SustainaWOOL program.
4. BES 6001 Framework Standard for Responsible Sourcing
5. Better Cotton Initiative (BCI), when level 3 volume claims applicable to the Cradle to Cradle Certified product can be made.

Requesting Additions to List of Approved Programs

Background: Assessors may request additions to the list of approved programs by providing C2CPII with the name of the proposed program and the following details:

1. A summary of the program and how it addresses fundamental human rights and other social fairness issues;
2. A list of any ecolabels/standards (other than C2C) or government programs that reward for use of materials certified under the program; and
3. A summary of any major criticism the program has received from NGOs or governments.

Interpretation: The following is also required and must be verified by the assessor:

4. Accessibility to the program is open to anyone who qualifies to apply. Programs that are administered/overseen by manufacturers allow competitors to join the initiative.

MATERIAL HEALTH ASSESSMENT METHODOLOGIES

Updates to the Material Health Assessment Methodology for V4.0

Material Health Assessment Methodology

Recycled Content Materials Assessment Methodology

Recycle Content Materials Analyte List*

Mixture Hazard Assessment Methodology

Exposure Assessment Methodology

Colorants Assessment Methodology

Biological Materials Assessment Methodology

Geological Materials Assessment Methodology

Polymer Assessment Methodology

*CLICK TO DOWNLOAD EXCEL FILE

Updates to the Cradle to Cradle Certified® Material Health Assessment Methodologies for Use in Version 4.0 Assessments

March 2021

Table of Contents

1 Introduction

As part of the Cradle to Cradle Certified® Product Standard Version 4.0 development process, several updates were made to the Cradle to Cradle Certified® Material Health Assessment Methodology and supporting methodologies. **These updates are provided in this document and are required for use in all Material Health assessments conducted for certification of products to the draft and final versions of the Cradle to Cradle Certified Version 4.0 standard.**

2 Updates to the Material Health Assessment Methodology

The following updates apply to the Material Health Assessment Methodology (the main Material Health assessment methodology document).

2.1 Changes to the Persistence Endpoint

In order to align the hazard level cut-offs with the ECHA/REACH definitions of persistent, bioaccumulative, and toxic substances (PBTs) and very persistent, very bioaccumulative substances (vPvBs), the persistence endpoint criteria have been modified as shown in Table 1 below.

Table 1 - Comparison of Version 3.1 and Version 4.0 hazard rating criteria for the Persistence endpoint.

GREEN	YELLOW	RED	PURPLE[1]	GREY
Version 3.1 Persistence Hazard Rating Criteria:				
T1/2 < 30/90 days in water/ soil or sediment; Readily biodegradable (>70 % within 28 days) based on OECD guidelines (301); Predicted to be readily biodegradable by	30/90 day < T1/2 < 60/180 days in water/ soil or sediment; 10% < DOC removal < 70% based on OECD guidelines (301) 10% < ThOD removal < 60% based on OECD guidelines (301) Inherently biodegradable	T1/2 > 60/180 days in water/ soil or sediment DOC and ThOD removal < 10% based on OECD guidelines Predicted to be recalcitrant by QSAR results.	Not Applicable	No relevant data for classification or substance is considered inorganic and not applicable

[1] Note: The “Purple” category is newly introduced with Version 4.0 to align with the REACH criteria defining vPvBs.

QSAR results	based on OECD guidelines (302, 304A); Predicted to be degradable within weeks to months by QSAR			
Version 4.0 Persistence Hazard Rating Criteria:				
T1/2 < 16[2] days in water, soil or sediment (Still aligns with the GHS aquatic tox approach.) T1/2 < 2 days in air[3] (aligned with REACH) Readily biodegradable (≥70% DOC removal or ≥ 60%ThOD removal within 28 days) based on OECD guidelines (301) Predicted to be readily biodegradable by QSAR results	16 days ≤ T1/2 ≤40 days in fresh or estuarine water 16 days ≤ T1/2 ≤ 60 days in marine water 16 days ≤ T1/2 ≤ 120 days in fresh or estuarine water sediment or soil 16 days ≤ T1/2 ≤ 180 days in marine sediment (upper value aligned with REACH/ECHA P in PBT) 20%[4] < DOC removal < 70% based on OECD guidelines (301) 20% < ThOD removal < 60% based on OECD guidelines (301) Inherently biodegradable based on OECD guidelines (302, 304A); Predicted to be	40 ≤ T1/2 ≤ 60 days in fresh or estuarine water. note: there is no RED value for marine water. See PURPLE value. 120 ≤ T1/2 ≤ 180 days in fresh or estuarine water sediment or soil. Note: there is no RED value for marine sediment. See PURPLE value. (aligned with REACH 'P' definition for PBTs) T1/2 > 2 days in air (aligned with REACH) DOC and ThOD removal < 20% based on OECD guidelines Predicted to be recalcitrant by QSAR	T1/2 > 60 in marine, fresh or estuarine water T1/2 > 180 days in marine, fresh or estuarine water sediment or in soil (aligned with REACH 'vP' definition for vPvBs)	No change

[2] Per GHS 2015 page 460, degradation of >70% within a 28 day period corresponds to a degradation half life of 16 days.
[3] See Page 42 of this https://echa.europa.eu/documents/10162/13632/information_requirements_r11_en.pdf page 17 of US EPA P2 Framework Manual 2012 EPA-748-B12-001 https://www.epa.gov/sites/production/files/2015-05/documents/05.pdf Also see Section 3.1 of this (older) document http://www.reach-info.de/dokumente/gutachten_gesamtpersistenz.pdf
[4] See page 38 of this ECHA/REACH doc https://echa.europa.eu/documents/10162/13632/information_requirements_r11_en.pdf and OECD, 2005 see page 7, paragraph 35 http://www.oecd.org/chemicalsafety/testing/34898616.pdf

	degradable within weeks to months by QSAR	results.		

2.2 Changes to the Bioaccumulation Endpoint

In order to align the hazard level cut-offs with the ECHA/REACH definitions of persistent, bioaccumulative, and toxic substances (PBTs) and very persistent, very bioaccumulative substances (vPvBs), the bioaccumulation endpoint criteria have been modified as shown in Table 2.

Table 2 - Comparison of Version 3.1 and Version 4.0 hazard rating criteria for the Bioaccumulation endpoint.

GREEN	YELLOW	RED	PURPLE	GREY
Version 3.1 Bioaccumulation Hazard Rating Criteria:				
BCF/BAF < 100 by experimental or QSAR results if log Kow < 6 *or* log Kow < 2 *or* Molecular weight > 1000	100 < BCF/BAF ≤ 500 by experimental or QSAR results if log Kow < 6	BCF/BAF > 500 by experimental or QSAR results if log Kow < 6	Not Applicable	No relevant data for classification. log Kow>2 and no additional information
Version 4.0 Bioaccumulation Hazard Rating Criteria:				
BCF/BAF < 500 by experimental or QSAR results if log Kow < 6 *or* log Kow < 2 *or* Molecular weight > 1000	500 ≤ BCF/BAF ≤ 2000 by experimental or QSAR results if log Kow < 6	2000 < BCF/BAF ≤ 5000 by experimental or QSAR results if log Kow < 6 (aligned with REACH 'B' definition for	BCF/BAF > 5000 by experimental or QSAR results if log Kow < 6. (aligned with REACH 'vP'	No change

(aligned with GHS aquatic tox related values)		PBTs)	definition for vPvBs)	

2.3 New Combined Persistence and Bioaccumulation Hazard Flag

In the revised Material Health Assessment Methodology, Persistence (P) and Bioaccumulation (B) receive a combined hazard flag separate from the combined aquatic toxicity risk flag as detailed in Table 3 below. If the combined PB hazard flag is PURPLE or RED, exposure must be assumed unless a closed loop recycling system is taking back 80% or more of the product and exposure is not likely during the manufacturing and use phases.

Table 3 - Deriving the new combined PB hazard flag from Persistence and Bioaccumulation hazard endpoint ratings.

Persistence Hazard Rating	**Bioaccumulation Hazard Rating**	**Combined PB Hazard Flag**
PURPLE	PURPLE	**PURPLE**
PURPLE	RED	**RED**
RED	PURPLE	**RED**
RED	RED	**RED**
Any other combination of hazard ratings may formally be assigned a combined PB hazard flag of 'GREEN' (these combinations factor into the combined aquatic toxicity flag, where they may lead to 'RED', 'YELLOW', or 'GREEN' ratings depending on the aquatic toxicity endpoints).		

2.4 Changes to the Climatic Relevance Endpoint

The rating criteria for the Climatic Relevance endpoint have been changed from a purely list based approach to one that is based on the key metrics that characterize a molecule's climatic impacts. The new rating criteria are in Table 4 below. Note that a GREY rating has been introduced.

Table 4 - Version 4.0 hazard rating criteria for the 'Climatic Relevance' endpoint.

GREEN	YELLOW	RED	GREY
Not listed in Annexes to the Montreal Protocol, ODP = 0 and 100-yr GWP = 0	Not listed in Annexes to the Montreal Protocol, ODP = 0 and 0 < 100-yr GWP[5] ≤ 10 OR Insufficient data to categorize as RED, YELLOW or GREEN based on the Montreal protocol, GWP and ODP, but substance is not a volatile organohalogen. Volatile is defined as boiling point < 260 °C[6]. Organohalogen is any substance containing a fluorine, bromine, chlorine or iodine - carbon bond.[7]	GHS Category 1: Listed in Annexes to the Montreal Protocol. OR ODP > 0 and/or 100-yr GWP > 10	Insufficient data to categorize as RED, YELLOW or GREEN. Note: The Grey hazard rating is only relevant to volatile organohalogens that cannot be categorized as RED, YELLOW or GREEN due to lack of data.

[5] **Regarding pentane, isopentane, and cyclopentane:** Varying GWPs have been indicated from 3 to 11. These substances are *Acceptable* per the US EPA and the EU Commission and are to be assigned a YELLOW hazard rating for this endpoint.
[6] US EPA, Technical Overview of Volatile Organic Compounds, https://www.epa.gov/indoor-air-quality-iaq/technical-overview-volatile-organic-compounds
[7] Note: Fluorinated substances are not ozone depleting substances due to their high stability/lack of reactivity but are often potent greenhouse gases when volatile.

2.5 Changes to the Rules for Assigning Single Chemical Risk Ratings

The rules for assigning Single Chemical Risk ratings in the Version 4.0 Material Health Assessment Methodology are modified as follows (added/modified rules are underlined):

1. If the chemical has received a combined PB hazard flag of PURPLE (see Section 2.3 above regarding the combined PB risk flag), the single chemical risk rating is 'x' and steps 2-6 below do not apply.
2. If the chemical has received a RED risk flag in any of the 17 endpoints resulting from the risk assessment (Section 4 of the Material Health Assessment Methodology regarding the combined Aquatic Toxicity risk flag), the single chemical risk rating is 'x' and steps 3-6 below do not apply.
3. Otherwise, if the chemical has received a GREY risk flag for any endpoint other than Carcinogenicity, Endocrine Disruption, Neurotoxicity, Climatic Relevance, or Terrestrial Toxicity, the single chemical risk rating is 'GREY' and steps 4-6 below do not apply.
4. Otherwise, if the chemical has received any YELLOW risk flags or any GREY risk flags for Carcinogenicity, Endocrine Disruption, Neurotoxicity, Climatic Relevance, or Terrestrial Toxicity, the single chemical risk rating is 'c' and step 5 and 6 below do not apply.
5. Otherwise, if the chemical has received any YELLOW hazard ratings, the single chemical risk rating is 'b' and step 6 below does not apply (the chemical has received only 'GREEN' risk flags, but one or more YELLOW hazard rating).
6. Otherwise, the single chemical risk rating is 'a' (the chemical has received only 'GREEN' hazard ratings).

3 Changes to the Exposure Assessment Methodology

The following changes apply to the Exposure Assessment Methodology.

3.1 Persistence and Bioaccumulation

The following rule has been added to Step 1A of the method:

Substances with a PURPLE hazard rating for the combined PB hazard flag (see Section 2.3 above) are always x assessed, unless a closed loop recycling system is taking back 80% or more of the product and exposure is not likely during the manufacturing and use phases.

3.2 Assessment of Effluent and Sludge

The Final Manufacturing Stage portion of the Exposure Assessment Methodology has been altered in order to ensure that the fate of individual chemicals potentially entering the effluent are addressed appropriately. (Note that the exceptions in Section 3.1.1 of the Exposure Assessment Methodology still apply as written, i.e., some substances must be x-assessed regardless of exposure considerations). Specifically, the potential for the chemical to volatilize and/or adsorb to sludge, and the ultimate fate of the sludge, must be considered in addition to the presence of the chemical in the effluent itself unless one of the following is true (text in *italics* is taken directly from the Version 3.1 Exposure Assessment Methodology):

1. *The chemical's hazard rating for Persistence is GREEN or, in the case of the aquatic toxicity endpoints (fish, daphnia, algae), the combined aquatic toxicity flag is YELLOW (i.e. Persistence and Bioaccumulation are both GREEN when the aquatic toxicity hazard rating and risk rating are RED or GREY).* NOTE: If the chemical will be exposed to anaerobic conditions (i.e., anaerobic digestion or substances that are expected to end up in sediment), the hazard rating for Persistence may be GREEN in either anaerobic or aerobic environments (both are predicted by the US EPA's BIOWIN).
2. *Water only comes into contact with the product at a point when the chemical with a RED or GREY hazard rating is unavailable for release (i.e. it is reacted into the material matrix).*
3. *Process water is kept flowing in a* **fully** *closed loop.* This is defined as a closed loop system that does not produce sludge-containing chemicals in scope and that is not periodically flushed, resulting in release of chemicals in scope with effluent.

If none of the above are true, a RED or GREY risk flag (as relevant) may be assigned for the Final Manufacturing Stage context (and no further assessment work or analytical testing is required[8]). Alternatively, the exposure assessment may continue as follows:

1. The fate of the chemical once it enters the effluent must be determined based on its physico-chemical properties.[9] At least some of the chemical is assumed to be present in each compartment (sludge, water, air) where the following are true:
    a. Present in sludge if:

[8] Note: Although testing is not required when assessing product relevant effluent for the purposes of this proposal, testing is required per some of the other water stewardship proposals.

[9] US EPA, Interpretive Assistance Document for Assessment of Discrete Organic Chemicals, Sustainable Futures Summary Assessment, June 2013. https://www.epa.gov/sites/production/files/2015-05/documents/05-iad_discretes_june2013.pdf

i. The soil adsorption coefficient (log K_{oc}) is ≥1.5[10] and

ii. The substance is not highly volatile from water: Henry's Law constant $<10^{-1}$

b. Present in water if:

i. The soil adsorption coefficient (log K_{oc}) is <4.5 and

ii. The substance is not highly volatile from water: Henry's Law constant $<10^{-1}$

c. Present in/released to air if:

i. Henry's law constant is $>10^{-5}$ (values above 10^{-5} are defined as moderately to very volatile from water)

Then, an assessment must be completed for each compartment that the chemical is expected to enter as follows:

2. If a portion of the chemical is expected to remain in the water (meets condition 1b above), a RED or grey risk flag must be assigned unless *testing using appropriate analytical methods and detection levels for the contaminant in question has shown that the chemical with the RED or GREY hazard rating is not present in effluent* (i.e. is below detection limits) OR is present below safe limits. This is described in the Effluent: Analytical Testing Methods & Limit Values section below.

3. If a portion of the chemical is expected to adsorb or adhere to the sludge (meets condition 1a above), then a RED or grey risk flag must be assigned unless the sludge, biosolids (dried and sanitized sludge), and/or digestate resulting from anaerobic digestion of the sludge (if such digestion occurs prior to disposal), are processed appropriately. This can be determined based on the following questions:

a. If landfilled, answer the questions posed in the Landfill section of the Exposure Assessment Methodology. (NOTE: this will not allow for assigning a YELLOW risk flag to a RED or grey hazard rating because substances that are not contained within a material matrix are assumed to leach from the landfill eventually. Therefore, It must be assumed that hazardous chemicals in sludge will eventually leach from landfills. No distinction is made between a hazardous waste or conventional landfill.)

b. If land applied or composted, answer the questions in the Compost section of the Exposure Assessment Methodology. (NOTE: this also will not allow for a YELLOW risk flag). Land application as a soil amendment is the most common end of use fate of biosolids and digestate in many locations unless identified as hazardous waste per regulatory definitions.

[10] Estimates of log Koc are available in the US EPAs EpiSuite. Specifically, KOCWIN estimates Koc using the Molecular Connectivity Index (MCI) and a log Kow-based method. The MCI method is more robust and is preferred per https://www.epa.gov/sites/production/files/2015-05/documents/05.pdf

c. If incinerated, and the substance is not RED for the *Toxic Metal* endpoint and also is not an organohalogen, then a RED or grey hazard rating may be assigned a YELLOW risk flag.

d. If recycled in a process of nutrient recovery (e.g. the chemical is removed from sludge and reused at the manufacturer's facility), and appropriate PPE is in use as determined at the site visit, a RED or grey hazard rating may be assigned a YELLOW risk flag.

NOTE: Appropriate test methods and limits relevant to sludge are not available at this time. Therefore, testing of sludge to show that hazardous chemicals are present below detection (or safe) limits is not provided as an option. For example, In the US, biosolids only have to be tested for metals and pathogens. The amount that is land applied is also regulated because some metals typically remain in the material.[11] In the EU, limits on metals for land application are set by individual member countries.[12] However, "because many pollutants are unregulated and the hazards posed by them are indeterminable, some regional states have banned the use of sewage sludge as fertilizer".[13]

4. If a portion of the chemical is expected to volatilize (meets condition 1c above) from the water and be released to air, then a RED or GREY risk flag must be assigned unless testing using appropriate analytical methods and detection levels for the contaminant in question has shown that the chemical with the RED or GREY hazard rating is not present in the air exiting control equipment (i.e. is below detection limits) OR is present below certain limits. In some cases a GREY rating is allowed in this context. This is described in the Air: Analytical Testing Methods & Limit Values section below. The fate of solid waste, if any, resulting from treatment (e.g. scrubber wet sludge) must also be assessed per the section for sludge above.

Effluent: Analytical Testing Methods & Limit Values

If a chemical is expected to be present in water and is still x or GREY assessed after completing the steps above, the effluent may optionally be tested to determine if individual chemicals are present below detection limits, below safe limits (if available), or are of low toxicity, as described below. Alternatively, both incoming water and effluent may be tested to determine if the concentration within the effluent is at or below the incoming concentration. In cases where effluent is discharged to a third party treatment facility, the required limits may be met either by the final manufacturing stage facility or by the third party treatment facility.

[11] US EPA, Title 40 Part 305.13

[12] http://ec.europa.eu/environment/waste/sludge/

[13] https://www.umweltbundesamt.de/en/topics/soil-agriculture/ecological-impact-of-farming/compost-sewage-sludge

If testing shows that a chemical is below the required limits within effluent, or present in effluent at or below the incoming concentration[14], a RED or grey hazard rating may be assigned a YELLOW risk flag **in the context of water** (sludge and air may still need to be considered per the points above). The following approaches are acceptable depending on the chemical, region, etc. as noted.

1. **For regulated substances**: national or international objective limits for water bodies may be applied to the effluent as it leaves the facility (unless permit limits are lower in which case those take precedence).[15] The limits indicated in the following references must be achieved using the associated test methods. Exception: if feasible detection limits are above safe limits (e.g. the limits of quantification (LOQ) are above the Environmental Quality Standards (EQS) using the EU terminology), testing shall not be used to alter a RED hazard rating.[16]
    a. If a facility is in the EU: *Directive 2008/105/EC on environmental quality standards (EQS) in the field of water policy* applies. If lower limits have been set by the relevant member state, those limits take precedence.
    b. If a facility is in the US: EPA priority pollutants and test methods including the listed detection limits apply unless objective limits have been set at the state level in which case those must be met.[17] Note that some states defer to the National Recommended Water Quality Criteria - Human Health and Aquatic Life. If there are limits indicated for both chronic and acute toxicity (as there are in the two prior links), the lower limit must be applied.
    c. EU facilities may apply the limits set per the US references above for any substance that is not regulated in the EU (and vice versa).
    d. For other regions: If similar objective limits have been set for the relevant water body that have been determined based on what is safe for humans and the environment, those limits may be applied. If not, the lower of the EU or US relevant limits above must be employed.
2. **For non-regulated substances** the following approaches may apply (i.e. the applicant and assessor select a method from those listed below as deemed most appropriate):

[14] If the applicant is actively choosing to use contaminated water this approach may not be used to apply a YELLOW rating - for example, if wastewater from another facility is used as an input to the final manufacturing stage. This approach does apply when, for example, water purchased from the municipality already contains high levels of a substance under consideration.

[15] Note: Technology based effluent limitations may not be employed (e.g. TBELs in the US and Best Available Technique/BAT based limits in the EU) because these are not necessarily safe limits.

[16] Note: Some regulatory limits for priority substances are set below the limits of quantification: European Union, Technical Report on Aquatic Effects Based Monitoring Tools, 2014, see page 19. https://circabc.europa.eu/sd/a/0d78bbf7-76f0-43c1-8af2-6230436d759d/Effect-based%20tools%20CMEP%20report%20main%2028%20April%202014.pdf

[17] For example see: US EPA, Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. 40 CFR Part 131, Thursday May 18, 2000.

a. For aquatic toxicity endpoints: the complete suite of Whole Effluent Toxicity (WET) testing may be employed. If the effluent is tested and exhibits low toxicity to aquatic life (i.e. the result of the tests = pass which means no significant difference between the effluent and the control), a YELLOW risk flag may be assigned. Note: WET testing is already required in the US for permit compliance in many cases and those results may be used to show lack of aquatic toxicity for Cradle to Cradle Certified. Conducting new WET testing for the purposes of certification (when not already required by permits) is an option, but note that these tests do require live animal testing and so are not reccomended.

b. Otherwise, the following limits apply and the assessor and/or an ISO 17025 certified laboratory may propose appropriate test methods.

    i. For Aquatic and Terrestrial Toxicity: A Predicted No Effect Concentration (PNEC)[18, 19] using assessment factors defined by the European Commission shall be applied as the effluent limit (see link in footnote below for calculation methods and the Appendix for examples of how it is applied).

    ii. For the Sensitization, Oral, and Dermal Toxicity: The mixture rules may be applied to effluent. i.e. the concentration needed for assigning a YELLOW risk flag as defined by the mixture rules shall be used as the limit. See the Appendix for further detail.

    iii. For the Skin, Eye, and Respiratory Corrosion/Irritation: Chemicals with a RED hazard rating for this endpoint that are irritating due to pH, may affect the pH of the effluent. In this case, permit or international guideline limits for pH apply. Substances that are grey for this endpoint are out of scope for effluent assessment (i.e. if grey for this endpoint, a YELLOW risk flag may be assigned in this context)

    iv. Otherwise, an ISO 17025 certified laboratory may propose feasible detection limits. If effluent is tested and the substance shown to be below feasible detection limits, then YELLOW risk flag may be applied. (This is the same as the Version 3.1 approach.)

Air: Analytical Testing Methods & Limit Values

As for effluent, analytical testing of air is not required. However, if a chemical is expected to be present in air (i.e. meets condition **1c** above) and is still x or grey assessed after completing the steps above,

[18] http://www.chemsafetypro.com/Topics/CRA/How_to_Calculate_Predicted_No-Effect_Concentration_(PNEC).html

[19] https://echa.europa.eu/documents/10162/13632/information_requirements_r10_en.pdf

the air may be tested to determine if individual chemicals are present below the required limits as described below. If a chemical is present below the required limits, a RED or grey hazard rating may be assigned a YELLOW risk flag **in the context of air** (water and sludge including air scrubber sludge may still need to be considered per the points above). Note that the approach for air is somewhat different from that of water because there is not currently a methodology for calculating PNEC in air nor a set of standardized toxicity tests applicable to outdoor air that can be applied. In addition, fewer substances are individually regulated in the context of air compared to water. The following approaches apply:

1. **For regulated substances**:
    a. National or international objective limits for ambient air quality may be applied to the air as it leaves the air control equipment used at the facility.[20] If limits have not been set in one region, those set in other regions may be applied (e.g. the EU has set limits on benzene and PAHs while the US has not).
    b. If objective limits have not been set (or if permit limits are lower than the objective limits, which is unlikely), the limits set by the permits apply.
    c. If permits do not exist, or do not indicate limits for the substance in question, limits set by the International Finance Corporation (IFC)[21] for the industry in question or similar (if industry specific limits are not available) apply.
    d. When total VOCs are limited by permits or the IFC guidelines, these limits apply in addition to the approach described in the non-regulated substances section that follows.
2. **For other non-regulated substances:**
    a. If there is a RED hazard rating for the Inhalation Toxicity endpoint, or for Respiratory Sensitization, the mixture rules may be applied to the concentration in air measured as it leaves the air control equipment (i.e. the concentration needed for assigning a YELLOW risk flag as defined by the mixture rules may be used as the limit).
    b. For substances that are toxic via inhalation that are not covered by the mixture rules (e.g. RED hazard for human health endpoints such as carcinogenicity but not a regulated substance), the assessor and/or an ISO 17025 certified laboratory may propose appropriate test methods and detection limits. If air is tested and the

[20] EU: http://ec.europa.eu/environment/air/quality/standards.htm US: https://www.epa.gov/criteria-air-pollutants/naaqs-table US, California: https://www.arb.ca.gov/research/aaqs/caaqs/caaqs.htm WHO: http://www.who.int/mediacentre/factsheets/fs313/en/

[21] IFC: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

substance shown to be **below feasible detection limits** in air as it leaves the control equipment, then a YELLOW risk flag may be applied.

c. **Otherwise, the assessor must review the scientific literature to determine if there are any known issues of high concern associated with release of the substance to air.** Currently there is not a specific hazard endpoint aside from the 'other' endpoint that addresses acidification or eutrophication. These issues must be taken into consideration as part of the research (note: this may be covered under the regulated substance section for some industries e.g. permits may include limits for sulfur and nitrogen oxides, ammonia, etc.). The research should also include determination of whether or not hazardous substances or reactants are likely to be returned to soil and/or water due to land deposition processes. If yes, then assessment in those contexts is also required. If no issues are identified, a YELLOW risk flag may be applied in the context of air. In other words, **endpoints that are GREY may be out of scope in the context of release to air.** If issues of high concern are identified, the assessor and/or an ISO 17025 certified laboratory may propose appropriate test methods and detection limits. If air is tested and the substance shown to be below feasible detection limits in air as it leaves the control equipment, then a YELLOW risk flag may be applied.

Sampling & Testing Frequency

Sampling: For regulated substances, sampling methods required by permits must be followed. Otherwise, for effluent, the sampling methods required for the Zero Discharge of Hazardous Chemicals (ZDHC) program or equivalent are required.

Testing frequency: Must align with permit requirements if considering regulated substances and/or if using test results that are also required by permits (e.g. Whole Effluent Toxicity testing). Otherwise, bi-annual (i.e. two per year) testing is required. If all tests have been in compliance after a two year period (four tests total), further tests are not required unless there have been changes in the manufacturing process. If changes have occurred, another two year period of bi-annual tests must be completed.

4 Changes to the Polymer Assessment Methodology

The following changes apply to the Polymer Assessment Methodology.

Residual monomers and oligomers[22] are now subject to review at 100 ppm or above in the homogeneous materials of the finished product. In the case that a residual monomer is present on the Restricted Substances List, and the threshold indicated there is lower than 100 ppm, or a specific concentration limit (SCL) for any toxicity endpoint of a substance is below 100 ppm as indicated by the Table of Harmonized Entries in Annex VI to the Classification, Labelling, and Packaging of Substances and Mixtures regulation, the lower threshold will apply[23].

The monomer concentration within a molded or extruded plastic part will be assumed to be the same as the monomer concentration within the polymer pellet or resin as purchased from the polymer manufacturer unless testing has shown otherwise.

An exposure assessment may be completed for monomers using the same method as for all other substances within the polymer.

A passed VOC test at the product level may be used as indication that inhalation exposure is not relevant (following the Exposure Assessment Methodology as for other substances).

In addition, any non-biodegradable or non-compostable polymer (see the biodegradability definition for how biodegradability or compostability is determined/verified) that contains an additive that has been intentionally added for the purposes of enhancing degradation renders a product non-certifiable as per the product eligibility requirements stated in Section 2 of the Cradle to Cradle Certified Product Standard, Version 4.0.

5 Changes to the Evaluation of Externally Managed Components (EMCs)

In Version 4.0, the requirements that an externally managed component (EMC) needs to fulfill in order to count as assessed are no longer included in the main standard document. Instead, they are considered a standalone assessment methodology similar to those for geological materials and recycled content materials.

[22] Oligomers are defined as material fraction with molecular weight < 500 Daltons (with reference to https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca/polymer-exemption-guidance-manual).
[23] For example, vinyl chloride is on the restricted substances list with a threshold of 5 ppm or 1 ppm depending on application.

5.1 Requirements

In order to count as assessed, an EMC will need to meet all requirements as stated in Section 3.4.1 of the Version 3.1 Cradle to Cradle Certified Product Standard (provided for reference in Section 5.3) with the following clarifications and additions:

- Version 3.1 of the Standard states that: "If, during use of the product for which the EMC is a component, a user is exposed to any part or chemical within the component, or if any part or chemical within the component is released to the environment, the component is not considered an EMC and will be assessed and inventoried like the other materials in the product." The following will be added in the new EMC methodology: 'In addition, any component of the product that is available for exposure to occur (including dermal), such as the housing, any external wiring, etc. may not be considered part of the EMC and must be assessed per the usual methodology.'
- A single core Restricted Substances List (RSL) declaration signed by the applicant or manufacturer of the EMC will be accepted. This declaration must be supported by one or more of the following:
    - RSL declarations from suppliers of all homogeneous materials contained within the EMC (these may be collected by the manufacturer and shared with the assessor; it is not required to provide all declarations to C2CPII)
    - Analytical testing of all internal EMC materials for which no RSL declaration from the material manufacturer has been obtained demonstrating compliance with the RSL. Contact C2CPII for information on appropriate test methods (methods recommended for the Recycled Content Materials Assessment Methodology apply).
    - The EMC manufacturer may sign a declaration if they have sufficient knowledge of the components material and chemical constituents to ensure that all contained materials are RSL compliant.

- The Platinum level Active Cycling requirements will apply to EMCs in determining whether or not an appropriate end of use / take-back system is in place. Specifically, the EMC must meet Platinum level requirements as described in Section 5.9 of the Version 4.0 standard, regardless of the certification level for the product overall.

- If the product is intended to be used outdoors and will be installed in such a way that the housing and/or other components of the EMC will be exposed to environmental media (e.g. rain, soil, ice,), the product must have received an appropriate International Electrotechnical Commission (IEC) International Protection (IP) rating or National Electrical Manufacturers

Association (NEMA) rating[24] (or similar depending on product type and location in which it is sold) for the environment in which it will be used. This will provide some assurance that the unassessed internal components of the EMC will not accidentally be released due to contact with water and soil, etc.

- The applicant will be asked for data on the rate of return for the product itself or for similar product(s) as well as proof that returned EMCs will be handled and recycled in a way that minimizes the risk of human or environmental exposure to hazardous substances. If less than 95% of the EMC is being returned or can be expected to be returned for appropriate handling and recycling (or if data are not available), then landfilling must be assumed as a plausible end of use scenario. In this case, leaching tests are required per the methods described below to ensure that the EMC is not defined as hazardous waste.

- Leaching test requirements for landfill scenario:
    - The extraction method used must be per EN 12457-1 -2 or -3 for granular waste (relevant to the EU's Council Decision 2003/33/EC Waste Acceptance Criteria). Alternatively, if the product will only be sold outside of the EU, then the extraction method outlined in the US EPA's Toxicity Characteristic Leaching Procedure (TCLP) may be employed instead.[25]
    - Eluate must meet the requirements for inert or non-hazardous waste per Section 2.2.2 *Limit values for non-hazardous waste* of Council Decision 2003/33/EC (or most recent version of the clause in the case that the directive is updated or amended) per the requirements in the EU member state(s) where the product is sold.[26] Alternatively, if the product will only be sold outside of the EU then the requirements outlined in the most recent version of the US EPA's TCLP may be met instead.

5.2 Verification

Documentation in support of meeting all requirements listed above will be required. This may include: An RSL declaration, RSL test results, IEC and NEMA rating documentation, hazardous waste test results, data on recovery rates and VOC test results.

[24] Information on IP ratings: https://www.nemaenclosures.com/blog/ingress-protection-ratings/ https://www.cnet.com/how-to/water-dust-resistance-ratings-in-gadgets-explained/
IP and NEMA ratings: http://www.siemon.com/us/standards/nema_comparison.asp
[25] Note: These tests may be used for complex products, but they would have to be granulated prior to completing the tests. See for example: http://sinovoltaics.com/solar-basics/introduction-to-solar-panel-recycling/. Also note that in the EU it is not likely that such a test would ever be needed on a complex electronic product like solar panel because it is mandatory that manufacturers take these back per WEEE.
[26] Limit values are listed for each of three possible liquid to solid (L/S) ratios; refer to extraction method used (either EN 12457-1 -2 or -3) to determine which limit value is relevant.

5.3 Version 3.1 Externally Managed Components (EMCs) Requirements

The following requirements and conditions from Version 3.1 still apply under Version 4.0 (with the modifications and additions described above). The text in *italics* is taken directly from the Version 3.1 Cradle to Cradle Certified® Product Standard, with clarifications and annotations added in parentheses:

The following information must be collected from the applicant or applicant's supplier if a sub-assembly is to be defined as an EMC (see Section 1.3.1.3 for definition and more information on EMCs):

1. *The supplier of the EMC has provided the applicant with a guarantee for take back and appropriate nutrient management. The supplier may designate a third party or parties for implementation.*
2. *The supplier has signed a declaration that chemicals in the EMC will not negatively impact humans or the natural environment during the intended and unintended but highly likely use of the product for which the EMC is a component. This guarantee may be provided if the EMC is Cradle to Cradle CertifiedTM (Gold level or higher), or other appropriate evidence.*
3. *The EMC has undergone testing by an accredited analytical laboratory to* [ensure] *that harmful substances are not being emitted from the EMC above the chemical's analytical detection limits. Off- gas testing is required for all indoor-use EMCs (See Section 3.9 for more information on VOCs emission testing). Migration and leaching testing may be required depending on the type of EMC.*

If the above are completed, the general requirement for full chemical compositional identification and assessment of the EMC will not apply.

The intent of these requirements is for the supplier to indicate, to the best of their knowledge, that the sub-assembly is a sealed component that is manufactured in a way that prohibits the migration of chemicals and materials from the component. If, during use of the product for which the EMC is a component, a user is exposed to any part or chemical within the component, or if any part or chemical within the component is released to the environment, the component is not considered an EMC and will be assessed and inventoried like the other materials in the product. [**Added for Version 4.0**: In addition, any component of the product that is available for exposure to occur (including dermal), such as the housing, any external wiring, etc. may not be considered part of the EMC and must be assessed per the usual methodology.]

It is recognized that it is not possible to know with absolute certainty that chemicals and materials in the EMC will not negatively impact humans or the natural environment during all the possible use and re-use scenarios. The overall intent is to allow for the use of product components that do not need to be

assessed the same way as the rest of a product because they are managed as a whole by the supplier or a third party. The EMC concept was invented by the founders of the Cradle to Cradle® framework to encourage manufacturers to design complex components that are completely managed after their use phase. Examples of potential EMCs are a pneumatic cylinder in an office chair, the motherboard in a computer, the electric motor inside an automated window shade product, and a solar panel.

Required Documentation

The following documents must be submitted to the assessor:

1. *A signed statement from the manufacturer guaranteeing take back and appropriate nutrient management of the EMCs, including a full description of the take back program and how the product or material will be returned.*
2. *A signed declaration that chemicals in the EMC will not negatively impact humans or the natural environment, as detailed above (this guarantee may be provided if the assembly/part is Cradle to Cradle Certified (Gold level or higher), or other appropriate evidence).*
3. *Test results, including a description of the test methods used and laboratory contact information.*

6 Appendix

6.1 Assessment of Effluent Using the Mixture Rules

The Mixture Rules apply to a subset of hazard endpoints as follows: Oral, Dermal, and Inhalation Toxicity, Irritation, Sensitization, and Aquatic Toxicity (Acute & Chronic).

The Cradle to Cradle Material Health Assessment Methodology Mixture Rules may be applied directly to effluent prior to completing the exposure assessment or deriving the combined aquatic toxicity risk flag for all covered endpoints except for Aquatic Toxicity (PNEC must be used for aquatic toxicity). In other words, the effluent may be assessed as a "material".[27] **This approach may only be used for simple mixtures (defined as 10 components or less)** due to the increased likelihood of interactions occurring between mixture components as complexity increases.[28] If the substance is also potentially entering the sludge and/or released to air, that must also be considered and assessed as described in the Exposure Assessment Method: Final Manufacturing Stage section above.

[27] Note: The Exposure Assessment Methodology states that, in the case of chemicals released to effluent at the final manufacturing stage facility, if *Persistence* is GREEN for endpoints other than aquatic toxicity, substances with RED or grey hazard ratings released to effluent may receive a YELLOW or GREEN risk rating. The combined aquatic toxicity risk flag is used in the case of the aquatic toxicity endpoint in which case both *Persistence* and *Bioaccumulation* must be GREEN to override a RED aquatic toxicity hazard rating.

[28] http://pubs.rsc.org/en/content/articlehtml/2016/RA/C6RA05406D

EXCEPTION: This approach may not be used for substances that are regulated in the context of industrial effluent.

In order to apply the Mixture Rules, **it will be necessary to determine concentrations for and assess ALL chemicals present in effluent** as opposed to only those chemicals relevant to the product to be certified. All chemicals present in intentional product input formulations and process chemical formulations at ≥1000 ppm, that are also potentially entering effluent, must be part of the assessment. Again, this applies to all products and processes at the facility, not only those used to manufacture the certified product.

Estimated concentrations of chemicals within the effluent as it leaves the facility, based on analytical testing or maximum theoretical concentrations, may be used when applying the Mixture Rules.[29, 30] Estimated concentration(s) must equal the highest of the values obtained via analytical testing (if testing is conducted). See Analytical Testing sections above for methods and frequency. If substances are released only periodically, sampling must coincide to capture concentration spikes.

6.2 Assessment of Effluent Using the Predicted No-Effect Concentration (PNEC)

Assessment of effluent using the Predicted No-Effect Concentration (PNEC) applies to Aquatic Toxicity hazard endpoints (Algae, Daphnia, and Fish) and the Terrestrial Toxicity hazard endpoint. To use this route of evaluation, PNECs need to be calculated for every environmental compartment (water [fresh, and marine], soil, sediment) for which toxicity data are available and exposure to effluent is feasible (algae/daphnia/fish in water, soil-living organism for soil, sediment-living organism for sediment). Each PNEC value will then be compared to the concentration of the substance in the effluent. If the concentration of the substance in the effluent is greater than the respective PNEC value, the substance will receive a RED risk flag for the toxicity endpoint relevant to the particular PNEC (in the case of aquatic toxicity, the PNEC-*fresh water* and PNEC-*marine water* corresponds to all aquatic toxicity endpoints, so a concentration > PNEC would result in a RED flag for all three aquatic toxicity endpoints).

Which PNECs Need to Be Calculated

The PNEC for each environmental compartment for each substance needs to be calculated if data relevant to that environmental compartment is available as follows:

[29] ECHA, Environmental Exposure Assessment, 2016. (See R.16.2 Release assessment). https://echa.europa.eu/documents/10162/13632/information_requirements_r16_en.pdf

[30] OECD, Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology, Revision 1 of the Resource Compendium of PRTR Release Estimation Techniques, January 8, 2013, (See estimation method described on page 25): http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2002)20/rev1&doclanguage=en

Environmental Compartment	**PNEC type**	**Calculate this PNEC if this data is available**
Fresh Water	PNEC-*fresh water*	The lowest value (EC50, LC50, NOEC) from one of the three aquatic toxicity endpoints (daphnia, algae, fish)
Marine Water	PNEC-*marine water*	Only derive if exposure to marine water is possible. If no marine-life aquatic toxicity data is available, PNEC-*marine water* = PNEC-*fresh water*/10
Soil	PNEC-*soil*	NOEC/EC10 values for sediment living organisms (equal to the lowest value of NOEC/EC10 from data available)
Sediment	PNEC-*sediment*	NOEC/EC10 values for sediment living organisms (equal to the lowest value of NOEC/EC10 from data available)
Sewage Treatment Plant Microorganism, Air, Predator	PNEC-*STP*, PNEC-*predator*, PNEC-*air*	Not necessary to calculate for this requirement.

How PNECs are Calculated

PNECs for each environmental compartment are derived from the respective lowest data values relevant to each environmental compartment (see table above) divided by a particular assessment factor. The assessment factors are calculated based on the type of data that is available as described in the following table[31]:

[31] http://www.chemsafetypro.com/Topics/CRA/How_to_Calculate_Predicted_No-Effect_Concentration_(PNEC).html

PNEC Type	Available Data	AFs
PNEC-*water* or PNEC-*soil*	At least one short-term L(E)C50 from each of three trophic levels	1000
	One long-term EC10 or NOEC from one trophic level	100
	Two long-term results (e.g. EC10 or NOECs) from species representing two trophic levels	50
	Long-term results (e.g. EC10 or NOECs) from at least three species representing three trophic levels	10
	Species sensitivity distribution (SSD) method	1-5
	Field data or model ecosystems	Case by case
PNEC-*STP micro-organism*	Short-term EC50 from activated sludge respiratory inhibition	100
	Long-term NOEC from activated sludge respiratory inhibition or biodegradability test	10
	Long-term NOEC from inhibition of nitrification bacteria	1
PNEC-*sediment*	One long-term test (NOEC or EC10) on one sediment living organism	100
	Two long-term test (NOEC or EC10) with two species of sediment living organism	50
	Three long-term test (NOEC or EC10) with three species of sediment living organism	10

Example of PNEC calculation and comparison to effluent concentration

Example: Substance A

Toxicity Data

- Daphnia Toxicity, LC50 - 8mg/L, NOEC - 2 mg/L.
- Algae Toxicity, LC50 - 5 mg/L.
- Fish Toxicity, LC50 - 3 mg/L.
- No data on terrestrial toxicity.
- No data on marine-life toxicity.

Concentration Data

- Substance A is present at 0.01 mg/ml in the effluent sample

Calculating PNEC values:

PNEC-*fresh water*: Lowest value is 2 mg/L, and there is one long term NOEC value from one trophic level so the assessment factor is = 100. The calculated PNEC-*freshwater* value is then 0.02 mg/L.

PNEC-*marine water:* The effluent in this assessment is predicted to be released into the marine environment. Since no data on marine animals was collected, the PNEC-*marine water*

value is then calculated from the PNEC-*freshwater* value (by a factor of 10). Therefore the PNEC-*marine water* value is 0.002 mg/L.

Comparison to concentration data

- Although the substance is at a concentration in the effluent sample lower than the PNEC-*fresh water* value, it is higher than the PNEC-*marine water* value. Therefore, it will receive a RED flag for all three aquatic toxicity endpoints.

Material Health Assessment Methodology

Last Revision: January 2019

COPYRIGHT

TRADEMARK

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS

BAF	bioaccumulation factor
BCF	bioconcentration factor
BN	biological nutrient
BW	body weight
CASRN	Chemical Abstracts Service registry number
DOC	dissolved organic carbon
EMC	externally managed component
GHS	Globally Harmonized System
IARC	International Agency for Research on Cancer
K_{ow}	n-octanol-water partition coefficient
LC50	lethal concentration 50
LOAEL	lowest observable adverse effect level
MAK	“maximale Arbeitsplatz-Konzentration” or maximum workplace concentration
MEST	mouse ear swelling test
NOEC	no observable effect concentration
ODP	ozone depleting potential
OECD	Organisation for Economic Co-operation and Development
PET	polyethylene terephthalate
QSAR	quantitative structure-activity relationship
ThOD	theoretical oxygen demand
TLV	threshold limit value
TN	technical nutrient
US EPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

REVISION LOG

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
May 2017	All	This document consolidates the information in the *Cradle to Cradle Certified Material Health Assessment Methodology, Version 3.0* and its associated guidance document, *Supplemental Guidance for the Cradle to Cradle Certified Material Health Assessment Methodology, Version 3.0* into one document. These documents were merged to improve ease of use, remove redundancies, and clarify inconsistencies. Note that the section numbers between the v3.0 documents and this document do not correspond. Section numbers listed to the left within the SECTIONS column of this table are for this document.	S. Klosterhaus
May 2017	Tables 5-23	Minor edits were made within the hazard rating tables in order to highlight alignment of Cradle to Cradle Certified with the Globally Harmonized System of Classification and Labelling (GHS). This included a slight change in language within several sections, a change of several > or < signs to ≥ or ≤ signs in the aquatic toxicity and bioaccumulation sections and moving indication of the GHS categories to the top of all rating tables.	S. Klosterhaus
May 2017	2.2 Process	Reflects change made in December 2014 to remove the cyclability assessment from the methodology (i.e. this is one of two changes made to v3.0 in developing v3.1)	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
May 2017	3.2 Information Sources	Added guidance regarding evaluation of data quality and selection of studies to assign hazard ratings using Klimisch scores. Quantitative structure-activity relationship (QSAR) modeling results and other newly developed modelling techniques may be used for additional endpoints (in addition to aquatic toxicity, bioaccumulation and persistence) upon pre-approval from C2CPII. EpiSuite and ECOSAR may not be used to model data relevant to surfactants.	S. Klosterhaus
May 2017	3.3.2 Endocrine Disruption	The YELLOW Rating Criteria have been clarified as follows: Insufficient evidence of endocrine disruption by evidence of endocrine activity without evidence of linked adverse health effects. The EU list categories were previously listed incorrectly in the GREEN and GREY rating sections. This has been corrected.	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
May 2017	3.3.3 Mutagenicity	This section has been updated to list several new OECD tests that may be referred to and indicate that some older OECD tests have been archived and are no longer preferred data sources. Several examples of test result combinations that result in GREEN, YELLOW or RED hazard ratings have been added to the Rating Criteria section. The limit of 100 mg/l was removed from the Rating Criteria table. Assessors are directed to use OECD guidance to determine appropriate test ranges. The Rating Criteria have been clarified to indicate that a negative Ames AND negative Chromosome Aberration test are sufficient to assign a GREEN hazard rating to this endpoint.	S. Klosterhaus
May 2017	3.3.4 Reproductive Toxicity and Developmental Toxicity	Clarification has been added to indicate that data is required on either reproductive toxicity or developmental toxicity in order to assign a hazard rating to this endpoint. Clarification has been added to indicate that the cut-off values listed for RED, YELLOW and GREEN hazard ratings take precedence over the GHS classifications. MAK C has been moved from the GREY column of the Rating Criteria table to the YELLOW column. (It was previously mistakenly included in the GREY column.)	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
May 2017	3.3.5-3.3.7 Oral, Dermal and Inhalation Toxicity	Language has been added to clarify that extrapolation to a "true" LOAEL is not allowed. Language has been added to clarify that sub-chronic or single exposure target organ toxicity studies of duration <90 days may be used only if no studies of duration >90 days are available and if criteria values have been adjusted for the study duration per point 3.9.2.9.5 of GHS Chapter 3.9.	S. Klosterhaus
May 2017	3.3.5 Oral Toxicity	Clarification has been added to indicate that in order to assign a YELLOW or GREEN rating for this endpoint, data are required on both acute and sub-chronic or chronic toxicity. Single exposure organ toxicity data are not required but must be considered when available.	S. Klosterhaus
May 2017	3.3.6 Dermal Toxicity	Clarification has been added that route to route extrapolation may be used in some cases per ECHA guidance when data are lacking. The assessor is required to document and provide all assumptions made as part of the assessment outcome. Although both acute and sub-chronic/chronic data are required for Oral Toxicity, only acute data are required for Dermal Toxicity. GHS classifications have been added to the Rating Criteria table.	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
May 2017	3.3.7 Inhalation Toxicity	Clarification has been added that route to route extrapolation may be used in some cases per ECHA guidance when data are lacking. The assessor is required to document and provide all assumptions made as part of the assessment outcome. For very volatile substances (boiling point < 0°C), both acute and sub-chronic or chronic toxicity data are required in order to assign a GREEN or YELLOW rating to the Inhalation Toxicity endpoint. H335: May cause respiratory tract irritation was removed from the YELLOW column of the Rating Criteria table. It is now included as part of the YELLOW criteria for Skin, Eye and Respiratory Corrosion/Irritation.	S. Klosterhaus
May 2017	3.3.10 Sensitization of Skin and Airways	The following clarification has been added: Data on skin sensitization alone is sufficient to assign a hazard rating to this endpoint. Data on respiratory sensitization must be considered when available. Results from local lymph node assays may be used to derive a hazard rating for this endpoint. This has been clarified in the Rating Criteria table. H320 has been added to the YELLOW column of the Rating Criteria table.	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
May 2017	3.3.12 Aquatic Toxicity (Fish, Daphnia & Algae Toxicity)	The following six aquatic toxicity endpoints have been combined into three endpoints: Acute Fish Toxicity, Acute Daphnia Toxicity, Acute Algae Toxicity, Chronic Fish Toxicity, Chronic Daphnia Toxicity, and Chronic Algae Toxicity. The new endpoints are: Fish Toxicity, Daphnia Toxicity and Algae Toxicity. Therefore, the total number of hazard endpoints considered is now 21 instead of 24. Generally, results from both acute and chronic studies may influence the ratings in these three aquatic toxicity endpoints. However, since chronic toxicity tests are rarely conducted, if there are no signs of toxicity in acute studies, chronic data is not required for an aquatic toxicity endpoint when acute data suggests a GREEN rating for that endpoint.	S. Klosterhaus
May 2017	3.3.14 Persistence	The following clarification was added: The half-life value chosen to determine the final rating for this hazard endpoint must reflect the dominant environmental compartment in order to be meaningful. Fugacity modeling available via the U.S. EPA's EPI Suite software may be used to estimate dominant environmental compartment of a chemical.	S. Klosterhaus
May 2017	3.3.15 Bioaccumulation	The following addition was made: QSAR Arnot/Gobas estimated BAF may be used for log K_{ow} 6-8.	S. Klosterhaus
May 2017	4.1 Exposure Assessment Methodology	The following clarification was added regarding chemicals of regulatory concern: The thresholds and use conditions as indicated by REACH apply.	S. Klosterhaus
May 2017	4.5 Combined Aquatic Toxicity Risk Flag	Clarification has been added to indicate that a RED rating is worse than a GREY rating. The matrix has been clarified and the logic behind the matrix has been described.	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
May 2017	7.3 Recycled Content Types	Added clarification that Type 4 recycled content may only be certified up through the Bronze level.	S. Klosterhaus
May 2017	Terms and Definitions	The prior terms and definitions section was deleted. Refer to the relevant toxicology literature for definitions as needed.	S. Klosterhaus
March 2017	3.3.5, 3.3.6, 3.3.7	Aligned with GHS/CLP guidance for interpolation between NOAEL and LOAEL values when both are available	S. Klosterhaus
March 2018	3.3.9	Changed < and > signs to ≤ and ≥ for pH values corresponding with a red rating for corrosion to align with GHS	S. Klosterhaus
March 2018	3.3.14	Clarified thresholds of DOC or ThOD removal for OECD test guidelines for GREEN, YELLOW, and RED ratings.	S. Klosterhaus
September 2018	3.2 Information Sources	Clarified that the RIFM database is an acceptable source of toxicity information for fragrance molecules	S. Klosterhaus
September 2018	3.3.4 Reproductive Toxicity	Clarified that a YELLOW rating is allowed when appropriate doses have been selected, even if the highest available negative measurement is still in the RED range.	S. Klosterhaus
September 2018	3.3.4 Reproductive Toxicity	Clarified that substances on REACH Annex XVII and the Candidate List of Substances of Very High Concern due to reproductive toxicity concerns must always receive a RED hazard rating for this endpoint.	S. Klosterhaus
September 2018	3.3.14 Persistence	Clarified that when empirical evidence is insufficient, estimation of degradation by QSAR results may be used for classification.	S. Klosterhaus
September 2018	3.3.14 Persistence	Replaced two $<$ signs with $\leq$ signs in the GREEN and YELLOW rating sections so that values equal to the cut-offs were included in a hazard rating category.	S. Klosterhaus
January 2019	4.1	Updated to reference new Exposure Assessment Methodology	S. Klosterhaus

1 OVERVIEW

1.1 Purpose and Content

This document describes the methodology used to assign an A, B, C, X, or GREY material assessment rating to each homogeneous material subject to review in a finished product that is applying for Cradle to Cradle certification. The procedure uses toxicity data for individual chemical substances, and/or toxicity data on homogeneous mixtures where available, from peer-reviewed studies, authoritative lists, and other sources, as well as a qualitative exposure assessment that considers specific product manufacturing, use, and end-of-use scenarios to determine whether the material contains one or more substances that have the potential to adversely impact human or environmental health.

The methodology applies to all types of homogeneous materials except those for which customized methodologies have been developed:

- textile dyestuffs and pigments (see separate document, *Colorants Assessment Methodology),*
- biological materials (see separate document, *Biological Materials Assessment Methodology),*
- geological materials (see separate document, *Geological Materials Assessment Methodology),*
- *polymeric materials* (see separate document, *Polymer Assessment Methodology)*
- *recycled content materials* (see separate document, *Recycled Content Assessment Methodology)*

1.2 Supporting Documents

The following documents are to be used in conjunction with the Cradle to Cradle Certified™ Material Health Assessment Methodology:

- *Cradle to Cradle Certified Product Standard, Version 3.1*
- *Colorants Assessment Methodology*
- *Biological Materials Assessment Methodology*
- *Exposure Assessment Methodology*
- *Geological Materials Assessment Methodology*
- *Polymer Assessment Methodology*
- *Recycled Content Assessment Methodology*
- *Any additional supporting documents and guidance posted on the Resources page of the C2CPII website* (http://www.c2ccertified.org/resources).

2 MATERIAL HEALTH ASSESSMENT METHODOLOGY

2.1 Materials Subject to Review

Material assessments are conducted for homogeneous materials subject to review in the product being assessed for certification (section 3.1 in the Cradle to Cradle Certified™ Product Standard, version 3.1 describes the process for identifying materials subject to review). For each certification level, material assessments are completed for a given minimum percentage of the product by weight (see section 3.6 in the Cradle to Cradle Certified Product Standard, version 3.1). In cases where a product is composed of only one homogeneous material, assessments are conducted for each chemical substance in the product (see section 2.2 below).

2.2 Process Steps

An A, B, C, X, or GREY rating is assigned to a homogeneous material subject to review using the following four steps:

1. Conduct chemical hazard assessment – Using the hazard criteria provided in **Section 3**, a hazard rating of either RED, YELLOW, GREEN, or GREY is assigned to each of the 21 human and environmental health hazard endpoints for each chemical substance subject to review in the material (see section 2.3 in this document and section 3.1 in the Cradle to Cradle Certified Product Standard, version 3.1, which describes the process for identifying chemicals subject to review in each material).

2. Conduct chemical exposure assessment – Following the exposure assessment guidelines described in **Section 4 and the Exposure Assessment Methodology document**, a risk flag of either RED, YELLOW, GREEN, or GREY is assigned to 16 of these hazard endpoints for each chemical substance using the hazard ratings and identified exposure scenarios during the final manufacture, use, and re-use of the product. Furthermore, the six Aquatic Toxicity endpoints are combined with the Persistence and Bioaccumulation endpoint to derive a combined Aquatic Toxicity risk flag, yielding a total of 17 risk flags.

3. Assign single chemical risk ratings – Using the rules defined in **Section 5**, a single chemical risk rating of a, b, c, x, or GREY is assigned to each chemical substance based on the chemical's risk flags.

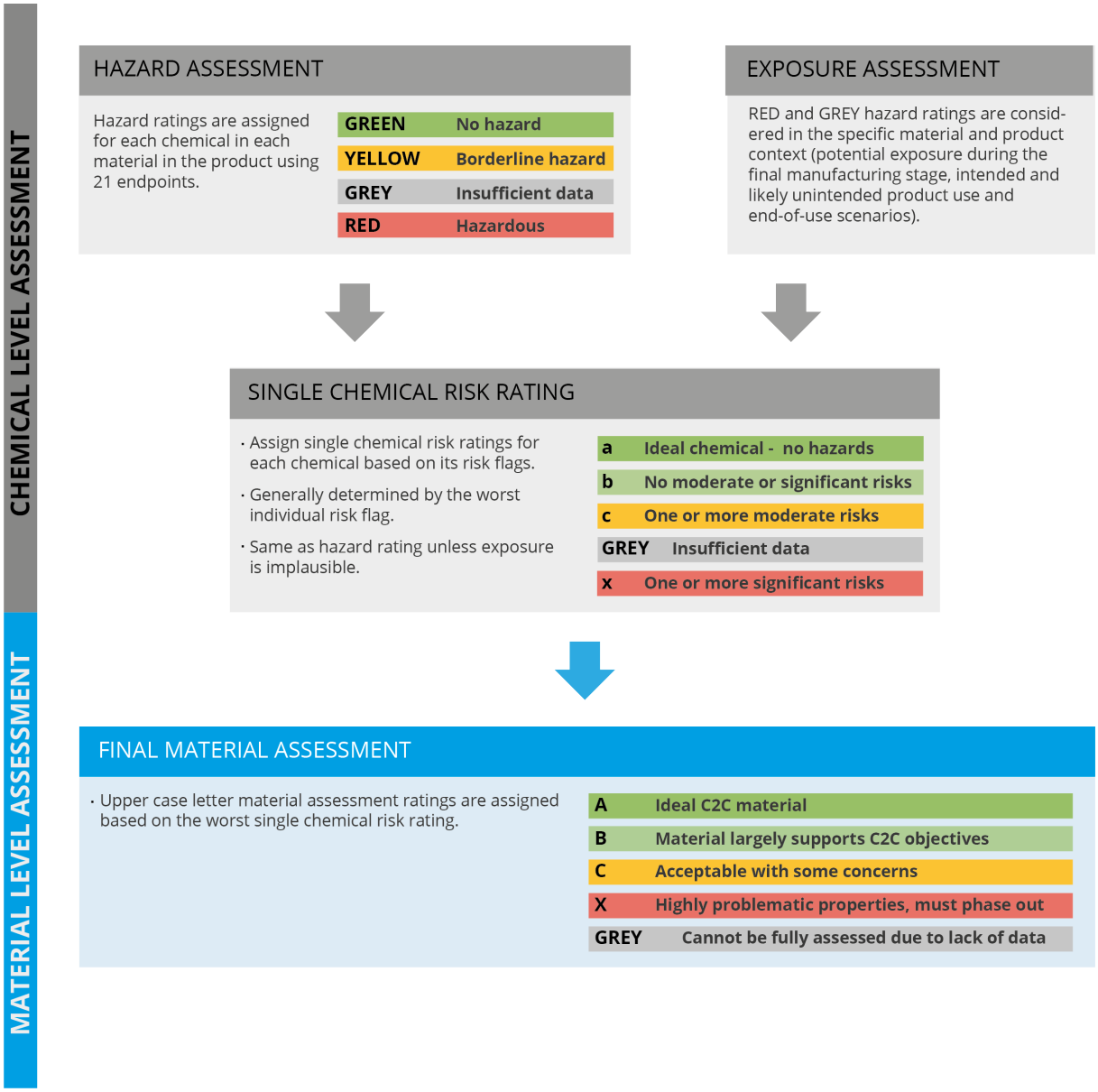
4. Assign material assessment rating – Using the rules defined in **Section 6**, a material assessment rating of A, B, C, X, or GREY is assigned to the material based on the single

chemical risk ratings. The material assessment rating is equal to the worst single chemical risk rating among all chemical substances subject to review in the material.

A summary of the material health assessment process is shown in Figure 1.

For products composed of only one homogeneous material, each chemical substance in the product receives an assessment rating following only steps 1-3 above (i.e., each chemical substance receives a single chemical risk rating but no material assessment rating is assigned to the product).

Figure 1 Cradle to Cradle Certified Material Health Assessment Methodology



2.3 Chemicals Subject to Review

The Material Health assessment is based on the chemical substances present in the finished product as it leaves the final manufacturing facility. The material assessment ratings are based on these, as well as the chemical's reaction products, during the intended and likely unintended uses of the product.

Other chemicals that are used as product inputs, but are not present in the finished product, may be assessed to provide additional information for the manufacturer and may factor into the chemical assessments required in the Water Stewardship category, but generally are not required and do not impact a product's material assessment ratings. Exceptions are **certain process chemicals that are always subject to review and must be factored into the material assessment ratings regardless of their concentration in the finished product**, even if they are not expected to be present (as stated in section 3.4 item 2.g of the standard these are: finishes (coatings, plating, paints), blowing agents, textile dye auxiliaries, paper bleaching agents, and plating chemicals). Separate from the material assessment ratings, all process chemicals used in the product's final manufacturing stage must be assessed to achieve the Platinum level requirement.

Materials are assessed based on the final chemical state of all substances in the material. Because of this, it is important to have an in-depth understanding of the key chemical reactions taking place and whether the chemical is still in its original form after curing or other reactions reach equilibrium. For example, UV inks contain several sensitizing and reactive chemicals in their "raw" state, but after the printing process is complete and the ink has cured, many of those substances are no longer present in their original state but rather have reacted to form a different molecular structure. Collecting chemical function data from supply chain technical staff is a good way to gain understanding of the full picture of the complex chemical mixtures present in the final material or product in order to assign the most accurate assessment rating. For example, when evaluating polyurethane foams, it is common to see polyols and isocyanates listed as separate chemicals. However, in the final foam material they do not exist separately, but rather have reacted together to form polyurethane molecules.

3 ASSIGNING HAZARD RATINGS

3.1 Chemical Hazard Assessment Methodology

The Cradle to Cradle Certified chemical hazard assessment methodology forms the basis of each chemical's evaluation by using specified criteria to assign a hazard rating to 21 different human health, environmental health, and chemical class endpoints (Tables 1-3). The rating scheme follows a "traffic-light" hierarchy where the chemical's hazard is communicated by a GREEN, YELLOW, RED, or GREY rating for each endpoint (Table 4). Section 3.3 provides a detailed description of each endpoint and the criteria used to assign the ratings.

Table 1 Human health hazard endpoints

HUMAN HEALTH ENDPOINTS	DESCRIPTION
Carcinogenicity	Potential to cause cancer.
Endocrine Disruption	Potential to negatively affect hormone function and impact organism development.
Mutagenicity	Potential to alter DNA.
Reproductive & Developmental Toxicity	Potential to negatively impact the reproductive system as well as the potential to affect pre- and post-natal offspring development.
Oral Toxicity	Potential to cause harm via oral exposure. Both short-term (acute) and longer-term (chronic) exposures are considered.
Dermal Toxicity	Potential to cause harm via dermal exposure. Both short-term (acute) and longer-term (chronic) exposures are considered.
Inhalation Toxicity	Potential to cause harm via inhalation exposure. Both short-term (acute) and longer-term (chronic) exposures are considered.
Neurotoxicity	Potential to cause an adverse change in the structure or function of the central and/or peripheral nervous system.

Skin, Eye, and Respiratory Corrosion/Irritation	Potential to cause direct reversible or irreversible damage to the skin, eyes, or respiratory system upon short-term exposure.
Sensitization of Skin and Airways	Potential to cause an allergic reaction upon exposure to skin or via inhalation.
Other	Any additional characteristic (e.g., flammability, skin penetration potential, etc.) relevant to the overall evaluation but not included in the previous criteria.

Table 2 Environmental health endpoints

ENVIRONMENTAL HEALTH ENDPOINTS	DESCRIPTION
Fish Toxicity	Measure of toxicity to fish (both saltwater and freshwater) from single, short-term exposure, or from longer term, chronic exposure.
Daphnia Toxicity	Measure of toxicity to Daphnia (or other aquatic invertebrates) from single, short-term exposure, or from longer term, chronic exposure.
Algae Toxicity	Measure of toxicity to algae from single, short-term exposure, or from longer term, chronic exposure.
Terrestrial Toxicity	Acute toxicity to avian species and soil organisms.
Persistence	Measure of how long a substance will exist in air, soil, or water.
Bioaccumulation	Potential for a substance to accumulate in fatty tissue.
Climatic Relevance	Measure of the impact a substance has on the climate (e.g., ozone depletion, global warming).
Other	Any additional characteristic relevant to the overall evaluation but not included in the previous criteria.

Table 3 Chemical class endpoints

CHEMICAL CLASS ENDPOINTS	DESCRIPTION
Organohalogens	Presence of a carbon-halogen (i.e., fluorine, chlorine, bromine, or iodine) bond.
Toxic Metals	Presence of a toxic metal compound (antimony, arsenic, cadmium, chromium VI, cobalt, lead, mercury, nickel, thallium, tin (organotins only), radioactive elements, and vanadium are considered toxic metals).

Table 4 Rating scheme used for each of the 21 hazard endpoints

GREEN	No hazard identified for the endpoint
YELLOW	Borderline hazard identified for the endpoint
GREY	Insufficient data available to determine hazard level for the endpoint
RED	Considered hazardous for the endpoint

3.2 Information Sources

In deriving hazard ratings, assessors are to rely on the best available, most recent, and most conservative information from sources including public and private databases, QSAR modeling and other toxicological predictive software, government reports, and the scientific literature. GreenScreen® assessments conducted by a licensed GreenScreen® Profiler (i.e., Certified GreenScreen assessments) may also serve as a data source for completing the hazard assessment.

In cases where a wide variety of study results are available, the most conservative value should be used unless there is a compelling weight of evidence to do otherwise. Data quality is to be evaluated following ECHA guidelines (ECHA, 2011: Guidance on information requirements and chemical safety assessment, Chapter R.4: Evaluation of available information) and preference given to studies that have been assigned a Klimisch score of 1 (K1, "Reliable without restriction") or 2 (K2, " Reliable with restrictions"). Studies with a Klimisch score of 4 (K4, "Not assignable") may be used as supporting studies, but shall not be determinative of the hazard rating in any given endpoint unless they are used to weigh the results of two or more conflicting K1 or K2 studies.

As a first pass to screen for widely recognized and well established hazards, the use of authoritative hazard lists such as those issued by the International Agency for Research on Cancer (IARC), California's Proposition 65 List, and lists maintained by various countries based on category criteria of the Globally Harmonized System for Classification and Labeling (GHS) will often be helpful. Some of these lists are explicitly cited in the methodology and within endpoint

criteria. In instances where multiple lists cited in the methodology would lead to conflicting hazard ratings, as per the established criteria, the result from the list yielding the most conservative Cradle to Cradle Certified hazard rating (in the order RED, YELLOW, GREEN) is to be used. Alternatively, the assessor may look further into the data sources and criteria used by the list issuing agencies and evaluate it directly against the governing endpoint criteria using a weight of evidence approach. An assessment rating determined via direct evaluation of all available data meeting the quality requirements takes precedence over an assessment based solely on authoritative lists. (However, also see the note about chemicals of regulatory concern in section 4.1.)

Quantitative structure-activity relationship *(*QSAR) modeling results and other newly developed modelling techniques may be used for the endpoints of aquatic toxicity (chronic and acute), bioaccumulation, and persistence, but only if no experimental data are available. For other endpoints, modeling results may not be used without pre-approval by C2CPII and the endpoint rating shall remain 'GREY' in the absence of experimental data (note that not all 'GREY' endpoint ratings translate to 'GREY' single chemical risk ratings, see section 5). When using models, the assessor is responsible for determining whether or not the model is robust for the endpoint or chemical class in question. For example, at the time of writing, EpiSuite and ECOSAR are not appropriate for modeling surfactants due to limited training set data relevant to these chemicals and their unique properties.

Read-across techniques are also acceptable for filling hazard data gaps and may be used based on the best professional judgment of the assessor. For example, surrogate-based NOAELs published in the Research Institute of Fragrance Materials (RIFM) database may be used in the absence of primary data on the substance to assign a reproductive and developmental toxicity hazard rating to a fragrance molecule.

3.3 Hazard Endpoint Definitions and Rating Criteria

3.3.1 Carcinogenicity

Definition

Carcinogenicity is the measure of a chemical's potential to cause cancer or a malignant neoplasm. A malignant neoplasm is an autonomous growth of tissue that demonstrates invasive growth characteristics, capable of spreading through the organ of origin and through metastasis to other tissues while showing no physiological attributes (Klaunig et al, 2008).

Although the toxicity endpoint of carcinogenesis is definitive, often the mechanism by which neoplastic development is caused is not readily apparent given its multi-step nature. Carcinogenesis is often broken down into three stages called initiation, promotion, and progression, all of which a given chemical can influence (Boyd, 1990). Initiation is a rapid, irreversible process that results in a carcinogen-induced mutational event. Initiation alone does not result in neoplastic development as the mutated cells can have multiple outcomes including:

1) remaining in a non-dividing state by growth control; 2) the cell may become unviable and be deleted through apoptosis; or 3) the cell may undergo division resulting in the proliferation of the initiated cells, which is also known as promotion. Progression is the final stage of carcinogenesis that results in the conversion of benign pre-neoplastic cells into neoplastic cancer. Often progression is another stage where genotoxic events take place due to the increase in DNA synthesis from the proliferation stage. Additional DNA damage including chromosomal aberration and translocations are often characteristic of progression.

Rating Criteria

The endpoint of carcinogenicity is given a GREY, RED, YELLOW, or GREEN rating based on the strength of scientific evidence available from peer-reviewed sources.

In order for a chemical to be rated RED for carcinogenicity, it is either known, presumed, or suspected to be a carcinogen based on human epidemiologic or animal studies. The YELLOW rating for carcinogenicity is reserved for chemical substances that, based on experimental evidence, cannot be classified as a carcinogen or non-carcinogen due to a lack of evidence, equivocal evidence based on experimental structure, or conflicting evidence. In order for carcinogenicity to be rated GREEN, the chemical in question is not suspected to be a human carcinogen based on evidence from long-term studies.

There are several existing classification systems that align with this rating scheme including the Threshold Limit Value (TLV), International Agency for Research on Cancer (IARC), maximum workplace concentration (MAK), and GHS. Based on these classification systems, if a chemical is listed within these publications, a hazard rating can be given for the carcinogenicity endpoint as summarized in Table 5 below.

Often chemicals are not listed by any of the classification systems adopted in this program and the assessor must determine the carcinogenicity rating of a chemical with available studies. As defined by GHS, the carcinogen classification of a chemical considers both the strength of evidence and the weight of evidence (UNECE, 2009). GHS differentiates these interrelated criteria with the following definitions:

> *Strength of evidence* – the enumeration of tumors in human and animal studies. Sufficient evidence in both human and animal studies demonstrates causality between exposure and development of cancer or an increased incidence of tumors. Limited evidence can demonstrate a positive association between exposure and incidence but cannot determine a causal relationship.
>
> *Weight of Evidence* – other factors that influence the overall likelihood that an agent may pose a carcinogenic hazard in humans. These factors include but are not limited to the following:
>
> 1. Tumor type and background incidence.
> 2. Multi-site responses.

3. Progression of lesions to malignancy.
4. Reduced tumor latency.
5. Whether responses are in single or both sexes.
6. Whether responses are in a single species.
7. Structural similarity or not to a chemical(s) for which there is good evidence of carcinogenicity.
8. Routes of exposure.
9. Comparison of absorption, distribution, metabolism, and excretion between test animals and humans.
10. The possibility of a confounding effect of excessive toxicity as test doses.
11. Mode of action and its relevance for humans, such as mutagenicity, cytotoxicity with growth stimulation, mitogenesis, immunosuppression (UNECE, 2009).

The strength and weight of evidence must be considered when determining whether a chemical is classifiable as a carcinogen by the definitions given above. Table 5 provides an overview of how a GREEN, YELLOW, RED, or GREY classification is reached for this endpoint:

Table 5 Rating Criteria for Carcinogenicity

Green	Yellow	Red	Grey
Not classified as GHS category 1A, 1B, or 2. Not a known, presumed or suspected carcinogen. Negative long-term cancer studies. Listed as: TLV A5, IARC 4	Not classified as GHS category 1A, 1B, or 2. Limited, marginal, equivocal or conflicting evidence of carcinogenicity. Listed as: MAK III 3A, 4, 5	Classified as GHS category 1A, 1B, or 2. Known, presumed or suspected carcinogen. Listed as: MAK III 1, 2, 3B IARC Group 1, 2A, 2B TLV A1, A2, A3 GHS Category 1A, 1B, 2 H350: May cause cancer H351: Suspected of causing cancer	No data available for classification. Listed as: IARC Group 3 TLV A4

3.3.2 Endocrine Disruption

Definition

For the purposes of this assessment methodology, it is important to recognize that endocrine disruption is considered a mode of action, not a hazard itself. Mode of action refers to the specific biochemical interaction of a drug or chemical through which a health effect is produced. A mode of action includes specific molecular targets to which a chemical will bind, in this case the

endocrine system. Concurrent with this caveat the definition developed by Weybridge is adopted in this methodology:

"An endocrine disruptor is an exogenous substance that causes adverse health effects in an intact organism, or its progeny, secondary (consequent) to changes in endocrine function. A potential endocrine disruptor is a substance that possesses properties that might be expected to lead to endocrine disruption in an intact organism." (Weybridge, 1996).

The endocrine system consists of glands and hormones that guide the development, growth, reproduction, and behavior of human beings and animals.

Rating Criteria

Following the definition given by Weybridge, the evidence needed to support rating a chemical as a known or suspected endocrine disruptor is two-fold. Primarily, evidence of adverse effects to sex organs, reproductive systems, accessory tissue, and development of offspring meets one criteria of the Weybridge definition. Secondly, in vitro or in vivo data identifying chemicals that bind to endocrine receptors, alter gene transcription, affects synthesis of sex hormones, possess androgenic activity, or anti-androgenic activity (e.g., identify the ancillary operation of changes in endocrine function) are needed. Where both of these measures are met there is sufficient evidence of endocrine disruption and rating of a chemical as RED for this endpoint. Although endocrine disruption is listed under human health, evidence of this adverse health effect in animals, including avian, amphibians, and fish, will also result in a RED rating.

Tantamount to the evidence required above are definitive lists including the Colborn list and the EU list Categories 1 and 2. Appearance on these lists also results in a RED rating for a given chemical. A useful additional reference that may include both YELLOW and RED rated chemicals for this endpoint is the TEDX List of Potential Endocrine Disruptors.

Exposure concentrations have not been set for this endpoint given the complex and controversial nature of this topic. Studies have shown that endocrine disruptors can act at extremely low levels, in the parts per billion or trillion, especially at critical points in the development of a fetus (Colborn, 1996). Moreover, in some cases, high doses will actually reduce adverse health effects and disruption of the endocrine system, while low doses show greater potency. The relationship of dose to response clearly does not exist in a straightforward manner for endocrine disruption as in other endpoints, and consequently potency and exposure concentrations have not been set for this endpoint.

Table 6 lists the hazard rating criteria for endocrine disruption. In cases where there have been adverse health effects linked to reproductive toxicity, teratogenicity, and other relevant endpoints but there is no evidence for endocrine activity, a rating of YELLOW is given where there is insufficient evidence of endocrine disruption. This rating is assigned due to endocrine disruption being a mode of action. In other words, conclusive evidence of endocrine disruption cannot be determined where mechanistic studies do not link changes in endocrine function to adverse health effects.

In instances where no adverse health effects are seen in in vivo studies, absence of toxic effects can be taken as definitive evidence of no endocrine disrupting properties (ECETOC, 2009). Additionally, if no endocrine activity has been identified through appropriate studies then there is conclusive evidence that endocrine disruption is of low concern and a GREEN rating is given. Where no empirical data are available and a chemical does not appear on the aforementioned Colborn or EU list, a rating of GREY is given.

Table 6 Rating Criteria for Endocrine Disruption

Green	Yellow	Red	Grey
Not known or suspected of endocrine disruption: Adequate data indicate neither endocrine activity nor adverse health effects that are linked to endocrine activity. *or* EU list category 3A	Insufficient evidence of endocrine disruption: Data provide evidence of endocrine activity without evidence of linked adverse health effects.	Sufficient evidence of endocrine disruption: Data indicate adverse health effects that are linked to endocrine activity. *or* Chemical appears on Colborn or EU list (Cat. 1 & 2).	No data available for classification. EU list category 3B

3.3.3 Mutagenicity

Definition

This endpoint is primarily concerned with chemicals that cause mutations in both germ and somatic cells in humans and other organisms that can either be passed along to progeny or cause initiation of neoplasms. Although the latter overlaps with the endpoint of carcinogenicity (Section 3.3.1), this testing is not always available and mutagenicity testing gives insight into the potential hazard within this category.

Mutagenicity is defined as a chemical's ability to alter genetic material in cells, both germ and somatic, resulting in the transmission of changes during cell division. Genotoxicity is also commonly used in this category and is termed to agents or processes which alter the structure, information content, or segregation of DNA (UNECE, 2009). Genotoxic studies are often taken as indicators for mutagenic effects.

When multiple studies are available for the determination of a chemical's mutagenic/genotoxic character, a hierarchy of relevance is applied based on the varying characteristics of the studies available. Studies that carry the most weight in terms of supplying confidence in how a chemical will affect the health of humans are in vivo eukaryotic studies. Examples of such studies include rodent dominant lethal mutation test (OECD 478), mouse heritable translocation assay (OECD 485), mammalian bone marrow chromosome aberration test (OECD 475), mouse spot test (OECD 484), and mammalian erythrocyte micronucleus test (OECD 474) (UNECE, 2009). Such tests complement in vitro tests well since they account for whole animal processes such as absorption,

tissue distribution, metabolites, and excretion of chemicals and their metabolites (Klaunig et al, 2008). When in vivo tests are not available, in vitro tests performed in eukaryotic cells are the next preferred type of study. Included within this categorization of studies is unscheduled DNA synthesis, sister chromatid exchange, chromosome aberrations, and mouse lymphoma assays. Lastly, given the rapid results and low cost, prokaryotic mutagenicity tests are considered both in Ames and E. Coli tests. For these studies to be sufficient they must include both assays where metabolic activation was used as well as those where it was not used. Since prokaryotic assays are performed in single celled organisms, do not account for whole animal processes, and have a low concordance with carcinogenic effects, these studies are given the least weight when considering the final rating for mutagenicity.

Below is a definitive list (at the time of writing) of tests developed by OECD that are applicable for this endpoint. Indicated in parenthesis is the GHS category that a positive result is typically associated with (in absence of conflicting higher weight evidence). This is provided for informational purposes and as further indication of the weight that should be applied to the different study types. Note however that Cradle to Cradle uses a more precautionary approach in applying a RED hazard rating to this endpoint than the GHS category 1 or 2 criteria.

In vivo tests in germ cells (positive result indicates or supports GHS category 1B)
OECD 478: Genetic Toxicology: Rodent Dominant Lethal Test. Tests for: Structural and numerical chromosome aberrations.
OECD 483: Mammalian Spermatogonial Chromosome Aberration Test. Tests for: Structural chromosome aberrations. Expected to be predictive of induction of heritable mutations in germ cells. Supports category 1B designation in combination with positive in vivo somatic cell test.
OECD 485: Genetic toxicology, Mouse Heritable Translocation Assay. Tests for: Structural chromosome aberrations.
OECD 488: Transgenic Rodent Somatic and Germ Cell Gene Mutation Assays. Tests for: Gene/point mutations and chromosomal rearrangements.

In vivo tests in somatic cells (positive result indicates GHS category 2 or Category 1B depending on other supporting information)
OECD 474: Mammalian Erythrocyte Micronucleus Test. Tests for: Structural and numerical chromosome aberrations.
OECD 475: Mammalian Bone Marrow Chromosome Aberration Test. Tests for: Structural chromosome aberrations.
OECD 488: Transgenic Rodent Somatic and Germ Cell Gene Mutation Assays. Tests for: Gene mutations/point mutations and chromosomal rearrangements.

In vivo genotoxicity tests in somatic cells (positive result in combination with positive *in vitro* tests indicates GHS category 2).
OECD 486: Unscheduled DNA Synthesis (UDS) Test with Mammalian Liver Cells *in vivo*. This test Identifies substances that induce DNA damage followed by DNA repair.

OECD 489: *In vivo* Mammalian Alkaline Comet Assay. This tests for DNA damage that may or may not lead to gene mutations and/or chromosome aberrations as the DNA may effectively be repaired.

In vitro tests (positive result supports a GHS category 2 indication)
OECD 471: Bacterial Reverse Mutation Test (Ames test). Tests for: point mutations.
OECD 473: *In vitro* Mammalian Chromosome Aberration Test. Tests for: Structural chromosome aberrations.
OECD 476: *In vitro* Mammalian Cell Gene Mutation Test (hprt or xprt). Tests for: Gene/point mutations
OECD 487: *In vitro* Mammalian Cell Micronucleus Test. Tests for: Structural and numerical chromosome aberrations.
OECD 490: *In vitro* Mammalian Cell Gene Mutation Tests Using the Thymidine Kinase Gene (includes methods for both the Mouse Lymphoma Assay and the TK6 assay). The MLA is more widely used and tests for point mutations and structural chromosome aberrations. Note: these tests were previously included as part of OECD 476 in an older version of the test guidelines.

Tests deleted/archived from the OECD Guidelines:
These tests may also be utilized if sufficient data based on the preferred tests listed above are not available. These tests were archived because they were rarely used for regulatory purposes, newer tests became available showing better performance for the same endpoint and/or because assays performed using mammalian cells are more relevant to humans.
OECD 477: Genetic Toxicology: Sex-Linked Recessive Lethal Test in Drosophila melanogaster. (*in vivo* heritable germ cell mutagenicity test)
OECD 479: Genetic Toxicology: In vitro Sister Chromatid Exchange Assay in Mammalian Cells. (*in vitro* genotoxicity test in somatic cells)
OECD 480: Genetic Toxicology: Saccharomyces cerevisiae, Gene Mutation Assay. (*in vitro* mutagenicity test)
OECD 481: Genetic Toxicology: Saacharomyces cerevisiae, Miotic Recombination Assay. (*in vitro* genotoxicity test in somatic cells)
OECD 482: Genetic Toxicology: DNA Damage and Repair, Unscheduled DNA Synthesis in Mammalian Cells in vitro. (*in vitro* genotoxicity test in somatic cells)
OECD 484: Genetic Toxicology: Mouse Spot Test. (*In vivo* somatic cell mutagenicity test)

Rating Criteria
Within the context of this methodology, mutagenicity is an endpoint that is solely based on empirical evidence, and neither QSAR results nor definitive global regulatory lists are relied upon for decision-making. Without any relevant studies for mutagenicity, the rating for this endpoint is GREY. Table 7 provides a summary of the rating criteria.

For the mutagenicity endpoint, a rating of GREEN is defined as a substance that has been tested and shown not to induce aberrations of chromosomes or aberrations of their segregation in *in vitro* systems. In addition, the substance has been shown not induce point mutations. For example, if only OECD 471 (Ames) and OECD 473 (chromosome aberration test) are available, the

results of both must be negative to assign a GREEN rating. A GREEN rating may also be assigned in the case that only OECD 487 (micronucleus) and OECD 473 (Ames) are available and both are negative.

A YELLOW hazard rating has been defined as a substance that has been tested and shown not to induce point mutations. For example, if OECD 471 (Ames) is negative and no other data are available, a YELLOW hazard rating is assigned. Also, for example, if one of the *in vivo* somatic cell genotoxicity tests (i.e. OECD 486 or 489) has been conducted and is positive, but there is one *in vitro* test that is negative (such as a negative OECD 490/Mouse Lymphoma Assay), then a YELLOW hazard rating is assigned.

A RED rating is assigned to this endpoint if the chemical shows statistically significant positive results in eukaryotic or prokaryotic mutagenic assays. For example, if only OECD 471 (Ames) and/or OECD 473 (chromosome aberration test) are available and one of these is positive, a RED hazard rating is assigned. In general, a positive result from a single well conducted study using one of the preferred methods in the preceding section is typically enough to give a RED rating in the absence of any additional conflicting data.

The examples above and the rating criteria in the table below represent cases of minimal data availability. In cases where additional eukaryote data are available, and the results conflict with these minimum data examples, a weight of evidence approach is taken in deriving the final hazard rating.

Assessors are to consider test ranges and/or limit values indicated for the tests under consideration in the most recent version of the OECD Guidelines for the Testing of Chemicals in evaluating the data. If a test has been performed using test substance concentrations greater than the recommended test ranges or specified limit values, the test result may be discounted at the assessor's discretion.

Table 7 Rating Criteria for Mutagenicity

Green	Yellow	Red	Grey
Not classified as GHS Category 1A, 1B, or 2. Substance does not induce aberrations of chromosomes OR substance does not induce chromosome segregation errors in *in vitro* systems. AND substance does not induce point mutations.	Not classified as GHS Category 1A, 1B, or 2. Insufficient data. Substance does not induce point mutations. Data lacking on chromosome aberration and segregation.	Classified as GHS Category 1A, 1B, or 2. or Evidence of mutagenicity supported by positive results *in vitro* or *in vivo* (see rating criteria guidance) *or* Listed as: MAK IX 1, 2, 3A, 3B, H340: May cause genetic defects H341: Suspected of causing genetic defects	No data available for classification.

3.3.4 Reproductive & Developmental Toxicity

Definition

GHS offers the following definition of reproductive toxicity:

"Reproductive toxicity includes adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in the offspring (UNECE, 2009)."

Appropriate experimental design for reproductive toxicity studies includes internationally accepted test methods such as OECD Guidelines 421 – Reproduction/ Developmental Toxicity Screening Test, 422 – Combined Repeated Dose Toxicity Study with Reproduction/ Developmental Toxicity Screening Test, and methods for two-generation toxicity testing (e.g., OECD Test Guidelines 415 and 416). Studies must also use appropriate routes of administration that apply to potential human exposure. For reproductive toxicity studies, administration is often given by the oral route, which is suitable for evaluating a chemical's relevancy to human health. However, if there is evidence that this route of administration is not relevant to humans by clearly identifying mechanistic and mode of action considerations, then a positive study for reproductive toxicity should not be considered.

In principle, adverse effects on reproduction seen only at very high dose levels in animal studies (e.g. doses that induce prostration, severe inappetence, excessive mortality) would not normally lead to classification unless other information is available (e.g. toxicokinetics information indicating that humans may be more susceptible than animals) to suggest that classification is appropriate. (UNECE, 2011)

While the GHS has included developmental toxicity under the wider category of "reproductive toxicity", there are some test methodologies that are specific to developmental toxicity and therefore it is helpful to define the term separately and provide further specific guidance here.

"Taken in its widest sense, developmental toxicity includes any effect which interferes with normal development of the conceptus, either before or after birth, and resulting from exposure of either parent prior to conception, or exposure of the developing offspring during prenatal development, or postnatally, to the time of sexual maturation. However, it is considered that classification under the heading of developmental toxicity is primarily intended to provide a hazard warning for pregnant women and men and women of reproductive capacity. Therefore, for pragmatic purposes of classification, developmental toxicity essentially means adverse effects induced during pregnancy, or as a result of parental exposure. These effects can be manifested at any point in the life span of the organisms. The major manifestations of developmental toxicity include death of the developing organism, structural abnormality, altered growth, and functional deficiency." (UNECE, 2009).

The Cradle to Cradle Certified methodology also takes a pragmatic approach to developmental toxicity where the scope of adverse effects is drawn from exposure of either parent prior to conception and prenatal exposure.

Primarily, studies that are difficult to interpret are those in which maternal toxicity that can affect the development of offspring throughout gestation and the early postnatal stage is also observed (UNECE, 2009). Generally, developmental effects seen in the presence of maternal toxicity are still rated RED unless it can be unequivocally demonstrated that the developmental effects are secondary to maternal toxicity. However, where minor developmental changes are seen (e.g., small changes in fetal/pup body weight, retardation of ossification) in association with maternal toxicity, a YELLOW rating is appropriate. Additionally, maternal mortality greater than 10% is considered excessive and the data for that dose level should not normally be considered for further consideration (UNECE, 2009).

Acceptable tests for developmental toxicity include:

- OECD Test Guideline 414, 415, and 416.
- OECD Test Guidelines 421 and 422.
- ICH Guideline S5A.
- ICH S5B.

This list is not exhaustive and studies structured similarly and within the guidelines of Good Laboratory Practices should be considered as well. The limit doses specified in the relevant OECD test, including any qualifying statements, apply.

Rating Criteria

For the purpose of rating reproductive and development toxicity, chemicals are given a GREY, RED, YELLOW, or GREEN rating based on evidence of adverse effects on sexual function, fertility, and development of offspring.

A RED rating is applied to those chemicals that have shown adverse effects to the male or female reproductive system or on the development of an embryo or fetus based on either evidence from humans or evidence from animal studies. Data from animal studies should provide clear evidence of adverse effects on human reproduction and fertility on the development of an embryo or fetus in the absence of other toxic effects. In the case of simultaneous toxic effects, the adverse effect on reproduction or development is not considered to be a secondary non-specific consequence of other toxic effects (UNECE, 2009). Collectively, this classification is for chemicals that are suspected, presumed, or known to be a reproductive or developmental toxicants. Other classifications that are harmonized with this rating include MAK Group A or B (damage to embryo or fetus in humans has been unequivocally demonstrated, or according to currently available information, damage to embryo or fetus must be expected), California's Proposition 65 list of reproductive and carcinogenic substances, and GHS's 1A, 1B, and 2 classifications.

A YELLOW rating is applied to studies that yield an equivocal result for reproductive and/or developmental toxicity. This includes where other toxic effects are present and reproductive toxicity is considered a secondary toxic effect. If a chemical is listed as a MAK Group C (there is no reason to fear damage to the embryo or fetus when MAK and BAT values are observed), this also warrants a YELLOW rating. In addition, if appropriate doses have been selected and a substance is not classified as GHS Category 1A, 1B, or 2 and exhibits no adverse effects to sexual function and fertility and/or to the development of an embryo or fetus based on human or animal studies, the substance will receive a YELLOW rating in cases where the highest dose tested was below the guidance value for a green hazard rating (in other words, in this case the highest dose tested, with a negative result, may be in the RED or YELLOW range to receive a YELLOW rating, as long as appropriate doses were selected). In general, dose levels should be spaced to produce a gradation of toxic effects. See the relevant OECD test guidelines for additional information.

A GREEN rating is applied to chemicals that have shown no adverse toxic effects to sexual function, fertility, or on the development of an embryo or fetus (i.e. data on both reproductive toxicity and developmental toxicity is not required in order to assign a GREEN rating). This evidence can be based on either human or animal studies.

Where no studies are available for the reproductive toxicity of a chemical and the chemical does not appear on either the MAK or California Proposition 65 list, a GREY rating is applied.

The hazard rating for reproductive and developmental toxicity is based on all appropriate available evidence. This includes epidemiological studies, case reports in humans, reproduction studies, and sub-chronic/chronic study results that provide relevant data to fertility and sexual function. The impact of a study on the final rating is determined by such factors as the quality of the study, consistency of results, nature and severity of effects, level of statistical significance for intergroup differences, number of endpoint affects, relevance of route of administration to humans, and freedom from bias (UNECE, 2009). All relevant data are considered, negative and positive results alike, to reach a final rating; however, a single positive result from a study showing statistically significant results and performed with sound scientific principles affords a RED rating.

Table 8 Rating Criteria for Reproductive & Developmental Toxicity

Green	Yellow	Red	Grey
Not classified as GHS Category 1A, 1B, or 2. Exhibits no adverse effects to sexual function and fertility and/or to the development of an embryo or fetus based on human or animal studies. Oral NOAEL > 500 mg/kgBW/day. Inhalation NOAEL >2.5 mg/l 6-8 h/day.	Not classified as GHS Category 1A, 1B, or 2. Equivocal evidence of toxic effects to sexual function and fertility but considered a secondary non-specific consequence of other toxic effects present. *and/or* Equivocal evidence of adverse effects to the development of an embryo or fetus based on human or animal studies. Oral NOAEL =50-500 mg/kg BW/day. Inhalation NOAEL =0.25-2.5 mg/l 6-8 h/day. *or* Listed as: MAK C	Classified as GHS Category 1A, 1B, or 2. Known, presumed, or suspected of causing adverse effects to sexual function and fertility and/or to the development of an embryo or fetus based on human or animal studies. *and/or* Oral NOAEL < 50 mg/kg BW/day. Inhalation NOAEL <0.25 mg/l 6-8 h/day. *or* Listed as: MAK Group A or B H360: May damage fertility or the unborn child. H361: Suspected of damaging fertility or the unborn child.	No data available for classification. Listed as: MAK D

Note: The NOAEL cut-offs in the Rating Criteria for Reproductive and Developmental Toxicity table above take precedence over the GHS classifications, H-phrases and MAK groups. Exception: Substances that are on REACH Annex XVII or on the Candidate List of Substances of Very High Concern because they are toxic for reproduction must always receive a RED hazard rating for this endpoint.

3.3.5 Oral Toxicity

Definition

Oral toxicity refers to adverse effects following oral administration of a single dose (acute) or longer-term repeated exposures (sub-chronic/chronic).

The definition given by the GHS for Acute Oral Toxicity states that, "Acute toxicity refers to those adverse effects occurring following oral administration of a single dose of a substance, or multiple doses given within 24 hours." (UNECE, 2009). This definition has been adopted for this methodology.

Acute toxicity values are expressed as LD_{50} values of mg of substance per kg of organism body weight (mg/kg). LD_{50} values represent the statistically derived median dose of a substance that

can be expected to cause death in 50% of the test population. However, specific organ toxicity not resulting in death can also occur from acute exposure. This is captured here as well.

The sub-chronic (90 day - 1 year) and chronic (1-2 years) hazard endpoints are intended to capture specific target organ toxicity that may present potential adverse health effects in humans when the target organ toxicity has not been classified in other endpoints of the Cradle to Cradle Certified methodology that are subject to repeated exposure (e.g., reproductive toxicity, carcinogenicity, etc). Sub-chronic or single exposure target organ toxicity studies of duration <90 days may be used only if no studies of duration >90 days are available and if criteria values have been adjusted for the study duration per point 3.9.2.9.5 of GHS Chapter 3.9 (UN 2013). Often these types of studies do not end in mortality, thus LD_{50} values are not appropriate and the measured endpoint used for the purposes of this classification system is the lowest observable adverse effect level (LOAEL). In cases where both a measured LOAEL value (as determine by the assessor) and a NOAEL value less than the criteria value are available, refer to the CLP/GHS guidance on the application of the CLP criteria on how to interpolate between the LOAEL and NOAEL values.[1]

Rating Criteria

Chemicals are allocated to one of three toxicity categories based on acute and/or sub-chronic/chronic toxicity by the oral route of exposure, measured by the LD_{50} and LOAEL, as summarized in Table 9. In order to assign a YELLOW or GREEN rating, data are required for both acute and sub-chronic/chronic toxicity. Single exposure organ toxicity data are not required but must be considered when available. In addition, single exposure organ toxicity data may not be used in place of chronic/sub-chronic data.

xxxivxxxiv

[1] https://echa.europa.eu/documents/10162/23036412/clp_en.pdf/58b5dc6d-ac2a-4910-9702-e9e1f5051cc5 - p 442

Table 9 Rating Criteria for Oral Toxicity

Green	Yellow	Red	Grey
Acute: Not Classified as GHS Category 1, 2, 3, or 4. LD50 > 2000 mg/kg BW	**Acute:** Classified as GHS Category 4 *or* 300 < LD50 ≤ 2000 mg/kg BW Listed as: H302: Harmful if swallowed	**Acute:** Classified as GHS Category 1, 2, or 3 *or* LD50 ≤ 300 mg/kg BW Listed as: H300a/b: Fatal if swallowed H301 Toxic if swallowed H304: May be fatal if swallowed and enters airways	No relevant data available for classification.
Single exposure organ toxicity: Not Classified. LOAEL > 2000 mg/kg BW	**Single exposure organ toxicity:** Classified as GHS Category 2 or 3 300 < LOAEL ≤ 2000 mg/kg BW Listed as: H371: May cause damage to organs via oral exposure	**Single exposure organ toxicity:** Classified as GHS Category 1 *or* LOAEL ≤ 300 mg/kg BW Listed as: H370: Causes damage to organs via oral exposure	
Sub –Chronic/Chronic: Not Classified. LOAEL > 100 mg/kg bw/day	**Sub –Chronic/Chronic:** Classified as GHS Category 2 10 < LOAEL ≤100 mg/kg bw/day Listed as: H373: May cause damage to (organs) through prolonged or repeated dermal exposure	**Sub –Chronic/Chronic**: Classified as GHS Category 1 *or* LOAEL ≤ 10 mg/kg bw/day Listed as: H372: Causes damage to (organs) through prolonged or repeated oral exposure	

3.3.6 Dermal Toxicity

Definition

Dermal toxicity refers to adverse effects following dermal administration of a single dose (acute) or longer-term repeated exposures (sub-chronic/chronic).

The definition given by GHS for Acute Dermal Toxicity states that, "Acute toxicity refers to those adverse effects occurring following dermal administration of a single dose of a substance, or

multiple doses given within 24 hours" (UNECE, 2009). This definition has been adopted for the Cradle to Cradle Certified™ methodology.

Acute toxicity values are expressed as LD_{50} values of mg of substance per kg of organism body weight (mg/kg). LD_{50} values represent the statistically derived median dose of a substance that can be expected to cause death in 50% of the test population. However, specific organ toxicity not resulting in death can also occur from acute exposure. This is captured here as well.

The sub-chronic (90 day - 1 year) and chronic (1-2 years) hazard endpoints are intended to capture specific target organ toxicity that may present potential adverse health effects in humans when the target organ toxicity has not been classified in other criteria of the Cradle to Cradle Certified methodology that are subject to repeated exposure (e.g., reproductive toxicity, carcinogenicity, developmental toxicity). Sub-chronic or single exposure target organ toxicity studies of duration <90 days may be used only if no studies of duration >90 days are available and if criteria values have been adjusted for the study duration per point 3.9.2.9.5 of GHS Chapter 3.9 (UN 2013). Often these types of studies do not end in mortality, thus LD_{50} values are not appropriate and the measured endpoint used for the purposes of this methodology is the LOAEL. In cases where both a measured LOAEL value (as determine by the assessor) and a NOAEL value less than the criteria value are available, refer to the CLP/GHS guidance on the application of the CLP criteria on how to interpolate between the LOAEL and NOAEL values.[2]

In the case that a thorough literature search has been completed and it is determined that dermal toxicity data are not available but would be required in order to assign other than a GREY single chemical risk rating, the assessor may consider the possibility of using route to route extrapolation. The relevant ECHA guidance is to be consulted (for example, ECHA, 2012 and 2014). If extrapolation is used, then all assumptions are to be documented and provided as part of the assessment outcome.

Rating Criteria

Chemicals are allocated to one of three toxicity categories based on acute and/or sub-chronic/chronic toxicity by the dermal route of exposure as measured by the LD_{50} and LOAEL and summarized in Table 10. Single exposure and sub-chronic/chronic toxicity data must be considered when available, but are not required in order to assign a rating to the Dermal Toxicity endpoint.

xxxvixxxvi

[2] https://echa.europa.eu/documents/10162/23036412/clp_en.pdf/58b5dc6d-ac2a-4910-9702-e9e1f5051cc5 - p 442

Table 10 Rating Criteria for Dermal Toxicity

Green	Yellow	Red	Grey
Acute: Not Classified as GHS Category 1, 2, 3, or 4. LD50 > 2000 mg/kg BW	**Acute:** Classified as GHS Category 4 *or* 1000 < LD50 ≤ 2000 mg/kg BW Listed as: H312: Harmful in contact with skin	**Acute:** Classified as GHS Category 1, 2, or 3 or LD50 ≤ 1000 mg/kg BW Listed as: H310a/b: Fatal in contact with skin H311: Toxic in contact with skin	No relevant data available for classification.
Single exposure organ toxicity: Not Classified. LOAEL > 2000 mg/kg BW	**Single exposure organ toxicity:** Classified as GHS Category 2 or 3 *or* 1000 < LOAEL ≤ 2000 mg/kg BW Listed as: H371: May cause damage to organs via dermal exposure	**Single exposure organ toxicity:** Classified as GHS Category 1 *or* LOAEL ≤ 1000 mg/kg BW Listed as: H370: Causes damage to organs via dermal exposure	
Sub –Chronic/Chronic: Not Classified. LOAEL > 200 mg/kg bw/day	**Sub –Chronic/Chronic:** Classified as GHS Category 2 *or* 20 < LOAEL ≤ 200 mg/kg bw/day Listed as: H373: May cause damage to (organs) through prolonged or repeated dermal exposure	**Sub –Chronic/Chronic:** Classified as GHS Category 1 *or* LOAEL ≤ 20 mg/kg bw/day Listed as: H372: Causes damage to (organs) through prolonged or repeated dermal exposure	

3.3.7 InhalationToxicity

Definitions

Inhalation toxicity refers to adverse effects following inhalation administration of a single dose (acute) or longer-term repeated exposures (sub-chronic/chronic).

The definition given by GHS for Acute Inhalation Toxicity states that, “Acute toxicity refers to those adverse effects occurring following an inhalation exposure of 4 hours” (UNECE, 2009). This definition has been adopted for the Cradle to Cradle Certified methodology.

Acute toxicity values are expressed as LC_{50} (inhalation) values of mg of substance per volume (mg/m^3). LC_{50} values represent the statistically derived median dose of a substance that can be expected to cause death in 50% of the test population. However, specific organ toxicity not resulting in death can also occur from acute exposure. This is captured here as well.

The sub-chronic (90 day - 1 year) and chronic (1-2 years) hazard endpoints are intended to capture specific target organ toxicity that may present potential adverse health effects in humans when the target organ toxicity has not been classified in other endpoints of the Cradle to Cradle Certified methodology that are subject to repeated exposure (e.g., reproductive toxicity, carcinogenicity, developmental toxicity). Sub-chronic or single exposure target organ toxicity studies of duration <90 days may be used only if no studies of duration >90 days are available and if criteria values have been adjusted for the study duration per point 3.9.2.9.5 of GHS Chapter 3.9 (UN 2013). Often these types of studies do not end in mortality, thus LD_{50} values are not appropriate and the measured endpoint used for the purposes of this methodology is the LOAEL. In cases where both a measured LOAEL value (as determine by the assessor) and a NOAEL value less than the criteria value are available, refer to the CLP/GHS guidance on the application of the CLP criteria on how to interpolate between the LOAEL and NOAEL values.[3]

In the case that a thorough literature search has been completed and it is determined that inhalation toxicity data are not available but would be required in order to assign other than a GREY single chemical risk rating, the assessor may consider the possibility of using route to route extrapolation. The relevant ECHA guidance is to be consulted (for example, ECHA, 2012 and 2014). If extrapolation is used, then all assumptions are to be documented and provided as part of the assessment outcome.

For inhalation toxicity, multiple forms of a substance must be considered. Inhalation of vapor/gas is considered separately from inhalation of dust/mist.

Rating Criteria

Chemicals are allocated to one of three toxicity categories based on the acute and/or sub-chronic/chronic toxicity by the inhalation route of exposure as measured by the LD_{50} and LOAEL and summarized in Table 11. For very volatile substances (boiling point < 0°C), both acute and chronic toxicity data are required in order to assign a GREEN or YELLOW rating. Single exposure organ toxicity data are to be considered if available but are not required. In addition, single exposure organ toxicity data may not be used in place of chronic/sub-chronic data.

xxxviiixxxviii

[3] https://echa.europa.eu/documents/10162/23036412/clp_en.pdf/58b5dc6d-ac2a-4910-9702-e9e1f5051cc5 - p 442

Table 11 Rating Criteria for Inhalation Toxicity

Green	Yellow	Red	Grey
Acute: Not Classified as GHS Category 1, 2, 3, or 4. Inhalation (gas) LC50 > 20000 ppmV Inhalation (vapor) LC50 > 20 mg/l/4hr Inhalation (dust/mist) LC50 > 5 mg/l/4hr	**Acute:** Classified as GHS Category 4 *or* Inhalation (gas) 2500 < LC50 ≤ 20000 ppmV Inhalation (vapor) 10 < LC50 ≤ 20 mg/l/4hr Inhalation (dust/mist) 1.0 < LC50 ≤ 5 mg/l/4hr Listed as: H332: Harmful if inhaled	**Acute:** Classified as GHS Category 1, 2, or 3 *or* Inhalation (gas) LC50 ≤ 2500 ppmV Inhalation (vapor) LC50 ≤ 10 mg/l/4hr Inhalation (dust/mist) LC50 ≤ 1 mg/l/4hr Listed as: H330a/b: Fatal if inhaled H331: Toxic if inhaled	No relevant data available for classification.

Green	Yellow	Red	Grey
Single exposure organ toxicity: Not Classified. LOAEL (gasses) > 20000 ppmV/4hr LOAEL (vapor) > 20 mg/L/4hr LOAEL (mists/dusts) > 5.0 mg/L/4hr	**Single exposure organ toxicity:** Classified as GHS Category 2 or 3 *or* 2500 < LOAEL (gasses) ≤ 20000 ppmV/4hr 10 < LOAEL (vapor) ≤ 20 mg/L/4hr 1.0 < LOAEL (mists/dusts) ≤ 5.0 mg/L/4hr Listed as: H371: May cause damage to organs via inhalation exposure H336: May cause drowsiness or dizziness	**Single exposure organ toxicity:** Classified as GHS Category 1 *or* LOAEL (gasses) ≤ 2500 ppmV/4hr LOAEL (vapor) ≤ 10 mg/L/4hr LOAEL (mists/dusts) ≤ 1.0 mg/L/4hr Listed as: H370: Causes damage to organs via inhalation exposure	
Sub –Chronic/Chronic: Not Classified. Inhalation (Gases) LOAEL > 250 ppmV/6h/d Inhalation (Vapors) LOAEL > 1.0 mg/L/6h/d Inhalation (Dusts & Mists) LOAEL > 0.2 mg/L/6h/d	**Sub –Chronic/Chronic:** Classified as GHS Category 2 *or* Inhalation (Gases) 50 < LOAEL ≤ 250 ppmV/6h/d Inhalation (Vapors) 0.2 < LOAEL ≤ 1.0 mg/L/6h/d Inhalation (Dusts & Mists) 0.02 < LOAEL ≤ 0.2 mg/L/6h/d Listed as; H373: May cause damage to (organs) through prolonged or repeated inhalation	**Sub –Chronic/Chronic:** Classified as GHS Category 1 *or* Inhalation (Gases) LOAEL ≤ 50 ppmV/6h/d Inhalation (Vapors) LOAEL ≤ 0.2 mg/L/6h/d Inhalation (Dusts & Mists) LOAEL ≤ 0.02 mg/L/6h/d Listed as: H372: Causes damage to (organs) through prolonged or repeated inhalation	

3.3.8 Neurotoxicity

Definition

Neurotoxicity is an adverse change in the structure or function of the central and/or peripheral nervous system following exposure to a chemical, physical, or biological agent (Tilson, 1990). Structural neurotoxic effects are defined as neuroanatomical changes occurring at any level of nervous system organization. While functional neurotoxic effects include adverse changes in

somatic/autonomic, sensory, motor, and/or cognitive function, structural neurotoxic effects are defined as neuroanatomical changes occurring at any level of nervous system organization (U.S. EPA, 1998).

Neurotoxic substances can elicit cellular, anatomical, physiological, or behavioral effects. Cellular effects can include inhibition of macromolecule transmitter synthesis, alteration of ion flow, or prevention of the release of neurotransmitters. Anatomical effects include alterations of the cell body, axon, or the myelin sheath. Physiological effects may include change in neural activation or reduction of neurotransmission speed. Lastly, behavioral effects include significant changes in sensations of sight, hearing, touch, reflexes, motor functions, and cognitive functions (U.S. EPA, 1998).

For the purposes of the Cradle to Cradle Certified methodology, the alterations to the central nervous system listed above are included as evidence of neurotoxic effects. Knowledge of exact mechanisms of action for adverse effects is not necessary to conclude that a chemical is neurotoxic.

Rating Criteria

As defined above, neurotoxic effects can be seen over a number of timelines including acute/ single, sub-chronic, and chronic exposures. There are several testing methods acceptable for this endpoint, including OECD 418, 419, and 424, not all of which require specific exposure periods. Since neurotoxic effects can be seen over a range of exposure periods, the criteria for single exposure organ toxicity, sub-chronic, and chronic toxicity are applied for neurotoxicity and summarized in Table 12.

Several types of data points can be used to rate a chemical's potential for neurotoxicity based on the definitions above. Human studies can be used, including clinical evaluations, case reports, epidemiologic studies, and human laboratory exposure studies if an OAEL or NO(A)EL have been determined. Animal studies, which provide more precise exposure information and control environmental factors, can be used as well for the purposes of rating a chemical's neurotoxic effects. Within animal studies, structural, neurochemical, neurophysiological, behavioral, and neurological endpoints are considered for this endpoint. Endpoints for these types of adverse health effects are provided below and are considered in this methodology:

<u>Structural or neuropathological endpoints</u>

- Gross changes in morphology, including brain weight.
- Histologic changes in neurons or glia (neuronopathy, axonopathy, myelinopathy).

<u>Neurochemical endpoints</u>

- Alterations in synthesis, release, uptake, degradation of neurotransmitters.
- Alterations in second-messenger-associated signal transduction.
- Alterations in membrane-bound enzymes regulating neuronal activity.
- Inhibition and aging of neuropathy enzyme.

- Increases in glial fibrillary acidic protein in adults.

Neurophysiological endpoints

- Change in velocity, amplitude, or refractory period of nerve conduction.
- Change in latency or amplitude of sensory-evoked potential.
- Change in electroencephalographic pattern.

Behavioral and neurological endpoints

- Increases or decreases in motor activity.
- Changes in touch, sight, sound, taste, or smell sensations.
- Changes in motor coordination, weakness, paralysis, abnormal movement or posture, tremor, ongoing performance.
- Absence or decreased occurrence, magnitude, or latency of sensorimotor reflex.
- Altered magnitude of neurological measurement, including grip strength, hind limb splay.
- Seizures.
- Changes in rate or temporal patterning of schedule-controlled behavior.
- Changes in learning, memory, and attention.

Developmental endpoints

- Chemically induced changes in the time of appearance of behaviors during development.
- Chemically induced changes in the growth or organization of structural or neurochemical elements (USEPA, 1998).

In addition to experimental data, a survey of industrial chemicals by Grandjean et al. provides a succinct summary of chemicals that have displayed neurotoxic effects (Grandjean, 2006 and 2014). If a chemical, identified by its CAS number, appears on the Mundy list, a RED rating is given as sufficient evidence available for adverse neurotoxic effects.

Table 12 Rating Criteria for Neurotoxicity

Green	Yellow	Red	Grey
Refer to Oral, Dermal and Inhalation Toxicity Single Exposure Organ, Sub-Chronic, and Chronic Toxicity criteria within Tables 9-11 for Green Rating.	Refer to Oral, Dermal and Inhalation Toxicity Single Exposure Organ, Sub-Chronic, and Chronic Toxicity criteria within Tables 9-11 for Yellow Rating.	Refer to Oral, Dermal and Inhalation Toxicity Single Exposure Organ, Sub-Chronic, and Chronic Toxicity criteria within Tables 9-11 for Red Rating. *or* Listed in Grandjean et al. text for neurotoxic effects.	No relevant data available for classification.

3.3.9 Skin, Eye, and Respiratory Corrosion/Irritation

Definition

Corrosion is the production of irreversible damage to the skin, eyes, or respiratory system. In skin, corrosion is typified by ulcer, bleeding, bloody scabs, and, by the end of observation at 14 days, by discoloration due to blanching of the skin (UNECE, 2009). For eyes, irreversible damage is observed by grade four cornea lesions observed during the test, as well as persistent corneal opacity, adhesion, pannus, and interference with the function of the iris or other effects that impair sight (UNECE, 2009). The respiratory tract is considered to comprise the nose, nasal cavity, larynx, trachea, bronchi, and alveoli. Irreversible effects on these organs include fibrosis, dyspneoea, bronchitis, and histomorphology.

Irritation is defined as the production of reversible damage to the skin, eyes, or respiratory tract in the appropriate time frames. For skin, an application of 4 hours is expected followed by 14 days of observation while for eyes a 21-day observation period is expected for reversible effects. Reversible effects on the respiratory tract include coughing, conjunctivitis, rhinitis, and scratchy throat.

Rating Criteria

Table 13 summarizes the rating scheme for corrosion/irritation. Review of human or animal in vivo studies are the primary resources for consultation to determine the appropriate hazard rating within this endpoint. Suitable studies for skin will have application periods of up to 4 hours and observation periods of 14 days. If within this time frame, one of three animals elicits signs of corrosion as described above, a rating of RED is given. In animal studies, if a mean score between 1.5 and 4.0 is generated for two of three animals, the chemical tested may be labeled as an irritant and classified YELLOW. Inflammation that occurs throughout the observation period but no signs of corrosion are present, a YELLOW rating is also warranted. If no irritating or corrosive effects are seen on the skin in animals or from human experience, the chemical may be classified GREEN.

For damage to the eye, irreversible effects in animal studies can be defined by several endpoints. Evidence that effects on the cornea, iris, or conjunctiva have not reversed or are expected to reverse within an observation period of 21 days are classified as RED. In addition, if 2 of 3 animals have received mean scores of ≥ 3 and/or >1.5 following grading at 24, 48, and 72 hours, a RED rating is warranted. A mild to severe irritant, a YELLOW rating, can be defined by 2 of 3 test animals receiving mean scores in the following gradings:

a. corneal opacity ≥ 1.

b. iritis ≥ 1.

c. conjunctival redness ≥ 2.

d. conjunctival oedema ≥ 2.

In cases where the mean scores are less than those listed above or no effects of irritation or corrosion are seen, a GREEN classification is given.

When no human or animal studies are available, pH extremes of ≤ 2 or ≥ 11.5 are the basis for classifying a chemical as RED. Such agents are expected to cause serious damage to eyes, skin, and the respiratory tract.

Additional criteria that can be used and are often presented for regulatory purposes are European Hazard Statements (H-phrases). This convention aligns with the definitions given above for irritation and corrosion and can thus be used for hazard ratings. H-phrases of 314 and 318 are used for classifying a substance as RED, while H-phrases of 315 and 319 are used for classifying a substance as YELLOW.

Table 13 Rating Criteria for Skin, Eye, and Respiratory Corrosion/ Irritation

Green	Yellow	Red	Grey
Not Classified as GHS Category 1, 2, or 3. No irritation to skin, eyes, or respiratory tract in relevant human or animal studies	Classified as GHS Category 2 or 3 for Skin Corrosion/Irritation and/or Category 2 for Eye Damage/Irritation. Mild to severe irritation to skin, eyes, or respiratory tract in relevant human or animal studies; *or* Listed as: H315: Causes skin irritation H319: Causes serious eye irritation H320: Causes eye irritation H335: May cause respiratory tract irritation	Classified as GHS Category 1 for Skin Corrosion/Irritation or Eye Damage/Irritation. Causes burns, corrosion, or serious damage to skin, eyes, or the respiratory tract* in relevant human or animals studies; *or* pH ≤ 2 or pH ≥ 11.5 *or* Listed as: H314: Causes severe skin burns and eye damage H318: Causes serious eye damage	No relevant data available for classification.

*Note: There are no separate GHS categories for respiratory corrosion/irritation. However, per GHS version 6, if a substance is determined to be corrosive (based on data such as skin or eye data), respiratory corrosivity hazard may also be communicated by some authorities in combination with the appropriate acute toxicity symbol (e.g. "corrosive to the respiratory tract").

3.3.10 Sensitization of Skin and Airways

Definition

The clinical definition of sensitization is an eczematous skin reaction resulting from hypersensitivity upon secondary skin or inhalation contact by an allergen (Smith et al, 2001). This adverse health effect is considered to have two phases, known as induction or sensitization and elicitation. Upon exposure to a sensitizing dose, the immune system develops a memory to the allergen and a second exposure to the same allergen elicits production of a cell-mediated or antibody, allergic response. Accordingly, appropriate tests incorporate both of these phases in order to identify clinical responses.

For the purposes of this methodology, a skin sensitizer is a substance that will lead to an allergic response following skin contact, and a respiratory sensitizer is a substance that will lead to hypersensitivity of the airways following inhalation (UNECE, 2009).

Rating Criteria

If there is either evidence in humans or positive results from an appropriate animal test that a substance can lead to sensitization by skin contact or respiratory inhalation, then the substance will be profiled RED for this endpoint. In the case of sensitization, results from animal studies are generally more reliable than studies from human exposure. Human studies are normally not conducted in controlled experiments for the purpose of hazard classification but rather as part of risk assessment (UNECE, 2009). For skin contact sensitization, human studies can include patch testing, epidemiological studies, well-documented episodes of allergic contact dermatitis (e.g., dermatitis from epoxy resins on watch wristbands) (UNECE, 2009). In airways sensitization, human evidence can include in vivo immunological tests, in vitro immunological tests, bronchial challenge tests, or studies that indicate specific hypersensitivity reactions. It is important to note that negative human data should not normally be used to disprove positive results from animal studies (UNECE, 2009).

Animal studies can either be classified as adjuvant, where an additional agent is used to modify the effects of a substance of interest, or non-adjuvant where the substance in question is tested alone. For an adjuvant animal study to be considered positive, a response must be elicited in 30% of the population, whereas in a non-adjuvant study, 15% of the population must show sensitizing effects (UNECE, 2009). Acceptable studies include Guinea Pig Maximization, Buehler guinea pig, mouse ear swelling test (MEST), and other methods that are scientifically validated. If these tests give an elicitation between 0-15% for non-adjuvant and 0-30% for adjuvant studies, this hazard endpoint will be classified as YELLOW.

Results from local lymph node assay (LLNA) may also be used according to GHS [UN, 2015].

If the data indicates no sensitization effects were seen in any populations, then this endpoint is assigned a GREEN hazard rating. However, experimental data are not always available and in these cases MAK designations are used for reference. If a substance is not listed as a MAK sensitizer of airways (MAK Sa) or sensitizer of skin (MAK Sh), a GREY rating is given. Where a chemical is listed according to the MAK definition as a medium to strong airway or skin sensitizer, a RED profile is given. Table 14 provides a quick reference for the hazard rating criteria for sensitization.

Data on skin sensitization alone is sufficient to assign a hazard rating to this endpoint although data on respiratory sensitization must be considered when available.

Table 14 Rating Criteria for Sensitizing Effects

Green	Yellow	Red	Grey
Not classified as GHS Category 1A or 1B. Adequate data available. No evidence of sensitization in human and/ or animal studies. *or* No data from human or animal studies are available; however, the substance is not classified under GHS, not listed as H334/317 or MAK, and there is a history of safe use (10 years or more) without reported cases of sensitization, as documented by a signed statement from the substance manufacturer.	Not classified as GHS Category 1A or 1B. Non-adjuvant animal studies elicit a response 15% > population > 0%. Adjuvant animal studies elicit a response of 30% > population > 0%. *or* 1< LLNA SI < 3	Classified as GHS Category 1A or 1B for Sensitization (respiratory and skin): *or* *LLNA SI ≥ 3* *or* Listed as: GHS Category 1A or 1B for Sensitization (respiratory and/or skin) MAK skin or airways sensitizer (MAK Sa or Sh). H334: May cause allergy or asthma symptoms or breathing difficulties in inhaled. H317: May cause an allergic skin reaction.	No relevant data for classification.

3.3.11 Other (Human Health)

Definition and Rating Criteria

The Other (Human Health) endpoint is intended to cover any additional characteristic relevant to the overall evaluation of human health not covered by other endpoints.

Unlike for other endpoints, an assessor may assign a RED hazard rating based on any credible piece of information that suggests a human health hazard not addressed by other hazard endpoints. Information that is typically assessed within the scope of this endpoint includes a chemical's flammability, oxidation potential, reactivity, skin penetration potential, and volatility. Based on this information and the assessor's professional judgment, a hazard rating of either RED or GREEN is assigned. Note that YELLOW or GREY hazard ratings are not possible within this endpoint.

As for all endpoints, if different information types considered (e.g., flammability, reactivity) would lead to the assignment of different hazard ratings, a RED rating trumps all other possible assignments. For example, chemicals that could be assigned to Category 1 or 2 based on GHS physical hazards criteria would typically receive a RED rating in this endpoint. However, other information that is too complex or too context-dependent to be amenable to the RED, YELLOW, GREEN rating scheme is also meant to be included here. For example, skin penetration potential or nanomaterial properties may or may not represent a hazard based on interactions with other hazard endpoints, material matrix composition, and the product's intended uses. In such cases, the assessor would note the relevant property and assign a RED hazard rating as a reminder to consider this additional information in the risk assessment step.

Ultimately, this endpoint also serves as a placeholder for other hazard endpoints that may be added to the standard in future revisions. As such, material assessors are expected to submit to the Institute an 'Other hazards and risks' report within two months of the Assessment Summary when a single chemical risk score of 'x' was assigned to a chemical based on a RED hazard flag in an 'Other' endpoint. The report has to provide sufficient context and documentation for an expert to understand the reasons that led to the specific chemical being considered hazardous in the situation. To protect confidential business information, generic terminology may be used to describe the material and the product in the context of the assessment that took place, but the evidence and reasoning that led to the decision must be clear. Such reports are then distributed in the Cradle to Cradle accredited Materials Assessment community and may be cited in future Assessment Summary Forms.

3.3.12 Aquatic Toxicity (Three separate endpoints: Fish, Daphnia, and Algae Toxicity)

Definition

Aquatic toxicity is the ability of a chemical to cause adverse or injurious health effects to an aquatic organism. For the purposes of the Cradle to Cradle Certified methodology, fish (vertebrate), daphnia (invertebrate), and algae are chosen since they cover a range of trophic levels and taxa in the aquatic environment and are generally representative of aquatic fauna and flora. In addition, data on these taxa are more likely to be available as they are accepted or required in many regulatory schemes. Toxicity to each of these three taxa is treated separately, as a separate endpoint, which means that they will receive three separate RED/YELLOW/GREEN/GREY hazard ratings. The discussion of the three endpoints is combined here since there are a lot of commonalities in the complicating experimental factors (such as unstable or insoluble substances), permissible modeling approaches, and in the requirements for when chronic toxicity data must be obtained in addition to acute toxicity data.

Acute aquatic toxicity is the ability of a chemical to cause adverse or injurious health effects to an organism in a short-term aquatic exposure scenario. Chronic aquatic toxicity is the intrinsic property of a substance to cause adverse effects to aquatic organisms during aquatic exposure that is determined in relation to the life-cycle of the organism (UNECE, 2009). Similar to acute toxicity, for the purposes of the Cradle to Cradle Certified methodology, fish (vertebrate), daphnia (invertebrate), and algae are chosen since they cover a range of trophic levels and taxa in the

aquatic environment and are generally representative of aquatic fauna and flora. Generally, results from both acute and chronic studies may influence the ratings in the three aquatic toxicity endpoints. However, since chronic toxicity tests are rarely conducted, if there are no signs of toxicity in acute studies, chronic data is not required for an aquatic toxicity endpoint when acute data suggests a green rating for that endpoint (see *Availability of Acute Toxicity vs. Chronic Toxicity Data* below).

Rating Criteria

Required tests for the aquatic toxicity endpoints include 96-hour LC_{50}, 48-hour EC_{50}, and 72- to 96-hour EC_{50} for fish, daphnia, and algal toxicity respectively. Data quality and interpretation of results that are dependent on a chemical's properties are also important for these endpoints. Criteria for RED, YELLOW, and GREEN ratings are provided in Tables 15-17.

The toxicity thresholds for aquatic toxicity endpoints should preferably be drawn from data required for regulatory purposes, recognized databases, and relevant literature. As a general rule, data generated by recognized international standards (OECD guidelines EPA, ASTM, or ISO EU) or conforming with Good Laboratory Practices is preferred. In cases where this is not available, less rigorous types of data can be used, such as MSDS data, or QSAR software can be used for appropriate chemicals.

For this rating scheme, freshwater and marine species toxicity are considered equivalent. No preference is given to exposure regimes that typically are employed in four types: static, static-renewal, recirculation, and flow-through. Depending on the characteristics of a chemical, different methods are used and as long as a valid test is performed all exposure scenarios are equivalent.

Occasionally there are multiple acceptable tests for a taxonomic group. In this case, the most sensitive test (i.e., study with the lowest $L(E)C_{50}$) is used for rating purposes. This is applied on a case-by-case basis and, where large data sets are available (four or more), a mean average of the results can be used for classification (UNECE, 2009). However, this should only be applied in cases where the tests are performed on the same species.

Difficult to Test Substances – Although the criteria are intended to apply to all chemicals and substances, it is recognized that there are some substances (i.e., metals, poorly soluble chemicals, volatile chemicals) that need special consideration when interpreting test results. Testing for aquatic toxicity requires the dissolution of the substance in the test water media and continuation of a constant exposure concentration over the duration of the test period (UNECE, 2009). However, some substances make this requirement difficult and professional judgment must be applied for these chemicals that generally cause difficulties in testing.

Chemical properties that can contribute to losses of concentration in testing conditions include poorly water soluble, volatile, photo-degradable, hydrolytically unstable, oxidizable, biodegradable, adsorbing, chelating, colored, hydrophobic, ionized, or complex mixtures (UNECE, 2009). In all of these difficult testing conditions, the actual test concentration is likely to be below the nominal test concentration provided by the guideline (UNECE, 2009). If acute toxicities are

reported to be <10 mg/L, the practitioner can be fairly confident in a RED rating. However, it is more difficult in cases where the L(E)C_{50} is reported to be >10 mg/L, where expert judgment is needed on the validity of the study and appropriate rating for a chemical.

Unstable Substances – Unstable substances include those that are quickly hydrolyzed in water, photo-degrade, oxidize, and are volatile or biodegrade. In these cases, not only is there concentration loss in the study, but secondary degradation products arise that can have unique toxicity hazards. In cases where chemicals exhibit these properties it is essential to have data on the measured exposure concentrations at suitable time points in the study. Without this prerequisite, a study should be deemed invalid for hazard ratings. Where these data are available, the mean average of the start and end concentrations of the test can be used to calculate the L(E)C_{50} (UNECE, 2009).

Where the identification of the breakdown products is known, classification of these chemicals for acute aquatic toxicity hazards should also be determined by the normal protocol. The resulting rating for acute aquatic toxicity of the breakdown products will affect the overall aquatic toxicity rating for the parent compound (i.e., a byproduct RED for acute aquatic toxicity will result in a RED rating for aquatic toxicity of the parent chemical).

Poorly Soluble Substances – Typically these chemicals are considered to be <1 mg/L, but there are additional scenarios where the guidance for these substances may be applicable. In older studies it is normal to find toxicity levels in excess of the water solubility, or where dissolved levels are below the detection limit of a method used (UNECE, 2009). Where studies of this kind are the only available data, some practical rules may be applied.

In studies that report acute toxic effects in the aquatic environment at levels in excess of the water solubility, the L(E)C_{50} may be assumed to be equal to the measured water solubility. The assumption in this case is that the excess, undissolved substance did not contribute to toxicity through physical effects and should be carefully considered. Similarly, where no acute toxicity effects are seen in excess of water solubility, the L(E)C_{50} may be considered to be greater than the measured water solubility (UNECE, 2009). This value still may not give clarity on the final rating a chemical should receive and it is therefore assumed that if a chemical does not show toxic effects within its range of solubility then it may be rated GREEN.

Some studies fail to report the concentration since the detection limit of the method used may not be sensitive enough and able to capture poorly soluble chemicals. In such instances, where acute toxic effects are observed, the L(E)C_{50} may be considered to be less than the analytical detection limit. Where no toxicity is observed, the L(E)C_{50} may be considered to be greater than the water solubility. As indicated above, in this latter case, a rating of GREEN may be given to this endpoint.

Other Factors – Several other factors can contribute to concentration loss in studies, including sedimentation, adsorption, and bioaccumulation. For sedimentation and bioaccumulation, determination of the L(E)C_{50} is analogous to chemicals that exhibit instability. Adsorption tends

to occur with chemicals that have high log Kow values and loss of concentration tends to be rapid. In these instances, end of test concentrations may be used to determine exposure thresholds.

Quantitative Structure Activity Relationships (QSAR) – When no other data are available through studies, Quantitative Structure Activity Relationships (QSARs) may be used to predict the aquatic toxicity of chemicals. In particular, Ecosar v.1.11, developed by the US EPA, is used for these purposes.

No Observable Effect Concentration – Chronic effects include a range of sub-lethal endpoints and are generally expressed in terms of a No Observable Effect Concentration (NOEC). Observable endpoints from acceptable tests (OECD 210 – Fish Early Life Stage, 211 – Daphnia Reproduction, and 201 Algal Growth) include survival, growth, morphological abnormalities, and behavioral effects. Other validated and internationally accepted test methods may be used in these classification schemes that are comparable to the OECD tests listed above. The NOEC's determined in the appropriate tests are used in the Cradle to Cradle Certified methodology in order to rate a chemical for its intrinsic chronic aquatic toxicity. The criteria for each rating are provided in Tables 15-17.

Availability of Acute Toxicity vs. Chronic Toxicity Data – Typically, acute toxicity is more widely available than chronic toxicity data for aquatic species and subsequently is relied upon in many classification schemes with the appropriate combination of biodegradation and bioaccumulation data. Where both data points are available for a given aquatic toxicity endpoint, preference shall be given to chronic toxicity rather than a combination of acute toxicity with degradability and bioaccumulation data. If a substance would obtain a GREEN rating for a given toxicity endpoint based on acute toxicity data and no chronic toxicity data is available, this lack of data will not impact the hazard rating for this endpoint. However, if a substance would obtain a YELLOW rating for a given toxicity endpoint based on acute toxicity data and no chronic toxicity data is available, the rating for that endpoint shall remain GREY until chronic toxicity data can be found or estimated through modeling. This is because the unknown chronic toxic effect may be more severe than the observed acute once thus creating the risk falsely assign a YELLOW rating based solely on acute data when the actual rating would be RED due to chronic effects.

Table 15 Rating Criteria for Fish Toxicity (Vertebrate)

Green	Yellow	Red	Grey
Not Classified as GHS Category 1,2, or 3. 96 hour LC50 > 100 mg/L QSAR 96 hour LC50 > 100 mg/L	**Acute** Classified as GHS Category 3 or 10 < 96 hour LC50 ≤ 100 mg/L or 10 < QSAR 96 hour LC50 ≤ 100 mg/L AND **Chronic** 1 < NOEC ≤ 10 mg/L for chronic toxicity based on experimental or modeled results	**Acute** Classified as GHS Category 1 or 2 or 96 hour LC50 ≤ 10 mg/L or QSAR 96 hour LC50 ≤ 10 mg/L Listed as: H400: Very toxic to aquatic life OR **Chronic:** Classified as GHS Category 1,2, or 3 *or* NOEC ≤ 1 mg/L for chronic toxicity based on experimental or modeled results Listed as: H410: Very toxic to aquatic life with long lasting effects H411: Toxic to aquatic life with long lasting effects H412: Harmful to aquatic life with long lasting effects H413: may cause long lasting harmful effects to aquatic life	No relevant data for classification.

Table 16 Rating Criteria for Daphia Toxicity

Green	Yellow	Red	Grey
Not Classified as GHS Category 1,2, or 3. 48 hour L(E)C50 > 100 mg/L QSAR 48 hour L(E)C50 > 100 mg/L	**Acute** Classified as GHS Category 3 *or* 10 < 48 hour L(E)C50 10 ≤ 100 mg/L 10 < QSAR 96 hour L(E)C50 ≤ 100 mg/L AND **Chronic** 1 < NOEC ≤ 10 mg/L for chronic toxicity based on experimental or modeled results	**Acute** Classified as GHS Category 1 or 2 *or* 48 hour L(E)C50 ≤ 10 mg/L QSAR 48 hour L(E)C50 ≤ 10 mg/L OR **Chronic** Classified as GHS Category 1,2, or 3 or NOEC ≤ 1 mg/L for chronic toxicity based on experimental or modeled results Listed as: H400: Very toxic to aquatic life H410: Very toxic to aquatic life with long lasting effects H411: Toxic to aquatic life with long lasting effects H412: Harmful to aquatic life with long lasting effects H413: may cause long lasting harmful effects to aquatic life	No relevant data for classification.

Table 17 Rating Criteria for Algae Toxicity

Green	Yellow	Red	Grey
Not Classified as GHS Category 1,2, or 3. 72/ 96 hour L(E)C50 > 100 mg/L QSAR 72/ 96 hour L(E)C50 > 100 mg/L	**Acute:** Classified as GHS Category 3 *or* 10 < 72/ 96 hour L(E)C50 ≤ 100 mg/L 10 < QSAR 72/ 96 hour L(E)C50 ≤ 100 mg/L AND **Chronic:** 1 < NOEC ≤ 10 mg/L for chronic toxicity based on experimental or modeled results	**Acute:** Classified as GHS Category 1 or 2 *or* 72/ 96 hour L(E)C50 < 10 mg/L QSAR 96 hour L(E)C50 < 10 mg/L OR **Chronic;** Classified as GHS Category 1,2, or 3. NOEC ≤ 1 mg/L for chronic toxicity based on experimental or modeled results Listed as; H400: Very toxic to aquatic life H410: Very toxic to aquatic life with long lasting effects H411: Toxic to aquatic life with long lasting effects H412: Harmful to aquatic life with long lasting effects H413: may cause long lasting harmful effects to aquatic life	No relevant data for classification.

3.3.13 Terrestrial Toxicity

Definition
Terrestrial toxicity is the ability of a chemical to pose an adverse health effect to a species that lives on land. For the purposes of the Cradle to Cradle Certified methodology, toxicity to avian species and soil organisms is considered within this endpoint as they are not represented in other endpoints in this methodology. Adverse health effects can include mortality, morbidity, and/or reproduction/ developmental endpoints.

Rating Criteria
To determine the hazard rating for terrestrial toxicity, several tests may be considered for a variety of avian species and soil organisms that are considered beneficial to soil by being able to increase its productivity. Toxicity studies for birds follow the same principles described above for acute toxicity and reproductive/ developmental toxicity and are measured by LD50s and NOECs, respectively. Table 18 provides a summary of the criteria using these measures for each hazard rating used in this methodology. Acceptable experimental designs for rating include:

- OECD 205: Avian Dietary Toxicity Tests.
- OECD 206: Avian Reproduction Test.

Observable endpoints for these tests include mortality, body weights of adults and of the young at 14 days, food consumption of adults and young, gross pathological examination of adult birds, egg product, cracked eggs, egg shell thickness, viability, hatchability, and effects on young birds. If significant adverse health effects are found in these studies the appropriate rating should be applied according the criteria displayed in Table 18 (e.g., small changes in body weight would not be considered a significant adverse health effect).

The importance of soil as a key component of ecosystems is now widely recognized and understanding how organisms that contribute to soil health are affected by chemicals is important. For invertebrate species, earthworms are the most commonly tested given their predominance in soil and their importance to ecological health. There are several established tests for earthworms including:

- OECD 207: Earthworm Acute Toxicity Tests.
- OECD 220: Enchytraeid Reproduction Test.
- OECD 222: Earthworm Reproduction Test.

In addition to earthworms there are several other invertebrates and insects that are considered crucial to the health of soil, including honeybees, mites, beetles, and springtails. Several standardized tests exist for these species including:

- OECD 213: Honeybees, Acute Oral Toxicity Test.

- OECD 214: Honeybees, Acute Contact Toxicity Test.
- OECD 226: Predatory mite reproduction test in soil.
- OECD 228: Determination of Developmental Toxicity of a Test Chemical to Dipteran Dung Flies.
- OECD 232: Collembolan Reproduction Test in Soil.

All of these species are considered to be organisms important to the health of soils and are included in this endpoint for rating purposes. Table 18 summarizes the criteria for rating a chemical's effect on these species.

Table 18 Rating Criteria for Terrestrial Toxicity

	Green	Yellow	Red	Grey
Birds (Sub-acute)	Chicken LD50 > 9000 mg/kg fodder (5 days) Duck LD50 > 15000 mg/kg fodder (5 days)	Chicken LD50 900 - 9000 mg/kg fodder (5 days) Duck LD50 1500 - 15000 mg/kg fodder (5 days)	Chicken LD50 < 900 mg/kg fodder (5 days) Duck LD50 < 1500 mg/kg fodder (5 days)	No relevant data for classification.
Birds (Sub-chronic/ Chronic)	Chicken NOEC > 3000 mg/kg fodder (≥ 20 weeks) Duck NOEC > 5000 mg/kg fodder (≥ 20 weeks)	Chicken NOEC 300 - 3000 mg/kg fodder (≥ 20 weeks) Duck NOEC 500 - 5000 mg/kg fodder (≥ 20 weeks)	Chicken NOEC < 300 mg/kg fodder (≥ 20 weeks) Duck NOEC < 500 mg/kg fodder (≥ 20 weeks)	No relevant data for classification.
Toxicity for Soil Organisms (Acute)	EC50 > 1000 mg/kg dry soil	EC50 100 - 1000 mg/kg dry soil	EC50 < 100 mg/kg dry soil	No relevant data for classification.
Toxicity for Soil Organisms (Sub-chronic/ Chronic)	NOEC > 100 mg/kg dry soil	NOEC 10 - 100 mg/kg dry soil	NOEC < 10 mg/kg dry soil	No relevant data for classification.

3.3.14 Persistence

Definition

Persistence is a measure of a substance's ability to remain as a discrete chemical entity in the environment for a prolonged period of time. Biodegradation is one process by which a substance or material is broken down by microorganisms and reduced to organic and inorganic molecules, ultimately taking the form of carbon dioxide, water, and salts. It is important to note that biodegradation applies solely to organic or organometallic chemicals. The concept of biodegradability as applied to organic compounds has limited to no meaning for inorganic compounds (UNECE, 2009). Inorganic chemicals react differently in the environment through changing speciation and do not have measurable endpoints such as oxygen depletion or carbon dioxide generation as organic compounds do.

Rating Criteria

To determine the hazard rating for this endpoint, different data types may be considered with empirical data from biodegradability tests being preferred and estimation of biodegradability by QSAR results representing the least accurate. A number of OECD guidelines have been developed for biodegradation and they are used for rating purposes. Results from OECD guidelines 301: "Ready Biodegradability" may be used for GREEN, YELLOW, or RED ratings depending upon the removal of Dissolved Organic Carbon (DOC) or Theoretical Oxygen Demand (ThOD). For a GREEN classification, either 70% removal of DOC or 60% removal of ThOD must be reached in a 10-day window within the 28-day timeframe. The 10-day window begins once 10% biodegradation has been reached by DOC, ThOD, or $ThCO_2$. If the 10% biodegradation is reached but the chemical in question does not reach the required degradation within 10 days, a YELLOW rating is given. In cases where 10% biodegradation does not trigger the 10-day window, a hazard of RED is given.

Inherent biodegradability (OECD Test Guidelines 302, 304A) may be used to determine hazard ratings; however, these tests may not be used to give a GREEN rating. The optimum conditions for biodegradation set within these guidelines, primarily the adaptation of microorganisms, cannot allow a practitioner to assume ready biodegradability of inherently biodegradable substances (UNECE, 2009). Substances that have been degraded more than 70% for inherent biodegradability may be rated as YELLOW. When inherent biodegradability studies are the only available data and less than 70% removal has been observed, a rating of RED is assigned. However, if half-life or QSAR results (discussed below) conflict with this rating, reevaluation of the endpoints is considered. If inherent biodegradability tests are employed without pre-exposure and adaptation of microorganisms, these results may be used for a GREEN rating.

When empirical evidence is insufficient for ready or inherent biodegradability studies, estimation of degradation by QSAR results are used for classification. BIOWIN is the QSAR model used for this methodology, as it is publicly available and updated regularly. When identifying chemicals by their CAS number, if BIOWIN gives a result of readily biodegradable, then a rating of GREEN is given. Where BIOWIN indicates, a chemical can be degraded within weeks to months a rating of YELLOW is given. If BIOWIN labels a substance as recalcitrant, a rating of RED is given.

The half-life value chosen to determine the final rating for this hazard endpoint must reflect the dominant environmental compartment in order to be meaningful. Fugacity modeling available via the U.S. EPA's EPI Suite software offers a rapid and cost-effective way to estimate dominant environmental compartment of a chemical.

Table 19 provides a quick reference for generating hazard ratings for persistence and biodegradation.

Table 19 Rating Criteria for Persistence and Biodegradation

Green	Yellow	Red	Grey
$T_{1/2} \leq$ 30/90 days in water/ soil or sediment; Readily biodegradable (≥70% DOC removal or ≥ 60% ThOD removal within 28 days) based on OECD guidelines (301); Predicted to be readily biodegradable by QSAR results	30/90 day < $T_{1/2} \leq$ 60/180 days in water/ soil or sediment; 10% ≤ DOC removal < 70% based on OECD guidelines (301) 10% ≤ ThOD removal < 60% based on OECD guidelines (301) Inherently (ultimate) biodegradable based on OECD guidelines (302, 304A) (≥70% DOC removal) Predicted to be degradable within weeks to months by QSAR	T1/2 > 60/180 days in water/ soil or sediment DOC and ThOD removal < 10% based on OECD 301 guidelines < 70% DOC removal under OECD 302 or 304A testing. Predicted to be recalcitrant by QSAR results.	No relevant data for classification *or* substance is considered inorganic and not applicable to this endpoint.

3.3.15 Bioaccumulation

Definition

Bioaccumulation is a measure of the tendency for a chemical to accumulate in an organism and is the net result of uptake, transformation, and elimination of a substance due to all routes of exposure. This is often measured by a bioaccumulation factor (BAF), which is the ratio of the concentration of a substance in a living organism (mg/kg) to the concentration of that substance in the surrounding environment (mg/L for aquatic systems). An additional endpoint that can be used to predict the bioaccumulation of a chemical in the environment is the n-octanol-water partition coefficient (K_{ow}). The K_{ow} is a measure of a chemical's lipophilicity and has been empirically shown that an increasing K_{ow} correlates with an increasing BAF. These endpoints, BAF and $K_{ow,}$ have been utilized for reference in determining the hazard rating of a chemical's potential to bioaccumulate in organisms. Note bioconcentration factors (BCF) are a type of BAF and pertain to bioaccumulation from water in laboratory tests.

Rating Criteria

Based on BCF or BAF and K_{ow} values, the rating of a chemical as GREY, RED, YELLOW, or GREEN for bioaccumulation potential is shown in Table 20.

Preference is given to high-quality studies that determine the BCF or BAF according to internationally accepted guidelines. The degree of bioconcentration/bioaccumulation depends on numerous intrinsic factors of the chemical but also experimental factors such as bioavailability, size of the organism, maintenance of exposure concentration, or exposure duration. GHS provides guidance on the determination of high-quality BCF studies in Annex 9 of the 3rd edition. These guidelines are used for reference in this methodology. When test data for fish species is not available, high-quality tests involving other species such as oysters, mussels, or scallops are also usable.

Experiments deriving the BCF value of low or uncertain quality can underestimate the potential for bioaccumulation. In such cases, consideration for the use of an experimentally determined K_{ow} value should be used instead. The determination of the K_{ow} value will also have to be considered as high-quality experiments or values assigned as "recommended values" are preferred. GHS provides guidelines for review of experiments in determining the K_{ow} and their overall quality in Annex 9 of the 3rd edition. These guidelines are followed for the purposes of rating a chemical for bioaccumulation.

Although the relationship between increasing K_{ow} and BCF has been empirically established, this linear relationship becomes equivocal for highly lipophilic substances ($K_{ow} > 6$). At K_{ow} values above 6, the relationship with BCF begins to decrease. This relationship has been postulated to be due to reduced membrane permeation and kinetic or reduced biotic lipid solubility for large molecules (UNECE, 2009). Based on the curvilinear relationship between K_{ow} and BCF, an upper limit of the K_{ow} is appropriate given the decreasing relationship. From the literature, the best upper limit for the K_{ow} is estimated at 8 (Bintein, 1993). When the experimental determination of K_{ow} is not always possible (e.g., very water-soluble substances, very lipophilic substances, and surfactants), a QSAR-derived K_{ow} may be used. For the purposes of this classification, the BioWin application is used (Syracuse Research Corporation).

For some chemicals, the determination of a BCF value becomes difficult as chemical properties can limit the ability of a chemical to be soluble in lipids present in water, or available for transfer across biological membranes. These substances include poorly soluble substances and high molecular weight substances. Poorly soluble substances for which the solubility is less than the detection limit create problems in interpreting the BCF. For such substances, the bioconcentration potential should be based on the experimental determination of log K_{ow} or QSAR estimations (UNECE, 2009). For chemicals with a high molecular weight the tendency to bioaccumulate decreases. This result is possibly due to the steric hindrance of a chemical preventing passage across biological membranes. For chemicals that have a molecular weight above 1000, it has been proposed that these chemicals do not have the potential to bioaccumulate and is employed for the purposes of this rating system (CSTEE, 1999).

Cases may arise where the available bioaccumulation data give conflicting results with regard to which hazard rating should be assigned. In general, a "weight of evidence" approach should be used where the highest quality study (or studies) for BCF or BAF is used. If this approach does not give parity to the data, then the highest value should be used to determine the hazard rating.

Table 20 Rating Criteria for Bioaccumulation Potential

Green	Yellow	Red	Grey
BCF/BAF ≤ 100 by experimental results for any log K_{ow}, or by QSAR results if log K_{ow} < 6* *or* log K_{ow} < 2 *or* Molecular weight > 1000 g/mole	100 < BCF/BAF < 500 by experimental results for any log K_{ow}, or by QSAR results if log K_{ow} < 6*.	BCF ≥ 500 by experimental results for any log K_{ow}, or by QSAR results if log K_{ow} < 6*. BAF ≥ 500 by experimental results for any log K_{ow}, or by Arnot/Gobas QSAR results if log K_{ow} < 8.	No relevant data for classification. log K_{ow} >2 and no additional information.

*Note: QSAR estimated BCF may only be used when log K_{ow} is < 6 because the relationship is no longer linear above 6. When log K_{ow} is > 6, a measured/experimental BCF value is required. Alternatively, a QSAR estimated BAF may be used for log K_{ow} 6-8.

3.3.16 Climatic Relevance

Definition

The Climatic Relevance endpoint covers both a chemical's climate impacts (global warming potential) and its impacts on the ozone layer (ozone depleting potential).

The Intergovernmental Panel for Climate Change (IPCC) offers a definition of Global Warming Potential (IPCC, 1999):

> *"Global warming potential is an index that attempts to integrate the overall climate impacts of a specific action (e.g., emissions of CH4, NOx or aerosols). It relates the impact of emissions of a gas to that of emission of an equivalent mass of CO2. The duration of the perturbation is included by integrating radiative forcing over a time horizon (e.g., standard horizons for IPCC have been 20, 100, and 500 years). The time horizon thus includes the cumulative climate change and the decay of the perturbation."*

GHS offers a definition of Ozone Depleting Potential (UNECE, 2009):

> "*Ozone Depleting Potential (ODP) is an integrative quality, distinct for each halocarbon source species, that represents the extent of ozone depletion in the stratosphere expected from the halocarbon on a mass-for-mass basis relative to CFC-11. The formal definition of ODP is the ration of integrated perturbations to total ozone, for differential mass emission of a particular compound relative to an equal emission of CFC-11.*"

Rating Criteria

Hazard ratings for this endpoint are entirely list-based, as shown in Table 21. A RED rating is assigned if the chemical is included among the known greenhouse gases in Table 6.7 of the IPCC Third Assessment Report and/or is on the EPA's list of Ozone Depleting Substance substitutes with global warming potential. If a chemical is not on either of these lists, and additionally not listed as either a Class I or II Ozone Depleting Substance by the Montreal Protocol, it receives a GREEN rating for this endpoint.

Table 21 Rating Criteria for Climatic Relevance

Green	Yellow	Red
Not listed as a known greenhouse gas in IPCC Third Assessment Report, an EPA ozone depleting substance substitute with global warming potential, and/or in Annexes to the Montreal Protocol.	Not applicable.	Listed as a known greenhouse gas in IPCC Third Assessment Report, an EPA ozone depleting substance substitute with global warming potential, and/or in Annexes to the Montreal Protocol. GHS Category 1.

3.3.17 Other (Environmental Health)

Definition and Rating Criteria

Analogous to the 'Other' endpoint for Human Health hazards, this endpoint is intended to cover any additional characteristic relevant to the overall evaluation of environmental health not covered by other endpoints.

Similar to the 'Other (Human Health)' endpoint, an assessor may assign a RED hazard rating based on any credible piece of information that suggests an environmental health hazard not addressed by other hazard endpoints. Information that is typically assessed within the scope of this endpoint includes a chemical's mobility in soils, ability to mobilize heavy metals from sediment (chelating agents), and its 'Wassergefährdungsklasse' (WGK) if one has been issued by the German Federal Ministry for the Environment (Umweltbundesamt, UBA). The UBA maintains a public database of chemicals that have been assigned a WGK.

Based on this information and the assessor's professional judgment, a hazard rating of either RED or GREEN is assigned. Note that YELLOW or GREY hazard ratings are not possible within this endpoint. The expectations regarding use and reporting of this endpoint are the same as those for the 'Other (Human Health)' endpoint (section 3.3.11).

3.3.18 Organohalogens

Definition

Organohalogens, defined as chemicals with a carbon to halogen bond (i.e., contains a carbon-to-fluorine, -chlorine, -bromine, or –iodine bond), are flagged for their tendency towards increased toxicity, bioaccumulation, and persistence as compared to non-halogenated analogs. The substances falling into this category are now ubiquitous in the environment and are being used in a variety of applications— from colorants and adhesives to plastic molding, piping, coatings,

and pesticides. They are also major components of commercial formulations in furniture foam (pentaBDE), plastics for TV cabinets, consumer electronics, wire insulation, back coatings for draperies and upholstery (decaBDE), and plastics for personal computers and small appliances (octaBDE). Toxicity testing indicates that many organohalogens cause a variety of adverse effects, from liver toxicity and thyroid toxicity, to neurodevelopmental abnormalities. In addition, polytetrafluoroethylene (PTFE), a popular material for non-stick applications, is a heavily fluorinated polymer manufactured with perfluorooctanoic acid (PFOA). PFOA and the congeners of PTFE degradants have been found in polar bears, marine life, fetal umbilical cord blood, and even in human breast milk.

Dietrich Henschler, an eminent German toxicologist, studied the human health impacts and potency of organohalogens and compared them to their non-halogenated analogues (Henschler, 1994). Henschler used a large data set of organic compounds that included organochlorines - chlorinated alkanes, alkenes, butadienes, benzenes, phenols, paraffins, dioxins, furan, biphenyls, and insecticides. Four major conclusions were reached in this study:

1. The introduction of chlorine into organic compounds is almost always associated with an increase in toxic potential for a variety of toxic effects.
2. Chlorination usually produces entirely new toxic effects.
3. With introduction of chlorine most organic compounds exhibit mutagenic and carcinogenic properties not present in the non-halogenated analogue.
4. Chlorination often increases the potency of toxic effects. With little empirical data on the toxic effects of all organochlorines and the limited knowledge of chlorinated by-products in the synthesis of this chemical class, the trend identified by Henschler demonstrates that there is something inherently dangerous in chlorinating organic molecules.

Chlorination radically affects the chemical stability of organic chemicals—usually increasing it. Because many organochlorines resist natural degradation processes, even very dilute discharges tend to build up in the environment over time. Some organochlorines, such as 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), do not break down to any appreciable degree; virtually all the TCDD released into the environment will remain in one place or another almost indefinitely. Many other organochlorines are persistent, but will degrade very slowly, with environmental half-lives in the years or decades.

Another effect of chlorination is that chlorine atoms invariably increase the ability of organic chemicals to dissolve in oils. Once oil-soluble organochlorines are released into the environment, they accumulate in the fatty tissues of living things—a process called bioaccumulation. Bioaccummulative compounds gravitate from the ambient environment into the food web, magnifying in concentration as they move upward from tiny organisms to large predators. By the time they get to the top of the food web (i.e., humans, eagles, polar bears, and other species), some organochlorines reach concentrations many millions of times greater than their levels in the ambient environment.

While not all organohalogens are toxic, they can act as precursors for dioxins and furans in fires below 450°C (Zhang et al., 2010). For example, the combustion of polyvinyl chloride (PVC) can contribute to the formation of dioxins and furans in two ways. While formation rates are minimized at high temperatures present in industrial and municipal incinerators, low temperature combustion cannot be ruled out as a likely unintended end-of-use scenario, given the prevalence of landfill fires, residential fires, and open-pit fires as a method for waste disposal in rural areas (backyard barrel burning) and developing countries (Zhang et al., 2010; US EPA, 2006). Thus, even though there may be organohalogen compounds that are safe during the use phase, there are risks during likely unintended end-of-use scenarios.

The environmental threat posed by organochlorines through their bioaccumulative and persistent nature is starting to be recognized globally as there is evidence of contamination in the upper atmosphere contributing to ozone depletion. Organochlorines such as DDT, hexachlorobenzene, chlordane, heptachlor epoxide, and lindane have been found in tree bark all over the world (IJCSAB, 1989). Dioxins have been found throughout the food chain as evidenced by EPA's estimate that 90% of the average American's dioxin exposure is from their diet (Yang, 1994). PCBs and a number of organochlorine pesticides have been identified in the bodies of seals, walruses, beluga whales, porpoises, and polar bears (Robins et al, 1982). Organochlorine pollutants even fall from the skies, having been found in falling snow throughout the arctic (Willes et al, 1993). The ubiquitous presence of organochlorine pollutants throughout the globe as well as in the fat tissue of humans, infants, and animals demonstrates an additional danger of this chemical class.

Rating Criteria

The trends discussed above are cause for concern for the organohalogen family as a whole, and subsequently any chemical with a carbon to halogen bond that is present at a concentration of 100 ppm or higher in a homogenous material receives a RED rating (the carbon-halogen bond must be present in the finished product, i.e., not hydrolyzed in the production/manufacturing process). A chemical that does not contain a carbon to halogen bond receives a GREEN rating, as shown in Table 22.

If a organohalogen (substance with a carbon-halogen bond) is present below 100 ppm in a homogenous material, it will still be subject to review (see main standard document section 3.4, point 2f) but it will not receive a RED rating for this endpoint. This means that the risk rating for an organohalogen <100 ppm in a material will be determined by the rest of its hazard profile, while the risk rating for an organohalogen >100 ppm in a material will always be 'x'.

Note that certain halogenated materials, such as polyvinyl chloride (PVC), polychloroprene, chlorinated polyethylene, and other chlorinated polymers, are on the Banned Chemical Lists and are therefore prohibited for use in Cradle to Cradle Certified products when present above the allowable thresholds.

Table 22 Rating Criteria for Organohalogens

Green	Yellow	Red
Chemical does not contain a carbon to halogen (fluorine, chlorine, bromine, or iodine) bond.	Not applicable	Chemical contains a carbon to halogen (fluorine, chlorine, bromine, or iodine) bond. The carbon-halogen bond must be present in the finished product (i.e., not hydrolyzed in the production/manufacturing process). This rating applies when a substance is present at > 100 ppm within a homogeneous material.

3.3.19 Toxic Metals

Definition

Antimony, arsenic, cadmium, chromium VI, cobalt, lead, mercury, nickel, thallium, tin (organotins only), radioactive elements, and vanadium are considered toxic metals in the Cradle to Cradle Certified methodology. In general, these metals have shown toxic effects regardless of the speciation of the metal, even if incorporated in an organo-metal structure.

Rating Criteria

If a substance has any of the toxic metals listed above in its molecular structure and that substance is present at a concentration of 100ppm or higher in a homogeneous material subject to review, the chemical receives a RED rating for this endpoint. If a substance does not have any of the toxic metals listed above in its molecular structure, or the substance is present below 100ppm in the homogeneous material subject to review, the substance receives a GREEN rating for this endpoint, as shown in Table 23.

Note that certain metals are on the Banned Chemical Lists and are therefore prohibited for use in Cradle to Cradle Certified products when present above the allowable thresholds. This threshold is 1000 ppm with the following exceptions for metals present in biological nutrients: Cadmium 2 ppm, lead 90 ppm, chromium 100 ppm, mercury 1 ppm, and arsenic 10 ppm. See the Cradle to Cradle Certified Product Standard version 3.1 for further information.

Table 23 Rating Criteria for Toxic Metals

Green	Yellow	Red
Chemical does not contain toxic metal compound (e.g. antimony, arsenic, cadmium, chromium VI, cobalt, lead, mercury, nickel, tin (organotins only), radioactive elements, and vanadium.	Not applicable	Chemical contains toxic metal compound (e.g. antimony, arsenic, cadmium, chromium VI, cobalt, lead, mercury, nickel, thallium, tin (organotins only), radioactive elements, and vanadium. This rating applies when a substance is present at > 100 ppm within a homogeneous material. (Note: If the material is a biological nutrient, certain toxic metals on the Banned List are prohibited for use in a certified product when present at < 100 ppm)

4 EXPOSURE ASSESSMENT & ASSIGNING RISK FLAGS

4.1 Exposure Assessment Methodology

Exposure assessments must be conducted according to the methods described in the Exposure Assessment Methodology. Please refer to the most recent version of the Exposure Assessment Methodology document for further detail and instructions beyond the high-level description below.

Exposure assessments are primarily undertaken when RED or GREY hazard ratings for one or more endpoints have been assigned. (Exposure assessment is optional in the case of a YELLOW or GREEN hazard rating).

For the exposure assessment, specific studies on the substance(s) in question are researched in the context of the material matrix in which the substance(s) is/are present, the function and location of these materials in the finished product, and the product's intended and likely unintended use and end-of-use scenarios. Additionally, exposure during manufacturing is considered based on the actual manufacturing conditions as observed during the site visit. Note that the exposure assessment conducted as part of Cradle to Cradle Certified Material Health Assessments is not an exposure assessment in the traditional sense, in that no attempt is made to quantify the magnitude, frequency, or duration of any potential exposure. Instead, the goal is to assess whether or not plausible avenues of exposure exist. Based on the precautionary principle, any amount of plausible exposure is deemed to be sufficient to rate a chemical as posing a risk due to identified, suspected, or unknown health hazards.

For each chemical that has been flagged with a RED or GREY hazard rating for one or more hazard endpoints, an exposure assessment is conducted. The high-level steps for completing an exposure assessment are described below. Please refer to the Exposure Assessment Methodology for full instructions.

1. The product's intended and likely unintended use and end–of-use scenarios are defined (see section 4.2 for the definition of intended and likely unintended use and end-of-use scenarios). Furthermore, the manufacturing scenario is observed during the site visit and included in the set of scenarios to be evaluated for step 2.
2. The potential for exposure to the chemical (as present in the material) via all pathways relevant to any of the flagged hazard endpoints is assessed. If exposure is not plausible at any level, in any of the defined scenarios, via any exposure pathway relevant to a specific endpoint with a RED or GREY hazard rating, the risk flag for that endpoint will be YELLOW.
3. The environmental fate of the chemical is assessed along with its potential for migrating out of the material(s) in which it is present.
    - For this chemical within the specific material matrix, have credible studies been conducted on:
        i. leaching potential?
        ii. offgassing?
        iii. physical migration?
    - If yes, are these studies relevant to and do they cover all conditions for the scenarios identified in step 1?
    - If yes, is there a preponderance of evidence suggesting that the chemical will remain bound within its material matrix, precluding plausible exposure via any pathway to humans or the environment for all scenarios identified in step 1?

      For example, certain plastic additives are considered reactive, i.e., they react with the other monomer(s) and become part of the polymer backbone and therefore are not free to migrate out of the finished resin. Much the same way, it has been shown that lead in cast aluminum is bound in the metal matrix and poses little to no risk.

    - If yes, for any endpoints with a RED or GREY hazard rating, the risk flag for that endpoint will be YELLOW.

After the exposure assessment has been completed for each chemical that had one or more RED or GREY hazard ratings, any endpoint that has not been assigned a YELLOW risk flag based on the exposure considerations above, is assigned a risk flag equal to it's hazard rating. This means that endpoints with a YELLOW hazard rating will generally receive a YELLOW risk flag (unless they can form hazardous reaction products, see Section 4.3, or an optional exposure assessment is conducted, see Section 4.4) and endpoints with a GREEN hazard rating will receive a GREEN risk flag (unless they can form hazardous reaction products, see Section 4.3). Endpoints with a RED hazard rating may receive a RED or YELLOW risk flag depending on the exposure assessment (as

described above). Similarly, endpoints with a GREY hazard rating may receive a GREY or YELLOW risk flag depending on the exposure assessment.

Note that if a chemical is of regulatory concern, the assessment may not be altered regardless of the exposure assessment, and the chemical will always have a risk flag equal to its hazard rating. For this purpose a chemical of regulatory concern is defined as any chemical currently restricted under REACH (Annex XVII), on the REACH candidate list for Substances of Very High Concern (SVHC), or on the POPs list of the Stockholm Convention. The regulatory thresholds and use conditions as indicated by REACH apply. An exposure assessment may be completed when these substances are used in non-regulated applications or below the indicated threshold. This set of lists is subject to change. The most current version of the lists or regulations referenced here is to be used at the time of the Material Health assessment is being conducted. The Exposure Assessment Methodology also notes several additional cases in which exposure assessments are either not necessary or are not allowed.

4.2 Intended and Likely Unintended Use and End-of-Use Scenarios

The intended and likely unintended end-of-use scenarios must cover the end-of-use fate of 80% or more of the products sold by the applicant. For example, if the assessor deems that incineration is not a likely unintended use scenario because the applicant has a well developed take-back program or only sells the product in regions with the appropriate recycling infrastructure in place, then it must be demonstrated that 80% or more of the products sold during the certification period can reasonably be assumed to arrive in one of the other end-of-use scenarios that are considered likely. Alternatively, all common end-of-use scenarios: recycling, composting, landfill, incineration, and uncontrolled burning (including backyard burning) must be considered likely end-of-use scenarios for the purpose of the exposure assessment, in which case the percentage of fates covered by the assessment does not need to be quantified.

To identify the intended and likely unintended use scenarios, the material health assessor must consult with the applicant to understand the full extent of a product's intended and likely unintended uses. For each chemical that has been flagged with a RED or GREY hazard rating for one or more hazard endpoints, the assessor must apply their professional judgment to establish whether, given the product scenarios and material context, exposure is plausible to humans via oral, dermal, or inhalation pathways or to the environment via volatile emissions, water, or other pathways. The scenarios must include all aspects of a product's reasonably foreseeable use and maintenance. The following additional guidelines apply to specific product groups and specific materials within products:

- For fabrics or parts of products composed thereof (e.g., upholstered furniture, rugs, apparel), washing in a machine or by hand across a range of temperatures must be considered.
- For solid, non-granular, non-powder homogenous materials that are not readily abraded during their intended use (i.e. not tires, or brake-pads, etc.), inhalation exposure to substances contained in the material may be deemed as non-plausible

- For any parts that can be disassembled with common household tools, disassembly and dermal contact to any materials thus accessible must be considered.
- For any kitchen ware or containers intended for use with food or beverages, exposure and possible leaching under a variety of solvents (water, vegetable oil, alcohol, etc.) and pH ranges (pH 3-10) must be considered, as must heating in the presence of liquids such as might occur on a stove, in an oven, dishwasher, microwave, or closed car, etc. where applicable.
- For products marketed towards infants, the possibility of oral exposure must be considered as a likely unintended use scenario in all cases.
- If hexavalent chromium is used in any plating processes, exposure is always assumed and the plated material will be X.
- For blowing agents used in the manufacture of foam, environmental and human exposure is also always assumed.
- For other blowing agents and chemicals subject to review regardless of the concentration in the finished product, if a chemical is known to volatize completely during manufacture, it is assumed to be present at less than 100 ppm in the final material or product.

4.3 Reaction Products

As part of the exposure assessment, it should be noted if peer-reviewed studies exist suggesting that reaction products of concern to human or environmental health can be produced from a chemical in any assessed material during any of the scenarios defined in step 1. Noted potential reaction products are then individually assessed as if they were part of the homogeneous material being assessed. The reaction product then receives a risk flag for each hazard endpoint and these risk flags are combined with those of the parent chemical. In combining the risk flags of a parent chemical with those of its reaction product(s), the most conservative risk flag (in the order RED, GREY, YELLOW, GREEN) among them is used for each endpoint. For example, a chemical may receive a RED risk flag for carcinogenicity if it is deemed to have the potential for carcinogenic reaction products in the product scenarios considered, even if the chemical itself is not carcinogenic and received a GREEN hazard rating for the endpoint (e.g., a non-hazardous azo-dye with the potential for forming aromatic amines, which are carcinogenic).

4.4 Optional Exposure Assessment for Endpoints with Yellow Hazard Ratings

An exposure assessment as described above may also be conducted for chemicals that do not have RED or GREY hazard ratings, but do have one or more YELLOW hazard ratings. To this end, the same three steps would be followed as described above for the chemicals with RED or GREY hazard ratings; however, if no plausible routes for exposure exist, the resulting risk flag would be GREEN rather than YELLOW. As described in Section 4, such an assessment helps to differentiate between a chemical that would merit a ‘b’ single chemical risk rating due to lack of exposure potential, but would otherwise receive a ‘c’ single chemical risk rating based on its hazard only.

This step is optional since there are no criteria in the standard that would differentiate between materials containing 'b' versus 'c' chemicals. However, certain manufacturers are striving to increase the number of 'b' chemicals in their products regardless of the requirements posed for certification. Additionally, when substituting for an 'x' chemical, a manufacturer may prefer a 'b' chemical over a 'c' chemical.

4.5 Combined Aquatic Toxicity Risk Flags

A 'combined Aquatic Toxicity risk flag' is derived for each chemical based on the worst of its three Aquatic Toxicity risk flags (for Fish Toxicity, Daphnia Toxicity, and Algae Toxicity), as well as its Persistence and Bioaccumulation hazard ratings. Table 24 illustrates how the worst Aquatic Toxicity risk flag (among all six flags in the order RED, GREY, YELLOW, GREEN with RED being worse than GREY), the Persistence hazard rating, and the Bioaccumulation hazard rating work together to generate a single combined Aquatic Toxicity risk flag. A chemical's combined Aquatic Toxicity risk flag corresponds to the bold value in the fourth column of the table within the row that contains the chemical's unique combination of ratings for worst Aquatic Toxicity risk flag (column 1), Persistence hazard rating (column 2), and Bioaccumulation hazard rating (column 3). Note that the Aquatic Toxicity risk ratings along with the hazard ratings for Bioaccumulation and Persistence factor into a chemical's single chemical risk rating through the combined Aquatic Toxicity risk flag, thus reducing the number of discrete endpoints used in deriving the single chemical risk rating from 21 to 17.

The rules that define the combined Aquatic Toxicity risk flag are as follows. Table 24 shows all possible combinations and the resulting combined Aquatic Toxicity risk flags based on these rules:

1. If the worst Aquatic Toxicity risk flag is RED, then the combined Aquatic Toxicity risk flag is RED with the following exception:
    a. If Persistence and Bioaccumulation (P&B) are both GREEN, then the combined flag is YELLOW
2. If the worst Aquatic Toxicity risk flag is GREY, then the combined Aquatic Toxicity risk flag is GREY with the following exceptions:
    a. If P&B are both RED, then the combined flag is RED
    b. If P&B are both GREEN, then the combined flag is YELLOW
3. If the worst Aquatic Toxicity risk flag is YELLOW, then the combined Aquatic Toxicity risk flag is YELLOW with the following exceptions:
    a. If P&B are both RED, then the combined flag is RED
    b. If P&B are both GREY, or if one is RED and the other is GREY, then the combined flag is GREY
    c. If P&B are both GREEN, then the combined flag is GREEN
4. If the worst Aquatic Toxicity risk flag is GREEN, then the combined Aquatic Toxicity risk flag is GREEN with the following exception:
    a. If P&B are RED and/or GREY, then the combined flag is YELLOW

Table 24 Matrix for the derivation of combined Aquatic Toxicity risk flags

Worst Aquatic Toxicity Risk Flag	Persistence Hazard Rating	Bioaccumulation Hazard Rating	Combined Aquatic Toxicity Risk Flag
RED	not GREEN*	ANY	**RED**
RED	GREEN	not GREEN*	**RED**
GREY OR YELLOW	RED	RED	**RED**
GREY	RED	not RED	**GREY**
GREY	not RED**	RED	**GREY**
GREY	GREY OR YELLOW	ANY	**GREY**
GREY	ANY	GREY OR YELLOW	**GREY**
RED OR GREY	GREEN	GREEN	**YELLOW**
YELLOW	GREY	GREY OR RED	**GREY**
YELLOW	GREY OR RED	GREY	**GREY**
YELLOW	not GREEN*	GREEN OR YELLOW	**YELLOW**
YELLOW	GREEN OR YELLOW	not GREEN*	**YELLOW**
YELLOW	GREEN	GREEN	**GREEN**
GREEN	RED OR GREY	RED OR GREY	**YELLOW**
GREEN	GREEN OR YELLOW	ANY	**GREEN**
GREEN	ANY	GREEN OR YELLOW	**GREEN**

*not GREEN = Endpoint may be assigned any hazard rating other than GREEN.
**not RED = Endpoint may be assigned any hazard rating other than RED.

5 ASSIGNING SINGLE CHEMICAL RISK RATINGS

A single chemical risk rating of a, b, c, x, or GREY is assigned to each chemical substance subject to review in a homogeneous material based on the chemical's risk flags. The single chemical risk assessment rating system is shown in Table 25.

Table 25 Single Chemical Risk Assessment Rating System

a	No moderate or significant hazards identified for the chemical. This chemical is ideal from a human and environmental health perspective.
b	No moderate or significant risks identified for the chemical
c	One or more moderate risks identified for the chemical
x	One or more significant risks identified for the chemical

Single chemical risk ratings are assigned using the following hierarchy of rules:

1. If the chemical has received a RED risk flag in any of the 17 endpoints resulting from the risk assessment (see Section 4 regarding the combined Aquatic Toxicity risk flag), the single chemical risk rating is 'x' and steps 2-5 below do not apply.
2. Otherwise, if the chemical has received a GREY risk flag for any endpoint other than Carcinogenicity, Endocrine Disruption, Neurotoxicity, or Terrestrial Toxicity, the single chemical risk rating is 'GREY' and steps 3-5 below do not apply.
3. Otherwise, if the chemical has received any YELLOW risk flags or any GREY risk flags for Carcinogenicity, Endocrine Disruption, Neurotoxicity, or Terrestrial Toxicity, the single chemical risk rating is 'c' and step 4 and 5 below do not apply.
4. Otherwise, if the chemical has received any YELLOW hazard ratings, the single chemical risk rating is 'b' and step 5 below does not apply (the chemical has received only 'GREEN' risk flags, but one or more YELLOW hazard rating).
5. Otherwise, the single chemical risk rating is 'a' (the chemical has received only 'GREEN' hazard ratings).

While single chemical risk ratings are assigned to individual chemicals, these ratings apply only in the context of the material and product for which they were assigned (see Section 4). They are not transferable to other materials or products.

6 ASSIGNING MATERIAL ASSESSMENT RATINGS

The material assessment rating for a homogeneous material equals the "worst" single chemical risk rating among the chemical substances subject to review within the material. The rules are as follows:

1. If any substances subject to review within the material have received a single chemical risk rating of 'x', the assessment rating for the material is 'X' and steps 2-4 do not apply.
2. Otherwise, if any substances subject to review within the material have received a single chemical risk rating of GREY, the assessment rating for the material is GREY and steps 3 and 4 do not apply.
3. Otherwise, if any substances subject to review within the material have received a single chemical risk rating of 'c', the assessment rating for the material is 'C' and step 4 and 5 do not apply.
4. Otherwise, if any substances subject to review within the material have received a single chemical risk rating of 'b', the assessment rating for the material is 'B' and step 5 does not apply.
5. Otherwise, the material assessment rating is 'A' (the material contains only substances without known, suspected, or undefined hazards in any of the evaluated endpoints).

Table 26 Material Assessment Ratings

A	No moderate or significant hazards identified for the material. The material is ideal from a human and environmental health perspective.
B	No moderate or significant risks identified for the material.
C	One or more moderate risks identified for the material. The material is still acceptable for use.
X	One or more significant risks identified for the material. The optimization of the product requires phasing out this substance or material.
GREY	This material cannot be fully assessed due to either lack of full material disclosure or lack of toxicity information for one or more substances.

7 GENERAL DATA AND INFORMATION SOURCES

1. Alchemy Compliance (no date). Structure–activity relationships, read across, and chemical grouping. Retrieved 11/9/2010. http://www.alchemycompliance.com/structure-activity-relationships-sar.html
2. American Conference of Governmental Industrial Hygienists. 2003 TLVs and BEIs, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH Worldwide 2003.
3. Bintein, S, Devillers J, Karcher W. Nonlinear dependence of fish bioconcentration on n-Octanol/water partition coffefficinets. SAR and QSAR in Env. Res. 1:29-39, 1993.
4. Boyd JA, Barrett JC. Genetic and Cellular Basis of Multistep Carcinogenesis. Pharmac. Ther., 46:469-486, 1990.
5. Cohrssen, John J., and Covello, Vincent. T. (1989) Risk Analysis: A Guide to Principles and Methods for Analyzing Health and Environmental Risks. The Council of Environmental Quality.
6. Colborn T, Dumanoski D, Myers JP. Our Stolen Future: Are We Threatening our Fertility, Intelligence and Survival: A Scientific Detective Story. New York: Plume, 1996.
7. European Chemicals Agency (ECHA), Guidance on the Application of the CLP Criteria, Version 4.1, June 2015, Section 3.1.3.3.4 and Example 8-9.
8. European Chemicals Agency (ECHA), Guidance on information requirements and chemical safety assessment Chapter R.8: Characterisation of dose [concentration]-response for human health, version 2.1, section R.8.4.2, ECHA, 2012.
9. Grandjean, P. and P.J. Landrigan. 2014. Neurobehavioural effects of developmental toxicity. Lancet Neurol. 13(3):330-338.
10. Grandjean P, Landrigan P. Developmental neurotoxicity of industrial chemicals. Lancet 368: 2167-2178, 2006.
11. Henschler D. Toxicity of chlorinated compounds: Effects of the introduction of chlorine in organic molecules. Angewandte Chemie International Edition (English), 33:1920-1935, 1994.
12. Intergovernmental Panel on Climate Change. Aviation and the Global Atmosphere (1999). J.E.Penner, D.H.Lister, D.J.Griggs, D.J.Dokken, M.McFarland (Eds.). Cambridge University Press, UK. pp 373.
13. International Joint Commission Science Advisory Board. 1989 Report. Windsor, ON: International Joint Commission, 1989.

14. Klaunig JE, Kamendulis LM. Chapter 8: Chemical Carcinogenesis in Casarett and Doull's Toxicology: Basic Principles of Poisons, 2008.

15. MAK List of Carcinogenic, Teratogenic, or Sensitizing Substances, Deutsche Forschungsgemeinschaft. 2000. List of MAK and BAT Values 2000: Maximum Concentrations and Biological Tolerance Values at the Workplace. Commission for the Investigation of Health Hazards if chemical Compounds in the Work Area. Report No. 36. Weinheim: Wiley-VCH.

16. McDonough W, Braungart M. Cradle to Cradle: Remaking the Way We Make Things. New York: North Point Press, 2002.

17. Norstrom RJ, Simon M, Muir DCG. Polychlorinated dibenzo-p-dioxins and dibenzofurans in marine mammals of the Canadian North. Environmental Pollution 66:1-19, 1990.

18. OECD Secretariat (May 2005). MANUAL FOR INVESTIGATION OF HPV CHEMICALS CHAPTER 3: DATA EVALUATION. Retrieved 11/9/2010. http://www.oecd.org/dataoecd/60/47/1947509.pdf.

19. Robbins D, Johnston R. The role of cognitive and occupational differentiation in scientific controversies. In: Collins HM, ed. Sociology of Scientific Knowledge: A Source Book. Bath: University of Bath Press, 1982: 219-238.

20. Schmieder, P. (Oct.2008). QSAR Overview. EPA, Office of Research and Development, National Health and Environmental Effect Research Lab, Mid-Continent Ecology Division, Duluth, MN. Retrieved 11/9/2010. http://www.epa.gov/pesticides/ppdc/testing/oct08/qsar-101.pdf.

21. Simonich SL, Hites RA. Global distribution of persistent organochlorine compounds. Science 269:1851-1854, 1995.

22. Smith C, Hotchkiss S. Allergic Contact Dermatitis: Chemical and Metabolic Mechanisms. London: Taylor and Francis, 2001.

23. Syracuse Research Corporation. Biodegradation Probability Program (BIOWIN). Syracuse. New York.

24. Tilson, HA. Neurotoxicology in the 1990s. Neurotoxcol Teratol 1990, 12:293-300.

25. United Nations (UN). 2013. Globally Harmonized System of Classification and Labeling of Chemicals (GHS). Fifth Revised Edition. ST/SG/AC/10/30/Rev.5. Available: http://www.unece.org/trans/danger/publi/ghs/ghs_rev05/05files_e.html

26. United Nations (UN). 2015. Globally Harmonized System of Classification and Labeling of Chemicals (GHS). Sixth Revised Edition. ST/SG/AC.10/30/Rev.6.

27. US EPA. Guidelines for Neurotoxicity Risk Assessment. Washington D.C., 1998

28. US EPA, Predictive Models and Tools for Assessing Chemicals under the Toxic Substances Control Act (TSCA), Download available at http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm

29. Weybridge. 1996. European Workshop on the impact of endocrine disrupters on human health and wildlife. 2-4 December 1996, Weybridge, UK. Report of Proceedings EUR 17549 Copenhagen, Denmark: European Commission DG XII, April 16, 1997). Available from: European Environment Agency, Kongens Nytorv 6, DK-1050 Copenhagen K, Denmark.

30. Willes, RF, Nestmann ER, Miller PA, Orr JC, Munro IC. Scientific principles for evaluating the potential for adverse effects from chlorinated organic chemicals in the environment. Regulatory Toxicology and Pharmacology 18: 313-356, 1993.

31. Yang RSH. Introduction to the toxicology of chemical mixtures. In: Yang RSH, ed. Toxicology of Chemical Mixtures. New York: Academic Press, 1994a: 1-10.

8 HAZARD DATA RESOURCES

8.1 Resources Referenced in Chemical Hazard Criteria Tables

The following resources are specifically referenced within the chemical hazard criteria tables:

1. International Agency for the Research on Cancer (IARC) – provides a list of classifications by CAS Registry Number order http://monographs.iarc.fr/ENG/Classification/index.php.
2. United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS) Revision 4, 2011 http://www.unece.org/trans/danger/publi/ghs/ghs_rev04/04files_e.html. Hazard categories and statements that have been developed based on the GHS are available on some MSDS and through other sources listed below.
3. United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS) Revision 6, 2015. United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS)
4. Maximum Workplace Concentrations (MAK) -- available for purchase from Wiley-VCH.
5. American Conference of Governmental & Industrial Hygienists (ACGIH) -- Total Limit Values (TLVs) for carcinogenicity may be available though the Hazardous Substances Databank http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB or for purchase from ACGIH.
6. Colborn List (of endocrine disruptors): http://www.ourstolenfuture.com/Basics/chemlist.htm.
7. EU Priority list of endocrine disruptors (download available here): http://ec.europa.eu/environment/endocrine/strategy/substances_en.htm#priority_list
8. California Proposition 65 List, Chemicals Known to the State to Cause Cancer or Reproductive Toxicity: http://oehha.ca.gov/prop65/prop65_list/newlist.html.
9. Grandjean, P. & Landrigan, P.L. Developmental neurotoxicity of industrial chemicals. The Lancet 368 (9553): 2167-2178, 2006.
10. Mundy List: http://www.epa.gov/ncct/toxcast/files/summit/48P%20Mundy%20TDAS.pdf.
11. International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH), Safety Guidelines http://www.ich.org/products/guidelines/safety/article/safety-guidelines.html.
12. Organisation for Economic Co-operation and Development (OECD), Guidelines for the Testing of Chemicals, http://www.oecd-ilibrary.org/content/package/chem_guide_pkg-en.
13. United Nations Economic Commission for Europe (UNICE), Part 3 Health Hazards, 2013. Available: http://www.unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev05/English/03e_part3.pdf

14. BIOWIN™ (and other QSAR models): available through the U.S. Environmental Protection Agency, Estimation Program Interface (EPI) Suite, http://www.epa.gov/oppt/exposure/pubs/episuite.htm.
15. Montreal Protocol, Ozone Depleting Substances; available through U.S. EPA http://www.epa.gov/ozone/science/ods/index.html.

8.2 Additional Chemical Hazard Profiling Resources

Additional useful chemical hazard profiling references for finding TLVs, LD50s, LC50s, LOAELs, NOAELs, half-lives, ready and inherent biodegradability test results, BCF and K_{ow} values, and other relevant data and information include:

1. European Chemical Substances Information System (ESIS) http://ecb.jrc.ec.europa.eu/esis/.
2. Australian Inventory of Chemical Substances (AICS): http://www.nicnas.gov.au/Industry/AICS/Search.asp.
3. National Toxicology Program (NTP) http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm.
4. U.S. Environmental Protection Agency (EPA), Ecotox (aquatic and terrestrial toxicity) http://cfpub.epa.gov/ecotox/.
5. U.S. Environmental Protection Agency, EPI Suite – Estimation Program Interface. https://www.epa.gov/tsca-screening-tools/download-epi-suitetm-estimation-program-interface-v411
6. U.S. Environmental Protection Agency, High Production Volume Information System (HPVIS) http://www.epa.gov/hpvis/.
7. U.S. Environmental Protection Agency, ACToR: http://actor.epa.gov/actor/faces/ACToRHome.jsp
8. Safe Work Australia, Hazardous Substance Information System http://hsis.ascc.gov.au/SearchHS.aspx.
9. Human and Environmental Risk Assessment on ingredients of household cleaning products (HERA project) http://www.heraproject.com/RiskAssessment.cfm.
10. International Programme on Chemical Safety (INCHEM) http://www.inchem.org/
11. MSDS online: http://www.msdsonline.com/ (available through purchase)
12. United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS) Revision 3, 2009 http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html.

8.3 Resources for Probable Routes of Human and Occupational Exposure

Information regarding probable routes of human exposure and occupational exposure concerns may be found in several of the resources listed above in the chemical hazard profiling section. The following will also be useful:

1. Hazardous Substances Data Bank: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.
2. NIOSH Pocket Guide to Occupational Hazards: http://www.cdc.gov/niosh/npg/.

9 APPENDIX - HAZARD ENDPOINT CRITERIA SUMMARY TABLE

Table 28 below lists the criteria for all human and environmental health hazard endpoints used for evaluation in the Cradle to Cradle Certified Product Standard.

Table 27 Summary of Hazard Criteria

ENDPOINT	Green	Yellow	Red	Grey
Carcinogenicity	Not classified as GHS category 1A, 1B, or 2. Not a known, presumed or suspected carcinogen. Negative long-term cancer studies. Listed as: TLV A5, IARC 4	Not classified as GHS category 1A, 1B, or 2. Limited, marginal, equivocal or conflicting evidence of carcinogenicity. Listed as: MAK III 3A, 4, 5	Classified as GHS category 1A, 1B, or 2. Known, presumed or suspected carcinogen. Listed as: MAK III 1, 2, 3B IARC Group 1, 2A, 2B TLV A1, A2, A3 GHS Category 1A, 1B, 2 H350: May cause cancer H351: Suspected of causing cancer	No data available for classification. Listed as: IARC Group 3 TLV A4

ENDPOINT	Green	Yellow	Red	Grey
Endocrine Disruption	Not known or suspected of endocrine disruption: Adequate data indicate neither endocrine activity nor adverse health effects that are linked to endocrine activity. *or* EU list category 3A	Insufficient evidence of endocrine disruption: Data provide evidence of endocrine activity without evidence of linked adverse health effects.	Sufficient evidence of endocrine disruption: Data indicate adverse health effects that are linked to endocrine activity. *or* Chemical appears on Colborn or EU list (Cat. 1 & 2).	No data available for classification. EU list category 3B
Mutagenicity	Not classified as GHS Category 1A, 1B, or 2. Substance does not induce aberrations of chromosomes OR substance does not induce chromosome segregation errors in *in vitro* systems. AND substance does not induce point mutations.	Not classified as GHS Category 1A, 1B, or 2. Insufficient data. Substance does not induce point mutations. Data lacking on chromosome aberration and segregation.	Classified as GHS Category 1A, 1B, or 2. or Evidence of mutagenicity supported by positive results *in vitro* or *in vivo* (see rating criteria guidance) *or* Listed as: MAK IX 1, 2, 3A, 3B, H340: May cause genetic defects H341: Suspected of causing genetic defects	No data available for classification.

ENDPOINT	Green	Yellow	Red	Grey
Reproductive & Developmental Toxicity	Not classified as GHS Category 1A, 1B, or 2. Exhibits no adverse effects to sexual function and fertility and/or to the development of an embryo or fetus based on human or animal studies. Oral NOAEL > 500 mg/kgBW/day. Inhalation NOAEL >2.5 mg/l 6-8 h/day.	Not classified as GHS Category 1A, 1B, or 2. Equivocal evidence of toxic effects to sexual function and fertility but considered a secondary non-specific consequence of other toxic effects present. *and/or* Equivocal evidence of adverse effects to the development of an embryo or fetus based on human or animal studies. Oral NOAEL =50-500 mg/kg BW/day. Inhalation NOAEL =0.25-2.5 mg/l 6-8 h/day. *or* Listed as: MAK C	Classified as GHS Category 1A, 1B, or 2. Known, presumed, or suspected of causing adverse effects to sexual function and fertility and/or to the development of an embryo or fetus based on human or animal studies. *and/or* Oral NOAEL < 50 mg/kg BW/day. Inhalation NOAEL <0.25 mg/l 6-8 h/day. *or* Listed as: MAK Group A or B H360: May damage fertility or the unborn child. H361: Suspected of damaging fertility or the unborn child.	No data available for classification. Listed as: MAK D

ENDPOINT	Green	Yellow	Red	Grey
Oral Toxicity	**Acute:** Not Classified as GHS Category 1, 2, 3 or 4. LD50 > 2000 mg/kg BW	**Acute:** Classified as GHS Category 4 *or* 300 < LD50 ≤ 2000 mg/kg BW Listed as: H302: Harmful if swallowed	**Acute:** Classified as GHS Category 1,2, or 3 *or* LD50 ≤ 300 mg/kg BW Listed as: H300a/b: Fatal if swallowed H301 Toxic if swallowed H304: May be fatal if swallowed and enters airways	No relevant data available for classification.
	Single exposure organ toxicity: Not Classified. LOAEL > 2000 mg/kg BW	**Single exposure organ toxicity:** Classified as GHS Category 2 or 3 300 < LOAEL ≤ 2000 mg/kg BW Listed as: H371: May cause damage to organs via oral exposure	**Single exposure organ toxicity:** Classified as GHS Category 1 *or* LOAEL ≤ 300 mg/kg BW Listed as: H370: Causes damage to organs via oral exposure	
	Sub – Chronic/Chronic: Not Classified. LOAEL > 100 mg/kg bw/day	**Sub – Chronic/Chronic:** Classified as GHS Category 2 10 < LOAEL ≤100 mg/kg bw/day Listed as: H373: May cause damage to (organs) through prolonged or repeated dermal exposure	**Sub – Chronic/Chronic**: Classified as GHS Category 1 *or* LOAEL ≤ 10 mg/kg bw/day Listed as: H372: Causes damage to (organs) through prolonged or repeated oral exposure	

ENDPOINT	Green	Yellow	Red	Grey
Dermal Toxicity	**Acute:** Not Classified as GHS Category 1, 2, 3, or 4. LD50 > 2000 mg/kg BW **Single exposure organ toxicity:** Not Classified. LOAEL > 2000 mg/kg BW **Sub – Chronic/Chronic:** Not Classified. LOAEL > 200 mg/kg bw/day	**Acute:** Classified as GHS Category 4 *or* 1000 < LD50 ≤ 2000 mg/kg BW Listed as: H312: Harmful in contact with skin **Single exposure organ toxicity:** Classified as GHS Category 2 or 3 *or* 1000 < LOAEL ≤ 2000 mg/kg BW Listed as: H371: May cause damage to organs via dermal exposure **Sub – Chronic/Chronic:** Classified as GHS Category 2 *or* 20 < LOAEL ≤ 200 mg/kg bw/day Listed as: H373: May cause damage to (organs) through prolonged or repeated dermal exposure	**Acute:** Classified as GHS Category 1,2, or 3 or LD50 ≤ 1000 mg/kg BW Listed as: H310a/b: Fatal in contact with skin H311: Toxic in contact with skin **Single exposure organ toxicity:** Classified as GHS Category 1 *or* LOAEL ≤ 1000 mg/kg BW Listed as: H370: Causes damage to organs via dermal exposure **Sub – Chronic/Chronic:** Classified as GHS Category 1 *or* LOAEL ≤ 20 mg/kg bw/day Listed as: H372: Causes damage to (organs) through prolonged or repeated dermal exposure	No relevant data available for classification.

ENDPOINT	Green	Yellow	Red	Grey
Inhalation Toxicity	**Acute:** Not Classified as GHS Category 1,2,3 or 4. Inhalation (gas) LC50 > 20000 ppmV Inhalation (vapor) LC50 > 20 mg/l/4hr Inhalation (dust/mist) LC50 > 5 mg/l/4hr **Single exposure organ toxicity:** Not Classified. LOAEL (gasses) > 20000 ppmV/4hr LOAEL (vapor) > 20 mg/L/4hr LOAEL (mists/dusts) > 5.0 mg/L/4hr	**Acute:** Classified as GHS Category 4 *or* Inhalation (gas) 2500 < LC50 ≤ 20000 ppmV Inhalation (vapor) 10 < LC50 ≤ 20 mg/l/4hr Inhalation (dust/mist) 1.0 < LC50 ≤ 5 mg/l/4hr Listed as: H332: Harmful if inhaled **Single exposure organ toxicity:** Classified as GHS Category 2 or 3 *or* 2500 < LOAEL (gasses) ≤ 20000 ppmV/4hr 10 < LOAEL (vapor) ≤ 20 mg/L/4hr 1.0 < LOAEL (mists/dusts) ≤ 5.0 mg/L/4hr Listed as: H371: May cause damage to organs via inhalation exposure H336: May cause drowsiness or dizziness	**Acute:** Classified as GHS Category 1,2 or 3 *or* Inhalation (gas) LC50 ≤ 2500 ppmV Inhalation (vapor) LC50 ≤ 10 mg/l/4hr Inhalation (dust/mist) LC50 ≤ 1 mg/l/4hr Listed as: H330a/b: Fatal if inhaled H331: Toxic if inhaled **Single exposure organ toxicity:** Classified as GHS Category 1 *or* LOAEL (gasses) ≤ 2500 ppmV/4hr LOAEL (vapor) ≤ 10 mg/L/4hr LOAEL (mists/dusts) ≤ 1.0 mg/L/4hr Listed as: H370: Causes damage to organs via inhalation exposure	No relevant data available for classification.

ENDPOINT	Green	Yellow	Red	Grey
Inhalation Toxicity (cont.)	**Sub – Chronic/Chronic:** Not Classified. Inhalation (Gases) LOAEL > 250 ppmV/6h/d Inhalation (Vapors) LOAEL > 1.0 mg/L/6h/d Inhalation (Dusts & Mists) LOAEL > 0.2 mg/L/6h/d	**Sub – Chronic/Chronic:** Classified as GHS Category 2 *or* Inhalation (Gases) 50 < LOAEL ≤ 250 ppmV/6h/d Inhalation (Vapors) 0.2 < LOAEL ≤ 1.0 mg/L/6h/d Inhalation (Dusts & Mists) 0.02 < LOAEL ≤ 0.2 mg/L/6h/d Listed as; H373: May cause damage to (organs) through prolonged or repeated inhalation	**Sub – Chronic/Chronic:** Classified as GHS Category 1 *or* Inhalation (Gases) LOAEL ≤ 50 ppmV/6h/d Inhalation (Vapors) LOAEL ≤ 0.2 mg/L/6h/d Inhalation (Dusts & Mists) LOAEL ≤ 0.02 mg/L/6h/d Listed as: H372: Causes damage to (organs) through prolonged or repeated inhalation	
Neurotoxicity	Refer to Oral, Dermal and Inhalation Toxicity Single Exposure Organ, Sub-Chronic, and Chronic Toxicity criteria for Green Rating.	Refer to Oral, Dermal and Inhalation Toxicity Single Exposure Organ, Sub-Chronic, and Chronic Toxicity criteria for Yellow Rating.	Refer to Oral, Dermal and Inhalation Single Exposure Organ, Sub-Chronic, and Chronic Toxicity criteria for Red Rating. *or* Listed in Grandjean et al. text for neurotoxic effects.	No relevant data available for classification.

ENDPOINT	Green	Yellow	Red	Grey
Skin, Eye, and Respiratory Corrosion/ Irritation	Not Classified as GHS Category 1, 2, or 3. No irritation to skin, eyes, or respiratory tract in relevant human or animal studies.	Classified as GHS Category 2 or 3 for Skin Corrosion/Irritation and/or Category 2 for Eye Damage/Irritation. Mild to severe irritation to skin, eyes, or respiratory tract in relevant human or animal studies; *or* Listed as: H315: Causes skin irritation H319: Causes serious eye irritation H320: Causes eye irritation H335: May cause respiratory tract irritation	Classified as GHS Category 1 for Skin Corrosion/Irritation or Eye Damage/Irritation. Causes burns, corrosion, or serious damage to skin, eyes, or the respiratory tract* in relevant human or animals studies; *or* pH ≤ 2 or pH ≥ 11.5 *or* Listed as: H314: Causes severe skin burns and eye damage H318: Causes serious eye damage	No relevant data available for classification.

ENDPOINT	Green	Yellow	Red	Grey
Sensitization of Skin and Airways	Not classified as GHS Category 1A or 1B. Adequate data available. No evidence of sensitization in human and/ or animal studies. *or* No data from human or animal studies are available; however, the substance is not classified under GHS, not listed as H334/317 or MAK, and there is a history of safe use (10 years or more) without reported cases of sensitization, as documented by a signed statement from the substance manufacturer.	Not classified as GHS Category 1A or 1B. Non-adjuvant animal studies elicit a response 15% > population > 0%. Adjuvant animal studies elicit a response of 30% > population > 0%. *or* 1< LLNA SI < 3	Classified as GHS Category 1A or 1B for Sensitization (respiratory and skin): *or* *LLNA SI >=3* *or* Listed as: GHS Category 1A or 1B for Sensitization (respiratory and/or skin) MAK skin or airways sensitizer (MAK Sa or Sh). H334: May cause allergy or asthma symptoms or breathing difficulties in inhaled. H317: May cause an allergic skin reaction.	No relevant data for classification.

ENDPOINT	Green	Yellow	Red	Grey
Fish Toxicity	Not Classified as GHS Category 1, 2, or 3. 96 hour LC50 > 100 mg/L QSAR 96 hour LC50 > 100 mg/L	**Acute** Classified as GHS Category 3 or 10 < 96 hour LC50 ≤ 100 mg/L or 10 < QSAR 96 hour LC50 ≤ 100 mg/L AND **Chronic** 1 < NOEC ≤ 10 mg/L for chronic toxicity based on experimental or modeled results	**Acute** Classified as GHS Category 1 or 2 or 96 hour LC50 ≤ 10 mg/L or QSAR 96 hour LC50 ≤ 10 mg/L Listed as: H400: Very toxic to aquatic life OR **Chronic:** Classified as GHS Category 1,2, or 3 *or* NOEC ≤ 1 mg/L for chronic toxicity based on experimental or modeled results Listed as: H410: Very toxic to aquatic life with long lasting effects H411: Toxic to aquatic life with long lasting effects H412: Harmful to aquatic life with long lasting effects H413: may cause long lasting harmful effects to aquatic life	No relevant data for classification.

ENDPOINT	Green	Yellow	Red	Grey
Daphnia Toxicity	Not Classified as GHS Category 1, 2, or 3. 48 hour L(E)C50 > 100 mg/L QSAR 48 hour L(E)C50 > 100 mg/L	**Acute** Classified as GHS Category 3 *or* 10 < 48 hour L(E)C50 10 ≤ 100 mg/L 10 < QSAR 96 hour L(E)C50 ≤ 100 mg/L AND **Chronic** 1 < NOEC ≤ 10 mg/L for chronic toxicity based on experimental or modeled results	**Acute** Classified as GHS Category 1 or 2 *or* 48 hour L(E)C50 ≤ 10 mg/L QSAR 48 hour L(E)C50 ≤ 10 mg/L OR **Chronic** Classified as GHS Category 1,2 or 3 or NOEC ≤ 1 mg/L for chronic toxicity based on experimental or modeled results Listed as: H400: Very toxic to aquatic life H410: Very toxic to aquatic life with long lasting effects H411: Toxic to aquatic life with long lasting effects H412: Harmful to aquatic life with long lasting effects H413: may cause long lasting harmful effects to aquatic life	No relevant data for classification.

ENDPOINT	Green	Yellow	Red	Grey
Algae Toxicity	Not Classified as GHS Category 1, 2, or 3. 72/ 96 hour L(E)C50 > 100 mg/L QSAR 72/ 96 hour L(E)C50 > 100 mg/L	**Acute:** Classified as GHS Category 3 *or* 10 < 72/ 96 hour L(E)C50 ≤ 100 mg/L 10 < QSAR 72/ 96 hour L(E)C50 ≤ 100 mg/L AND **Chronic:** 1 < NOEC ≤ 10 mg/L for chronic toxicity based on experimental or modeled results	**Acute:** Classified as GHS Category 1 or 2 *or* 72/ 96 hour L(E)C50 < 10 mg/L QSAR 96 hour L(E)C50 < 10 mg/L OR **Chronic;** Classified as GHS Category 1,2, or 3. NOEC ≤ 1 mg/L for chronic toxicity based on experimental or modeled results Listed as; H400: Very toxic to aquatic life H410: Very toxic to aquatic life with long lasting effects H411: Toxic to aquatic life with long lasting effects H412: Harmful to aquatic life with long lasting effects H413: may cause long lasting harmful effects to aquatic life	No relevant data for classification.
Terrestrial Toxicity: Birds (Sub-acute)	Chicken LD50 > 9000 mg/kg fodder (5 days) Duck LD50 > 15000 mg/kg fodder (5 days)	Chicken LD50 900 - 9000 mg/kg fodder (5 days) Duck LD50 1500 - 15000 mg/kg fodder (5 days)	Chicken LD50 < 900 mg/kg fodder (5 days) Duck LD50 < 1500 mg/kg fodder (5 days)	No relevant data for classification.

ENDPOINT	Green	Yellow	Red	Grey
Terrestrial Toxicity: Birds (Sub-chronic/ Chronic)	Chicken NOEC > 3000 mg/kg fodder (≥ 20 weeks) Duck NOEC > 5000 mg/kg fodder (≥ 20 weeks)	Chicken NOEC 300 - 3000 mg/kg fodder (≥ 20 weeks) Duck NOEC 500 - 5000 mg/kg fodder (≥ 20 weeks)	Chicken NOEC < 300 mg/kg fodder (≥ 20 weeks) Duck NOEC < 500 mg/kg fodder (≥ 20 weeks)	No relevant data for classification.
Terrestrial Toxicity: Toxicity for Soil Organisms (Acute)	EC50 > 1000 mg/kg dry soil	EC50 100 - 1000 mg/kg dry soil	EC50 < 100 mg/kg dry soil	No relevant data for classification.
Terrestrial Toxicity: Toxicity for Soil Organisms (Sub-chronic/ Chronic)	NOEC > 100 mg/kg dry soil	NOEC 10 - 100 mg/kg dry soil	NOEC < 10 mg/kg dry soil	No relevant data for classification.
Persistence	$T_{1/2} \leq$ 30/90 days in water/ soil or sediment; Readily biodegradable (≥70 % DOC removal or ≥ 60 % ThOD removal within 28 days) based on OECD guidelines (301); Predicted to be readily biodegradable by QSAR results	30/90 day < $T_{1/2} \leq$ 60/180 days in water/ soil or sediment; 10% ≤ DOC removal < 70% based on OECD guidelines (301) 10% ≤ ThOD removal < 60% based on OECD guidelines (301) Inherently (ultimate) biodegradable based on OECD guidelines (302, 304A) (≥70 % DOC removal) Predicted to be degradable within weeks to months by QSAR	T1/2 > 60/180 days in water/ soil or sediment DOC and ThOD removal < 10% based on OECD 301 guidelines < 70 % DOC removal under OECD 302 or 304A testing. Predicted to be recalcitrant by QSAR results.	No relevant data for classification or substance is considered inorganic and not applicable to this endpoint.

ENDPOINT	Green	Yellow	Red	Grey
Bioaccumulation	BCF/BAF ≤ 100 by experimental results for any log K_{ow}, or by QSAR results if log K_{ow} < 6* *or* log K_{ow} < 2 *or* Molecular weight > 1000 g/mole	100 < BCF/BAF < 500 by experimental results for any log K_{ow}, or by QSAR results if log K_{ow} < 6*.	BCF ≥ 500 by experimental results for any log K_{ow}, or by QSAR results if log K_{ow} < 6*. BAF ≥ 500 by experimental results for any log K_{ow}, or by Arnot/Gobas QSAR results if log K_{ow} < 8.	No relevant data for classification. log K_{ow} >2 and no additional information.
Climatic Relevance	Not listed as a known greenhouse gas in IPCC Third Assessment Report, an EPA ozone depleting substance substitute with global warming potential, and/or in Annexes to the Montreal Protocol.	Not applicable.	Listed as known a greenhouse gas in IPCC Third Assessment Report, an EPA ozone depleting substance substitute with global warming potential, and/or in Annexes to the Montreal Protocol. GHS Category 1.	Not applicable.
Organohalogens	Chemical does not contain a carbon to halogen (fluorine, chlorine, bromine, or iodine) bond. This rating applies when a substance is present at ≥ 100 ppm within a homogeneous material.	Not applicable (i.e. substance is present at <100 ppm within a homogeneous material).	Chemical contains a carbon to halogen (fluorine, chlorine, bromine, or iodine) bond. The carbon-halogen bond must be present in the finished product (i.e., not hydrolyzed in the production/manufacturing process). This rating applies when a substance is present at ≥ 100 ppm within a homogeneous material.	Not applicable.

ENDPOINT	Green	Yellow	Red	Grey
Toxic Metals	Chemical does not contain toxic metal compound (e.g. antimony, arsenic, cadmium, chromium VI, cobalt, lead, mercury, nickel, tin (organotins only), radioactive elements, and vanadium. This rating applies when a substance is present at ≥ 100 ppm within a homogeneous material.	Not applicable (i.e. substance is present at <100 ppm within a homogeneous material).	Chemical contains toxic metal compound (e.g. antimony, arsenic, cadmium, chromium VI, cobalt, lead, mercury, nickel, thallium, tin (organotins only), radioactive elements, and vanadium. This rating applies when a substance is present at ≥ 100 ppm within a homogeneous material.	Not applicable.

Recycled Content Materials Assessment Methodology

Revised August 2020

COPYRIGHT

TRADEMARK

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

REVISION LOG

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
May 2017	All	Information outlining the assessment of recycled content in the *Cradle to Cradle Certified Product Standard Version 3.0*, and the *Cradle to Cradle Certified Product Standard Material Health Assessment Methodology, Version 3.0*, both dated November 4, 2013, has been clarified and merged into this document so that all relevant information related to assigning material assessment ratings to these types of materials is located in one supplemental document. Note that the section numbers between the v3.0 document and this document do not correspond. Section numbers listed to the left within the SECTIONS column of this table are for this document.	S. Klosterhaus
May 2017	2.3 Recycled Content Types	Added clarification that Type 4 recycled content may only be certified up through the Bronze level.	S. Klosterhaus
August 2020	All	The *Recycled Content Assessment Methodology* document last revised in May 2017 has been superseded by the document revised in August 2020. A summary of the changes made as part of this revision are listed below (i.e. the changes with a revision date of August 2020).	S. Klosterhaus
August 2020	2. Assessment of Recycled Content	The four types of recycled content materials ("Type 1-4") are no longer defined or referred to.	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
August 2020	2. Assessment of Recycled Content	The recycled content materials that may be assessed via the standard Material Health Assessment Methodology are the same except for the following, which must now be assessed via the new process described: ● "Type 3" post-consumer materials (i.e. material from a clean narrow stream of one material type), and ● Treated post-consumer paper (i.e. paper made with recycled paper inputs)	S. Klosterhaus
August 2020	2. Assessment of Recycled Content	Analytical testing requirements for the entry-level of certification (i.e. Basic in v3.1 or Bronze in the second draft of v4) and the Silver level are newly defined for several commonly recycled material types. The testing requirements are based on the Cradle to Cradle Certified Restricted Substances List (RSL) which is primarily based on REACH Annex XVII and XIV (the Restriction and Authorisation lists) and the REACH Candidate List of Substances of Very High Concern for Authorisation.	S. Klosterhaus
August 2020	2. Assessment of Recycled Content	Approaches for reducing the amount of testing that must be done at the Silver level are described, and a process for defining testing requirements for additional recycled content material types is provided.	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
August 2020	2. Assessment of Recycled Content	**ABC-X assessment ratings are no longer defined or used for recycled materials unless the materials can be fully defined and assessed using the standard Material Health Assessment Methodology**. Instead, the new methodology described herein defines the minimum requirements that have to be met for recycled content materials for each of the Material Health achievement levels. The allowable achievement level must be indicated instead of an ABC-X rating. Recycled content materials meeting the requirements at a given level may then count as assessed on their own or within another product certified at that level.	S. Klosterhaus

1 OVERVIEW

1.1 Purpose and Content

This document describes the methodology used to assess recycled content materials for the purposes of Cradle to Cradle certification. Due to the often variable and unknown composition of these materials, analytical testing is required. Recycled content materials in products being assessed for Cradle to Cradle certification are therefore assessed following this customized methodology, rather than the general Material Health Assessment Methodology alone.

This methodology is required to be used for the assessment of recycled content materials in products certifying against Version 4.0 (and subsequent versions) of the Cradle to Cradle Certified™ Product Standard, including drafts of Version 4.0 as part of the Version 4.0 Pilot Program.

1.2 Supporting Documents

The following documents are to be used in conjunction with this document:

- Cradle to Cradle Certified™ Product Standard, Version 4.0 (draft and final versions)
- Cradle to Cradle Certified™ Product Standard, Version 3.1 (optional)
- Cradle to Cradle Certified™ Material Health Assessment Methodology and Exposure Assessment Methodology
- Any additional supporting documents and guidance posted on the Cradle to Cradle Products Innovation Institute (C2CPII) website

Visit the C2CPII website (c2ccertified.org) to download the standard documents and obtain the most current information regarding the product Standard.

2 ASSESSMENT OF RECYCLED CONTENT MATERIALS

2.1 Scope

This methodology applies to all recycled content materials from post-consumer and post-industrial sources, with several exceptions. The exceptions are for the following materials, which

may be fully defined and therefore are to be assessed via the general Material Health Assessment Methodology:

- Metals of known alloy grade,
- Glass for which elemental analysis has been carried out[1],
- Chemically recycled polymers,
- Other post-industrial or post-consumer recycled materials that can be traced back to the original manufacturer(s)/formulator(s), for which the trade name is known and full material disclosure has been obtained.

For chemically recycled polymers and recycled materials that can be traced back to the original manufacturers (third and fourth bullet points above), the relevant manufacturer(s) must provide a description of the collection and recycling process, including controls on contamination that are in place. The assessor is responsible for ensuring that the material is not at risk of being contaminated and/or that it is cleaned to remove possible contaminants if it is to be assessed per the general Material Health Assessment Methodology. If contamination is a concern, for example if post-industrial material is mixed with other items on the manufacturing floor and then swept up to be mechanically recycled, use of the general Material Health Assessment Methodology alone is not permitted. Note that it is rarely possible to assess post-consumer recycled materials from mixed or multiple sources per the general Material Health Assessment Methodology.

2.2 Requirements for Recycled Content Materials by Achievement Level

Table 1 below provides an overview of the requirements for recycled content materials at each achievement level. See Sections 2.3-2.6 for additional details.

Materials meeting these requirements may be certified, or count as assessed when used in certified products, at the level indicated. Basic level requirements must be met in all cases, even when the material will not count as assessed. At higher achievement levels, all lower level requirements must also be met in order for the recycled content material to count as assessed.

Table 1 - Minimum requirements for recycled content materials by achievement level

Level	Minimum Requirements
Basic (Also applicable to second draft v4 Bronze	● RSL compliance for intentionally used substances and known contaminants[2] is verified via RSL attestations signed by the material supplier(s). ● Compliance with restrictions on toxic elements as indicated in the RSL is verified via analytical testing. (Note: Testing for an expanded list of elements is required for biological nutrient (BN) materials).

viiiviii

[1] Does not apply to mixed crushed glass. The glass must be reprocessed and uniform in nature.

[2] Note: "Intentionally used substances and known contaminants" are defined in Section 2.5, Assessment of Intentionally Used Substances and Known Contaminants.

level and above)	● Compliance with the organohalogen restriction is verified via analytical testing.
Bronze	● If the material is to count as assessed at the Bronze level, all intentionally used substances and known contaminants, including residual monomers and catalysts of the recycled content in the case of polymers, have been identified by chemical name and CASRN and assessed using the general Material Health Assessment Methodology.
Silver	● Compliance with the RSL is verified via analytical testing (as relevant to the material type) and full material disclosure of all intentionally used substances and known contaminants. ● Analytical testing for substances on the Candidate List of Substances of Very High Concern (SVHC) for Authorisation has been conducted (as relevant to the material type). ● The material does not contain chemicals classified or listed as carcinogenic, mutagenic, or reproductive toxicants (CMRs) or of equivalent concern, or, if these substances are present, exposure to them is unlikely or expected to be negligible. In addition, the product does not contain persistent, bioaccumulative, and toxic (PBTs) or very persistent and very bioaccumulative (vPvBs) substances. CMRs, PBT/vPvBs, and substances of equivalent concern are as defined in the draft version 4 standard Section 4.5, and compliance must be verified via analytical testing and/or full material disclosure of intentionally used substances and known contaminants. Notes: ● If the material will not count as assessed, there are no additional requirements at the Silver level beyond those listed for the Basic level. ● Depending on the product type, the Silver level VOC requirements must have been met for the entire product when applying at the Silver level (see Sections 4.9 and 4.10 of the draft Cradle to Cradle Certified Product Standard, Version 4 for details). ● For substances listed on the SVHC Candidate List for Authorisation that are not PBTs or vPvBs and not on Annex XIV (and so also not on the RSL), an exposure assessment may be conducted regardless of the concentration in the material. For most substances listed on the RSL, an exposure assessment is allowed when the concentration in the material is below the maximum allowable concentration indicated in the RSL. See the Cradle to Cradle Certified Exposure Assessment Methodology for further information.
Gold & Platinum	● All intentionally used substances and known contaminants subject to review in the material (including those identified through analytical testing) are a, b, or c assessed.

	• Recycled material used for food contact applications or in toys or other children's products (when available for mouthing to occur) must be food grade per the regulations relevant to where the product is sold[3] and meet all other requirements (regardless of the certification level for the product overall).

2.3 Analytical Testing Requirements

2.3.1 Analytes and Maximum Allowable Concentrations by Material Type

For all recycled content materials that cannot be defined and assessed per the general Material Health Assessment Methodology, the following are required:

- For all achievement levels:
    - Analytical testing for the toxic metals and metalloids listed on the RSL core list is required for all material types. Additional elements included on the RSL biological nutrient (BN) supplementary list must be tested for in BN recycled content materials (this is required for any metals, metalloids with a maximum allowable concentration ≤1000 ppm, and also for selenium). The maximum allowable concentrations indicated on the RSL apply.
    - In addition, analytical testing is required to ensure compliance with the organohalogen restriction for all non-exempt recycled materials except glass and metals (see Section 4.4 of the draft Cradle to Cradle Certified Product Standard, Version 4 for additional exemptions to the organohalogen restriction).

- For the Silver level and above:
    - Analytical testing for additional substances on the RSL and the REACH Candidate List of Substances of Very High Concern for Authorisation is required. Substances to be tested vary by material type because certain material types are very unlikely to contain some of the listed substances. Analytes that must be tested have been predefined for several common recycled material types including: Metals (alloy/grade unknown), glass (without full elemental analysis), paper, polymers, wood (mixed waste and clean), and textiles. ***The current draft list of analytes is provided to assessors upon request and will be published on the***

xx

[3] Food contact regulations that are pre-approved for the purposes of this requirement are those that are in place in the EU, UK, US and Japan. If applying to use recycled content material that is approved for food contact in other countries, the regulations relevant to that country must be reviewed by the assessor to ensure that they are equivalent to one or more of those that are pre-approved. If these regulations are found to be less stringent, or there is evidence that enforcement is lax, then the recycled content material may not be used in Cradle to Cradle Certified food contact or children's products.

C2CPII website once version 4 finalized. The maximum allowable concentrations indicated on the RSL apply. The assessor may provide rationales for reducing the list of analytes in some cases as described in the next section.

NOTE: If the applicant and/or assessor are aware of additional substances of concern (i.e. substances that would normally result in an x-assessment per the general Material Health Assessment Methodology) that are highly likely to be present in the material type under consideration, C2CPII must be informed and these substances must be added to the list of analytes for which testing must be conducted.

2.3.2 Analyte List Development & Process for Potential Reduction of Analytical Testing Requirements

In general, the lists of required analytes by material type were created by considering the current and prior uses of the listed chemicals as detailed by the relevant REACH dossiers and the United States National Library of Medicine's Hazardous Substance Data Bank (now merged with PubChem). Where a chemical is not used or has not previously been used in the given application per these references, it was not included as an analyte for the material type. Cleanliness of the recycling stream and/or a high likelihood of removal during processing due to process conditions were considered in some cases in order to remove analytes from the lists.

The analyte lists that are required for each material type were created as described below. The list of analytes to test for may be reduced on a case-by-case basis, pending pre-approval by C2CPII. In all cases, the assessor must provide their rationale for removal of any analyte from the lists. Examples of approaches that may be used when developing a rationale for reducing the lists are also provided below.

- Metals and glass: Due to the high processing temperatures and the inherent characteristics of these material types, there is a high likelihood that the majority of RSL chemicals (i.e. all organic compounds) will be removed during secondary processing of these materials. Therefore, only the toxic metals are included on these lists.

- Paper: Chemicals known to be used in paper manufacturing and processing and chemicals that have been used in adhesives and colorants are on this list. The list has been pared down by removing chemicals with high water solubilities (high was defined as water solubility >1000 mg/L) due to the water-based processing that occurs in re-pulping operations. It is assumed that chemicals with high water solubility will not be present in the finished recycled content material (although they could be present in effluent).

- Polymers: The current list for polymers is extensive and includes all substances that have been used in polymers or polymer processing. Examples of how the polymer-relevant list of analytes may be reduced are provided below.
    - In cases where the sorting process fully removes some polymer types from the input stream, the assessor may review prior and current uses of the listed target analytes and remove substances from the list that have been used exclusively in the polymer type(s) that are eliminated by the recycling process. Information must be provided that describes the sorting process and how the applicant ensures that polymers of other types are fully removed during the process. An indication of prior use and references supporting the conclusion that the analyte is not expected in the polymer type under consideration must be provided. For example, some polymers may be separated from others based on their density and/or near-infrared reflectance properties.
    - In cases where the polymer is thoroughly washed in water during processing, analytes with high water solubility that are also not expected to be partially or fully bound within the polymer matrix (thereby reducing the likelihood of removal during washing), may be removed from the list.
    - In cases where a thermal cleaning treatment is employed, analytes with boiling points well below the thermal treatment temperature may be removed from the list.

- Wood (mixed post-consumer): This list includes chemicals that could be present in wood preservatives, paints and stains, flame retardants, agricultural use pesticides, etc. It would most likely be difficult to shorten this list in the case of a mixed wood stream (e.g. sourced from construction and demolition waste streams and including painted and stained wood). This type of wood most likely could not be used past the Bronze level, if at all.

- Wood (clean): This list does not include wood preservatives, flame retardants, or any chemicals that could be present in paints or stains. If using this list as a starting point, the assessor must provide a description of the material source and explanation of how it is ensured that only clean untreated wood is part of the material input stream. Pesticides are included on this list. For post-industrial clean wood waste, a pesticide may be removed from the list if it is not expected to be present based on consideration of wood source, age, and potential for use of the pesticide(s) in the region during this time frame. For example, if the wood is known to be sourced only from certain regions of the EU, and a listed pesticide was banned in that region prior to original harvesting, that pesticide does not have to be tested for.

- Textiles: This list may not be reduced for textiles used in apparel or other prolonged or permanent skin contact applications. For textiles that are not used in prolonged skin contact applications, the assessor may use the same types of considerations indicated for paper and wood to reduce the list of analytes. Prolonged is defined as cases where cumulative, single, multiple or repeated long-term use or contact is likely to exceed 24 hours[4], per ISO 10993[5].

In addition to the various approaches and considerations described above that may be used to reduce the list of analytes, the assessor may also complete an exposure assessment per the most recent version of the Cradle to Cradle Certified Exposure Assessment Methodology prior to testing. If exposure is not plausible for specific analytes given their known properties and the way in which the product is manufactured, used, cycled, and disposed, then testing for those analytes is not required.

2.3.3 Analytical Testing Methods and Laboratory Accreditation

- For REACH Annex XVII substances, the methods indicated in ECHA's 'Compendium of Analytical Methods Recommended by the Forum to check compliance with REACH annex XVII restrictions' (most recent version) must be employed.
- For all other substances, the appropriate analytical methods to use must be determined by the selected laboratory.
- For the organohalogen testing requirement, a general screening test may be employed. For example, oxygen bomb combustion sample preparation followed by ion chromatography to identify the concentrations of organic (and inorganic) bromine, chlorine, and fluorine may be used. If the elemental concentration of each halogen is less than 100 ppm in the finished homogeneous material, further analytical testing in support of counting the recycled content material as assessed at the Silver level or above in Material Health is not required for the majority of individual halogenated substances (see current list of analytes for details). In these cases, a supplier declaration will be accepted as evidence that the restrictions on individual halogenated substances with RSL thresholds below 100 ppm have been met.
- Sampling must be carried out based on a predefined sampling plan in coordination with an ISO 17025 accredited laboratory. Sampling plans shall, whenever reasonable, be based on appropriate statistical methods.
- If a specific detection limit is indicated in the RSL, it must applied. Otherwise, detection limits must be below the maximum allowable concentration indicated in the RSLs, below 100 ppm, or below the Specific Concentration Limit (if any), whichever is lower.

xiiixiii

[4] Note: Prolonged is defined as 24 hours to 30 days. Greater than 30 days of contact is defined as permanent skin contact per ISO 10993

[5] https://www.fda.gov/downloads/medicaldevices/deviceregulationandguidance/guidancedocuments/ucm348890.pdf

- If it is possible to show that all individual substances with exposure potential (other than intentionally used substances, e.g. other than the specific polymer that is being recycled) are each present below 100 ppm through GC/MS and/or other testing methods, it may then only be necessary to test for substances on the RSLs with thresholds below 100 ppm. In addition, if using this approach, it is not necessary to fully identify all individual substances/contaminants as long as it can be determined that the required thresholds are met.[6]
- Laboratories must be ISO 17025 accredited to carry out the specific tests that are conducted.
- Tests may be conducted on the recycled content itself or on the final homogeneous material that the recycled content becomes a part of. However, in either case, the RSL and 100 ppm thresholds apply to the final homogeneous material (i.e. the concentration in the final homogeneous material can be calculated based on the ratio of recycled input to final material if the recycled content is tested rather than the final material).

2.3.4 Analytical Testing Frequency

- Basic and Bronze levels: Tests must be repeated prior to each two-year renewal/recertification.
- Silver level and above: Tests must be conducted and results provided on a quarterly basis during the first two-year certification period (although if prior test results completed on the same or similar interval prior to applying for certification are available, those may be provided instead). If RSL substances are not identified above the RSL or the 100 ppm threshold (as relevant) during the first two years, then the frequency of testing and result reporting may be reduced to once prior to each two-year renewal period. If a change in the recycling process or material source occurs, testing must be reset to be conducted on a quarterly basis.

xivxiv

[6] In an example case, mechanically recycled HDPE pellets were tested using a methyl tert-butyl ether extraction at 60°C for 30 minutes followed by GC/MS. The method was capable of determining that all individual volatile and semi-volatile substances with boiling points < 350°C and carbon chain length up to C24 were each present below 100 ppm in the HDPE. Some substances (e.g. phthalates) with higher boiling points and longer chain lengths are also detectable and quantifiable via this method (depending on vapor pressure although the critical pressure beyond which substances cannot be identified or quantified was not disclosed). The argument was made that exposure was not plausible for any substance that was not extracted and identified (or at least partially identified and determined to be present below 100 ppm) via this method. Total halogens and toxic metals were tested for separately and found to be below the required thresholds. Note that, depending on the material type and test results, restricted substances with restriction limits below 100 ppm may also need to be tested for individually if using this approach.

2.3.5 Process for Creating an Analyte List for Additional Material Types

In the case that a list of analytes has not been developed for the recycled content material type under review, a new list of relevant analytes may be created by a C2C Certified material health assessment body. The following are required:

- At a minimum, all substances listed on the RSL, REACH Annex XVII, Annex XIV, and the Substances of Very High Concern Candidate List must be included on the initial list of substances that may be present in the material.
- The assessor must review the prior uses for each chemical on these lists as indicated by REACH dossiers, Annex XV reports, and the United States National Library of Medicine's Hazardous Substances Data Bank (now part of PubChem - see Use and Manufacturing sections by substance). Additional references (e.g. SDS) may be used as well. The list must include all chemicals of concern that are used or have previously been used in the material type under consideration.
- **If the applicant or assessor is aware of additional substances of concern (i.e. substances that would normally result in an x-assessment per the general Material Health Assessment Methodology) that have a high likelihood of being present in the material under consideration, it is the assessor's responsibility to inform C2CPII and to include these on the list**, even if they are not on the REACH lists mentioned above.
- Once the full list of substances that may be present in the material has been created as described above, the list of analytes to test for is then produced by providing a rationale for the removal of any substances on the list as described in Section 2.3.2. Similar considerations as described there may be used, and the same limitations described within that section also apply. For example, if the material will be in prolonged skin contact, the list may not be reduced.
- A list of contaminants that was created by compiling all references cited must be provided to C2CPII, with each item on the list referenced back to the relevant source(s). Rationales regarding why individual substances known to have been used in the given application need not be tested for must also be provided.
- All information sources used must be provided, regardless of whether or not they were used to define the final list of analytes.
- In some cases, this type of research may have already been completed by another entity. Existing lists may apply as long as the assessor verifies that the relevant sources were adequately searched and incorporated into the list.
- New lists of analytes, including a description of the scenarios under which they apply, may be made publicly available by C2CPII for others to use in the future.

2.4 Special Considerations

The following special considerations apply to recycled content material that has been approved for food contact per United States or European Union regulations when used in applications other than food contact, toys, and other children's products.

- The Basic and Bronze level testing is still required in these cases.
- Manufacturers of these materials may provide a signed statement indicating that the material meets all of the other restricted substance thresholds, as indicated in the applicable list of required analytes for the material type under review (see the 'maximum allowable concentration at Silver level' and 'restriction notes' columns). Note: This exception does not mean that the food contact or certified materials are exempt from meeting the Silver level recycled content testing requirements, only that they are allowed to meet them in a different way (i.e. without providing test results or completing additional testing). The material health assessor is responsible for reviewing food contact regulations at the time of certification and notifying the material manufacturers/suppliers that there are some cases where substances allowed in food contact items are restricted by the C2C Certified standard (such as antimony trioxide in PET or nonylphenol in some food contact material production) and ensuring that it is appropriate for the manufacturer to sign such a statement.
- Proof of food contact approval or certification, as applicable, must be provided.
- Additional certifications that ensure screening for problematic substances has already been completed may be added to this list in the future upon special request by an assessor.

2.5 Assessment of Intentionally Used Substances and Known Contaminants

In order to be eligible for certification above Bronze level and in cases where the recycled material will count as assessed at Bronze, the intentionally used substances and known contaminants (either from the manufacturing of the virgin material, contaminants known to be picked up during the use phase, or contaminants from the recycling process), including residual monomers and catalysts in the case of polymers, must be identified by chemical name and CASRN and assessed using the general Material Health Assessment Methodology. Identification must occur via the assessor requesting a complete list of substances present in the material above the subject to review threshold from the supplier and asking about the presence and concentration of specific substances that may be expected in the material based on prior research. (For example, the base polymer, residual monomers, and residual catalyst within recycled content material, when known to remain in virgin material above inventory threshold, must be assessed even if they have not been intentionally added to the recycled material.)

2.6 Additional Requirements for Food Contact, Toys, and Other Children's Products

Recycled material used for food contact applications or in toys or other children's products (when

available for mouthing to occur) must be food grade per the regulations relevant to where the product is sold[4] and meet all other requirements in this methodology (regardless of the certification level for the product overall). In addition, recycled content materials used in these applications are NOT exempt from the Silver level recycled content material testing requirements.

Mixture Hazard Assessment Methodology

March 2018

Copyright

Trademark

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

LIST OF TABLES

REVISION LOG

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
March 2018	Initial Release		S. Klosterhaus

1 OVERVIEW

1.1 Purpose and Content

This document describes the methodology used to assign a RED, YELLOW, GREEN, or GREY hazard rating to a homogeneous mixture for a select set of toxicity endpoints based on the concentrations of individual component chemicals in the homogeneous mixture. This mixtures assessment methodology may be used as an alternative to the traditional Cradle to Cradle Certified™ Material Health Assessment Methodology when assigning hazard ratings. However, instead of single chemicals receiving hazard ratings, the whole mixture will receive a hazard rating. An exposure assessment is still required after obtaining one or more hazard ratings for the mixture to complete the material health assessment.

The procedure uses toxicity data for individual chemical substances comprising the homogeneous mixture, and/or toxicity data on homogeneous mixtures where available, from peer-reviewed studies, authoritative lists, and other sources. Then, an approach based upon the European Union's Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation (CLP Regulation) and the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) methodology pertaining to the hazard assessment of mixtures is used to assign a RED, GREY, GREEN, or YELLOW hazard rating to the entire mixture for the following set of endpoints:

- *Skin, Eye, and Respiratory irritation;*
- *Skin and Respiratory Sensitization;*
- *Aquatic Toxicity (fish, daphnia, algae), and*
- *Acute Mammalian Toxicity (oral, dermal, and inhalation)*

1.2 Recommended Use of this Document

It is recommended to use this methodology in applicable situations, since not using it may result in the consideration of specific substance hazards that are irrelevant based on the way the substance is used in the product (i.e. non-use may result in overly conservative ratings). The applicable situation for use of this methodology is when after conducting a traditional Cradle to Cradle Certified material health assessment, it is determined that a homogeneous material is X-assessed only due to a substance(s) present at a relatively low concentration (< 10%) and with a red hazard rating from one or more of the toxicity endpoints addressed in the mixtures methodology (see section 1.5 for the scope of toxicity endpoints). The following are examples of when it is appropriate to use the mixtures methodology and when it is not:

1. Material A is given an X assessment due to a substance at a concentration of 2% with a red hazard rating for carcinogenicity. The material also contains another substance at a concentration of 1% with a red hazard rating for acute oral mammalian toxicity. **Use of this methodology is not recommended** because the material is X-assessed due to the presence of a substance with a red hazard rating for a toxicity endpoint not addressed in this methodology (i.e. the outcome won't change regardless of mixture rule application).
2. Material B is given a X assessment due to a substance at a concentration of 1% with a red hazard rating for fish toxicity. **Use of this methodology is recommended** because the material contains a substance at a low concentration with a red hazard rating for a toxicity endpoint addressed in this methodology (i.e. the outcome may change based on mixture rule application).
3. Material C is given an X assessment due to a substance at a concentration of 30% with a red hazard rating for skin irritation. **Use of methodology is not recommended** because this substance is at too high a concentration for this methodology to produce a different risk rating (i.e. the outcome won't change regardless of mixture rule application).

1.3 Supporting Documents

The following documents are to be used in conjunction with this mixtures methodology document:

- Cradle to Cradle Certified™ Product Standard
- Cradle to Cradle Certified™ Material Health Assessment Methodology
- Regulation (EC) No 1272/2008 Of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.
- Globally Harmonized System of Classification and Labelling of Chemicals (GHS). Sixth revised edition (2015).

1.4 Terms and Definitions

Table 1: Terms and Definitions

Term	Definition
ATE	Acute Toxicity Estimate
CLP	Classification, Labelling, and Packaging of Substances and Mixtures (EC No. 1272/2008)
Concentration Addition	Concentration addition (CA) assumes that chemicals in a mixture act by the same mechanism/mode of action, and differ only in their potencies.
Concentration Limit	The minimum concentration for a substance to trigger the classification of a mixture for a specific hazard endpoint.
Cut-Off Value	The minimum concentration for a substance to be taken into account for GHS classification purposes (do not necessarily trigger classification).
EC	European Commission
EU	European Union
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
Homogeneous Material	Material of uniform composition throughout that cannot be mechanically disjointed, in principle, into different materials.
Mixture	A homogeneous material that contains two or more chemicals that have been combined such that each chemical retains its own chemical identity.
SCL	Specific Concentration Limit
Sub-endpoint	A sub-endpoint is a toxicity endpoint that makes up a part of a Cradle to Cradle hazard endpoint.

1.5 Scope

This methodology describes the methodology for assigning a Cradle to Cradle Certified hazard rating to a mixture for the following Cradle to Cradle Certified endpoints:

- *Skin, Eye, and Respiratory Irritation;*
- *Skin and Respiratory Sensitization;*

- *Fish Toxicity (acute and chronic toxicity);*
- *Daphnia Toxicity (acute and chronic toxicity);*
- *Algae Toxicity (acute and chronic toxicity);*
- *Oral Toxicity (Acute Mammalian Toxicity only);*
- *Dermal Toxicity (Acute Mammalian Toxicity only);*
- *Inhalation Toxicity (Acute Mammalian Toxicity only);*

These endpoints are a subset of the endpoints included in the Cradle to Cradle Certified hazard assessment methodology and a subset of endpoints for which mixture hazard assessment methodology applies under the CLP/GHS systems.

Endpoints for which the mixture hazard assessment methodology applies in the CLP/GHS systems but not in the Cradle to Cradle Certified methodology include:

- *Germ Cell Mutagenicity*
- *Carcinogenicity*
- *Reproductive Toxicity*
- Specific Target Organ Toxicity & Single and Repeated Exposure

The rationale for not including these endpoints in the Cradle to Cradle Certified mixture hazard assessment methodology is that there is not a strong and consistent scientific basis for assuming that dilution of the chemical in a product results in reduced hazard for these endpoints.

2 BACKGROUND

2.1 Chemical Mixtures Toxicity Assessment

Chemical mixtures vary widely in their specific chemical contents and concentrations. Some mixtures consist of a relatively small number of chemicals (e.g., ten or fewer chemicals) and have a known composition (simple mixture). However, in many cases, mixtures comprise tens, hundreds, or thousands of chemicals and the composition is not fully known (complex mixture). The chemicals in the mixture can interact with each other, exhibiting a toxic effect either greater than (synergism) or less than (antagonism) expected, or work in a non-interactive way that does not influence each other´s mode of action. Chemical interactions like antagonism or synergism occur at medium or high dose levels because at low exposure levels these interactions are not occurring or are occurring at rates that are toxicologically insignificant (EC 2014).

Two approaches have been used to assess the toxicity of mixtures: a whole-mixture approach and a component-based approach. The whole-mixture approach relies on testing of the whole product/mixture to identify the hazard of the mixture and is mainly applied to assess the effects of mixtures with (partly) unknown compositions. In this approach, the identity of the substances driving the overall response may remain unidentified (EC 2014).

A more common approach to assess the toxicity of a mixture is to consider the toxicity of its individual constituents, that is, a component-based approach. This requires more information regarding identity, concentration, and toxicity (including mode of action) of the chemicals in the mixture. When applying the component-based approach, interactions between the chemicals have to be taken into account. Two models, Concentration Addition and Independent Action, have been suggested as default models for assessing toxicological interaction and predicting mixture toxicity. Generally, models based on the Concentration Addition approach are the most frequently applied to estimate the toxicity of mixtures as they provide reliable estimates of combined effects and are considered to be more conservative than Independent Action models (EC 2014).

2.2 CLP/GHS Classification of a Mixture Based on Its Components

The consideration of mixtures toxicities for hazard endpoints is addressed within the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) and the European Regulation (EC) No 1272/2008 on Classification, Labelling and Packaging (CLP) of Substances and Mixtures. The CLP came into force on 20 January 2009 in all EU Member States (EC 2008) and implements the 2nd edition of the GHS guidance into EU law. However, the original CLP legal text has been amended on a number of occasions since its original publication following updates

to the GHS. The classification of mixtures under CLP/GHS basically follows the same methodology as the classification of substances and includes the same hazard classes.

It is recommended that mixture hazard classifications be derived from hazard data on the whole mixture. However, the alternative approach, which is the basis of the Cradle to Cradle Certified Mixture Hazard Assessment Methodology, is a mixture being classified based on available data on its individual component chemicals using concentration addition as the main assumption for the combined effects of multiple chemicals. Which chemicals are considered in this approach is determined by cut-off values and concentration limits that are applied accordingly.

This approach first requires gathering information on the chemical composition of the mixture, the hazards of those chemical components, and their concentrations in the mixture. Then, three different models are used to classify the hazard of the mixture under CLP/GHS. Two are additive methods and one is non-additive:

1. Additive Methods
    a. Summation Method
    b. Additivity Formula Method
2. Non-Additive Method

In the additive method, the concentrations of the chemicals with the same hazard are added together and if the sum of the concentrations of one or several classified substances in the mixture equals or exceeds the generic concentration limit established for that particular hazard endpoint, the mixture must then be classified for that hazard. Within this approach two models are applied: summation method and additivity formula.

In the non-additive method, the classification is based on concentration thresholds**,** which requires using a cut-off limit (limit of concern) and a generic concentration limit (GCL) to assign a classification. In these cases, if the mixture contains two substances each below the GCLs defined for that endpoint, even if the sum is above this limit, the mixture will not be classified (for additional details, see the CLP methodology below for these endpoints).[1]

The CLP/GHS mixture hazard assessment methodology is applicable to human health and some, but not all, environmental endpoints as shown below. The hazard endpoints relevant to the Cradle to Cradle Certified Mixture Hazard Assessment Methodology are in **bold** text:

[1] Under CLP only, some substances may have been assigned SCLs. These could be lower or higher than GCL and are supported by data. SCLs are only available for health hazard endpoints and take precedence over any other concentration limits. SCLs are given in Annex VI of the CLP (Table 3.1), and now may also be set by REACH registrants and CLP notifiers when they submit their classifications to ECHA.

- The additive method is used for the following hazard classes:
    - **Acute Mammalian Toxicity (Oral, Dermal, Inhalation) [Additivity Formula Method]**
    - **Skin Corrosion/Irritation [Summation Method]**
    - **Serious Eye Damage/Eye Irritation [Summation Method]**
    - **Acute and Long-Term Aquatic Hazards [Summation Method]**

- The non-additive method is applied for the following hazard classes:
    - Germ Cell Mutagenicity
    - Carcinogenicity
    - Reproductive Toxicity
    - Specific Target Organ Toxicity & Single and Repeated Exposure
    - **Skin and Respiratory Sensitization**

In the next section, the CLP mixture hazard assessment methodology is explained in more detail for each GHS endpoint relevant to the Cradle to Cradle Certified Mixture Hazard Assessment Methodology.

2.3 CLP/GHS Endpoint Specific Mixture Hazard Classification Criteria

2.3.1 Acute Mammalian Toxicity

Mixture Hazard Assessment Method: Additivity Formula

The CLP/GHS hazard classification criteria of a mixture for the Acute Mammalian Toxicity endpoint are based on the Acute Toxicity Estimate (ATE) value of the mixture calculated from the ATE values for all relevant chemicals according to the following formula for Oral, Dermal or Inhalation Toxicity (CLP section 3.1.3.6.2, EC 2008)

$$\frac{100}{\text{ATE mixture}} = \sum_n \frac{\%\ \text{chemical is in formulation}}{LD_{50}\text{ or }LC_{50}\text{ Entry}}$$

In this approach, the oral, dermal, and inhalation LD_{50}/LC_{50} values for all the relevant mixture components are required for the calculation. The ATE value for the mixture is then compared against the GHS criteria for the Acute Mammalian Toxicity endpoint to assign a classification.

According to CLP, in case of the total concentration of the relevant substance (s) with unknown acute toxicity being >10%, the formula presented above is corrected to adjust for the percentage of the unknown substance(s) as follows:

$$\frac{100 - (\sum_n \%\ \text{chemicals unknown} > 10\%)}{\text{ATE mixture}} = \frac{\sum_n \%\ \text{chemical is in formulation}}{LD_{50}\text{ or }LC_{50}\text{ Entry}}$$

2.3.2 Skin Irritation

Mixture Hazard Assessment Method: Summation Method

The GHS[2] hazard classification criteria of a mixture for the Skin Irritation endpoint are based on the summation method that is described in the GHS guidance (UN 2015), chapter 3.2, Table 3.2.3 (shown below in Table 2) using the relevant chemicals (i.e. present at a concentration ≥ 1%). A weighting factor of 10 is used for corrosive components when they are present below the generic concentration limit for a classification with Category 1 (> 0.1%), but are still at a concentration that will contribute to the classification of the mixture as an irritant.

Table 2: Calculation of GHS mixture hazard classification for the Skin Irritation endpoint based on the concentration of component chemicals classified for Skin Irritation.

Sum of Chemicals Classified as:	**Concentration triggering classification of a mixture as:**		
	Skin Corrosive	**Skin Irritant**	
	Category 1	**Category 2**	**Category 3**
Skin Corrosive Categories 1A, 1B, 1C [*present at ≥ 1%]*	≥ 5%	≥ 1% but < 5%	--
Skin Irritant Category 2 [*present at ≥ 1%]*	--	≥ 10%	≥ 1% but < 10%
Skin Irritant Category 3 [*present at ≥ 1%]*	--	--	≥ 10%
(10x Skin Corrosive Category 1A, 1B, 1C [*present at ≥ 0.1% and < 1 %*]) + Skin Irritant Category 2 [*present at* ≥ 1%]	--	≥ 10%	≥ 1% but < 10%
(10x Skin Corrosive Category 1A, 1B, 1C [*present at ≥ 0.1% and < 1 %*]) + Skin Irritant Category 2 [*present at ≥ 1%]* + Skin Irritant Category 3 [*present at ≥ 1%]*	--	--	≥ 10%

[2] The GHS mixture hazard assessment methodology is used here instead of CLP as the latter did not adopt Category 3 for this endpoint (skin irritation)

Alternatively, if the product contains strong acids/bases, classification of mixture shall be based on the mixture pH as described in Table 3.2.4 of the CLP (shown in Table 3 below)[3] (EC 2008). The mixture may also be classified as corrosive (GHS Category 1 skin irritant) if it has a pH ≥ 2 or a pH ≥ 11.5 per section 3.2.3.1.2 of the GHS Guidance (UN 2015).

Table 3: Calculation of GHS mixture hazard classification for the Skin Irritation endpoint based on the concentration of strong acids, bases, or corrosives in the mixture.

Chemicals	**Concentration**	**Skin Irritation Classification for Mixture**
Acid with pH ≤ 2	≥ 1%	Category 1
Base with pH ≥ 11.5	≥ 1%	Category 1
Other Corrosive (Categories 1A, 1B, 1C) chemicals for which additivity does not apply	≥ 1%	Category 1
Other Irritant (Category 2) chemicals for which additivity does not apply, including acids and bases	≥ 3%	Category 2

2.3.3 Eye Irritation

Mixture Hazard Assessment Method: Summation Method

The CLP/GHS hazard classification criteria of a mixture for the Eye Irritation endpoint are based on the summation method that is described in section 3.3.3.3 of the CLP criterion and in Table 3.3.3 (shown below in Table 4)[4] (EC 2008) using the relevant chemicals (i.e., present in a concentration ≥ 1 %). A weighting factor of 10 is used for corrosive components when they are present below the generic concentration limit (1%) for classification with Category 1, but are still

[3] CLP Table 3.2.4 Concentration of chemicals of a mixture when the additivity approach does not apply, that would trigger classification of the mixture as hazardous to skin (EC 2008).
[4] CLP Table 3.3.3 Generic concentration limits of chemicals of a mixture classified as Skin Corrosive Category 1 and/or Eye Irritation Category 1 or 2 for effects on the eye that trigger classification of the mixture for effects on the eye (Category 1 or 2) (EC 2008).

at a concentration that will contribute to the classification of the mixture (> 0.1%) as an irritant as described in CLP section 3.3.3.3.2 (EC 2008). The calculation for this endpoint is complex, as available data on the Skin Irritation endpoint needs to be considered as well[5].

Table 4: Calculation of GHS mixture hazard classification for the Eye Irritation endpoint based on the concentration of component chemicals classified for Eye Irritation and Skin Irritation.

Sum of Chemicals Classified as:	**Concentration triggering classification of a mixture as:**	
	Irreversible Eye Effects	**Reversible Eye Effects**
	Category 1	**Category 2**
Eye Effects Category 1 or Skin Corrosive Category 1A, 1B, 1C [*present at* ≥ *1* %]	**≥ 3%**	**≥ 1% but < 3%**
Eye Effects Category 2/2A [*present at* ≥ *1* %]	**--**	**≥ 10%**
(10x Eye Effects Category 1 [*present at* ≥ *0.1* % *and* < *1* %]) + Eye Effects Category 2/2A	**--**	**≥ 10%**
Skin Corrosive Category 1A, 1B, 1C + Eye Effects Category 1 [*present at* ≥ *1* %]	**≥ 3%**	**≥ 1% but < 3%**
10 x (Skin Corrosive Category 1A, 1B, 1C + Eye Effects Category 1 [*each present at* ≥ *0.1* % *and* < *1* %]) + Eye Effects Category 2A/2B [*present at* ≥ *1* %]	**--**	**≥ 10%**

Note: reproduced from EC (2008)

Alternatively, if the product contains strong acids/bases, classification of a mixture shall be based on the CLP rule described in Table 3.3.4 and shown in in Table 5 below[6] (EC 2008).

[5] Section 3.3.3.2 states that for this endpoint, a weighting factor needs to be applied for the chemicals that are corrosive when they are present in the mixture at a concentration of < 1% (EC 2008).
[6] CLP Table 3.3.4 Concentration of chemicals of a mixture for which the additivity approach does not apply that trigger classification of the mixture as hazardous to the eye (EC 2008).

Table 5: Calculation of GHS mixture hazard classification for the Eye Irritation endpoint based on the concentration of strong acids, bases or corrosives in the mixture.

Chemical	Concentration	Eye Irritation Classification for Mixture
Acid with pH ≤ 2	≥ 1%	Category 1
Base with pH ≥ 11.5	≥ 1%	Category 1
Other Corrosive (Category 1) substance	≥ 1%	Category 1
Other Eye Irritant (Eye Category 2) substance	≥ 3%	Category 2

2.3.4 Respiratory Irritation

Mixture Hazard Assessment Method: Summation Method

In the CLP/GHS framework, respiratory tract irritation is considered within the specific target organ toxicity — single exposure endpoint (STOT-SE). Substances that cause mild and reversible respiratory irritation are classified to CLP/GHS Category 3 for STOT-SE. The CLP/GHS hazard classification criteria of a mixture for the respiratory irritation endpoint is based on the summation method applying a generic concentration limit of 20%, as described in section 3.8.3.4.5 of the CLP criterion (EC 2008).

2.3.5 Skin Sensitization

Mixture Hazard Assessment Method: Non-additive Method

The CLP/GHS criteria for Skin Sensitization classification of a mixture are based on the concentration threshold as described in section 3.4.3.3.1 of the CLP criterion and in Table 3.4.3 (shown below in Table 6)[7] (EC 2008). According to this table,

[7] CLP Table 3.4.3 Generic concentration limits of chemicals of a mixture classified as either skin sensitizers or respiratory sensitizers that trigger classification of the mixture (EC 2008).

- The mixture is classified to CLP/GHS Category 1A if it contains at least one substance that is classified to CLP/GHS Category 1A and is present at or above the threshold of 0.1%

Or

- The mixture is classified to CLP/GHS Category 1B if it contains at least one substance that is classified to CLP/GHS Category 1B and is present at or above the threshold of 1.0%.

Table 6: Calculation of GHS mixture hazard classification for the Skin Sensitization endpoint based on the concentration of component chemicals classified for Skin Sensitization.

Substance Classified as:	**Concentration limits triggering classification of a mixture as:**
	Skin Sensitizer
	All Physical States
Skin Sensitizer Category 1	≥ 0.1%
Skin Sensitizer Sub-category 1A	≥ 0.1%
Skin Sensitizer Sub-category 1B	≥ 1.0%

Note: Reproduced from EC (2008).

2.3.6 Respiratory Sensitization

Mixture Hazard Assessment Method: Non-additive Method

The CLP/GHS hazard classification criteria for Respiratory Sensitization of a mixture are based on the concentration threshold as described in section 3.4.3.3.1 of the CLP criterion and in Table 3.4.3 (shown below in Table 7)[8](EC 2008). According to this table,

- The mixture is classified to CLP/GHS Category 1A if it contains at least one substance that is classified to CLP/GHS Category 1A and is present at or above the threshold of 0.1%

Or

- The mixture is classified to CLP/GHS Category 1B

[8] CLP Table 3.4.3 Generic concentration limits of chemicals of a mixture classified as either skin sensitizers or respiratory sensitizers that trigger classification of the mixture (EC 2008).

- if it contains at least one substance (**solid/liquid**) that is classified to CLP/GHS Category 1B and is present at or above the threshold of 1.0%

Or

- The mixture is classified to CLP/GHS Category 1B if it contains at least one substance (**gas**) that is classified to CLP/GHS Category 1B and is present at or above the threshold of 0.2%

Table 7: Calculation of GHS mixture hazard classification for the Respiratory Sensitization endpoint based on the concentration of component chemicals classified for Respiratory Sensitization.

Substance Classified as:	**Concentration limits triggering classification of a mixture as:**	
	Respiratory Sensitizer	
	Solid/Liquid	**Gas**
Respiratory Sensitizer Category 1	≥ 0.1%	≥ 0.1%
Respiratory Sensitizer Sub-category 1A	≥ 0.1%	≥ 0.1%
Respiratory Sensitizer Sub-category 1B	≥ 1.0%	≥ 0.2%

Note: reproduced from EC (2008).

2.3.7 Acute and Chronic Aquatic Toxicity

Mixture Hazard Assessment Method: Summation Method

The GHS[9] hazard classification criteria of a mixture for the Acute Aquatic Toxicity endpoint are based on the summation method that is described in the GHS guidance (UN 2015), chapter 4.1, Table 4.1.3 (shown below in Table 8)[10] using the relevant chemicals (i.e., present at a concentration ≥ 0.1 %). A multiplying factor (M) is used for Acute Category 1 and Chronic Category 1 components. The multiplying factors to be applied to these components are defined using the

[9] The GHS mixture hazard assessment methodology is used here instead of CLP as the latter did not adopt Category 2 or 3 for this endpoint (Acute Aquatic Toxicity)
[10] GHS Table 4.1.3 Classification of a mixture of short-term (acute) hazards based on summation of the concentration of classified chemicals (UN 2015).

toxicity value, as summarised in Table 4.1.5 in the GHS guidance (UN 2015) (shown below in Table 9). Therefore, in order to classify a mixture containing Acute Category 1 substances, the acute toxicity values for substances with a red hazard rating are required in order to determine the M-factor.

Table 8: Calculation of GHS mixture hazard classification for the Acute Aquatic Toxicity endpoint based on the concentration of component chemicals classified for Acute Aquatic Toxicity.

Sum of the Concentrations (in %) of Chemicals Classified as:	**Mixture is Classified as:**
Acute 1 x M[a] ≥ 25	Acute 1
(M x 10 x Acute 1) + Acute 2 ≥ 25	Acute 2
(M x 100 x Acute 1) + (10 x Acute 2) + Acute 3 ≥ 25	Acute 3

Note: reproduced from UN (2015).

Table 9: Multiplicative (M) factors corresponding to different L(E)C_{50} or NOEC values.

Acute toxicity		**Chronic toxicity**		
L(E)C_{50} value (mg/L)	**M factor**	**NOEC value (mg/L)**	**M factor**	
			NRD[a] components	**RD[b] components**
0.1 < L(E)C_{50} ≤ 1	1	0.01 < NOEC ≤ 0.1	1	-
0.01 < L(E)C_{50} ≤ 0.1	10	0.001 < NOEC ≤ 0.01	10	1
0.001 < L(E)C_{50} ≤ 0.01	100	0.0001 < NOEC ≤ 0.001	100	10
0.0001 < L(E)C_{50} ≤ 0.001	1000	0.00001 < NOEC ≤ 0.0001	1000	100
0.00001 < L(E)C_{50} ≤ 0.0001	10000	0.000001 < NOEC ≤ 0.00001	10000	1000
(continue in factor 10 intervals)		(continue in factor 10 intervals)		
[a] Non-rapidly degradable [b] Rapidly degradable				

Note: reproduced from UN (2015) and EC (2008).

The CLP/GHS hazard classification criteria of a mixture for the Chronic Aquatic Toxicity endpoint

are based on the theory of summation method that is described in CLP Table 4.1.2 (shown below in Table 10)[11] (EC 2008) using the relevant chemicals (i.e. present in a concentration ≥ 0.1 % for Chronic Category 1 and ≥ 1% for the categories two through four)[12] and a multiplying factor (M) as described in the section above.

Table 10: Calculation of GHS mixture hazard classification for the Chronic Aquatic Toxicity endpoint based on the concentration of component chemicals classified for Acute Aquatic Toxicity.

Sum of Components Classified as:	**Mixture is Classified as:**
Chronic Category 1 x M ([a]) ≥ 25%	Chronic Category 1
(M x 10 x Chronic Category 1) + Chronic Category 2 ≥ 25%	Chronic Category 2
(M x 100 x Chronic Category 1) + (10 x Chronic Category 2) + Chronic Category 3 ≥ 25%	Chronic Category 3
Chronic Category 1 + Chronic Category 2 + Chronic Category 3 + Chronic Category 4 ≥ 25%	Chronic Category 4

Note: reproduced from EC (2008).

[11] CLP Table 4.1.2 Classification of a mixture for chronic (long term) hazards, based on summation of classified components (EC 2008).

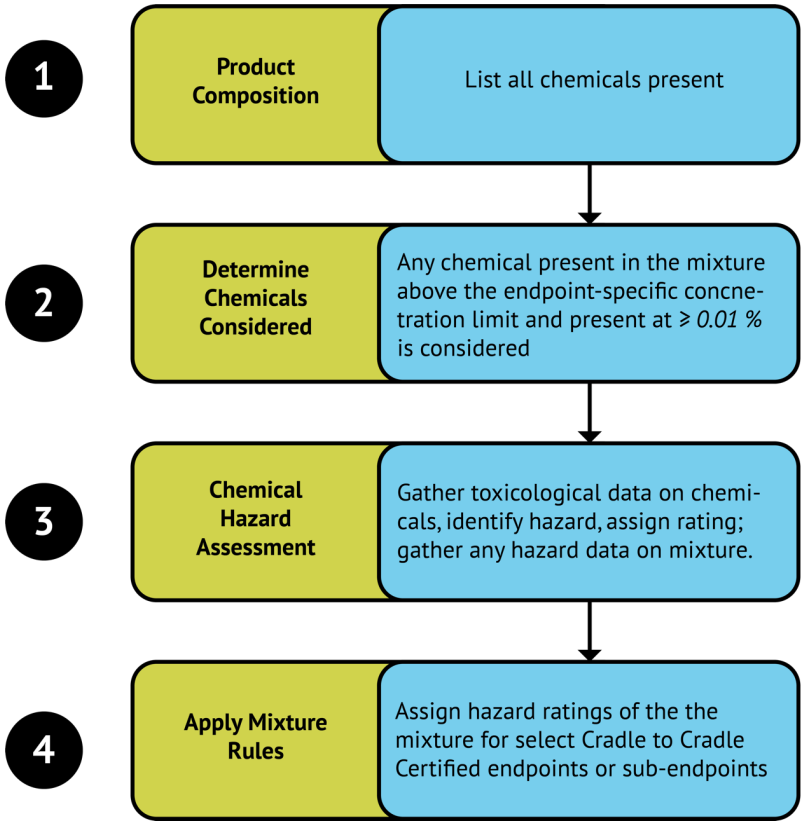
[12] According to CLP section 4.1.3.1.(EC 2008): The 'relevant components' of a mixture are those which are classified 'Acute Category 1' or 'Chronic Category 1' and present in a concentration of 0.1% (w/w) or greater, and those which are classified 'Chronic Category 2', 'Chronic Category 3' or 'Chronic Category 4' and present in a concentration of 1% (w/w) or greater, unless there is a presumption (such as in the case of highly toxic components (see 4.1.3.5.5.5) that a component present in a lower concentration can still be relevant for classifying the mixture for Aquatic Environmental hazards. Generally, for substances classified as 'Acute Category 1' or 'Chronic Category 1' the concentration is to be taken into account is (0.1 %) (see Table 1.1 in CLP (EC 2008)).

3 PROCESS FOR ASSIGNING HAZARD RATINGS TO MIXTURES

3.1 Summary of Process

Figure 1 illustrates an overview of the process to assign a Cradle to Cradle Certified hazard rating for a homogenous material (mixture) using the adapted CLP/GHS mixture hazard assessment methodology.

Figure 1: Summary of process for assigning a mixture hazard rating for a select set of Cradle to Cradle Certified endpoints or sub-endpoints.



In Step 1: the chemical composition of the homogenous material being evaluated is identified. This is accomplished by listing all chemicals present in the homogenous materials at or above 100 ppm (0.01% by weight). The chemical name and CAS number are identified for each chemical.

In Step 2: the chemicals that are included in the assessment are determined. Each chemical is screened against ECHA C&L inventory to check if any specific concentration limit (SCL) has been established for any of the relevant hazard endpoints assessed here (ECHA 2017). Then, the following steps are taken:

- Any chemical without an SCL and present at ≥ 0.01% in the homogenous material is considered in the assessment.
- Any chemical with an established SCL that is present above its SCL is considered in the assessment. If an SCL exists and the substance is present below its SCL, it is not considered. Note: the SCL threshold takes precedence over the 0.01%. For example, 1,2 benzisothiazolin-3-one (CAS #2634-33-5) has an SCL of 0.05% for the Skin Sensitization endpoint (ECHA 2017; EC 2008). Therefore, if it is present in the mixture (homogenous material) below 0.05%, it is not considered in the assessment.

It is important to note that very few chemicals have an SCL established under CLP. So, in most cases, the threshold of 0.01% is applied for chemicals subject to assessment. The SCLs are given in Table 3.2, Annex VI, of the CLP Regulation (EC 2008) or alternatively they are listed in the ECHA C&L inventory.

In Step 3: If available, hazard data from test data of the mixture are gathered for relevant endpoints. If test data for the mixture is not available for one or more of the endpoints, hazards associated with the individual chemicals included in **Step 2** are classified under CLP/GHS and Cradle to Cradle Certified criteria for the relevant health and environmental endpoints. For this step, toxicological data for the chemicals needs to be collected for the following endpoints, which are a subset of the full suite of 22 hazard endpoints comprising a full Cradle to Cradle Certified chemical hazard assessment:

- **Human Health Endpoints and Sub-endpoints**: Sensitization of Skin and Airways (Skin and Respiratory treated separately), Skin, Eye, and Respiratory Irritation (each treated separately) and Acute Mammalian Toxicity (comprises Oral, Dermal, and Inhalation).

- **Aquatic Toxicity Endpoints**: Aquatic Toxicity (Acute and Chronic treated separately)

Further details on the information/data sources and the methodology for Cradle to Cradle Certified chemical hazard assessment can be found in the Cradle to Cradle Certified™ Material Health Assessment Methodology document (C2CPII 2017).

In Step 4: The CLP/GHS mixture hazard assessment methodology is applied to assign hazard ratings at the material level for the hazard endpoints listed above in Step 3. The methodology for assigning mixture hazard ratings are described in Section 3.2 of this document. If the whole mixture has been tested for its hazard, then the hazard ratings derived from this take precedence over the mixture hazard ratings derived from following the Cradle to Cradle Certified hazard criteria.

3.2 Cradle to Cradle Certified Endpoint-specific Guidance on Hazard Classification for a Mixture

3.2.1 *Oral, Dermal, and Inhalation Toxicity* (Acute Mammalian)

Acute Mammalian Toxicity is a sub-endpoint of three separate Cradle to Cradle Certified human health endpoints (Oral Toxicity, Dermal Toxicity, and Inhalation Toxicity) which each also contain sub-endpoints for single-exposure target organ toxicity and sub-chronic/chronic. Because the Cradle to Cradle Certified Mixture Hazard Assessment Methodology does not address single-exposure specific target organ toxicity or sub-chronic/chronic toxicity, those sub-endpoints must be assessed by the traditional material health assessment methodology. Then, the single-exposure specific target organ toxicity or sub-chronic/chronic toxicity ratings (from each individual substance) may be combined with the mixture ratings for the acute toxicity sub-endpoint from the mixture hazard assessment for each of the three exposure pathways (oral, dermal, inhalation) to obtain an overall hazard rating for the Oral, Dermal, and Inhalation Toxicity Cradle to Cradle Certified endpoints for each substance.

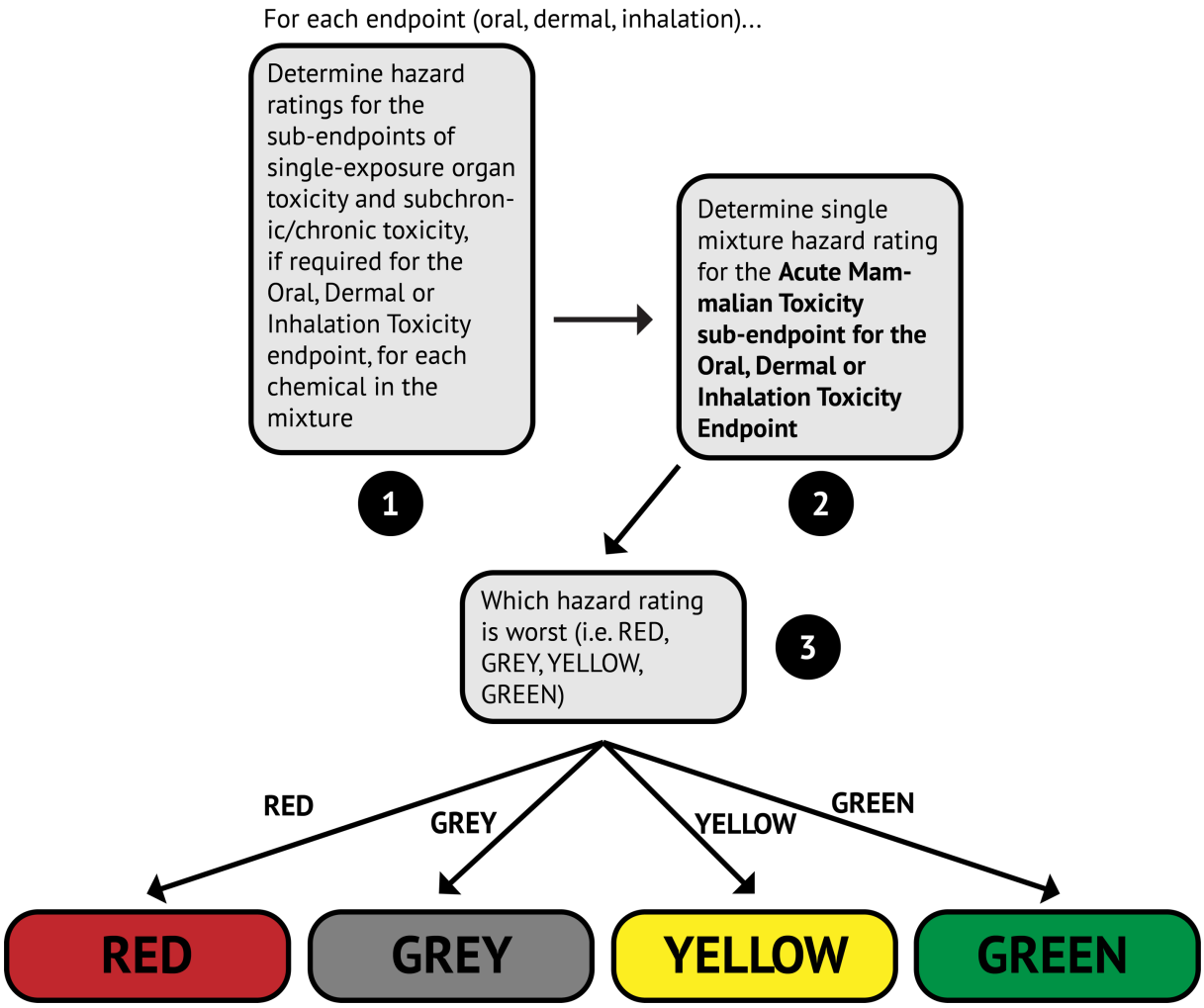


Figure 2: Summary of process for assigning a hazard score for the Cradle to Cradle Certified endpoints of oral, dermal, and inhalation toxicity that takes into account mixture hazard ratings for the Acute Mammalian Toxicity sub-endpoint for oral, dermal and inhalation toxicity endpoints.

3.2.1.1 *Oral, Dermal, and Inhalation Toxicity* (Acute Mammalian)

Mixture Hazard Assessment Method: Additivity Formula Method

References: For information on the Cradle to Cradle Certified hazard rating criteria please refer to sections 3.3.5, 3.3.6, and 3.3.7 and tables 9, 10, and 11 in the Cradle to Cradle Certified Material Health Assessment Methodology (C2CPII 2017). For a comparison between Cradle to Cradle Certified chemical hazard rating and GHS classification for this endpoint see section Appendix section 5.1.1 and Table 18 in this document. Differences between Cradle to Cradle Certified Mixture Hazard Assessment Methodology and CLP/GHS mixture hazard assessment methodology

for this endpoint may be found in Appendix section 5.1.2.1 in this document. The ATE calculation is derived from the equations demonstrated in section 2.31.

Process for Assigning Mixture Hazard Rating

1. **Collect L(C)D_{50} values for each exposure route for each chemical considered in the mixture.**

2. **Apply the cut-off values (Table 11)** to determine which chemical components with oral, dermal, inhalation Acute Mammalian Toxicity sub-endpoint ratings are considered for the mixture hazard rating derivation in this endpoint:

Table 11: Cut-off values by hazard rating for the Acute Mammalian Toxicity sub-endpoint.

Endpoint for Chemical Component	Cut-Off Value for Consideration Toward This Mixture Hazard Rating
Acute Mammalian Toxicity (Oral, Dermal, Inhalation)	RED rated chemicals present at ≥ 0.1%, YELLOW rated chemicals present at ≥ 1%, and GREY rated chemicals ≥ 0.1%[13]

3. **Calculate the ATE value for the mixture from component chemicals' L(C)D_{50} values (see section 2.3.1)**

4. **Assign the mixture hazard rating** for the Acute Mammalian Toxicity sub-end point *via* the following process (also shown in Figure 3). The mixture will have a Cradle to Cradle Certified hazard rating for the Acute Mammalian Toxicity sub-endpoint of:

- **RED** if
    - The oral ATE for the mixture is ≤ 300 mg/kg,
    - The dermal ATE for the mixture is ≤ 1,000 mg/kg, or
    - The inhalation ATE for the mixture is ≤ 10 mg/L (Gas or vapor) or ≤ 1 mg/L (Dust/Mist/Fumes)
- **YELLOW** if
    - The oral ATE for the mixture is > 300-2,000 mg/kg,
    - The dermal ATE for the mixture is > 1,000-2,000 mg/kg, or
    - The inhalation ATE for the mixture is > 10-20 mg/L (Gas or vapor) or > 1.0-5.0 mg/L (Dust/Mist/Fumes)
- **GREEN** if
    - The oral ATE for the mixture is > 2,000 mg/kg,
    - The dermal ATE for the mixture is > 2,000 mg/kg, or
    - The inhalation ATE for the mixture is > 20 mg/L (Gas or vapor) or > 5.0 mg/L

[13] According to CLP Table 1.1: the 'relevant chemicals' of a mixture for Acute Mammalian Toxicity are those which are classified as Category 1, 2, or 3 and present at concentrations of 0.1 % or greater or are classified as Category 4 and present at concentrations of 1% or greater (w/w for solids, liquids, dusts, mists and vapors and v/v for gases) (CLP (EC 2008)).

(Dust/Mist/Fumes)

- **GREY** if the ATE for the mixture meets YELLOW or GREEN thresholds with one or more grey substances present at or above 0.1%.

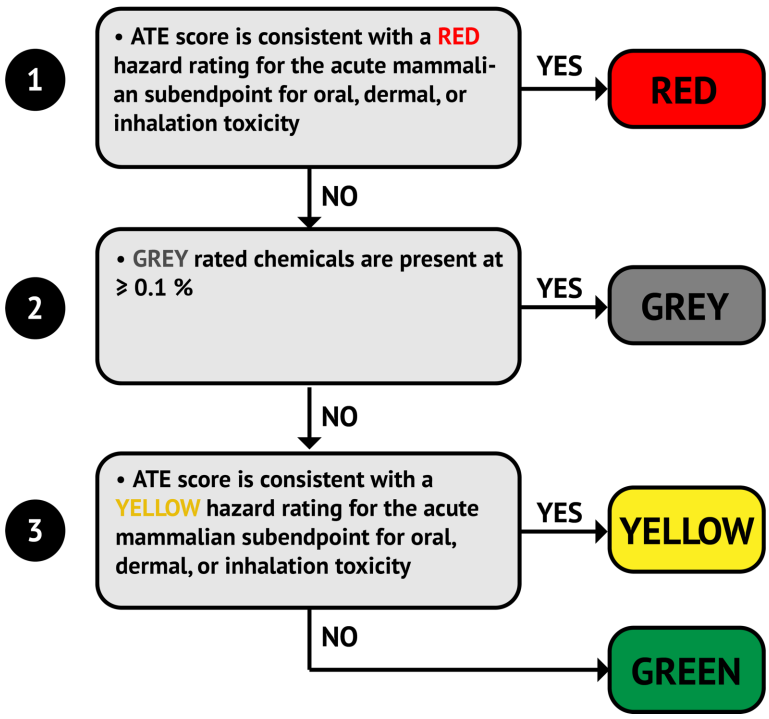


Figure 3: Mixture hazard assessment methodology flowchart for the Cradle to Cradle Certified sub-endpoint of Acute Mammalian Toxicity for Oral, Dermal, and Inhalation toxicity endpoints, respectively that results in a RED, GREY, YELLOW, or GREEN hazard rating for the mixture for those sub-endpoints.

3.2.2 *Skin, Eye, and Respiratory Irritation*

In the Cradle to Cradle Certified Material Health Assessment methodology *Skin, Eye, and Respiratory Irritation* comprise a single endpoint with the three exposure pathways as sub-endpoints. All three sub-endpoints are considered in combination when assessing an individual chemical. That is, only data on skin, eye, or respiratory irritation alone is required in order to rate a chemical as RED, YELLOW, or GREEN for the *Skin, Eye, and Respiratory Irritation* endpoint (though if data is available on any of the three sub-endpoints, it needs to be taken into account).

However, when assessing components of a mixture, the Skin Irritation and Eye Irritation endpoints must be considered separately since GHS/CLP mixture classifications differ for each sub-endpoint. The mixture hazard assessment methodology is not applied to the Respiratory Irritation sub-endpoint, since there is not a separate category for respiratory corrosion/irritation in GHS classification and the only hazard rating specific to Respiratory Irritation in GHS leads to a YELLOW assessment (H335). Once the mixture is classified for the Skin Irritation and Eye Irritation sub-endpoints using the mixture hazard assessment

methodology, all sub-endpoint hazard ratings will be considered jointly toward the Cradle to Cradle Certified endpoint for *Skin, Eye, and Respiratory Irritation* (**Figure 4**).

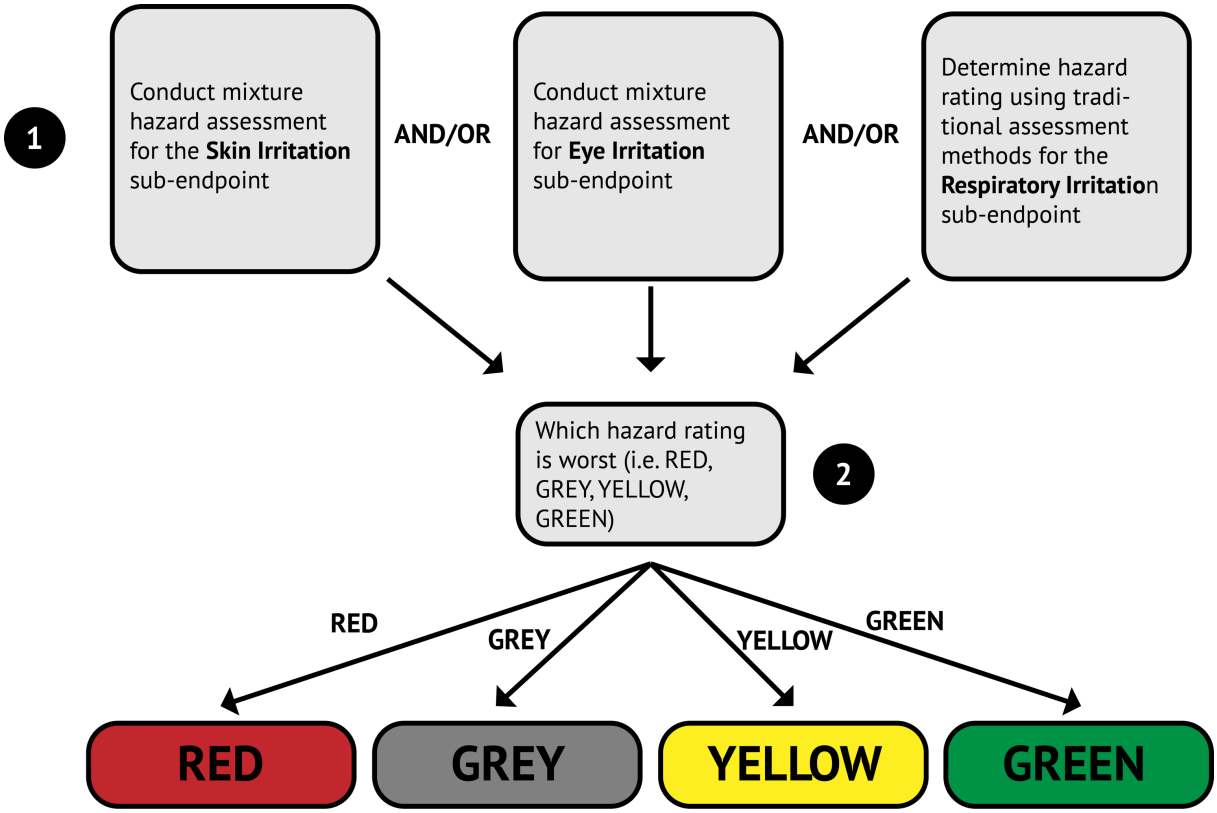


Figure 4: Summary of process for assigning a hazard rating for the Cradle to Cradle Certified endpoint of *Skin, Eye, and Respiratory Irritation* that takes into account mixture hazard ratings for the sub-endpoints of Skin Irritation and Eye Irritation.

3.4.2.1 Skin Irritation

Mixture Hazard Assessment Method: Summation Method

References: For information on the Cradle to Cradle Certified hazard rating criteria refer to sections 3.3.9 and Table 12 in the Cradle to Cradle Certified Material Health Assessment Methodology (C2CPII 2017). For a comparison between Cradle to Cradle Certified chemical hazard rating and GHS classification for this endpoint see Appendix section 5.1.1 and Table 18 in this document. Differences between the Cradle to Cradle Certified Mixture Hazard Assessment Methodology and the CLP/GHS mixture hazard assessment methodology for this endpoint may be found in Appendix section 5.1.2.2 in this document.

Process for Assigning Mixture Hazard Rating

1. **Apply the cut-off values (Table 12)** to determine which chemical components with Skin Irritation hazard are considered when deriving the mixture hazard rating for this sub-endpoint:

Table 12: Cut-off value by hazard rating for the Skin Irritation sub-endpoint.

Endpoint for Chemical Component of Mixture	Cut-off Value for Consideration Toward This Mixture Hazard Rating		
	RED	**YELLOW**	**GREY**
Skin Irritation	≥ 1 % for RED rated	≥ 0.1 % for RED rated and ≥ 1% for YELLOW rated	≥ 1% for RED rated, ≥ 0.1 % for GREY rated

2. **Assign the mixture hazard rating** for the Skin Irritation sub-end point via the following process (also illustrated in **Figure 5)**. The mixture will have a Cradle to Cradle Certified hazard rating for the Skin Irritation sub-endpoint of:

- **RED** if
    - The sum of chemicals classified as RED (present in concentrations ≥ 1 %) makes up ≥ 5 % of the mixture.
- **GREY** if the conditions for a RED rating are not fulfilled **AND**:
    - The sum of chemicals classified as RED (present in concentrations ≥ 1 %) makes up < 5 % of the mixture; **AND**
    - The sum of chemicals classified as RED (present in concentrations ≥ 1 %) and GREY (present in concentrations ≥ 0.1 %) makes up ≥ 5 % of the mixture.
- **YELLOW** if the conditions for a RED or GREY rating are not fulfilled **AND**:
    - The sum of chemicals classified as RED (present in concentrations ≥ 1 %) make up ≥ 1 % but < 5 % of the mixture; **OR**
    - [10 X the sum of chemicals classified as RED (present in concentrations ≥ 0.1 % but < 1 %) + the sum of chemicals classified as YELLOW (present in concentrations ≥ 1 %)] makes up ≥ 1 % of the mixture.
- **GREEN** if
    - The conditions for neither a RED, nor a YELLOW, nor a GREY hazard mixture rating are met.

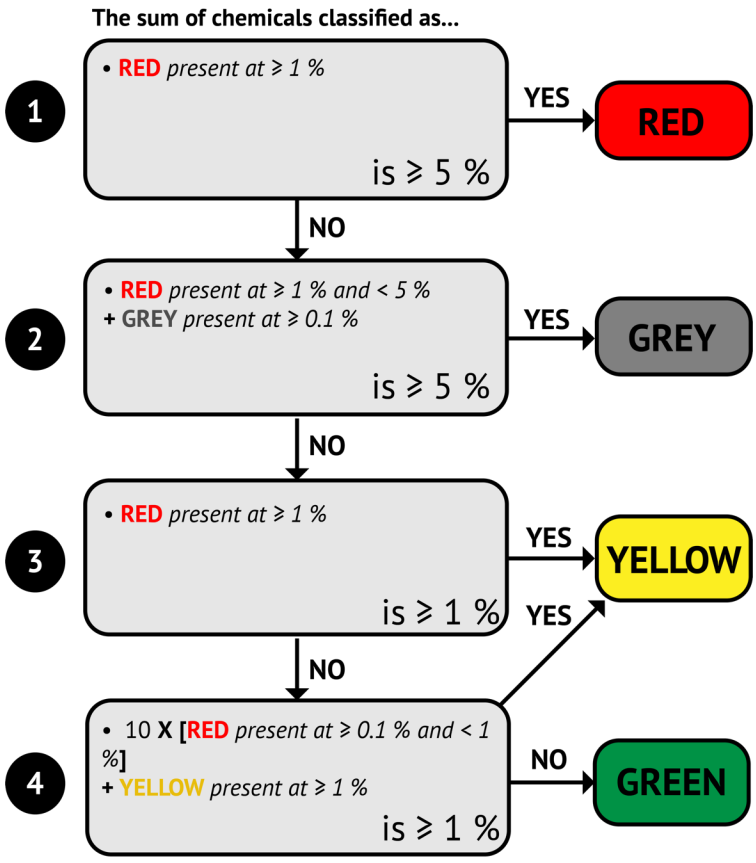


Figure 5: Mixture hazard assessment methodology flowchart for the Cradle to Cradle Certified Skin Irritation sub-endpoint that results in a RED, GREY, YELLOW, or GREEN hazard rating for the mixture for that sub-endpoint.

3.2.2.2 Eye Irritation

Mixture Hazard Assessment Method: Summation Method

References: For information on the Cradle to Cradle Certified hazard rating criteria refer to sections 3.3.9 and Table 12 in the Cradle to Cradle Certified Material Health Assessment Methodology (C2CPII 2017). For a comparison between Cradle to Cradle Certified chemical hazard rating and GHS classification for this endpoint see Appendix section 5.1.1 and Table 18 in this document. Differences between Cradle to Cradle Certified Mixture Hazard Assessment Methodology and the CLP/GHS mixture hazard assessment methodology for this endpoint may be found in Appendix section 5.1.2.3 in this document.

Process for Assigning Mixture Hazard Rating

1. **Apply the cut-off values (Table 13)** to determine which chemical components with Eye Irritation or Skin Irritation* sub-endpoint chemical hazard ratings are considered when deriving the mixture hazard rating for the Eye Irritation sub-endpoint

Table 13: Cut-off values by hazard rating for the Eye Irritation sub-endpoint.

Endpoint for Chemical Components	Cut-off Value for Consideration Toward This Mixture Hazard Rating		
	RED	**YELLOW**	**GREY**
Eye Irritation	≥ 1 % for RED rated	≥ 1 % for RED rated, **OR** between 0.1 % and 1 % for RED rated + ≥ 1% for YELLOW rated	≥ 1% and < 3 % for RED rated, ≥ 0.1 % for GREY rated
Skin Irritation*	≥ 1 % for RED rated	Not considered	Not considered

*Skin Irritation endpoints for chemical components are only considered in combination with Eye Irritation endpoints.

2. **Assign the mixture hazard rating** for the Eye Irritation sub-end point via the following process (also illustrated in **Figure 6)**. The mixture will have a Cradle to Cradle Certified hazard rating for the Skin Irritation sub-endpoint of:

- **RED** if
    - The sum of chemicals classified as RED (present in concentrations ≥ 1 %) makes up ≥ 3 % of the mixture.
- **GREY** if the conditions for a RED rating are not fulfilled **AND**:
    - The sum of chemicals classified as RED (present in concentrations ≥ 1 %) makes up < 3 % of the mixture; **AND**
    - The sum of chemicals classified as RED (present in concentrations ≥ 1 %) and GREY (present in concentrations ≥ 0.1 %) makes up ≥ 3 % of the mixture.
- **YELLOW** if the conditions for a GREY rating are not fulfilled **AND**:
    - The sum of chemicals classified as RED (present in concentrations ≥ 1 %) make up ≥ 1 % but < 3 % of the mixture; **OR**
    - [10 X the sum of chemicals classified as RED (present in concentrations ≥ 0.1 % but < 1 %) + the sum of chemicals classified as YELLOW (present in concentrations ≥ 1 %)] makes up ≥ 10 % of the mixture
- **GREEN** if
    - The conditions for neither a RED, nor a YELLOW, nor a GREY hazard mixture ratings are met.

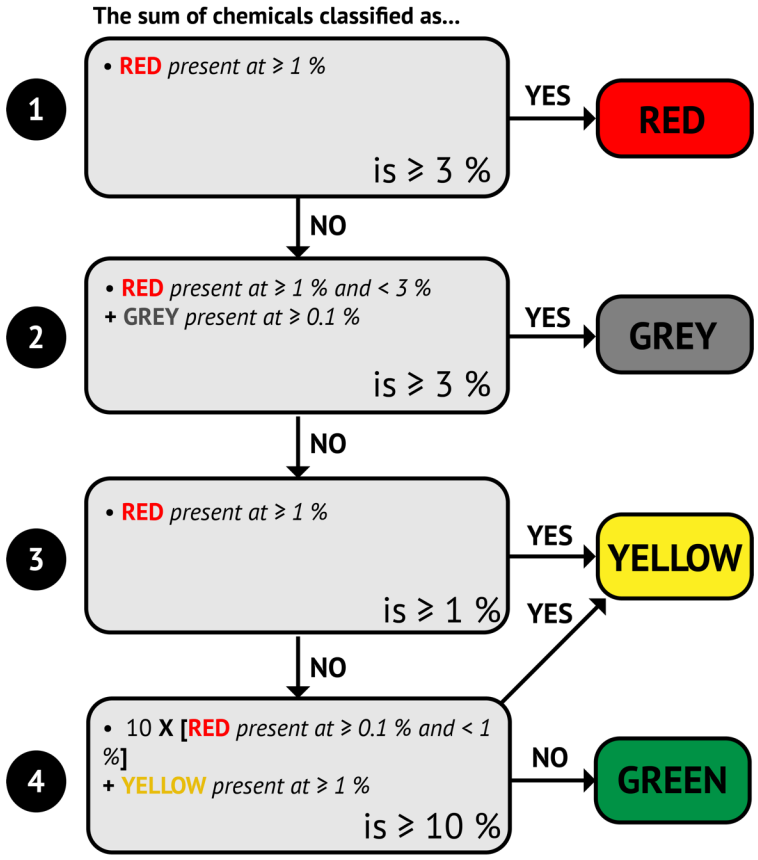


Figure 6: Mixture hazard assessment methodology flowchart for the Cradle to Cradle Certified sub-endpoint of Eye Irritation that results in a RED, GREY, YELLOW, or GREEN hazard rating for the mixture for that sub-endpoint.

3.2.3 *Skin and Respiratory Sensitization*

In the Cradle to Cradle Certified Material Health Assessment Methodology, *Skin and Respiratory Sensitization* is assessed as one endpoint (C2CPII 2017). However, when assessing components of a mixture, the Skin Sensitization sub-endpoint is considered separately from the Respiratory Sensitization sub-endpoint toward the mixture hazard classification. Only once the mixture itself is classified can both sub-endpoint categories for *Skin and Respiratory Sensitization* be considered jointly.

Both Skin Sensitization and Respiratory Sensitization data must be assessed if data are available. However, only data on one of the sub-endpoints is necessary to obtain a non-GREY rating. Then, the mixture hazard rating for this Cradle to Cradle Certified endpoint is determined by the worst hazard rating of Skin and Respiratory Sensitization (RED, GREY, YELLOW, GREEN in that order). This process is summarized in Figure 7.

The process for assigning a mixture hazard rating for Skin Sensitization or Respiratory Sensitization is identical to the standard Cradle to Cradle Material Health Assessment Methodology with regard to GHS Category 1 and 1A skin sensitizers. With regard to mixtures

containing Category 1B skin or respiratory sensitizers – the mixture will be classified as RED if it contains at least one substance that is classified as a CLP/GHS Category 1B skin or respiratory sensitizer and is present at or above the threshold of 1.0 %

Another difference with the Cradle to Cradle Material Health Assessment Methodology that may occur is when an SCL exists for a chemical for either sensitization sub-endpoint that is above or below the standard 0.01 % threshold. In either of these cases, the SCL will take precedence over the 0.01 % threshold.[14] And, if that chemical is present above that SCL threshold for either sub-endpoint, the mixture will receive a RED hazard rating.

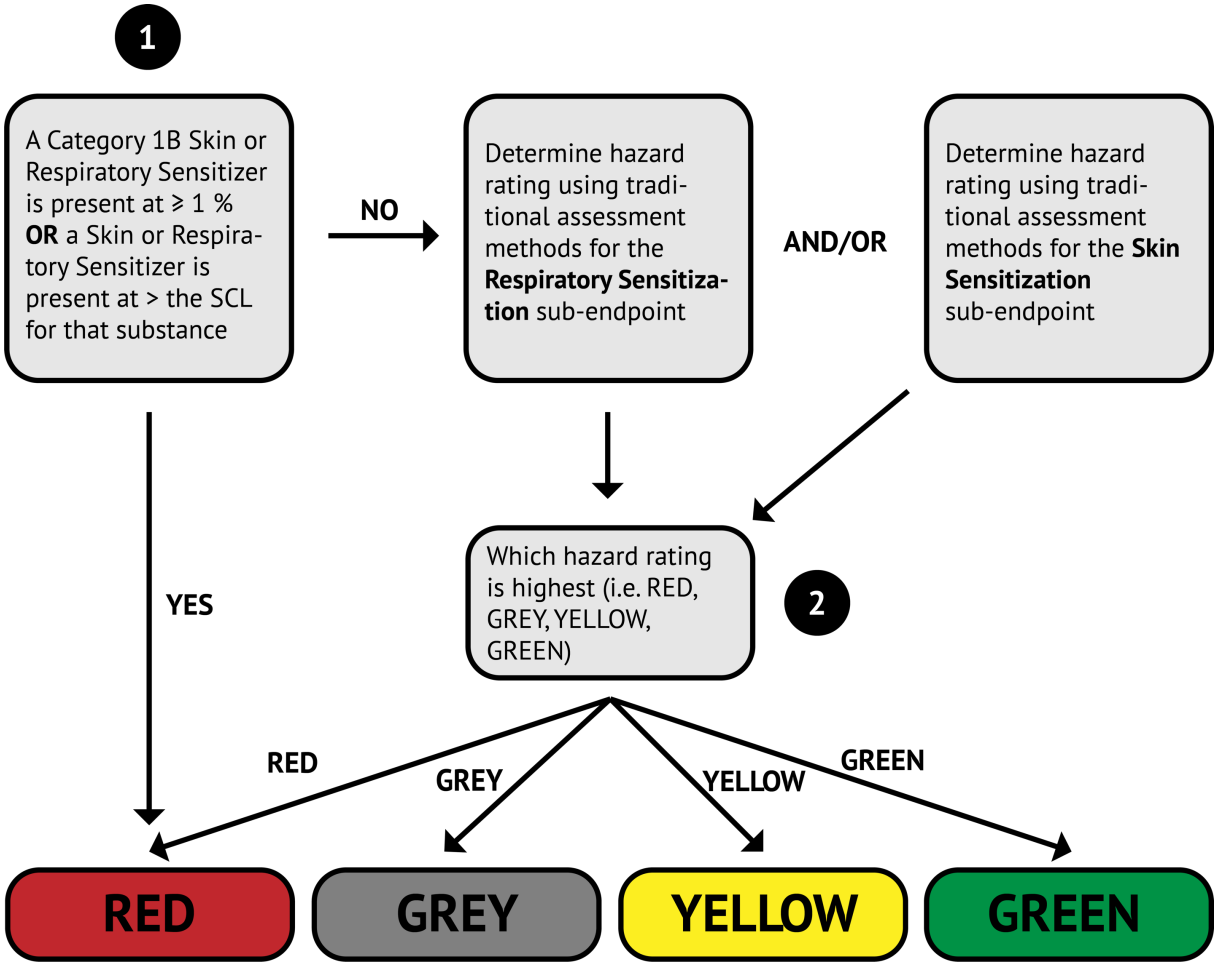


Figure 7: Summary of process for assigning a hazard rating of a mixture for the Cradle to Cradle Certified endpoint of *Skin and Respiratory Sensitization*.

[14] SCL's must be considered for formulated consumer products – pending acceptance by CSB for version 4.

3.2.4 *Acute and Chronic Aquatic Toxicity*

In the Cradle to Cradle Certified Material Health Assessment Methodology, the Acute and Chronic Aquatic Toxicity endpoints comprise of three toxicity endpoints for the different aquatic taxa (*Fish Toxicity* [acute and chronic toxicity]; *Daphnia Toxicity* [acute and chronic toxicity]*; Algae Toxicity* [acute and chronic toxicity]*).* However, when assessing the hazard of a mixture, the Acute Aquatic Toxicity sub-endpoint is considered separately from the Chronic Aquatic Toxicity sub-endpoint in the mixture hazard classification for Acute Aquatic Toxicity. Then, once the mixture itself is classified, the two sub-endpoint categories for each taxon (i.e. acute and chronic) are considered jointly. This process is summarized in Figure 8. The mixture assessment for Chronic Aquatic Toxicity (see section 3.4.7.2) is only required when the Acute Aquatic Toxicity mixture hazard assessment results in a YELLOW rating. However, if Chronic Aquatic Toxicity data is available it should be considered.

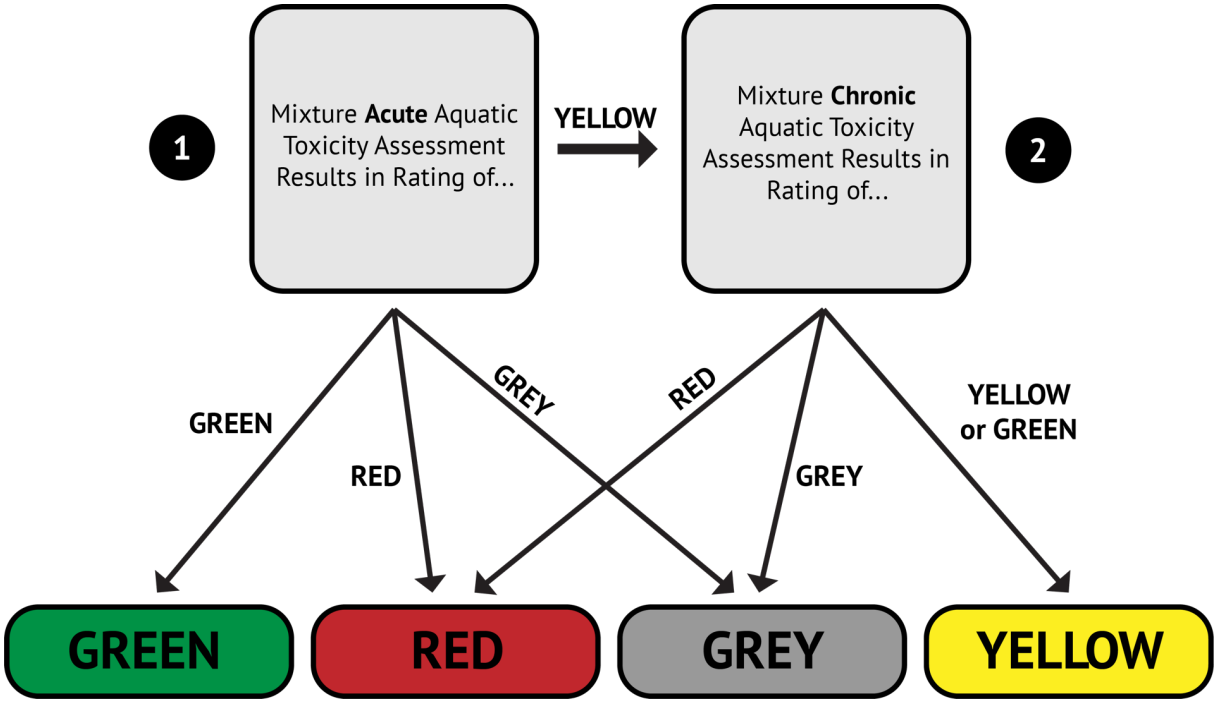


Figure 8: Summary of process for assigning a hazard rating for each of the three Cradle to Cradle Certified endpoints for Acute and Chronic Aquatic Toxicity (Fish, Daphnia, Algae) that takes into account mixture hazard ratings for the sub-endpoints of Acute Aquatic Toxicity and Chronic Aquatic Toxicity.

3.2.4.1 Fish, Daphnia and Algae Toxicity (Acute Toxicity)

Mixture Hazard Assessment Method: Summation Method

References: For information on the Cradle to Cradle Certified hazard rating criteria refer to sections 3.3.12 and Tables 16, 17, and 17 in the Cradle to Cradle Certified Material Health Assessment Methodology (C2CPII 2017). For a comparison between Cradle to Cradle Certified chemical hazard rating and GHS classification for this endpoint see Appendix section 5.1.1 and Table 18 in this document. Differences between the Cradle to Cradle Certified Mixture Hazard Assessment Methodology and the CLP/GHS mixture hazard assessment methodology for this endpoint may be found in Appendix section 5.1.2.6 in this document.

Process for Assigning Mixture Hazard Rating

1. **Determine Cradle to Cradle Certified chemical hazard rating and M factor from GHS classification and/or L(E)C_{50} values (Table 14).** Cradle to Cradle Certified chemical hazard ratings for Acute Aquatic Toxicity are designated as Acute 1, Acute 2, YELLOW, GREEN, or GREY. If classified as Acute 1, determine what M factor applies. If only GHS classification or H-statements are available, and no toxicity data is available, the M-factor may be assumed to equal one.

Table 14: M Factors by L(E)C_{50} values (mg/l) and GHS Chronic Aquatic Toxicity Classification or designated Cradle to Cradle Certified hazard ratings for the Chronic Toxicity sub-endpoint (fish, daphnia, or algae).

L(E)C_{50} value (mg/l) or GHS Acute Aquatic Toxicity Classification for Fish, Daphnia, or Algae	**Designated Hazard Classification**	**Designated M factor**
No data available	GREY	N/A
> 100 or GHS Not Classified	GREEN[a]	N/A
100 ≥ L(E)C_{50} > 10; GHS Acute Category 3: H402	YELLOW	N/A
10 ≥ L(E)C_{50} > 1; GHS Acute Category 2; H401	Acute 2	N/A
1 ≥ L(E)C_{50} > 0.1; GHS Acute Category 1; H400	Acute 1	1
0.1 ≥ L(E)C_{50} > 0.01		10
0.01 ≥ L(E)C_{50} > 0.001		100
0.001 ≥ L(E)C_{50} > 0.0001		1000
(continue in factor 10 intervals)		10 X previous entry

2. **Apply the cut-off values (Table 15)** to determine which chemical components with Acute Aquatic Toxicity sub-endpoint hazard ratings are considered when deriving each mixture hazard rating for the Acute Aquatic Toxicity sub-endpoint.

Table 15: Cut-off values by chemical hazard rating for the Acute Aquatic Toxicity (daphnia, fish, algae) sub-endpoints.

Sub-endpoint for Chemical Component	Cut-off Values for Consideration Toward This Mixture Hazard Rating		
	RED	**YELLOW**	**GREY**
Acute Aquatic Toxicity	≥ 0.1 % for Acute 1 rated chemicals, ≥ 1 % for Acute 2, chemicals	≥ 0.1 % for Acute 1 rated chemicals, ≥ 1 % for Acute 2 rated chemicals, ≥ 1 % for YELLOW rated chemicals	≥ 0.1 % for Acute 1 rated chemicals, ≥ 1 % for Acute 2, and ≥ 0.1 % for GREY rated

3. **Assign the mixture hazard rating** for the Acute Aquatic Toxicity sub-end point via the following process (also illustrated in **Figure 9**). The mixture will have a Cradle to Cradle Certified hazard rating for the Acute Aquatic Toxicity sub-endpoint of:

- **RED** if
    - [10 X the sum of chemicals classified as Acute 1 (present in concentrations ≥ 0.1 %) X M + the sum of chemicals classified as Acute 2 (present in concentrations ≥ 1 %)] is ≥ 25 %.
- **GREY** if the conditions for assigning a RED hazard mixture rating are not met **AND**:
    - [10 X the sum of chemicals classified as Acute 1 (present in concentrations ≥ 0.1 %) X M + the sum of chemicals classified as Acute 2 (present in concentrations ≥ 1 %) + 10 X the sum of chemicals classified as GREY (present in concentrations ≥ 0.1 %)] is ≥ 25 %
- **YELLOW** if conditions for assigning a RED or GREY hazard mixture rating are not met **AND**:
    - [100 X the sum of chemicals classified as Acute 1 (present in concentrations ≥ 0.1 %) X M + 10 X the sum of chemicals classified as Acute 2 (present in concentrations ≥ 1 %) + the sum of chemicals classified as YELLOW (present in concentrations ≥ 1 %)] is ≥ 25 %.
- **GREEN** if
    - If the conditions for assigning a RED, YELLOW, and GREY rating are not met.

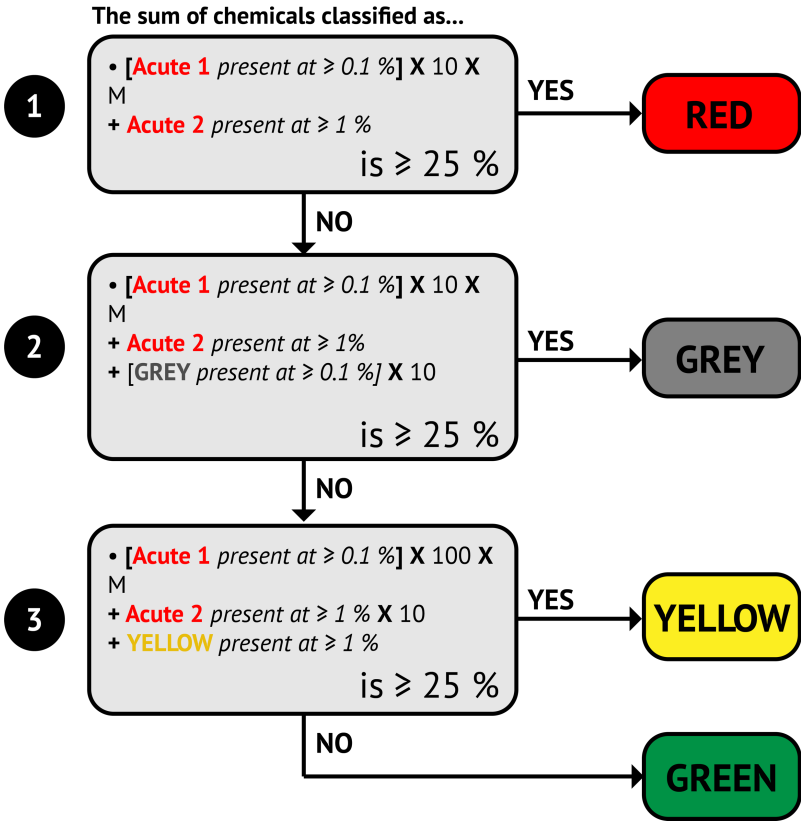


Figure 9: Mixture hazard assessment methodology flowchart for the Cradle to Cradle Certified sub-endpoint of Acute Aquatic Toxicity (for Fish, Daphnia, and Algae) that results in a RED, GREY, YELLOW, or GREEN hazard rating for the mixture for that sub-endpoint.

3.2.4.2 Fish, Daphnia, and Algae Toxicity (Chronic Toxicity)

Mixture Hazard Assessment Method: Summation Method

References: For information on the Cradle to Cradle Certified hazard rating criteria refer to sections 3.3.12 and Tables 15, 16, and 17 in the Cradle to Cradle Certified Material Health Assessment Methodology (C2CPII 2017). For a comparison between Cradle to Cradle Certified chemical hazard rating and GHS classification for this endpoint see Appendix section 5.1.1 and Table 18 in this document. Differences between the Cradle to Cradle Certified Mixture Hazard Assessment Methodology and the CLP/GHS mixture hazard assessment methodology for this endpoint may be found in Appendix section 5.1.2.7 in this document.

Process for Assigning Mixture Hazard Rating

1. **Determine Cradle to Cradle Certified chemical hazard rating and M factor from GHS classification and/or L(E)C_{50} values (Table 16).** Cradle to Cradle Certified chemical hazard ratings for Chronic Aquatic Toxicity are designated as Chronic 1, Chronic 2, Chronic 3, Chronic 4, YELLOW, GREEN, or GREY. If classified as Chronic 1, determine what M factor

applies. If only GHS classification or H-statements are available, and no toxicity data is available, the M-factor may be assumed to equal one.

Table 16: M Factors by NOEC values (mg/l) and GHS Chronic Aquatic Toxicity Classification or Cradle to Cradle Certified hazard rating for The Chronic Toxicity sub-endpoint (fish, daphnia, or algae).

NOEC value (mg/l) or GHS Chronic Aquatic Toxicity Classification for Fish, Daphnia, or Algae	Designated Hazard Classification	Designated M factor
No data available	GREY	N/A
NOEC > 10	GREEN	N/A
10 ≥ NOEC > 1	YELLOW	N/A
GHS Category Chronic 4; H413	Chronic 4	N/A
GHS Category Chronic 3; H412	Chronic 3	N/A
1 ≥ NOEC > 0.1 or GHS Category Chronic 2; H411	Chronic 2	N/A
0.1 ≥ NOEC > 0.01; GHS Category Chronic 2; H410	Chronic 1	1
0.01 ≥ NOEC > 0.001		10
0.001 ≥ NOEC > 0.0001		100
0.0001 ≥ NOEC > 0.00001		1000
continue in factor 10 intervals)		10 X previous entry

2. **Apply the cut-off values (Table 17)** to determine which chemical components with Chronic Aquatic Toxicity must be considered when deriving each hazard mixture rating for the Chronic Toxicity sub-endpoint.

Table 17: Cut-off values by chemical hazard rating for the Chronic Aquatic Toxicity (daphnia, fish, algae) sub-endpoints.

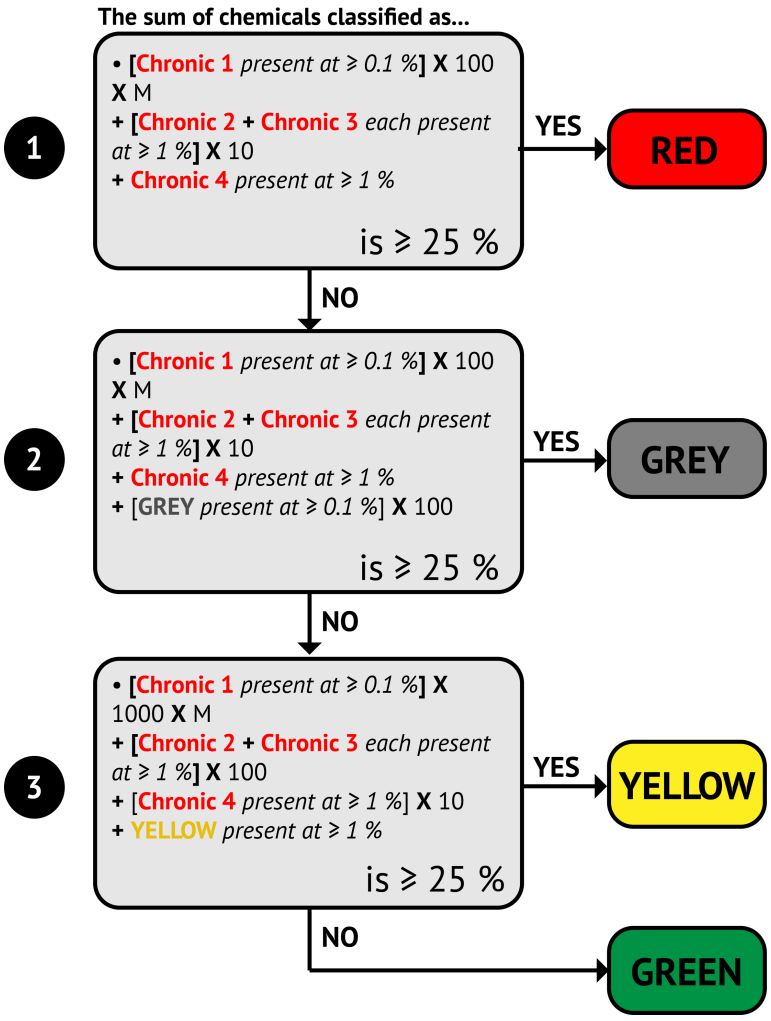
Endpoint for Chemical Component	Cut-off Values for Consideration Toward This Mixture Hazard Rating		
	RED	**YELLOW**	**GREY**
Chronic Aquatic Toxicity	≥ 0.1 % for Chronic 1[15] rated chemicals), ≥ 1 % for Chronic 2, 3, and 4 rated chemicals	≥ 1 % for YELLOW rated chemicals	≥ 0.1 % for GREY rated

3. **Assign the mixture hazard rating** for the Chronic Aquatic Toxicity sub-end point via the following process (also demonstrated in **Figure 10**). The mixture will have a Cradle to Cradle Certified hazard rating for the Acute Aquatic Toxicity sub-endpoint of:

- **RED** if
    - [100 X the sum of chemicals classified as Chronic 1 (present in concentrations ≥ 0.1) X M + 10 X the sum of chemicals classified as Chronic 2 and Chronic 3 (each present in concentrations ≥ 1 %) + the sum of chemicals classified as Chronic 4 (present in concentrations ≥ 1 %)] is ≥ 25 %.
- **GREY** if the conditions for assigning a RED hazard mixture rating are not met **AND**:
    - [100 X the sum of chemicals classified as Chronic 1 (present in concentrations ≥ 0.1) X M + 10 X the sum of chemicals classified as Chronic 2 and Chronic 3 (each present in concentrations ≥ 1 %) + the sum of chemicals classified as Chronic 4 (present in concentrations ≥ 1 %) + 100 X the sum of chemicals classified as GREY] is ≥ 25 %.
- **YELLOW** if the conditions for assigning a RED or GREY hazard mixture rating are not met **AND**:
    - [1000 X the sum of chemicals classified as Chronic 1 (present in concentrations ≥ 0.1) X M + 100 X the sum of chemicals classified as Chronic 2 and Chronic 3 (each present in concentrations ≥ 1 %) + 10 X the sum of chemicals classified as Chronic 4 (present in concentrations ≥ 1 %) + the sum of chemicals classified as YELLOW (present in concentrations ≥ 1 %)] is ≥ 25 % of the mixture
- **GREEN** if
    - If the conditions for assigning a RED, YELLOW, and GREY hazard mixture rating are not met.

[15] If the Chronic 1 chemical is highly toxic (NOEC ≤ 0.01 mg/ml), this chemical will also be considered if at a concentration < 0.1 %.

Figure 10: **Process to assign mixture hazard ratings** for the Cradle to Cradle Certified Chronic Aquatic Toxicity sub-endpoint (for Fish, Daphnia, and Algae).



4 GENERAL DATA AND INFORMATION SOURCES

1. Cradle to Cradle Products Innovation Institute (C2CPII). 2017. Cradle to Cradle Certified™ Products Standard Version 3.1. Material Health Assessment Methodology. Available: http://s3.amazonaws.com/c2c-website/resources/certification/standard/MTD_Material_Health_Assessment_FINAL_052617.pdf

2. European Commission (EC). 2008. Regulation (EC) No 1272/2008 Of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006. Available: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:353:0001:1355:EN:PDF

3. European Commission (EC). 2014. Assessment of Mixtures - Review of Regulatory Requirements and Guidance. Available: https://eurl-ecvam.jrc.ec.europa.eu/news/assessment-mixures-report

4. United Nations (UN). 2015. Globally Harmonized System of Classification and Labelling of Chemicals (GHS). Sixth revised edition. Available: http://www.unece.org/trans/danger/publi/ghs/ghs_rev06/06files_e.html

5 APPENDIX

5.1 CLP/GHS Criteria and Mixture Hazard Assessment Methodology in the Context of Cradle to Cradle Certified Material Health Assessment

5.1.1 Mapping CLP/GHS Hazard Ratings to Cradle to Cradle Certified Hazard Ratings

In order to perform a Cradle to Cradle Certified Mixture Hazard Assessment based on the GHS/CLP mixture hazard assessment methodology, it is helpful to have an understanding of how the RED, YELLOW, GREEN, and GREY chemical hazard ratings correspond to GHS/CLP chemical hazard classification. Table 11 details how Cradle to Cradle Certified chemical hazard ratings compare to GHS/CLP chemical hazard classifications.

Table 18: How Cradle to Cradle Certified Hazard Ratings correspond with CLP/GHS Classifications and H-statements.

Cradle to Cradle Certified Endpoint	Sub-Endpoint for Mixture Classification Purposes	CLP/GHS Chemical Hazard Classification or Data Corresponding to Cradle to Cradle Certified Chemical Hazard Ratings			
		RED	YELLOW	GREEN	GREY
Acute Toxicity (Oral, Dermal, or Inhalation)	**Acute Mammalian Toxicity (Oral, Dermal, or Inhalation)**	CLP/GHS Category 1, 2 or 3 (H300, H301, 3311, H330, H331)	CLP/GHS Category 4 (H302, H312, H332)	Not classified per CLP/GHS.	No data identified.
Skin, Eye, and Respiratory Irritation	**Skin Irritation**	CLP/GHS Cat. 1A, B, or C for Skin Irritation (H314)	GHS Cat. 2 (H315) or Cat 3 (H316) for Skin Irritation	No evidence of Skin Irritation in human or animal studies.	No data identified.
	Eye Irritation	CLP/GHS Cat. 1 for Eye Irritation (H318)	CLP/GHS Cat 2A (H319), or GHS Cat. 2B (H320) for Eye Irritation	No evidence of Eye Irritation in human and/or	No data identified.

				animal studies	
	Respiratory Irritation	Respiratory Irritation endpoint not considered for chemical substances for the Cradle to Cradle Certified Mixture Hazard Assessment Methodology.			
Skin and Respiratory Sensitization	**Skin Sensitization**	GHS Cat. 1 for Skin Sensitization	Triggers positive responses in animal testing, but not enough to trigger GHS classification	No evidence of Skin Sensitization in human or animal studies	No data identified
	Respiratory Sensitization	GHS Cat. 1 for Respiratory Sensitization	Triggers positive responses in animal testing, but not enough to trigger GHS classification	No evidence of Skin Sensitization in human or animal studies	No data identified
Acute Aquatic Toxicity		GHS Cat. 1 (H400), GHS Category 2 (H401). *L(E)C_{50} is ≤ 10 mg/L*.	GHS Cat. 3 (H402). *10 < L(E)C_{50} ≤ 100 mg/ml or 1 < NOEC ≤ 10 mg/ml.*	Not Classified for Acute or Chronic. *L(E)C_{50} ≥ 100 mg/L in any of three trophic levels or NOEC > 10 mg/ml.*	No data identified for acute toxicity.
Chronic Aquatic Toxicity		GHS Category 1 (H410), 2 (H411), 3 (H412), or 4	1 < NOEC ≤ 10 mg/ml	GHS Not Classified. *NOEC > 10 mg/ml.*	No data identified for chronic toxicity.

		(H413). *NOEC is < 1 mg/ml.*			

5.1.2 Differences Between the GHS/CLP Mixture Hazard Assessment Methodology and the Cradle to Cradle Certified Mixture Hazard Assessment Methodology.

5.1.2.1 *Oral, Dermal, and Inhalation Toxicity* (Acute Mammalian)

The Cradle to Cradle Certified criteria for assessing the hazard of a mixture for this endpoint are very similar to the CLP/GHS criteria. The main difference is in how a GREY rating for a mixture is derived. CLP/GHS has no guidance as to rating a mixture as GREY. In the case of Cradle to Cradle Certified criteria, a GREY rating is derived if only GREY rated chemicals (present at ≥ 0.1%) are present in the mixture and no RED rated chemicals (present at ≥ 0.1%) are present in the mixture.

5.1.2.2 Skin Irritation

Because a GHS Category 2 (H315: Causes Skin Irritation) and a GHS Category 3 (H316: Causes mild Skin Irritation) both correspond to Cradle to Cradle Certified YELLOW hazard rating for Skin Irritation, the methodology is significantly simplified. As a result, the Cradle to Cradle Certified Mixture Hazard Assessment Methodology is also more conservative than the GHS methodology since GHS Category 3 are grouped with GHS Category 2 chemicals. This means that if GHS Category 3 chemicals are present at concentrations > 1%, as opposed to 10% as indicated by the CLP/GHS criteria, the mixture is rated overall as YELLOW.

Weighting factors and concentration limits in the CLP/GHS methodology are applied similarly in Cradle to the Cradle Certified Mixture Hazard Assessment Methodology.

5.1.2.3 Eye Irritation

The CLP/GHS mixture hazard assessment methodology also takes into account chemical components' Skin Irritation hazard ratings toward the Eye Irritation mixture hazard classification. However, Skin Irritation is only taken into account if it would contribute to a GHS Category 1 hazard mixture rating (or a Cradle to Cradle Certified RED mixture hazard rating) for Eye Irritation. The Cradle to Cradle Certified Mixture Hazard Assessment Methodology similarly combine Skin Irritation and Eye Irritation hazard ratings for chemical components toward an overall mixture hazard assessment.

Weighting factors and concentration limits in the CLP/GHS mixture hazard assessment methodology is applied similarly in the Cradle to Cradle Certified Mixture Hazard Assessment Methodology.

5.1.2.4 Skin Sensitization

The main difference between the GHS/CLP mixture hazard assessment methodology and the Cradle to Cradle Certified Mixture Hazard Assessment Methodology for this sub-endpoint is that a chemical that produces mild Skin Sensitization is assigned a YELLOW hazard rating for Skin Sensitization in the Cradle to Cradle Certified Mixture Hazard Assessment Methodology, but is not classifiable per CLP/GHS.

5.1.2.5 Respiratory Sensitization

The main difference between GHS/CLP and Cradle to Cradle Certified mixture hazard assessment methodology for this sub-endpoint is that a chemical that produces a positive response in animal studies is assigned a YELLOW hazard rating in the Cradle to Cradle Certified Mixture Hazard Assessment Methodology, but is not classifiable per CLP/GHS.

5.1.2.6 Fish, Daphnia, and Algae Toxicity (Acute Toxicity)

The Cradle to Cradle Certified chemical hazard rating criteria for Acute Aquatic Toxicity are not directly correlated to GHS hazard classification criteria for this endpoint: a chemical with a Cradle to Cradle Certified hazard rating of RED corresponds either to GHS Category 1 ($LC_{50}/EC_{50} \leq 1$ mg/L; H400) or GHS Category 2 ($LC_{50}/EC_{50} > 1$ but ≤ 10 mg/L; H401). However, the YELLOW hazard rating corresponds to a GHS Category 3 ($LC_{50}/EC_{50} > 10$ but ≤ 100 mg/L; H402). Therefore, in order to create the Cradle to Cradle Certified Mixture Hazard Assessment Methodology that apply GHS mixture hazard assessment criteria, chemicals that are assigned a Cradle to Cradle Certified hazard rating of RED need to be split into two categories based on their LC_{50}/EC_{50} values. These include chemicals with $LC_{50}/EC_{50} \leq 1$ mg/L (Acute 1) and chemicals with $LC_{50}/EC_{50} > 1$ but ≤ 10 mg/L (Acute 2). These two terminologies are used below in the process for assigning the mixture hazard rating.

The concentration limits in the GHS mixture hazard assessment methodology applies similarly in the Cradle to Cradle Certified Mixture Hazard Assessment Methodology. According to the GHS mixture hazard assessment methodology, a classification is relevant only when chemicals classified as Acute Aquatic Toxicity Category 1 (RED rated and Acute 1 under Cradle to Cradle Certified) are present at ≥ 0.1%, while the chemicals classified as Acute Aquatic Toxicity Category 2 (RED rated and Acute 2 under Cradle to Cradle Certified)) or 3 (YELLOW rated under Cradle to Cradle Certified) is present at ≥ 1%[16].

[16] According to CLP section 4.1.3.1 and the GHS guidance (UN 2015) section 4.1.3.1: The 'relevant components' of a mixture are those which are classified as 'Acute Category 1' or 'Chronic Category 1' and present in a concentration of 0.1% (w/w) or greater, and those which are classified as 'Acute/Chronic Category 2', 'Acute/Chronic Category 3' or 'Chronic Category 4' and are present at

5.1.2.7 Fish, Daphnia, and Algae Toxicity (Chronic Toxicity)

The Cradle to Cradle Certified chemical hazard rating criteria for Chronic Aquatic Toxicity are not directly correlated with CLP/GHS hazard classification criteria for this endpoint. Mainly, a chemical with a GHS Category Chronic 1 (H410), GHS Category Chronic 2 (H411), GHS Category Chronic 3 (H412), and GHS Category 4 (H413) corresponds to a Cradle to Cradle Certified hazard rating of RED. However, there is no corresponding CLP/GHS classification for the YELLOW hazard rating. These differences in hazard criteria result in the following differences in the mixture hazard assessment methodology criteria:

- Chemicals that are assigned a Cradle to Cradle Certified hazard rating of RED need to be split into four categories based on their CLP/GHS classification. These include **Chronic 1** (H410), **Chronic 2** (H411), **Chronic 3** (H412) and **Chronic 4** (H413). These terminologies are used below for the process for assigning the mixture hazard rating for this endpoint.
- Because a Cradle to Cradle Certified YELLOW hazard rating criteria for a Chronic Aquatic Toxicity corresponds to a chemical not being classified per CLP/GHS (not associated with H statement), the CLP/GHS mixture assessment principles described in the process for assigning a mixture hazard rating for Categories 2, 3, and 4 are applied here to determine the Cradle to Cradle Certified hazard rating of YELLOW for the mixture.
- CLP/GHS criteria take into account the biodegradability and persistence of the component chemical when classifying the GHS Category and M-factor for Chronic Aquatic Toxicity. However, because persistence and bioaccumulation is evaluated separately under the Cradle to Cradle Certified hazard assessment methodology, only the NOEC valueis considered toward Chronic 1 categorization, unless GHS classification or H-statements are available for that chemical component.
- CLP/GHS criteria take into account Acute Aquatic Toxicity with persistence/bioaccumulation data to fill in data gaps in Chronic Aquatic Toxicity data. However, because Acute Aquatic Toxicity is considered in combination with Chronic Aquatic Toxicity when evaluating the overall mixture, only NOEC values are considered here, unless GHS classification or H-statements are available for that chemical component.

The concentration limits in the GHS mixture hazard assessment methodology applies similarly in Cradle to Cradle Certified Mixture Hazard Assessment Methodology. According to the GHS mixture

---

a concentration of 1% (w/w) or greater, unless there is a presumption (such as in the case of highly toxic components (see 4.1.3.5.5.5) that a component present in a lower concentration can still be relevant for classifying the mixture for Aquatic Environmental hazards. Generally, for substances classified as 'Acute Category 1' or 'Chronic Category 1' the concentration to be taken into account is (0.1 %) (see Table 1.1 in CLP (EC 2008)).

hazard assessment methodology, a classification is relevant only when the substance classified as Chronic Aquatic Toxicity Category 1 (RED rated and Chronic 1 under Cradle to Cradle Certified) is present at ≥ 0.1%, while chemicals classified as Chronic Aquatic Toxicity Categories 2, 3, or 4 (RED rated and Chronic 2, 3, or 4 under Cradle to Cradle Certified) are present at ≥ 1%.[17] This is applied to Cradle to Cradle Certified Mixture Hazard Assessment Methodology.

[17] According to CLP section 4.1.3.1 and the GHS guidance (UN 2015) section 4.1.3.1: The 'relevant components' of a mixture are those which are classified as 'Acute Category 1' or 'Chronic Category 1' and present in a concentration of 0.1% (w/w) or greater, and those which are classified as 'Acute/Chronic Category 2', 'Acute/Chronic Category 3' or 'Chronic Category 4' and are present at a concentration of 1% (w/w) or greater, unless there is a presumption (such as in the case of highly toxic components (see 4.1.3.5.5.5) that a component present in a lower concentration can still be relevant for classifying the mixture for Aquatic Environmental hazards. Generally, for substances classified as 'Acute Category 1' or 'Chronic Category 1' the concentration to be taken into account is (0.1 %) (see Table 1.1 in CLP (EC 2008).

Exposure Assessment Methodology

Last Revision: October 2020

Copyright

Trademark

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

EXPOSURE ASSESSMENT METHODOLOGY REVISION HISTORY

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
September 22, 2017	Initial Release		S. Klosterhaus
March 2018	3.1.1	Added interpretation of how to assess exposure to vanadium or other non-lead, non-nickel toxic metals that are part of the alloy crystallites in a true alloy such as steel.	S. Klosterhaus
March 2018	3.2.1	Clarified the documentation needed for final manufacturing sites that are not visited (including those for MHCs).	S. Klosterhaus
March 2018	3.2.3a(i)	Clarified scope of the material “bound to or encapsulated by the material matrix” to include metals within metal alloys when a part of the alloy crystallites.	S. Klosterhaus
March 2018	3.2.3b(iv)	Clarified assumption of environmental exposure during use to include cases where there is aquatic toxicity but no GREEN ratings for Persistence and Bioaccumulation.	S. Klosterhaus
March 2018	3.2.4a(iii)	Clarified scope of bound materials in a matrix to include metals.	S. Klosterhaus
September 2018	3.2.1(i) and Appendix 1	Added options for assessing effluent.	S. Klosterhaus
September 2018	3.2.3	Clarified that the use phase questions can be applied to intermediate products in some cases.	S. Klosterhaus
September 2018	3.2.3 and Appendix 2	Added requirements for verifying that exposure to dermal sensitizers is not plausible during professional use.	S. Klosterhaus
October 2020	3.1.1	Added a footnote clarifying how to interpret the “others” category that is sometimes included on alloy spec sheets.	S. Klosterhaus
October 2020	3.1.2, step 1b, c.ii	Deleted “and boiling point is >400ºC” and added a footnote clarifying that modeled data may be used for vapor pressure determination.	S. Klosterhaus
October 2020	3.2.2 and Appendix 2	Added section to clarify exposure considerations for subsequent manufacturing steps that were previously addressed in other sections.	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
October 2020	3.2.3	Clarified the processes and products this section is applicable to. Clarified exposure considerations for professional installation, application, use and/or maintenance that were previously addressed in the use stage section.	S. Klosterhaus
October 2020	3.2.3b and Appendix 2	Clarified the exception for intermediate and other professional use products, which allows for the inclusion of a disclaimer on the certificate regarding issues with sensitization or corrosion/irritation (not previously addressed) when evidence of training on proper handling of product and use of PPE is provided.	S. Klosterhaus
October 2020	3.2.4 a.i	Added quartz in bulk form as another example of substances that may be considered bound in a material matrix. This is also now noted in section 3.2.1.	S. Klosterhaus
October 2020	3.2.4 iv	Clarified the categories of products that must be considered to be released to the environment during use.	S. Klosterhaus
October 2020	3.2.5	Clarified which end of use scenarios must be considered for long use phase products.	S. Klosterhaus

1 DOCUMENT OVERVIEW

1.1 PURPOSE AND CONTENT

The Cradle to Cradle Certified exposure assessment method is briefly described in the Cradle to Cradle Certified Material Health Assessment Methodology document. The purpose of this document is to clarify and further define how to complete an exposure assessment.

An exposure assessment is completed after hazard ratings have been assigned to individual endpoints. Once an exposure assessment is complete, risk flags, abc-x single chemical risk ratings, and ABC-X material assessment ratings may be assigned. The process for assigning hazard ratings, risk flags, abc-x single chemical risk ratings, and ABC-X material assessments are further described in the Cradle to Cradle Certified Material Health Assessment Methodology.

1.2 SUPPORTING DOCUMENTS

The following documents are to be used in conjunction with this document:

- Cradle to Cradle Certified™ Product Standard
- Cradle to Cradle Certified™ Material Health Assessment Methodology
- Any additional Cradle to Cradle Certified standard documents and methodology documents posted on the C2CPII website.

2 EXPOSURE ASSESSMENT OVERVIEW

2.1 A QUALITATIVE, NOT QUANTITATIVE APPROACH

Exposure to a chemical substance in conjunction with its inherent hazard properties will determine its effect on target organisms or target organs/tissues. In the Cradle to Cradle Certified Material Health Assessment and Exposure Assessment Methodologies, the likelihood of detrimental effects, or risk, is considered to be a function of intrinsic hazard and exposure. The Cradle to Cradle methodology differs from traditional exposure and risk assessment in that no attempt is made to quantify the amount of exposure that occurs.

2.2 SUMMARY OF METHODOLOGY

The exposure assessment for an individual chemical begins when the chemical has been associated with a particular material and product, and the chemical hazard profile has been completed. At this point, each hazard endpoint will have been assigned a GREEN, YELLOW, RED or GREY hazard rating. An exposure assessment is then completed separately for individual hazard endpoints.

An exposure assessment is primarily undertaken when RED or GREY hazard ratings for one or more endpoints have been assigned. Exposure assessment is optional in the case of a YELLOW or GREEN

hazard rating. Therefore, for the remainder of these instructions it is assumed that only RED and GREY hazard ratings are under consideration.

If exposure is unlikely to occur, one or more RED or GREY hazard ratings can be assigned YELLOW risk flags. In order to assign a YELLOW risk flag to an endpoint with a RED or GREY hazard rating, it must be determined that relevant exposure is unlikely in all use cycle stages[1], beginning with the final manufacturing stage. If there is uncertainty regarding whether or not exposure will occur, a precautionary approach is applied and exposure is assumed to occur.

Step 1 of the method addresses cases where exposure assessments are not required, either due to certain exceptions to the rules or because data gaps do not affect the single chemical risk rating. Step 2 explains how to incorporate exposure considerations when required. If, after Step 1 is complete, only YELLOW and GREEN hazard ratings remain for the chemical under consideration, then a single chemical risk rating of ‘c’ may be assigned and the exposure assessment is complete (i.e. it is not necessary to conduct Step 2).

It usually will not be necessary to go through every step of the exposure assessment process for each RED or GREY endpoint, depending on the specific chemical’s hazard profile, the material it is in, and product context. This is because a single RED risk flag leads to an x single chemical risk rating, thus obviating the need for further assessment. If a definitive abc-x rating can be derived for a substance following any subset of the rules below for any number of endpoints, the remainder of the rules and/or endpoints need not be evaluated. In addition, the Cradle to Cradle Mixture Rules should be consulted as they may influence whether or not an exposure assessment is required.

2.3 SPECIAL CONSIDERATIONS: TOXICITY TESTING OF MIXTURES

In some cases, toxicity testing may have been performed on an entire homogeneous material or formulation. If such testing makes it possible to assign a GREEN or YELLOW hazard rating to one or more endpoints for a homogeneous material, this may be used in place of toxicity data and associated hazard ratings for individual chemicals within the material or formulation. In this case an exposure assessment would not be required for the relevant endpoints of the individual chemicals. Instead, if relevant RED hazard ratings are identified for the homogeneous material, an exposure assessment should be undertaken for the homogeneous material. Tests that are sometimes available for homogeneous materials or formulations are those relevant to the *Sensitization of Skin and Airways*, aquatic toxicity (*Fish Toxicity, Daphnia Toxicity* and *Algae Toxicity*), and acute toxicity (*Oral Toxicity*) endpoints.

[1] All use cycle stages = final manufacturing, installation, use, and end of use (e.g., recycling, incineration, back yard burning and/or landfill). Commonly known as life-cycle stages.

2.4 MAINTAINING CONSISTENCY

For the purposes of Cradle to Cradle certification and the Cradle to Cradle Material Health Certificate Program, exposure assessments are conducted by Cradle to Cradle Products Innovation Institute (C2CPII) accredited material health assessment bodies, who have expertise in the areas of chemistry and toxicology. Assessors are required to follow the methodology described in this document when carrying out an exposure assessment to ensure consistency among Material Health assessments.

This methodology aligns with current Cradle to Cradle Certified exposure assessment practices and covers common chemicals, materials, and product types. However, new and/or uncommon chemicals and materials, or unique exposure scenarios, may occasionally need to be assessed. In addition, the availability of new information, data, and/or techniques may result in the need for altered methods. Therefore, assessors must use their expert knowledge and critical thinking when completing each exposure assessment to ensure that a precautionary approach is always taken. In the case that an assessor finds that the method below would result in a less than precautionary outcome, or believes that these rules do not result in the correct assessment rating, that assessor is required to notify C2CPII so that the best approach can be determined and consistency can be maintained. Assessors may use alternative exposure assessment methods only upon discussion with and pre-approval from C2CPII.

3 EXPOSURE ASSESSMENT METHODOLOGY

3.1 STEP 1: IDENTIFY ENDPOINTS AND SPECIFIC ROUTES OF EXPOSURE WITHIN ENDPOINTS THAT DO NOT REQUIRE AN EXPOSURE ASSESSMENT

The Outcome of Step 1:

- If Step 1A requires that a RED risk flag and x single chemical risk rating be assigned to any endpoint, the homogeneous material will be X assessed.
- If Step 1A does not require that a RED risk flag be assigned to any endpoint, and any GREY hazard ratings are due to data gaps that do not affect the single chemical risk rating as described in Steps 1A and 2, then the single chemical risk rating will be ‘c’ and the homogeneous material will be C assessed.
- For all other endpoints that are still assigned either RED or GREY hazard ratings after Step 1 is complete, follow the methodology outlined in Step 2.

3.1.1 Step 1A: Exclude endpoints for which there are exceptions to the rules

1. Chemicals of regulatory concern,[2] are always assigned risk flags equal to their hazard ratings. Therefore, an exposure assessment is not necessary in these cases. The relevant regulatory conditions including thresholds apply. An exposure assessment may be completed when these substances are used in non-regulated applications or below the relevant threshold.[3]

2. Substances with a RED hazard rating for *Persistence* and *Bioaccumulation* as well as a RED hazard rating for toxicity of any type (i.e. any endpoint) will always be x assessed. This is because persistence and bioaccumulation enhance the exposure potential. For such substances, it is assumed that exposure will eventually occur. (However, see the special conditions for metals listed in point #5 below which take precedence.)

3. The exposure assessment does not need to be completed for the following endpoints when they have been assigned GREY hazard ratings: *Carcinogenicity*, *Endocrine Disruption*, *Neurotoxicity* and *Terrestrial Toxicity*. This is because a GREY hazard rating for these endpoints does not affect the single chemical risk rating.

4. There are several additional cases for certain material types where GREY hazard ratings do not affect the single chemical risk rating. These materials are covered by specific guidelines. Currently they include pigments, which are assessed according to the Colorants Assessment Methodology, and certain biological and geological materials, as outlined in the Biological Materials Assessment Methodology and the Geological Materials Assessment Methodology. Please see the most recent versions of those documents for further information.

5. If a RED hazard rating has been assigned to the *Climatic Relevance*, *Organohalogens*,[4] or *Toxic Metals* endpoints, the chemical will be x assessed, unless one of the exceptions for *Toxic Metals* listed below applies, given the material/product context. In these cases, all endpoints with RED or GREY hazard ratings related to the metal in question may be assigned a YELLOW risk flag and the material may be C assessed (assuming no other RED or GREY risk flags are present for other chemicals in the material) as long as the answers to the final manufacturing stage questions in Step 2, when relevant to handling of the material in question, are YES.

[2] Per Standard version 3.1, a chemical of regulatory concern is defined as any chemical currently restricted under REACH Annex XVII (see the conditions listed by REACH; e.g. at the time of writing this document, all category 1 & 2 CMRs were of "regulatory concern" when used in "mixtures intended for supply to the general public" i.e. formulated consumer products) on the REACH candidate list for Substances of Very High Concern (SVHC), or on the POPs list of the Stockholm Convention. This set of lists is subject to change. The most current version of the lists or regulations is to be used at the time of the Material Health assessment is being conducted.

[3] Rationale: This approach is taken for several reasons: Prior to inclusion in the regulatory lists indicated, some consideration of exposure and risk has already occurred. In addition, this approach will ensure that chemicals or materials that cannot be sold into the EU will not be Cradle to Cradle C or B-assessed or allowed in Gold certified products. The approach also ensures that manufacturers participating in the program are made aware of the chemicals of regulatory concern within their products and are encouraged to work on phasing these chemicals out.

[4] Note: Organohalogens and the toxic metals lead, cadmium, mercury and hexavalent chromium are subject to review at any level. However, a material will always be X assessed only if these substances are present ≥100 ppm. Lower thresholds apply for these Toxic Metals in biological nutrients (2ppm Cd, 90ppm Pb, 100 ppm Cr+6, 1ppm Hg).

Cases for which a RED hazard rating for Toxic Metals *may not lead to an x assessment:*

a. The toxic metal is used in a colorant and it is in a stable crystalline form exhibiting low toxicity (e.g. spinel and rutile forms). See the Colorants Assessment Methodology for further information.

b. The toxic metal is fused within glass. The metal is not present at ≥ 100 ppm in the crystalline form (i.e. it is not in the form of a salt, for example a metal oxide or metal sulfate) but is present only in the ionic form and is bound within the silicate glass structure. Leaching tests are required to demonstrate non-detectable migration unless studies clearly support lack of migration and subsequent exposure concerns for the product type under consideration (e.g. testing would be required for leaded glass in food contact).

c. The toxic metal is lead contaminating a metal alloy (e.g. A380) due to use of recycled content. In this case the thresholds for lead are aligned with the RoHS thresholds when answers to Step 2 use stage questions 3.2.4a and/or b (Oral) are **YES**. The RoHS threshold for lead in aluminum is 0.4% at time of publication. This threshold may be lowered to 0.1% in the future. The RoHS threshold for lead in steel is 0.35%. This threshold will be applied to all metal alloys other than aluminum. Therefore, at the time of publication, if the conditions within point c are met, lead may be present in aluminum at ≤ 0.4% and in other metals at ≤ 0.35% and the metal may be C assessed.[5] If lead is intentionally added to improve machinability of aluminum, steel, or brass, the 0.01% (100 ppm) threshold applies and the metal must be X assessed (but also see point e below). Note that standard composition information for some metal alloys does not always list percentage lead content even though lead may be present. If lead is not listed, the assessor may need to communicate with suppliers and/or obtain information from the relevant metal industry group or producer regarding typical lead content for the alloy under consideration to ensure that full material disclosure has been obtained prior to assigning a C assessment[6].

d. The toxic metal is nickel within a steel alloy and it does not come into contact with human skin as a part of the product's intended use. If it is intended to come into prolonged or repeated contact with human skin during the product's use, it is given a RED risk flag for *Sensitization of Skin and Airways* and the *Toxic Metals* endpoints and the steel will be X assessed, unless the nickel release rate is shown to be below 0.5 µg/cm^2/week or below 0.2 µg/cm2/week for parts of products inserted into pierced ears

[5] RoHS Exemption FAQ, The Aluminum Association (accessed August 11, 2020). The lead in aluminum threshold for children's products in the US is 300 ppm (100 ppm for other materials used in children's products). See: Petition Requesting Exception from the Lead Content Limits, 2011 AND Technological Feasibility of 100 ppm for Lead Content, 2011, AND Final Decision. EU Directive relevant to children's products/toys that may be mouthed sets limit at 0.05% lead by weight: Commission Regulation (EU) 2015/628.

[6] In cases where lead or other toxic metals are not explicitly listed on alloy composition data sheets but could be part of "others" present at up to 0.05% each (a common category on ASTM specification sheets), the possible presence of lead or other toxic metals does not have to be considered as part of the assessment. However, if lead or other toxic metals are explicitly listed at ≥0.01%, it must be assumed that they have been added intentionally unless supplier(s) of the material(s) confirm otherwise.

and other pierced parts of the human body, or in direct contact with skin as determined via leaching tests on the material in accordance with the standards adopted by the European Committee for Standardization.[7]

e. The toxic metal is vanadium in a steel alloy or a different non-lead, non-nickel, toxic metal part of the alloy crystallites in a true alloy[8] (needs to be demonstrated by the assessor) and exposure is not plausible during the final manufacturing, installation, use, or end of use phases.[7] In other words, in this case, the full exposure assessment method must be applied. However, the question relevant to the incineration scenario for end of use is not required unless it is needed in order to represent at least 80% of product sold. If recycling is one of the relevant end of use scenarios, then it must still be demonstrated through a literature search that exposure during recycling operations is not plausible. Sufficient background information must be provided to support use of this exception. Also, see the exceptions specific to lead and nickel within metals, which include additional stipulations and take precedence.

f. Note that theoretically there is also the potential for materials containing toxic metals to be C assessed in the case that a recycling system under the control of the manufacturer is fully functioning, taking back 80% or more of products sold, and exposure is unlikely in the other use cycle stages based on the assessment process below. However, a situation such as this has not yet been identified.

3.1.2 Step 1B: Exclude endpoints and specific routes of exposure within endpoints based on physico-chemical properties

1. Data gaps are to be ignored for any route-specific endpoint, or individual routes of exposure within endpoints, that are deemed scientifically unjustified (i.e. exposure is unlikely or of low concern) based on the physico-chemical properties listed below.[9] However, if there are data indicating a hazard through a given route of exposure, it must be considered and the exposure assessment conducted, even if that route of exposure could be excluded based on these properties.

The following is a list of default situations by exposure route in which data gaps are to be ignored because exposure is unlikely or of low concern. Consider the temperature thresholds below in the context of the temperatures expected to occur during all use cycle stages including likely unintended use, cutting of materials during installation, etc. to ensure unlikely exposure. If

[7] As of the time of writing the applicable test methods are EN 1811, and if nickel-containing alloy is coated additionally EN 12472. EN 16128 is to be used for glasses. Any future applicable test methods that may be released by the European Committee for Standardization for nickel leaching tests are also to be used.

[8] **Definition of true alloy:** Substances present in the alloy are integral parts of the alloy (i.e. part of the alloy crystallites as opposed to being present between the crystallites). Note: Lead in aluminum or steel is present between the crystallites.

[9] Note: This point is tied both to whether or not toxicity data need to be collected for specific endpoints, as well as to whether or not certain routes of exposure need to be considered when completing Step 2. For example, *Mutagenicity* and *Endocrine Disruption* tests typically do not provide information regarding route of exposure. For this reason, it will be useful to determine if some routes are of low concern prior to completing Step 2. On the other hand, if inhalation exposure is deemed of low concern due to the boiling point, data would not be required for the *Inhalation Toxicity* endpoint when completing the chemical profile (i.e. a GREY hazard rating would not affect the overall abc-x rating).

extreme conditions are expected to occur, it may be necessary to alter these default assumptions (for example some home ovens can reach 500°F/260°C).

a. Oral exposure is of low concern when consumption or absorption are unlikely.
- **i.** Consumption is unlikely when the chemical is highly volatile (defined as boiling point less than 0°C).[10]
- **ii.** Absorption is unlikely when molecular weight is greater than 1000 g/mol[11] and the molecule is known not to undergo hydrolysis or cleave under acidic conditions (e.g. starch has a molecular weight much greater than 1000 but is absorbed once ingested).
- **iii.** Absorption is unlikely when the substance meets at least three of the following conditions[12]:
  1. Molecular weight is greater than 500 g/mol
  2. The octanol-water partition coefficient (log K_{ow}) is greater than 5
  3. The substance has more than 5 hydrogen bond donors (defined as the total number of nitrogen-hydrogen and oxygen-hydrogen bonds)
  4. The substance has more than 10 hydrogen bond acceptors (defined as all nitrogen and oxygen atoms)

b. Dermal exposure (i.e. dermal absorption) is of low concern when:
- **i.** Molecular weight is greater than 1000 g/mol[13, 14, 15] OR;
- **ii.** Molecular weight is greater than 500 g/mol AND the log K_{ow} is greater than 4.[16]

c. Inhalation exposure to volatiles is of low concern when:
- **i.** Boiling point is greater than 240°C,[17] OR;
- **ii.** Vapor pressure is less than 10^{-6} mm Hg.[18]

[10] Technical Overview of Volatile Organic Compounds, U.S. Environmental Protection Agency. (accessed May 17, 2017).

[11] Hazardous Substances in Plastic Materials, Danish Technological Institute, 2013.

[12] Note: This is Lipinski's rule of 5. There are many references available on this topic.

[13] Draft Guidance Notes for the Estimation of Dermal Absorption values, OECD, 2008. and update: Guidance Notes on Dermal Absorption, OECD 2011.

[14] "Generally the smaller the molecule the more easily it may be absorbed. Molecular weights below 500 are favorable for absorption; molecular weights above 1000 do not favor absorption." Source: Guidance for Human Health Risk Assessment (Biocides), ECHA, 2013.

[15] This reference states that "...a rule of thumb on dermal absorption used in the EPA/OPPT New Chemical Program assumes 10% dermal absorption (multiply exposure value by 0.1) for chemicals with MW > 500 AND log Kow <-1 or >4 and assume 100% dermal absorption for all other chemicals." Interpretive Assistance Document for Assessment of Discrete Organic Chemicals, Sustainable Futures Summary Assessment, US EPA, June 2013 (accessed May 17, 2017)

[16] per conversations with the American Chemistry Council (ACC) referencing EPA Sustainable Futures, OECD, and ECHA. Also, based on unpublished work by the ACC that compared these properties between two groups of substances (one group of high concern and another group of low concern).

[17] Technical Overview of Volatile Organic Compounds, US EPA. (accessed May 17, 2017)

[18] Interpretive Assistance Document for Sustainable Futures Summary Assessments, Assessment of Discrete Organic Chemicals, US EPA (2013). Note: The value in point c.ii may be below what can be measured analytically. US EPA thresholds assume use of modeled data. If analytical data are not available, refer to modeled data for making this determination (e.g. per EpiSuite).

d. Inhalation exposure to particulates and aerosols is of low concern when the aerodynamic diameter is greater than 100 µm.[19]

e. Aquatic toxicity is of low concern when solubility is less than 0.001 mg/l.[20] The combined aquatic risk flag and associated instructions further define situations in which exposure to the aquatic environment is of low concern. At higher solubilities, a comparison between the solubility level and toxic concentrations can be made, as explained in the Aquatic Toxicity section of the Material Health Assessment Methodology (see paragraph on *Poorly Soluble Substances*).

3.2 STEP 2: DETERMINE IF PROCESSES AND PRODUCT ARE DESIGNED TO PREVENT EXPOSURE

How to apply Step 2:

- If considering a RED or GREY hazard for an environmental health (EH) endpoint, then the questions below marked for EH are to be asked. If considering a RED or GREY hazard for a human health (HH) endpoint, then the questions marked for both HH and EH are to be asked.
- Only those routes of exposure that are possibly relevant to the endpoint in question (as determined in Step 1) need to be considered. In the case that some endpoints and routes of exposure within endpoints were not excluded (i.e. determined to be unlikely/of low concern) within Step 1, then the following must be assumed to be possibly relevant when beginning Step 2: Oral exposure, dermal exposure, exposure via inhalation, and exposure to the environment (i.e. release to air/water/soil). These routes of exposure are possibly relevant to all endpoints except where the endpoint, by definition, applies only to certain exposure routes (e.g. for Oral Toxicity the oral and environmental exposure routes are to be considered possibly relevant when beginning Step 2).
- Note that in some cases where the assessment process below would result in a RED risk flag, it would be possible for the assessor and applicant to follow up by having specific tests completed to show that the chemical of concern is removed, degraded, or not migrating, leaching, or washing out, etc. above thresholds of concern (e.g. if it is shown that a textile produced using a sensitizing dye is not in itself sensitizing.[21]) However, specific testing methods and thresholds that would be required and acceptable for Cradle to Cradle Certified have not yet been developed. Appropriate tests would need to be approved by C2CPII at which point they would be added to this document. This note has been inserted within the methodology as a holding place and to indicate that this approach will be further developed in the future.

The outcome of Step 2:

- In the case of a RED risk flag resulting from a RED risk in one or more use cycle stages, the single chemical risk rating will be ‘x’ and the homogeneous material will be X assessed. In the case of a GREY risk flag, the single chemical risk rating will depend on whether or not there are any RED risk flags for other endpoints. If not, the rating will be GREY.

[19] Threshold Limit Values for Chemical Substances and Physical Agents, ACGIH, 1993.

[20] Flame Retardants in Printed Circuit Boards, US EPA, August 2015 and references therein.

[21] Refer to the Cradle to Cradle Colorants (Textile Dyestuffs and Pigments) Assessment Methodology.

- In the case that exposure is unlikely in all use cycle stages, a YELLOW risk flag may be assigned to the endpoint in question. When all endpoints for the chemical in question receive YELLOW or GREEN risk flags, the single chemical risk rating will be ‘c’ or ‘b’, respectively.

3.2.1 Final Manufacture

The final manufacturing stage includes the processes defined by the Cradle to Cradle Certified Methodology for Applying the Final Manufacturing Stage Requirements. Note that the ‘final’ manufacturing stage is relative to the applicant’s product that is being assessed. The product may be a consumer product or a business to business product – including intermediate products and raw materials for which subsequent manufacturing steps will occur.

A site visit is required at the final manufacturing stage facility or facilities to verify answers to the questions below. For any sites that are not visited, and in the case of Material Health Certificate applications, the assessor must verify answers to the questions below by reviewing documentation provided by the applicant's Environmental, ,nd Safety personnel (e.g. EH&S management system, processes and procedures).

The answer must be **YES** to **one** of the following (a-b) in order to assign a YELLOW risk flag for this stage (unless considering an endpoint that may be GREY without affecting the single chemical risk rating as mentioned in Step 1). If the answers are all **NO** or unsure, assign a RED or GREY risk flag as appropriate. If a RED or GREY risk flag is assigned for this stage, the exposure assessment is complete (i.e. there is no need to continue to the questions for subsequent manufacturing, installation/maintenance, use, or end-of use).

a. HH & EH: Is the chemical reacted into a material prior to the final manufacturing stage such that exposure during final manufacturing is not likely to occur? The answer to this question will be **YES**, when the chemical is:

i. Bound to or encapsulated by the material matrix (e.g. titanium dioxide and carbon black as polymer fillers/pigments or within liquids or gels (e.g. paint), other inorganic pigments within polymers, polymer crosslinkers, and colorants fused within a glass matrix, metals within metal alloys when part of the alloy crystallites [also see exceptions for Toxic Metals in section 3.1.1], and quartz (SiO_4) in bulk form or bound within a polymer matrix.) This includes the molecules of the matrix itself, as in the case of solid plastics and other substances with molecules of diameter greater than 950 µm.[22]

ii. A polymer additive with molecular weight greater than 1000 g/mol. For example, flame retardants and plasticizers with molecular weights greater than 1000 may be considered bound by the polymer. Substances with low molecular weights including residual monomers, some oligomers (e.g. styrene trimers and dimers), some additive flame retardants, residual solvents, and substances that are known to degrade to substances with molecular weights less than 1000 once incorporated into a polymer cannot be assumed to remain within the polymer matrix.

[22] Targeted Risk Assessment, Technical Report No. 93., ECETOC, December 2004. See page 109.

Note: Certain conditions (e.g. temperature, pH) and processes (e.g. sawing, grinding) may affect whether or not a substance remains bound within a material. The questions above must be answered within the range of conditions expected to occur at final manufacturing locations.

b. Is exposure via the relevant routes sufficiently controlled during final manufacturing? The answers must be **YES** to all questions below pertaining to all relevant exposure route(s) in order to assign a YELLOW risk flag based on question b.

i. **HH: Are effective administrative or engineering controls[23] in place and/or is sufficient personal protective equipment (PPE) in use?** Assessor to consider EU & US OSHA requirements for the relevant industry, OSHA compliance, and Safety Data Sheet (SDS) indications when determining what, where, and how PPE should be used. If the manufacturer is located in a country with well-developed and enforced worker health and safety regulations[24] and the manufacturer has not had any OSHA violations or similar (depending on region) in the last two years relevant to chemical toxicity, then it may be assumed, at the assessor's discretion and upon consideration during the site visit, that sufficient PPE is in use. If insufficient controls or PPE are used, assign a risk flag equal to the hazard rating (i.e. if the hazard rating is RED or GREY, the risk flag will also be RED or GREY).

ii. **HH & EH**: **Are sufficient controls in place to keep the chemical out of environmental media (air/water/soil)?** Assessor to consider Best Available Techniques (BATs)[25] for the industry in question and adherence to these techniques in determining if sufficient controls are in place. However, release to the environment and subsequent human and environmental exposure (e.g. via ground or surface water) is deemed likely in cases where the effluent used in product manufacture leaves the facility (i.e. process water is not kept flowing in a closed loop) unless one or more of the following is true:

1. Testing using appropriate analytical methods and detection levels for the contaminant in question has shown that the chemical with the RED or GREY hazard rating is:
    - ***a.*** not present in effluent (i.e. it is below detection limits).[26] Exception: this method may not be used when objective limits are below the limits of quantification (applicable to priority substances for which objective limits have been set),
    - ***b.*** a priority substance that is present in effluent below objective limits set for water bodies (see Appendix 1 for further information), or
    - ***c.*** present in effluent at or below the incoming concentration (#3 applies only when contamination of incoming water is outside the applicant's control);

[23] Definition of administrative and engineering controls per the Center for Disease Control.

[24] Countries currently assumed to have well-developed and enforced worker health and safety regulations are countries within the EU, Switzerland, United Kingdom, United States, Canada and Japan. Note: This list may be extended in the future.

[25] Link to Best Available Techniques documents (EU).

[26] Note: Appropriate analytical methods and detection limits have not been defined yet for Cradle to Cradle Certified.

2. Water only comes into contact with the product at a point when the chemical with a RED or GREY hazard rating is unavailable for release (i.e. it is reacted into the material matrix as described above in question a.i-ii);
3. The chemical's hazard rating for *Persistence* is GREEN or, in the case of the aquatic toxicity endpoints (fish, daphnia, algae), the combined aquatic toxicity flag is YELLOW (i.e. Persistence and Bioaccumulation are both GREEN when the aquatic toxicity hazard rating and risk rating are RED or GREY).

3.2.2 Subsequent Manufacturing

This section is applicable to intermediate products that are or will be Cradle to Cradle Certified or have a Material Health Certificate. Examples of intermediate products are printing inks and industrial coatings.

The answer must be **YES** to **one** of the following (a-b) in order to assign a YELLOW risk flag for this stage (unless considering an endpoint that may be GREY without affecting the single chemical risk rating as mentioned in Step 1). If the answers are all **NO** or unsure, assign a RED or GREY risk flag as appropriate. If a RED or GREY risk flag is assigned for this stage, the exposure assessment is complete (i.e. there is no need to continue to the questions for professional installation, application, and maintenance, use, and end-of-use). Note: In addition to the questions below, see the Colorants Assessment Methodology for additional rules applicable specifically to dyestuffs that are Cradle to Cradle Certified or have a Material Health certificate and will be used subsequently in textile dying operations.

a. **HH & EH: Is the chemical reacted into a material prior to subsequent manufacturing such that exposure during subsequent manufacturing is not likely to occur?** See section 3.2.1 a.i-ii for sub-questions. Note that certain conditions (e.g. temperature, pH, etc.) and processes (e.g. sawing and grinding) may affect whether or not a substance remains bound within a material. This question must be answered within the range of conditions expected to occur at subsequent manufacturing locations.

b. **HH & EH: Is exposure via the relevant exposure routes sufficiently controlled during subsequent manufacturing?** The answers must be **YES** to all questions below pertaining to all relevant exposure route(s) in order to assign a YELLOW risk flag based on question b. Note: Oral exposure may be assumed implausible during subsequent manufacturing.

    i. **HH: Will the chemical be unavailable for human contact to occur during subsequent manufacturing, such that PPE or administrative controls (e.g. personnel rotation) are not required?** For example, it is sequestered within fully closed and sealed containers and self-cleaning lines during transport and transfer, and at <u>all</u> subsequent manufacturing facilities. If **NO** or unsure, and if chemical has a RED or GREY hazard rating for *Sensitization of Skin and Airways and/or Skin, Eye, and Respiratory Corrosion/ Irritation* go to the next question below:
        1. **HH – Dermal and/or Inhalation (sensitization and irritation/corrosion): Are workers at all subsequent manufacturing facilities adequately trained regarding safe handling of the product and the use of appropriate PPE?** If PPE is necessary to avoid exposure during subsequent manufacturing, sufficient use of

PPE may only be assumed if workers at all subsequent manufacturing facilities are trained by the original manufacturer or an entity contracted by the original manufacturer on safe handling of the intermediate product and use of appropriate PPE. Otherwise, the answer to this question is NO.

See Appendix 2 for verification and communication requirements when answering YES to either portion of this question (i.e. b.i or b.i.1). A disclaimer on the certificate is required depending on endpoints of concern and Material Health achievement level.

ii. **HH & EH - Will the chemical be unavailable for environmental (air/water/soil) contact to occur during subsequent manufacturing?** For example, it is sequestered within fully closed and sealed transport, transfer, and dosing systems (as applicable) at all subsequent manufacturing facilities such that there is no opportunity for environmental contact to occur. See Appendix 2 for verification and communication requirements when answering YES to this question.

OR, If environmental contact is expected, does the chemical degrade into a substance of low toxicity? This may be assumed if the chemical's hazard rating for *Persistence* is GREEN or, in the case of the aquatic toxicity endpoints (fish, daphnia, algae), the combined aquatic toxicity flag is YELLOW (i.e. Persistence and Bioaccumulation are both GREEN when the aquatic toxicity hazard rating and risk rating are RED or GREY).

3.2.3 Professional Installation, Application, Use, and/or Maintenance

This stage is only applicable if there is a separate installation, application, maintenance, or in some cases formulation stage that is intended to be carried out exclusively by trained professionals (e.g. installation of building materials, formulation of paint at the point of sale, application of professional paints, and use of professional cleaning products).

For products that may be installed, applied, and/or maintained by either professional installers/contractors or by the general public, apply the section 3.2.4 Use phase questions to installation, application, maintenance, and use, assuming all are done by the general public (this is the more precautionary approach).

The answer must be **YES** to **one** of the following (a-b) in order to assign a YELLOW risk flag for this stage (unless considering an endpoint that may be GREY without affecting the single chemical risk rating as mentioned in Step 1). If the answers are all **NO** or unsure, assign a RED or GREY risk flag as appropriate. If a RED or GREY risk flag is assigned for this stage, the exposure assessment is complete (i.e. there is no need to continue to the questions for use and end-of-use).

a. **HH & EH: Is the chemical reacted into the material such that exposure is not likely to occur during professional installation, application, use, and/or maintenance (as relevant)?** See section 3.2.1 a.i-ii for sub-questions. Note that certain conditions (e.g. temperature, pH, etc.) and processes (e.g. sawing and grinding) may affect whether or not a substance remains bound within a material. This question must be answered within the range of conditions expected to occur during professional installation and maintenance.

b. HH & EH: Is exposure via the relevant exposure routes sufficiently controlled during professional installation, application, use, and/or maintenance (as relevant)? The answers must be **YES** to all questions below pertaining to all relevant exposure route(s) in order to assign a YELLOW risk flag based on question b. Note: Oral exposure may be assumed implausible during professional use.

i. HH: **Will the chemical be unavailable for contact to occur during professional installation, application, use, and/or maintenance (as relevant), such that PPE or administrative controls (e.g. personnel rotation) are not required?** For example, it is sequestered within fully closed and sealed containers and dosing systems and professional users are informed via product labels and/or inserts of the relevant hazards in the event they choose to tamper with the system. If **NO** or unsure, and if chemical has a RED or GREY hazard rating for *Sensitization of Skin and Airways and/or Skin, Eye, and Respiratory Corrosion/ Irritation* go to the next question below:

1. **HH – Dermal and/or Inhalation (sensitization and irritation/corrosion): Are professional installers, users, and contractors (as applicable) adequately trained regarding safe handling of the product and the use of appropriate PPE?** If PPE is necessary to avoid exposure during subsequent manufacturing, sufficient use of PPE may only be assumed if workers at all subsequent manufacturing facilities are trained by the original manufacturer or an entity contracted by the original manufacturer on safe handling of the intermediate product and use of appropriate PPE. Otherwise, the answer to this question is NO.

See Appendix 2 for verification and communication requirements when answering YES to either portion of this question (i.e. b.i or b.i.1). A disclaimer on the certificate is required depending on endpoints of concern and Material Health achievement level.

ii. HH & EH: **Will the chemical be unavailable for environmental (air/waster/soil) contact to occur during installation, application, use and/or maintenance (as relevant)?** For example, it is sequestered within fully closed and sealed containers and dosing systems such that there is no opportunity for environmental contact to occur. See Appendix 2 for verification and communication requirements when answering YES to this question.

OR, If environmental contact is expected, does the chemical degrade into a substance of low toxicity? Environmental exposure during use and subsequent human exposure (e.g. via ground and surface water contamination) in the case of HH endpoints must be assumed for the following product types without GREEN hazard ratings for *Persistence or, in the case of aquatic toxicity, without GREEN hazard ratings for both Persistence and Bioaccumulation*:

- All wet applied and sprayed on products (e.g. paint, cleaning products)

3.2.4 Use

The use stage is not applicable to the assessment of process chemicals that are not present in the final product.

The use stage includes likely unintended use and installation, application, maintenance, and disassembly for recycling if completed by the non-professional product user.

The answer must be **YES** to **one** of the following (a-c) in order to assign a YELLOW risk flag for this stage. If the answers are all **NO** or unsure, assign a RED or GREY risk flag as appropriate. If a RED or GREY risk flag is assigned for this stage, the exposure assessment is complete (i.e. there is no need to continue to the questions for end-of-use).

a. **HH & EH: Is the chemical reacted into the material in both new and old/worn/damaged product such that exposure is not likely to occur?** The answer to this question will be **YES**, when the chemical is:
    i. Bound to or encapsulated by the material matrix (e.g. titanium dioxide and carbon black as polymer fillers/pigments or within liquids or gels (e.g. paint), other inorganic pigments within polymers, polymer crosslinkers, and colorants fused within a glass matrix, metals within metal alloys when part of the alloy crystallites [also see exceptions for Toxic Metals in section 3.1.1], and quartz (SiO_4) in bulk form or bound within a polymer matrix.) This includes the molecules of the matrix itself, as in the case of solid plastics and other substances with molecules of diameter greater than 950 µm.[27]
    ii. A polymer additive with molecular weight greater than 1000 g/mol. For example, flame retardants and plasticizers with molecular weights greater than 1000 may be considered bound by the polymer. Substances with low molecular weights including residual monomers, some oligomers (e.g. styrene trimers and dimers), some additive flame retardants, residual solvents, and substances that are known to degrade to substances with molecular weights less than 1000 once incorporated into a polymer cannot be assumed to remain within the polymer matrix.

    Certain conditions may affect whether or not a substance remains bound within a material. When exposure to such conditions will occur regularly during use, the effect on the integrity of the material as the product ages must be considered. Conditions to consider in the context of the questions above include, but are not limited to, exposure to extreme temperatures, acidic to basic pH, ultraviolet (UV) light, solvents (including environmental solutions such as rain water, sweat, etc.), irradiation (microwave, x-ray, and others), air pollution, and mechanical forces/abrasion. These conditions may cause corrosion, break chemical bonds, and result in the release of chemicals or particles that were previously bound within the material. If the material will regularly be exposed to one or more of these conditions, it must be assumed that the chemical with a RED or GREY hazard rating will be released from the material and made available for exposure to occur, unless it can be determined, based on published research, that this will not be the case. “Regularly” is defined as a standard part of the product’s intended or likely unintended use. For example, outdoor use products will regularly be exposed to UV.

[27] Targeted Risk Assessment, Technical Report No. 93., ECETOC, December 2004. See page 109.

Watches and jewelry will regularly be exposed to human sweat. Tires, brake pads, and shoe soles are regularly exposed to friction and subsequently abrade.

b. Is the product installed or used in such a way that plausible exposure for <u>all</u> relevant exposure routes is ruled out? The answers must be **YES** to all questions below pertaining to all relevant exposure route(s) in order to assign a YELLOW risk flag for the use stage based on question b.

i. HH - Oral: Will the product or part of product be unavailable for oral contact to occur during use? For example, it is installed out of reach, such as within a wall or it is within an assembly that cannot be disassembled using common household tools, OR <u>all</u> of the following conditions are met:

1. The product will not be marketed to/for children (mouthing is assumed to occur in the case of children's products).
2. The product is not meant to be used on/applied to/in contact with the skin during use. (i.e. oral exposure is assumed to occur for the following and similar product types: cosmetics, washing soap, toothbrush, facial tissue, bedding, clothing, etc.).
3. The product will not be used to prepare, hold, or serve food or come into contact with food by some other means (i.e. oral exposure is assumed to occur for the following and similar product types: kitchen counter, table top, desk top, dish detergent, etc.).
4. The product is not a liquid for use in or around the home (the assumption is that children or others may accidently drink such liquids).
5. The product is not intended to be hand-held or used as an arts and craft supply (some users will commonly chew on hand-held devices such as pens or paint brushes, even if they are not intended to be used in such a way).

ii. HH - Dermal: **Will the product or part of product be unavailable for dermal contact to occur during use?** For example, it is installed out of reach (by an installation professional using PPE if necessary per use stage question #2) such as on a ceiling, or within a wall, is within an assembly that is not typically accessed by the user, or is enclosed by another material (e.g. foam within a polymer layer on an arm rest). If **NO** or unsure, and if chemical has a RED or GREY hazard rating for *Sensitization of Skin and Airways*, go to the next question below.

1. **HH - Dermal (sensitization of skin)**: **Will the product or part of product be used or installed such that repeated (i.e. once a month or more frequent) dermal contact is unlikely to occur?**

iii. HH - Inhalation/ release of volatiles: Will volatile chemicals be unavailable for contact to occur during use? The product is used exclusively outdoors. Definition of volatile for the purpose of this question: Boiling point is less than 240°C (the opposite of the threshold indicated in Step 1, point #5). Consider in the context of use stage temperatures.

OR, Has the product passed the Cradle to Cradle Certified VOC testing requirement?

iv. **HH & EH - Can contact of the product or part of product with the environment (air/water/soil) be excluded during use? OR, If environmental contact is expected, does the chemical degrade into a substance of low toxicity?** Environmental exposure during use and subsequent human exposure (e.g. via ground and surface water contamination) in the case of HH endpoints must be assumed for the following product types without GREEN hazard ratings for *Persistence or, in the case of aquatic toxicity, without GREEN hazard ratings for both Persistence and Bioaccumulation*:

- Any liquid or gaseous consumer product (soaps, paints that will be applied by the final user/consumer, spray can propellants, etc.),
- Personal care products (excluding articles as defined by REACH[28]),
- Textiles and clothing that may be washed in water,
- Products that will be used outdoors or are otherwise exposed to water and/or other environmental elements (e.g. tools, outdoor furniture, exterior building components),
- Products known to wear, abrade, and/or release particulates during regular use (e.g. brake pads, tires, shoe soles),
- Products commonly found in roadside litter (e.g. single use packaging including carry out bags)

For products types that are not listed, the default answer to this question is **YES**; lack of environmental exposure during use is assumed.

c. **HH & EH**: **Is the product manufactured with a functional barrier that encloses the material containing the chemical, preventing migration/release of and contact with the chemical?** In order to answer **YES** to this question, testing must have been performed under the range of use conditions identified (including old/damage/worn conditions and exposure to conditions listed in 3a if relevant) to ensure that this is the case. Examples: Foil or wax layers in food contact packaging or a sealed assembly that restricts release of dry graphite lubricant particles. Note: Test methods acceptable to Cradle to Cradle Certified are still to be determined and approved by C2CPII.

3.2.5 End-of-use

The answer must be **YES** to all of the questions below for **all** end-of-use scenarios accounting for 80% of products sold in order to assign a YELLOW risk flag for this stage. If any answers are **NO** or unsure, assign a RED or GREY risk flag as appropriate (also see exceptions for *Toxic Metals* listed in Step 1).

For products that are just reaching the market, and will take several years until end of use is reached, a realistic forecast of % distribution between the end-of use scenarios listed below would be admissible based on company take-back plans, waste management practices in the regions where the product is sold and recycled, and return rates for similar products. If unsure about the percentages of product or material that will be processed via the common end-of-use scenarios listed below, all end-of-use scenarios are to be considered (although compost only needs to be considered for Biological Nutrients).

[28] REACH defines an article as an object which during production is given a special shape, surface or design that determines its function to a greater degree than its chemical composition. According to REACH, articles are for example clothing, flooring, furniture, jewelry, newspapers and plastic packaging.

For products with a likely use phase greater than 10 years (e.g. building materials that will be installed for long periods of time) and for which a well-developed recycling industry does not already exist (per point b.ii below), all possible end-of-use scenarios must be included in the assessment of the constituent materials unless an active take back program is in place and recovery rate data are available to demonstrate that 80% or more of the material or product sold is recovered and processed via a more limited set of end-of-use scenarios.

a. **Landfill - HH & EH: Will the chemical remain in the material matrix and therefore remain in the landfill OR degrade into substance of low toxicity if released from landfill? Alternatively, is the dermal route of exposure the only route of concern?**
    i. If the dermal route of exposure is the only route of concern, the default answer to this question is **YES** (i.e. skin contact and dermal exposure are not considered relevant to the landfill scenario).
    ii. If the hazard rating is GREY for *Sensitization of Skin and Airways* and/or for *Skin, Eye, and Respiratory Corrosion/Irritation* this will not affect the risk rating for the landfill scenario.
    iii. **For chemicals within polymers or glass, or metals** that were determined to be bound within the material matrix per use stage question 3a, the default answer to this question is **YES**. However, it may not be assumed that products with stable barriers maintain their integrity within a landfill (as in 3c).[29]
    iv. **All other chemicals and endpoints:**
        1. When the hazard rating for *Persistence* is YELLOW or GREEN, the default answer to this question is YES.
        2. In all other cases, it is assumed that release to the environment (air/water/soil) occurs and subsequent human exposure may occur (e.g. via ground and surface water contamination resulting from landfill leaching).

b. **Recycling - HH & EH: Is release of and exposure to the chemical unlikely during recycling?**
    i. **When recycling is done by the manufacturer or other known manufacturers:** Ask the same questions that were posed for the final manufacturing stage in the recycling context.
    ii. **When a well-developed recycling industry for the material in question exists that is outside the manufacturer's control:** Consider scientific studies and other publicly available information to determine if the chemical is of HH or EH concern during recycling. This may be done for the commonly recycled metals (aluminum, steel, copper), glass, and paper. If there is no information available regarding exposure to or fate of the chemical during recycling processes, or the evidence is insufficient to indicate low risk, a RED or GREY hazard rating will result in a RED or GREY risk flag. It cannot be assumed that sufficient PPE or controls on release to the environment will be used by all recyclers

[29] The Fate of Heavy Metals in Landfills: A Review, 2006 (accessed May 17, 2017)

if these would be necessary to prevent exposure due to the global nature of the scrap trading and recycling industry.[30]

iii. **When a recycling infrastructure is not well-developed and is also outside the manufacturer's control** (assumed for materials that are not listed above in point ii): It must be assumed that the material will be landfilled and/or incinerated. See the questions for those end of use scenarios in this case. (Note: The 80% still applies here, and in most cases both landfill and incineration will have to be considered.)

c. **Compost - HH & EH (Biological Nutrients only): Does the chemical degrade or react into a substance of low toxicity in typical home or industrial (as relevant) composting conditions?** Combined aquatic toxicity risk flags of RED or GREY are not altered (e.g. if the combined aquatic toxicity risk flag is RED, the single chemical risk rating will be RED for the composting scenario). For all other endpoints, when the chemical's hazard rating for *Persistence* is GREEN, the default answer to this question is **YES**. In all other cases, it is assumed that release to the environment (air/water/soil) occurs and subsequent human exposure may occur (e.g. via ground and surface water contamination).

d. **Incineration and uncontrolled burning - HH & EH: Is the chemical free of organohalogens and toxic metals?** This end-of-use scenario only concerns the *Toxic Metals* and *Organohalogens* endpoints (and no others). For these chemical classes, the hazard rating is equal to the risk rating due to the likely release of highly toxic substances during combustion. Therefore, a material containing an organohalogen or toxic metal that may end up being incinerated or burned will always be X assessed with several exceptions for the toxic metals as described in Step 1. Furthermore, this scenario must be considered likely for the toxic metals and organohalogens in all cases other than for the exceptions described in Step 1. In the case of the Step 1 exceptions the answer may be NO to this question and a YELLOW risk flag may be assigned to the *Toxic Metals* endpoint. Otherwise, if the answer to this question is NO, a RED risk flag must be assigned.

3.2.6 Out of Scope Stages and Processes

The following stages and processes are currently excluded from the exposure assessment:

- Raw material extraction and production and any manufacturing steps that occur prior to the final manufacturing stage for the product under review.
- Material recovery processes that occur prior to disposition in the listed end-of use scenarios (e.g. building demolition and resizing/cutting of materials prior to handling at a recycling facility).
- Handling of materials at transfer stations, landfills, or incineration facilities prior to placement in a landfill or incineration.

[30] Locating and Estimating Air Emissions from Sources of Lead and Lead Compounds, US EPA, 1998. "Each processing step in the secondary aluminum industry is a potential source of lead emissions, which are generally emitted as PM. Lead emissions will be a small fraction of total particulate emissions and will vary with the lead content of the scrap." AND Inhalation Exposure in Secondary Aluminium Smelting, Elsevier Science Ltd on behalf of British Occupational Hygiene Society, 2001 Heavy Metals in Waste, EU Commission, 2002. "Cadmium, lead and mercury may be present as contaminant in iron and steel scrap, making secondary steel production an important source of release of these metals to air. Chromium and to some extent lead is also used as alloy in steel. The heavy metals may as well be present in aluminium scrap, but compared to steel scrap the total turnover with aluminium scrap is small."

Note that for any chemical that is subject to review (as defined by the Cradle to Cradle Certified Product Standard) but that is out of scope for the exposure assessment itself these stages and processes are still addressed. For example, the exposure method may not be applied to chemicals of regulatory concern, PBTs, organohalogens, or toxic metals as defined in section 3.1. These chemicals are required to be phased out of certified products at varying achievement levels (depending on the specific issues of concern) and will not be present at all in Gold and Platinum certified products.

4 DEFAULTS FOR COMMON CHEMICALS

This section provides examples of common chemicals used in consumer products, their context, and their typical assessment ratings:

1. The following substances are carcinogenic via inhalation. When incorporated into a polymer, exposure to these chemicals is assumed to be unlikely to occur in all use cycle stages. The polymer containing these substances may be C assessed.
    a. Titanium dioxide, CAS 13463-67-7
    b. Carbon black, CAS 1333-86-4 (Note: If there is potential exposure to PAHs, for example when carbon black containing PAHs is used in toys, this must be considered as part of the assessment as well per the Cradle to Cradle Certified Product Standard Version 3.1).
    c. Silica dust, crystalline, in the form of quartz or cristobalite, CAS 14808-60-7

    (However, when the polymer itself is the subject of certification, and hence exposure may occur during the final manufacturing stage, exposure to these materials needs to be considered.)

2. Antimony trioxide: Antimony trioxide is typically present above 100 ppm in PET when used as the catalyst and is carcinogenic via all routes of exposure (oral, dermal, inhalation). PET-containing antimony trioxide will always be X assessed. Exposure is deemed likely during end-of-use when the polymer is burned or recycled (in particular if recycled for textile applications where antimony leaches from polymers during the dyeing and washing processes).

3. Aluminum alloy with intentionally added lead above 100 ppm (e.g. to improve machinability): Lead (CAS 7439-92-1) is a toxic metal with RED hazard ratings for *Carcinogenicity*, *Endocrine Disruption*, *Reproductive Toxicity, Mutagenicity, Neurotoxicity*, and combined aquatic toxicity (PBT). Aluminum is highly recycled. Release of lead to the environment during secondary aluminum processing does occur and is of concern (both particulates and volatilized lead are released per the US EPA and others). For this reason, lead that is intentionally added at 100 ppm or above will receive a RED risk flag for the *Toxic Metals* endpoint and the aluminum will be X assessed. Exception: See below.

4. Aluminum alloy containing recycled content: Some aluminum alloys (e.g. die cast aluminum A380) contain between 500 and 3,500 ppm lead.[31, 32] An exception to the 100 ppm threshold

[31] Aluminum Alloys for die casting according to the Japanese Standards (accessed on March 15, 2017).
[32] Aluminium-Gusslegierungen (accessed on March 15, 2017).

has been instituted in the case of aluminum and other metals containing recycled content. The reason for the exception is that it is not currently feasible in many cases to reduce the lead concentration below 100 ppm when recycled content is used. This is due to the lead content of the recycled material. The threshold in this case aligns with RoHS (0.4% at time of publication; likely to be lowered to 0.1% or 1000 ppm in the future for aluminum). The higher threshold may only be applied in the case that:

   a. Sufficient PPE and controls on environmental release are used during the manufacturing stage.
   b. The material/product meets the requirements listed in use stage question 3a and 3b (i.e. it will not regularly be exposed to conditions resulting in release of the lead AND it is not a product marketed to children, used to cook food, etc.).

If the material meets the requirements above, it may be C-assessed when lead is present at 100-4000 ppm.

5. Steel alloy containing nickel. Nickel (CAS 7440-02-0) is a toxic metal with RED hazard ratings for *Carcinogenicity* (with some conflicting data), *Oral, Dermal, and Inhalation Toxicity, Sensitization of Skin and Airways* and combined aquatic toxicity. Nickel is bound within the steel alloy such that exposure via any route, as well as release to the environment during the use stage, is unlikely. It is assumed that sufficient PPE is in use during manufacturing. In addition, steel is highly. The steel alloy may in this case receive a C assessment. However, if the steel alloy will be in dermal contact as part of its intended use, sensitization may occur. Exposure to human sweat may result in release of nickel ions and subsequent dermal absorption. Therefore, for products that will be in contact with human skin (and presumably sweat) during their intended use, nickel will receive a RED risk flag for *Sensitization of Skin and Airways* and *Toxic Metals* and the alloy will be X assessed (and may be further restricted under v4 as per the current Restricted Substances List (RSL) draft). See Step 1 for additional information.

APPENDICES

1 APPLYING OBJECTIVE LIMITS TO ASSESSMENT OF EFFLUENT

The objective limits for priority substances indicated in the following references apply unless permit limits are lower, in which case those take precedence. These limits must be achieved using the associated test methods indicated by the regulation. If feasible detection limits are above safe limits (e.g. the limits of quantification (LOQ) are above the objective Environmental Quality Standards (EQS)), testing may not be used to alter a RED hazard rating. Furthermore, technology based effluent limitations may not be employed (e.g. TBELs in the US and Best Available Technique/BAT based limits in the EU) because these are not necessarily safe limits. NOTE: Priority substances will tend to be of concern during use and end of use as well and will likely be x-assessed even if they are below objective limits in effluent. For this reason, this approach is most useful for assessing naturally occurring substances (e.g. some of the metals that exhibit low toxicity to humans but that are toxic to aquatic life).

1. If a facility is in the EU: Directive 2008/105/EC on environmental quality standards (EQS) in the field of water policy and amendment 2013 (2013/39/EU) apply[33]. If lower limits have been set by the relevant member state, or more locally, those limits take precedence.

2. If a facility is in the US: EPA priority pollutants and test methods[34] including the listed detection limits apply unless objective limits have been set at the state level[35] or more locally in which case those must be met. Note that some states defer to the National Recommended Water Quality Criteria - Human Health and Aquatic Life[36]. If there are limits indicated for both chronic and acute toxicity (as there are in the prior reference), the lower limit must be applied.

3. Facilities located in the EU may apply the limits set per the US references above for any substance that is not regulated in the EU or more locally (and vice versa).

4. For other regions: If similar objective limits have been set for the relevant water body that have been determined based on what is safe for humans and the environment, those limits may be applied. If not, the lower of the EU or US relevant limits above must be employed.

The effluent as it leaves the manufacturing facility or the relevant third party treatment plant may be tested. For example: If the effluent from the applicant's facility is tested and does not meet objective limits for the contaminant in question, the applicant and assessor may then choose to test the effluent from the municipal treatment facility that the applicant facility releases to. The objective limits would have to be met at either the applicant facility or the municipal treatment plant.

2 INTERMEDIATE AND OTHER PROFESSIONAL USE PRODUCTS: VERIFICATION & COMMUNICATION REQUIREMENTS

This appendix provides verification and communication requirements applicable to sections 3.2.2 Subsequent Manufacturing and 3.2.3 Installation, Application, Use, and Maintenance.

[33] DIRECTIVE 2008/105/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on environmental quality standards in the field of water policy https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0105 AND
DIRECTIVE 2013/39/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32013L0039&from=NL

[34] US Environmental Protection Agency, Toxic and Priority Pollutants Under the Clean Water Act, https://www.epa.gov/eg/toxic-and-priority-pollutants-under-clean-water-act#toxic AND Approved Clean Water Act Chemical Test Methods https://www.epa.gov/cwa-methods/approved-cwa-chemical-test-methods#analyte

[35] For example: US EPA, Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. 40 CFR Part 131, Thursday May 18, 2000.
https://drive.google.com/file/d/0B0VEGIqcuw12dFEwX1VFNVJjVnM/view

[36] US Environmental Protection Agency, National Recommended Water Quality Criteria, Human Health https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table AND Aquatic Life https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table

A. Scenario: Human and/or environmental exposure is completely avoided, PPE is not required

Applicable to the Following Endpoints: All, excluding cases where an exposure assessment is not allowed per section 3.1.1 (i.e. chemicals of regulatory concern, PBTs, organohalogens, toxic metals unless there are exceptions noted in 3.1.1).

Verification Requirements - The following will be accepted as verification that human and/or environmental exposure (as relevant) is not plausible:

- Evidence that the product is sold exclusively to corporate, professional customers. An attestation from the applicant will be accepted as evidence.
- Evidence that customers are adequately informed regarding the relevant hazard(s), as applicable. Information must be provided on the safety data sheet, product label or insert, and the company website.
- Description and photos of systems that are in place that allow for the avoidance of exposure during transport, transfer, manufacturing, and/or professional installation, application, use, and/or maintenance as applicable.
- Evidence that all relevant customers are using the systems described.

Communication Requirements - The Material Health Certificate and Cradle to Cradle Certified certificate must note the following if applying at Silver, Gold, or Platinum level in Material Health and the Material Health level is dependent upon the following assumptions: This [intermediate] product was assessed exclusively for application by professional [insert type of manufacturer e.g. can manufacturers] employing fully closed and sealed [transport, manufacturing lines, and/or dosing systems as relevant] to protect [workers and/or the environment] from [list endpoints of concern e.g. endocrine disrupting, carcinogenic, etc.] substances.

[If relevant, add: The concentration of the certified [intermediate] product in final products sold to the general public must be at or below [X] for the assessment results to be valid.]

The requirements for certification have only been met under these conditions.

B. Scenario: Professional users are trained on proper product handling and use of PPE

Applicable to the Following Endpoints <u>Only</u>: Sensitization of Skin and Airways and Skin, Eye, and Respiratory Corrosion/Irritation.

Verification Requirements - The following will be accepted as verification that exposure to sensitizers and corrosive or irritating substances is not plausible during professional use. Required for colorants assessed per the Colorants Assessment Methodology and for other substances assessed per this document.

- Evidence that the product is sold exclusively to corporate, professional customers. An attestation from the applicant will be accepted as evidence.

- Evidence that customers are adequately informed regarding the sensitization and/or corrosion/irritation hazard(s), as applicable. Information must be provided on the safety data sheet, product label, and the company website.
- Evidence that all customers are adequately trained regarding safe handling of the product, such that it is possible to state that contact or repeated (i.e. once a month or more frequent) contact for corrosion/irritation and sensitization respectively is unlikely to occur. Training may be done by the applicant, an entity contracted by the applicant, or an industry association to which the applicant belongs.
- A literature search must also be conducted to determine if existing evidence indicates that the recommended safety measures are not effective. If incidences of corrosion/irritation and/or sensitization as applicable among the relevant group of professionals in the applicable markets are high in spite of commonly used protective measures (assuming the commonly used measures are the same as those recommended by the applicant), then a RED risk flag must be assigned.

Communication Requirements - The Material Health Certificate and Cradle to Cradle Certified certificate must note the following if applying at Gold or Platinum level in Material Health and the Material Health level is dependent upon the following assumptions: This product was assessed exclusively for use by professional [insert type of manufacturer] trained in the proper handling and use of protective equipment for [sensitizing and/or corrosive and/or irritating] [insert type of material].

[If relevant, add: The concentration of the certified [intermediate] product in final products sold to the general public must be at or below [X] for the assessment results to be valid.]

The requirements for certification have only been met under these conditions.

Colorants (Textile Dyestuffs and Pigments) Assessment Methodology

Last Revision: June 2019

Copyright

Trademark

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

METHODOLOGY FOR THE ASSESSMENT OF COLORANTS REVISION HISTORY

REVISION DATE	SECTION	TYPE OF CHANGE	AUTHORIZED BY
June 2015	Initial Release		S. Klosterhaus
February 2016	1.1 & 3.2	Clarified purpose and preconditions for use of the assessment methodology contained in this document	S. Klosterhaus
February 2016	3.3.1	Added explanation of the exposure scenarios that were considered in the development of the assessment criteria	S. Klosterhaus
February 2016	3.5.5 & 3.5.6	Clarified situations in which irritation or sensitization testing for the dyed textile is not required despite a dyestuff product being sensitizing or irritating	S. Klosterhaus
February 2016	3.5.8	Clarified the trumping rules for various types of mutagenicity data that may be evaluated for the purpose of determining criteria compliance (the REACH approach is to be followed)	S. Klosterhaus
February 2016	3.5.11	Added explanation regarding permissible approaches in cases where neither experimental BCF data are available nor QSAR works	S. Klosterhaus
February 2016	3.5.14	Added explanation regarding what should be done when a dyestuff product is known to be toxic in endpoints not covered by this criteria set	S. Klosterhaus
April 2017	4.3.1	Clarified that the molecular structure criteria for pigments only apply to pigments present at 100 ppm or above in a homogenous material of the finished product Added hematite and inorganic pigments of similar stability to the types of crystal structures for which an exception to the toxic elements rule for pigments applies Specified how data from dissolution tests may be used to evaluate pigment stability	S. Klosterhaus

April 2017	4.3.3	Clarified how potential contamination of commercially available pigments must be considered. Clarified how inhalation risk is to be considered for products in which pigments in an inhalable form are used as part of the final manufacturing stage	S. Klosterhaus
September 2018	4.3.1	Clarified that a product containing a homogeneous material with ≥100 ppm of a pigment containing carcinogenic aromatic amines is limited to the Bronze level of certification.	S. Klosterhaus
June 2019	2 and 3.5.12	Clarified exposure assumptions to be used in the assessment of dyestuff auxiliaries under this methodology	S. Klosterhaus

1 OVERVIEW

1.1 PURPOSE AND CONTENT

This document outlines a customized methodology for the material health assessment of colorants, specifically textile dyestuffs and pigments, as part of the Material Health requirements in the Cradle to Cradle Certified Product Standard (the 'Standard'). This methodology differs from the general Material Health Assessment Methodology ('the Methodology') for use with other substance types, but is aligned with the current practices used in product assessments for textile dyestuffs and pigments. Information in this document supersedes any conflicting information that may be present in the original Standard document, but only for the specific substance and material classes discussed and only if the preconditions for application of this guidance document have been fulfilled.

1.2 SUPPORTING DOCUMENTS

The following documents are to be used in conjunction with this document:

- *Cradle to Cradle Certified™ Product Standard*
- *Cradle to Cradle Certified™ Material Health Assessment Methodology*
- *Any additional supporting documents and guidance posted on the C2CPII website*

Visit the Cradle to Cradle Products Innovation Institute website to download the Standard documents and obtain the most current information regarding the product Standard (http://www.c2ccertified.org/product_certification/c2ccertified_product_standard).

2 INTRODUCTION

Because toxicity data are limited, most colorants would receive a single chemical risk rating of GREY due to missing toxicological information using the general assessment Methodology outlined in the Standard. This would prevent products with colorant-containing materials as a primary component (25% by weight or more) from reaching the Bronze level of certification or higher, thereby preventing them from maintaining certification after the two-year, Basic-level provisional certification period has run its course. To allow for the inclusion of products containing textile dyestuffs and pigments in the certification program, customized assessment approaches were developed that take into consideration the specific aspects of potential exposure that distinguish these substance classes from others, as well as the amount and quality of toxicity data that is

typically available. Because of the fundamental differences in their physicochemical properties and applications, two separate approaches were developed for these colorant classes, one for textile dyestuffs and one for pigments.

For dyestuffs, a modified methodology that yields a final ABC-X material assessment rating for the commercial dyestuff product was developed. This methodology applies to the assessment of textile dyestuff products applying for certification as such, or textiles that have been dyed with the dyestuff product. For the most part, this methodology was developed with the specific exposure scenarios that apply to textile dyestuffs already taken into account, therefore allowing the final assessment rating to be derived in one step. This is in contrast to the general assessment Methodology, in which hazard criteria are applied initially to derive hazard ratings for each chemical substance and exposure considerations follow in a secondary step. An exception to this is the assessment of the auxiliaries in the dyestuff product, for which the general assessment Methodology for deriving the single chemical risk ratings (abc-x) must still be used, albeit using the dyestuff product-specific exposure assumptions described in section 3.3.1. While the assessment criteria in this customized methodology are primarily hazard-based, their selection was informed by exposure considerations that have narrowed the endpoints to only those hazards that are directly relevant in the dyestuff manufacture, use, and end-of-use context. Because this assessment approach only considers exposure scenarios related to the use of dyestuff products on textiles, it does not apply to dyestuff products used for other applications (e.g., paper, foodstuff, or hair coloring). The general assessment Methodology must be used to assess dyestuff products in non-textile applications.

For pigments, a modified methodology that yields abc-x single chemical risk ratings for pigments as pure chemical substances was developed. This methodology consists of a set of customized screening criteria that are applied prior to following the general Methodology. If a pigment has passed all of the customized screening criteria, GREY hazard endpoint ratings are then ignored when deriving a pigment's single chemical risk rating. The rating obtained for each pigment is then rolled into the final ABC-X assessment rating for any material containing the pigment.

3 ASSESSMENT OF TEXTILE DYESTUFFS

3.1 DEFINITION AND PROPERTIES

Dyestuffs are colored compounds that are soluble or dispersible in a liquid (usually water) and have the ability to permanently adhere to a material by covalent, electrostatic, or van der Waals bonds or just by migration and distribution into the material itself.

The term “dyestuff” is used to describe two different types of substances:

1. Dyestuff molecule: The dyestuff molecule is the pure, active chemical compound itself. It is a colored compound that sticks to the fiber after being applied in the dye bath. It is a pure chemical substance with a certain color index (C.I.) number and a unique CAS number (e.g., *Acid Blue 1*, Color Index # 42045 with CAS # 116-95-0). In contrast to the CAS number, the C.I. designation is not a molecular identifier; thus, knowing the C.I. number alone is not sufficient. The CAS number is a prerequisite for the toxicity assessment.

2. Dyestuff product: The dyestuff product is the commercial mixture containing the dyestuff molecule and the dyestuff formulation auxiliaries. Common dyestuff formulation auxiliaries include salts, solvents, de-dusting agents, preservatives, chelators, dispersants, and surfactants. A dyestuff product has a brand name and extension (e.g., *Drimaren® Yellow CL-S gr* produced by the dyestuff supplier *Archroma)*. The commercial mixture, including both the dyestuff molecule and the dyestuff auxiliaries, will be referred to as the dyestuff product in this document.

Textile dyestuffs are typically classified according to the dyeing mechanism and the substrate. The most important classes with respect to textiles are the following:

- Reactive dyes for dyeing cellulose fibers (e.g., cotton)
- Vat dyes for dyeing cellulose fibers (e.g., cotton)
- Disperse dyes for dyeing polyester fibers (e.g., PET or PLA)
- Acidic (*or* anionic) dyes for dyeing polyamide fibers (e.g., silk, wool, or nylon)
- Basic (*or* cationic) dyes for dyeing polyacrylonitrile (PAN) and certain types of polyamide fibers
- Direct (*or* substantive) dyes for various substrates
- Sulfur dyes for dyeing cellulose fibers (e.g., cotton)

Dyestuffs can also be classified with respect to the chemical group responsible for the color (i.e., the chromophoric group). Some examples under this classification are the following:

- Azo dyes
- Anthraquinone dyes
- Triarylmethane dyes
- Acridine dyes
- Nitro dyes

More detailed information on dyestuffs, classification systems, and the mechanism of dyeing can be found in standard technical literature, e.g. ULLMANN’S Encyclopedia of Industrial Chemistry [1] and Industrial Dyes [2].

1 Wiley: ULLMANN'S Encyclopedia of Industrial Chemistry. John Wiley and Sons, Inc. NY 2014

2 Hunger K, (ed.): Industrial Dyes – Chemistry, Properties, Applications. WILEY-VCH Verlag GmbH&Co. KGaA, Weinheim 2003

3.2 PRECONDITIONS FOR THE USE OF THIS METHODOLOGY FOR DYESTUFF PRODUCTS

In developing the assessment criteria contained herein, certain assumptions were made regarding the exposure of workers to dyestuff products during the textile dyeing process (see the following section). Specifically, the dyeing process in the dyehouse is assumed to be performed by trained personnel using protective equipment that prevents significant oral, dermal, or inhalation exposure to the dyestuff product. Consequently, these criteria may only be applied for the assessment of dyed textiles or products containing dyed textiles when lack of significant exposure to dyehouse workers is guaranteed. Furthermore, the ratings and achievement levels of dyestuff products assessed with this methodology will be based on an assumed lack of exposure during product application and only be valid in such contexts. If a textile manufacturer is not able to provide such a guarantee, or if plausible routes of exposure of workers to the dyestuff product are observed during the site visit in the context of a textile product being assessed for certification, the assessment criteria contained in this methodology document may not be used and the general Methodology must instead be employed to assess the dyestuff product. Even dyestuff products certified at the Gold level in Material Health cannot be assumed to be safe under conditions in which direct exposure of workers to the raw (i.e. non-textile bound) dyestuff product exists.

3.3 ASSESSMENT CRITERIA DEVELOPMENT

The methodology described in this section was developed for use in deriving A, B, C, X, or GREY assessment ratings for commercial textile dyestuff products. The methodology considers dyestuff-specific toxicity data and typical exposure scenarios during the life cycle of a textile dyestuff product, from the final textile manufacturing phase and textile use through to textile end-of-use.

3.3.1 Exposure Scenarios

The following exposure scenarios during textile dyestuff application, use, and end-of-use phases have been considered:

1. Dyehouse (final manufacturing step):
   The dyeing process in the dyehouse is assumed to be performed by trained and protected personnel, resulting in limited exposure of workers to the dyestuff product. Since some of the dyestuff molecule and most of the dyestuff auxiliaries reach the wastewater, a high level of environmental exposure to the dyestuff product is assumed.
2. Textile use:
   During use of the textile, oral and inhalation uptake of the dyestuff is assumed to be rather limited, as the dyestuff molecule adheres to the fiber. However, dermal exposure to the fiber-

bound dyestuff molecule takes place and dermal uptake with sweat as a carrier may occur.

3. End-of-use scenario 1 (intended / biological nutrient):
   In the case of composting biodegradable textiles (e.g. a dyed cotton shirt), the dyestuff molecule is assumed to be slowly released and degraded. The dyestuff molecule must neither prevent biodegradation of the fiber nor form very toxic or persistent metabolites itself.
4. End-of-use scenario 2 (intended / technical nutrient):
   In the case of recycling of the dyed textile, the dyestuff molecule is assumed to be either regained (and reused) or combusted.
5. End-of-use scenario 3 (highly likely unintended / incineration):
   In the case of incinerating the textile after use, the dyestuff molecule is assumed to be completely destroyed.

3.3.2 Assessment Criteria

The assessment criteria described in this methodology differ from those in the general Methodology, as they are customized to apply to the limited amount and type of information typically available for dyestuff products. Toxicity data for dyestuffs are typically limited to the information that can be obtained from the dyestuff product material safety data sheet (MSDS) and from direct information from the dyestuff manufacturer.

The following hazard endpoints and other topics were selected for inclusion in the assessment of textile dyestuff products based on the specific exposure conditions that apply to dyestuff products, the specific hazards that are most frequently associated with dyestuff molecules, and the toxicity data that are typically available for these products:

- Toxic metal content (dyestuff molecule only)
- Organohalogen content (dyestuff molecule and formulation auxiliaries)
- Cleavable carcinogenic amines (azo dyestuffs only)
- Acute oral toxicity (dyestuff product)
- Irritant effect on skin/eyes (dyestuff molecule after application)
- Sensitization (dyestuff molecule after application)
- Aquatic toxicity (dyestuff product)
- Mutagenicity (dyestuff product)
- Carcinogenicity (dyestuff molecule)
- Degradation products (dyestuff product)
- Bioaccumulation potential (dyestuff molecule only)
- Dyestuff formulation auxiliaries
- Impurities of dyestuff product

3.4 ASSESSMENT METHODOLOGY

3.4.1 Data Collection

The following information is needed in order to conduct the assessment of a dyestuff product:

1. Dyestuff product MSDS

2. Structure of dyestuff molecule
3. List of dyestuff formulation auxiliaries and their CAS numbers from the dyestuff product manufacturer
4. Standard hazard data resources as specified in the general Methodology (for formulation auxiliaries only)
5. In case of incomplete MSDS data, a statement from the dyestuff manufacturer with toxicity data for endpoints not addressed in the MSDS

3.4.2 Assessment Rules

Using the assessment criteria in Table 1, an A, B, C, X, or GREY rating is assigned to the dyestuff product using the following rules:

The overall dyestuff product ABC-X rating is determined by the best (i.e., leftmost) rating column in which all criteria are fulfilled.

If any of the criteria are not fulfilled because the toxicological properties are worse than the condition in the rightmost column (i.e., column C), the rating for the dyestuff product is X.

Otherwise, if any of the criteria in the rightmost column (i.e., column C) are not fulfilled due to lack of data, the rating for the dyestuff product is GREY. The only assessment criteria that can be fulfilled without data or signed statements are carcinogenicity and degradation products (topics 9 and 10).

A more detailed description of each assessment endpoint and topic is provided in Section 3.5.

Note: When assessing a dyestuff product applied to a textile, the final assessment rating for the dyed textile is equal to the lower rating between the base textile material and the dyestuff product in the order X, GREY, C, B, A.

3.4.3 Material Assessment Ratings

A-rated dyestuff products are ideal from a Cradle to Cradle® perspective: They are fully defined, contain neither metals nor organohalogen compounds, are neither toxic nor ecotoxic, and cannot cleave off carcinogenic aromatic amines. All of their biodegradation products are known and do not pose a risk to human health or the environment.

B-rated dyestuff products largely support Cradle to Cradle® objectives: They are fully defined. However, they may contain moderately problematic (c-assessed) formulation auxiliaries and the dyestuff molecules' biodegradation products are not known.

C-rated dyestuff products have moderately problematic properties in terms of quality from a Cradle to Cradle® perspective: They are fully defined. The dyestuffs may contain copper when used in technical cycles or very low amounts of organohalogen compounds, and may have moderate

toxicity to humans or aquatic organisms. Their non-mutagenicity is indicated based on negative Ames test only and data on the biodegradation of the dyestuff molecules or the formulation auxiliaries are not available.

Table 1: Assessment Criteria for Textile Dyestuffs.

	Endpoint/Topic	A	B	C
1	Toxic metal content	Dyestuff molecule is free of toxic metals.	Dyestuff molecule is free of toxic metals.	Dyestuff molecule is free of toxic metals. For fibers going into the technical metabolism, copper complex dyestuffs are acceptable.
2	Organohalogen content	Dyestuff molecule(s) is(are) free of non-hydrolysable carbon-halogen bonds.	Dyestuff molecule(s) is(are) free of non-hydrolysable carbon-halogen bonds.	Content of non-hydrolysable organohalogen compounds is below 0.1% in the dyestuff product.
3	Cleavable carcinogenic aromatic amines	Dyestuff molecule cannot cleave off any aromatic amine listed either under last update of 2002/61/EC or under MAK III 3B or other carcinogenic aromatic amines (either reductively or hydrolytically).	Dyestuff molecule cannot cleave off any aromatic amine listed either under last update of 2002/61/EC or under MAK III 3B or other carcinogenic aromatic amines (either reductively or hydrolytically).	Dyestuff molecule cannot cleave off any aromatic amine listed under last update of 2002/61/EC under reductive conditions.
4	Acute oral toxicity	LD50 (oral, mammal) of dyestuff product > 2,000 mg/kg.	LD50 (oral, mammal) of dyestuff product > 2,000 mg/kg.	LD50 (oral, mammal) of dyestuff product > 300 mg/kg.
5	Irritation potential	Dyestuff product is not labelled with H314, H315, H318 or H319.	Dyestuff product is not labelled with H314, H315, H318 or H319.	Dyestuff product is not labelled with H314 or H318 (exception: dyestuff products that are irritating before application only, see section 3.5.5).
6	Sensitization potential	Dyestuff product is non-sensitizing as shown by test (such as Mouse Local Lymph Node Assay).	Dyestuff product is non-sensitizing as shown by test or no reported cases of sensitization*	Dyestuff product is non-sensitizing as shown by test or no reported cases of sensitization* (exception: dyestuff products that are sensitizing before application only, see section 3.5.6).

	Endpoint/Topic	A	B	C
7	Acute aquatic toxicity	LC50 fish (96 h) of dyestuff product > 100 mg/l and LC50 daphnia (48 h) of dyestuff product > 100 mg/l **	LC50 fish (96 h) of dyestuff product> 100 mg/l and LC50 daphnia (48 h)of dyestuff product > 100 mg/l **	LC50 fish (96 h) of dyestuff product > 10 mg/l or LC50 daphnia (48 h) of dyestuff product > 10 mg/l ** (at least one value available; MSDS values must be > 10 mg/l)
8	Mutagenicity	Dyestuff product or dyestuff molecule have been tested and are not mutagenic.	Dyestuff product or dyestuff molecule have been tested and are not mutagenic.	Dyestuff product is not suspected of being mutagenic based on a negative Ames test only.
9	Carcinogenicity	Dyestuff molecule is neither a known nor a suspected carcinogen.	Dyestuff molecule is neither a known nor a suspected carcinogen.	Dyestuff molecule is neither a known nor a suspected carcinogen.
10	Degradation Products	Information on degradation pathway exists for all formulation components (including the dyestuff molecule) and has been reviewed; no risks have been identified.	Information on degradation pathway exists at least for the dyestuff auxiliaries and has been reviewed; no severe risks have been identified	No information available.
11	Bioaccumulation potential	BCF of dyestuff molecule < 100 or solubility in water > 1 g/L (25°C)	BCF of dyestuff molecule < 100 or solubility in water > 1 g/L (25°C)	100 < BCF of dyestuff molecule < 500
12	Dyestuff formulation auxiliaries	All formulation auxiliaries are declared and assessed according as a or b.	All formulation auxiliaries are declared and assessed according as a, b or c.	All formulation auxiliaries are declared and assessed according as a, b or c.
13	Impurities	Dyestuff product meets ETAD standard for impurities.	Dyestuff product meets ETAD standard for impurities.	Dyestuff product meets ETAD standard for impurities.

* Sensitization: *"No reported cases of sensitization"* means that the dyestuff supplier has provided a signed statement that there have been no reported cases of sensitization.

** Acute aquatic toxicity: If the solubility of the dyestuff is lower than the LC50/EC50 value, the endpoint is not applicable.

3.5 ENDPOINT AND TOPIC DESCRIPTIONS

3.5.1 Toxic Metals

This endpoint applies to the dyestuff molecule only.

Certain dyestuff molecules, commonly referred to as metal complex dyes, contain metal atoms as a central part of their chromophore. As of the time of this writing, only four different types of metal atoms are typically used in metal complex dyes: nickel, cobalt, chromium, and copper. During combustion, nickel, cobalt, and sometimes chromium complex dyes form carcinogenic compounds. Therefore, all dyestuff products containing these metal complex dyes receive an X assessment rating.

Copper compounds formed by combustion are less problematic. Copper complex dyes are therefore acceptable for use when used on textiles intended to enter a technical cycle after use. However, many copper compounds are ecotoxic. Copper complex dyes are therefore not acceptable for textiles intended to enter a biological cycle (e.g., through composting) after use.

If other metal atoms are used in a metal complex dye, the metal must be assessed following the general Methodology. Toxicity data for simple inorganic or the pure forms of the metal may be used, as chemical transformation is likely once the metal complex dye is released into the environment (during the dyeing process or likely unintended end-of-use scenarios of the dyed textile).

Data Source: Comprehensive data about the metal content in a specific dyestuff product can be obtained from the structure of the dyestuff molecule and from its product MSDS. A typical entry in the MSDS would be in section 12 (Ecological information): “The product does not contain heavy metals in concentrations of concern for waste water.”

3.5.2 Organohalogens

This endpoint applies to the dyestuff molecule only. However, in the MSDS organohalogen content is sometimes specified as a percent of the dyestuff product overall.

Dyestuff molecules often contain stable halogen-carbon bonds for coloristic reasons. Several common dyestuff products will therefore be X-assessed for the purposes of Cradle to Cradle certification.

On the other hand, many reactive dyes contain halogens in the anchor group. This halogen-carbon bond is usually hydrolyzed during formation of the bond between dyestuff molecule and textile fiber, forming harmless halides (i.e., fluoride, chloride, bromide). If the organohalogen group in a dyestuff molecule is cleavable (hydrolysable), the dyestuff product is acceptable with respect to this endpoint.

Sometimes small amounts of additional organohalogen dyestuff molecules used for the final adjustment of shade are added to the dyestuff product. With typically 1% of the dyestuff molecule on the fiber, amounts of 0.1% halogen in the dyestuff product lead to approximately 10 ppm halogen on the fiber, which is deemed acceptable (i.e., C-rated dyestuff product).

Data Source: Comprehensive data regarding the halogen content in a specific dyestuff product can be obtained from the structure of the dyestuff molecule and from its product MSDS. A typical entry

in the MSDS would be in section 12 (Ecological information): "Product does not add to the AOX-value of the sewage."

3.5.3 Cleavable carcinogenic aromatic amines

This endpoint applies to the dyestuff molecule only.

Azo dyestuffs are characterized by their specific chromophore, the azo group: -N=N- . This dyestuff class is important because it encompasses more dyestuffs than all of the other dyestuff classes combined.

Azo dyestuffs may cleave off aromatic amines by reductive cleavage of the azo group. A number of such amines are known to be carcinogenic. Because reductive cleavage may occur within the human gut and under other conditions, it is important to evaluate the potential of an azo dye to cleave off carcinogenic amines when assessing its safety for humans and the environment. The use of azo dyestuffs that may cleave off certain carcinogenic aromatic amines has been forbidden in the European Union[3]; however, such dyestuffs may still be in use outside of the European Union. While category C just considers the specific aromatic amines referenced on the European legislation [3], categories A and B moreover consider any known or suspected carcinogenic aromatic amines that may be cleaved off under reductive or hydrolytic conditions.

Data Source: The structure of the dyestuff molecule provides sufficient information about cleavable aromatic amines.

3.5.4 Acute oral toxicity

This endpoint applies to the dyestuff product.

Acute oral toxicity is the standard indicator for toxicity. It has been determined for nearly every substance.

Data Source: Acute oral toxicity data for a specific dyestuff product can be obtained from the dyestuff product MSDS. A typical entry in the MSDS would be in section 11 (Toxicological information): "Acute oral toxicity: LD50 > 2,000 mg/kg (rat)."

3.5.5 Irritation potential

This endpoint applies to the dyestuff molecule only. However, in the MSDS the irritation potential is usually specified for the whole dyestuff product.

Irritation potential is an important parameter for the dyed textile due to intensive skin contact between textile and consumer. Therefore, irritating dyestuffs should not be used. However, if the

3 Point 43 of Annex I of Council Directive of 27 July 1976 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (76/769/EEC) (OJ L 262, 27.9.1976, p. 201) lastly amended on 21.11.2008. Available in consolidated form at: http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1976L0769:20081211:EN:PDF.

dyestuff manufacturer can prove by testing that the dyed textile is not irritating, the dyestuff product may be used. Testing is not necessary if the irritation potential of the dyestuff product before application originates from one of the following:

- *dyestuff formulation auxiliaries that are known not to stay on the fiber after dyeing and rinsing, or*
- *reactive dyestuffs that form a chemical bond with the textile fiber during the dyeing process, after which the original dyestuff as such is no longer present* [4]

Data Source: Irritation potential for a specific dyestuff product can be obtained from the dyestuff product MSDS. A typical entry in the MSDS would be in section 11 (Toxicological information): "Irritant effect on skin: non-irritant (rabbit)." If the MSDS indicates irritation potential for the dyestuff product but the dyestuff manufacturer has conducted testing indicating the dyed textile is not irritating, the manufacturer may submit a report on the tests performed by a textile laboratory on textiles dyed with the product to the assessor. If the report indicates that the dyed textile is not irritating, the dyestuff product may qualify for a C assessment rating. In the case of reactive dyes, any irritation is assumed to be caused by the unreacted dyestuff molecule only and the dyestuff product can qualify for a 'C' rating based on this endpoint without any additional data being required.

3.5.6 Sensitization potential

This endpoint applies to the dyestuff molecule only. However, in the MSDS the sensitization potential is usually specified for the whole dyestuff product.

Similar to irritation potential, sensitization potential is an important parameter for the dyed textile due to intensive skin contact between the textile and the consumer. Therefore, sensitizing dyestuffs should not be used. However, if the dyestuff manufacturer can demonstrate via testing that the dyed textile is not sensitizing, the dyestuff product may be used. Testing is not necessary if the sensitization potential of the dyestuff product before application originates from one of the following:

- *dyestuff formulation auxiliaries that are known not to stay on the fiber after dyeing and rinsing, or*
- *reactive dyestuffs that form a chemical bond with the textile fiber during the dyeing process, after which the original dyestuff as such is no longer present* [5]

Data Source: Sensitization potential for a specific dyestuff product can be obtained from the dyestuff product MSDS. A typical entry in the MSDS would be in section 11 (Toxicological information): "Sensitization: Non-sensitizing (mouse); Method: Mouse Local Lymph Node Assay (LLNA)." If the MSDS indicates sensitization potential for the dyestuff product but the dyestuff manufacturer has conducted testing indicating the dyed textile is not sensitizing, the manufacturer may submit a report on the tests performed by a textile laboratory on textiles dyed with the product to the assessor. If the report indicates that the dyed textile is not sensitizing, the dyestuff product may qualify for a C assessment rating. In the case of reactive dyes, any sensitization is

4 Hunger K, (ed.): Industrial Dyes – Chemistry, Properties, Applications. WILEY-VCH Verlag GmbH&Co. KGaA, Weinheim (p. 627) 2003
5 Hunger K, (ed.): Industrial Dyes – Chemistry, Properties, Applications. WILEY-VCH Verlag GmbH&Co. KGaA, Weinheim (p. 627) 2003

assumed to be caused by the unreacted dyestuff molecule only and the dyestuff product can qualify for a 'C' rating based on this endpoint without any additional data being required.

3.5.7 Acute aquatic toxicity

This endpoint applies to the dyestuff product.

During typical dyeing processes, a significant portion of the dyestuff molecule, as well as most of the dyestuff auxiliaries, reach the wastewater. Thus, there is a large potential for exposure to the dyestuff product in aquatic environments. As such, aquatic toxicity is an important parameter to consider in the assessment of a dyestuff product. If both acute fish and acute daphnia toxicity data are available, both need to be considered, with the overall assessment rating driven by the target species with the lowest LC50 value (i.e., highest toxicity). If data for only one target species is available, this is deemed sufficient for the assessment of a textile dyestuff product and the available data point will determine categorization for this endpoint. Chronic toxicity data is typically not available and does not need to be considered. Algae toxicity data are not appropriate, as light absorption by the dye solution always leads to reduced algae growth (the measured endpoint), thus obscuring possible toxicity impacts.

Data Source: Acute aquatic toxicity for a specific dyestuff product can be obtained from the dyestuff product MSDS or from the dyestuff manufacturer. A typical entry in the MSDS would be in section 12 (Ecotoxicological information): "Fish toxicity: LC50 > 100 mg/l (96 h, guppy (Lebistes reticulatus))."

3.5.8 Mutagenicity

This endpoint applies to both the dyestuff molecule and the dyestuff product.

Mutagenicity is an important indicator for carcinogenicity. It is an essential endpoint, as many dyestuff molecules are derivatives of carcinogenic compounds, especially aromatic amines. Dyestuff products without mutagenicity data are GREY-assessed.

At a minimum, a negative Ames test (OECD 471) is required. This would be sufficient for a C rating. For a dyestuff product to receive an A or B rating, data on additional mutagenicity/genotoxicity tests are required. Any of the tests listed in section 7.1.3 of the general Methodology are acceptable for this purpose.

In contrast to non-dyestuff substances that are assessed following the general Methodology, dyestuffs are assessed following the REACH approach. This means that a positive Ames test can be superseded by a negative *in vitro* mammalian chromosomal aberration test plus a negative *in vitro* mammalian gene mutation test. A positive *in vitro* mammalian cell test can be superseded by a negative *in vivo* mammalian cell test. For details of the REACH approach, see "Proposed Integrated

Decision-tree Testing Strategies for Mutagenicity and Carcinogenicity in Relation to the EU REACH Legislation" [6] and "Integrated testing strategy for mutagenicity under REACH" [7].

Data Source: Mutagenicity data for a specific dyestuff product can be obtained from the dyestuff product MSDS or from the dyestuff manufacturer. A typical entry in the MSDS would be in section 11 (Toxicological information): "Mutagenicity: No mutagenic response in the Ames-Test."

3.5.9 Carcinogenicity

This endpoint applies to the dyestuff molecule only. However, if addressed in the MSDS, the carcinogenicity of the complete dyestuff product is typically specified.

Carcinogenicity data are typically not available for dyestuff molecules due to the high costs of the required animal tests. Should data be available, they need to be considered for the rating of the dyestuff product. Rating of carcinogenicity is performed according to the hazard endpoint criteria specified for carcinogenicity in the general Methodology, i.e. if the dyestuff molecule meets the "red" criteria for the carcinogenicity endpoint, the dyestuff product will be rated X.

Data Source: While carcinogenicity data is rarely available for dyestuff products, it may appear on the dyestuff product MSDS or be provided by the dyestuff manufacturer. No additional sources need to be checked for the dyestuff molecule with regards to this endpoint.

3.5.10 Degradation products

This topic applies to the dyestuff molecule and the dyestuff auxiliary molecules.

Knowledge about the degradation products of the dyestuff molecule is important for the assessment of the environmental risk posed by the dyestuff in the textile's end-of-use phase, especially in case of release to soil. Unfortunately, these data on degradation products exist only for a small number of dyestuff molecules. Thus, this information is only required to obtain an A rating for the dyestuff product.

To obtain an A rating, all known degradation products of the dyestuff molecule and auxiliaries must have been assessed following the general Methodology and must have received an a or b single chemical risk rating.

To obtain a B rating, information on the degradation products of all dyestuff auxiliaries must have been obtained and they must have been assessed following the general Methodology. None of these degradation products may have received a single chemical risk rating of x.

As a substitute for knowledge of degradation products, the assumption is made that a dyestuff molecule that contains neither organohalogens nor toxic metal atoms will likely degrade into non-

6 R.Combes, C.Grindon, M.Cronin, D.Roberts and J.Garrod : Proposed Integrated Decision-tree Testing Strategies for Mutagenicity and Carcinogenicity in Relation to the EU REACH Legislation. Altern Lab Anim 35 ,267-287, 2007
7 http://www.prc.cnrs-gif.fr/reach/diagrams_en/testing_strategy_muta_en.pdf

toxic and non-persistent molecules (metal and organohalogen content are already covered by the first and second endpoints, see above). Thus, a C rating for a dyestuff product can be obtained even if no additional information on degradation products is available.

Data Source: The identities of degradation products of dyestuff molecules and auxiliaries are to be obtained from peer-reviewed scientific papers on the topic such as [8] and [9].

3.5.11 Bioaccumulation potential

This endpoint applies to the dyestuff molecule only.

In contrast to their persistence, most textile dyestuffs are readily water-soluble and therefore not suspected of being bioaccumulative. However, certain dyestuffs (e.g., disperse and vat dyes) are not water-soluble. Their bioaccumulation potential needs to be known, especially if they are used for coloration of biodegradable fibers. If dyestuff solubility in water is higher than 1 g/L (25°C), the BCF value is assumed to be far below 100 and no specific BCF data is needed.

Data Source: Data on bioaccumulation potential can be found in the product MSDS or can be requested from the dyestuff supplier. Alternatively, bioaccumulation potential can be calculated by standard QSAR methods for substances with log K_{ow} < 6 (see Standard Section 7.1.15). However, experimental data always supersede QSAR data. In cases in which neither experimental BCF data are available nor QSAR works, additional dyestuff molecule properties (i.e. molecular weight, molecule size, and solubility in octanol) may be considered. In particular, a dyestuff molecule with molecular weight higher than 500 atomic mass units and solubility in octanol lower than 10 mg/l can be assumed not to be bioaccumulative [10]. A typical entry in the MSDS would be in section 9 (Physical and chemical properties): “Solubility in water: 40 g/l (25 °C)” – meaning good water solubility and consequently no bioaccumulation potential.

3.5.12 Formulation auxiliaries

This topic applies to the formulation auxiliaries in the dyestuff product.

As the majority of formulation auxiliaries will reach the wastewater during the textile dyeing process, knowledge of their fate and impact on the environment (particularly the aquatic environment), is crucial. Therefore, the dyestuff manufacturer needs to reveal all auxiliaries present in the dyestuff product at concentrations of 100 ppm or above. Without such disclosure by the dyestuff manufacturer, the assessment of dyestuff products is not possible, leading to a GREY rating for the dyestuff product. It is not necessary to reveal the exact percentages of each auxiliary in the dyestuff product, as long as all auxiliaries present at 100 ppm or above have been provided. If this is guaranteed by the dyestuff product manufacturer, it is sufficient to report approximate

8 I K Konstantinou and T A Albanis. TiO2-assisted photocatalytic degradation of azo dyes in aqueous solution: kinetic and mechanistic investigations. Applied Catalysis B: Environmental 49 (2004) 1-14 Elsevier
9 X Zhao, I R Hardin and H-M Hwang. Biodegradation of a model azo disperse dye by the white rot fungus Pleurotus ostreatus. International Biodeterioration & Biodegradation 57 (2006) 1-6 Elsevier
10 R.Anliker, P.Moser, D.Poppinger: Bioaccumulation of dyestuffs and organic pigments in fish. Relationships to hydrophobicity and steric factors. Chemosphere, Vol.17, No.8, pp 1631-1644, 1988

concentration ranges for each substance in the dyestuff product (i.e., <0.1%, 0.1 – 1.0%, 1.0 – 10%, and >10%). In cases in which multiple dyestuff products from the same manufacturer are being assessed, the manufacturer may submit one list containing all auxiliaries for a group of dyestuff products.

Auxiliaries are assessed following the general Methodology (albeit using the dyestuff product-specific exposure assumptions described in section 3.3.1). For a dyestuff product to obtain an A rating, all auxiliaries must have received a single chemical risk rating of either a or b. For a dyestuff product to obtain a B or C rating, all auxiliaries must have received a single chemical risk rating of either a, b, or c.

Data Source: Formulation information must be obtained from the dyestuff supplier. Toxicity data can be obtained from the standard scientific data resources.

3.5.13 Impurities

This topic applies to the dyestuff product.

Dyestuff products may contain impurities due to impurities in reactants or raw materials, residues of solvents, reactants or reaction by-products, metal traces from the use of metal catalysts in synthesis, or from corrosion of manufacturing equipment. The concentrations of these impurities are a measure of product quality. The members of the dyestuff suppliers' association ETAD ("The Ecological and Toxicological Association of Dyes and Organic Pigments Manufacturers") guarantee that their products do not exceed certain, well-defined impurity thresholds.

Data Source: A dyestuff supplier must follow the ETAD limits to receive an A, B, or C rating for the dyestuff product. Dyestuff products from manufacturers that are ETAD members are preferred. If the manufacturer is not an ETAD member, they must sign and submit a written declaration guaranteeing that none of the impurities specified in ETAD guidelines are present in the product above their allowable concentration limit. Limit values are published in *ETAD recommendation for threshold limits on impurities in dyes, 2014* (http://www.etad.com/lang-en/publications.html).

3.5.14 Further Information

Should the MSDS or other data from the dyestuff manufacturer indicate high chronic toxicity, reproductive toxicity, or endocrine disruption potential of the product, this information needs to be considered and reflected in the final rating (i.e. the substances with this toxicity potential need to be evaluated separately following the general Methodology instead of the simplified Methodology contained herein).

4 ASSESSMENT OF PIGMENTS

4.1 DEFINITION AND PROPERTIES

Pigments are colored, insoluble chemical compounds with the ability to give color to another material. The fundamental difference between dyestuffs and pigments is that pigments are not intended to be soluble in order to adhere to a material. Pigments have to be dispersed in the material to imbue it with color. Alternatively, they can be dispersed within a binder matrix, which is then applied to the surface of a material. In contrast to dyestuffs, pigments keep their original shape (as small crystals) over the complete life cycle, a consideration that must be taken into account during the material health assessment process.

Pigments are typically classified according to their chemical make-up and can be divided into two groups:

1. Inorganic pigments: Inorganic pigments, often metal oxides or metal sulfides, usually show high light fastness and temperature stability, but often limited brilliance. Important inorganic pigments are titanium dioxide, iron oxide, zinc oxide, zinc sulfide, barium sulfate, chromium(III) oxide, cobalt blue, lead oxide, cinnabar and cadmium yellow.
2. Organic pigments: Similar to dyestuff molecules, organic pigments can be classified according to their chemical structure. Classes of organic pigments include:

    - Azo pigments
    - Disazo pigments
    - Polycyclic pigments
    - Anthraquinone pigment
    - Dioxazine pigments
    - Triarylcarbonium pigments
    - Quinophthalone pigments

    Similar to azo dyestuff products, the azo pigments are the commercially most important group of organic pigments.

Pigments are often marked with a specific number, the color index (C.I.) number. In contrast to dyestuffs, there is a distinct correlation between pigment name, CAS number, C.I. name, and C.I. number (e.g., titanium dioxide, TiO2, CAS # 13463-67-7, Pigment White 6, C.I. 77891).

Pigments are applied as pure pigments or as pigment formulations (i.e., pigment masterbatches). Masterbatches are used to avoid dust formation in the factory (for occupational safety) and to simplify pigment dispersion in the matrix.

More detailed information on pigments, their use, and their classification systems can be found in standard technical literature, e.g. ULLMANN'S Encyclopedia of Industrial Chemistry [11] and Industrial Organic Pigments [12].

In contrast to dyestuff products, pigments are used in a wide range of applications, which include paints, inks, coatings, fiber bulk colorations, plastics, rubber, paper, cosmetics, and ceramics. The below assessment methodology is applicable to any application of pigments as long as the conditions described under 'Limitations' in section 4.3.3 are fulfilled.

4.2 ASSESSMENT METHODOLOGY DEVELOPMENT

Several toxicity studies have been performed on pigments for select hazard endpoints including acute toxicity, mutagenicity, and irritation potential[13]. The results showed that very few pigments are hazardous. The main reason for this is that most pigments are poorly water soluble and predominantly chemically inert, and as a consequence are not bioavailable. In many applications (e.g., coatings, paints, colored plastics) pigments are embedded in a matrix and therefore exposure is limited. For this reason, there has been little attention devoted to the toxicological characterization of pigments and the availability of toxicity data for pigments is relatively poor. If pigments were to be assessed following the general Methodology, most pigments would receive a GREY rating due to a lack of toxicity data.

The general Standard Methodology was therefore modified to allow for the assessment of pigments when little toxicity information is available. This modified approach is based on the specific physicochemical properties of pigments and assumes that an ideal pigment is chemically stable (i.e., inert) and insoluble in any solvent. Due to its stability and insolubility, it is assumed that such a pigment does not change its macroscopic crystalline shape during use and the solid pigment crystals are too large to pass through biological membranes. As a consequence, an ideal pigment would not be bioavailable, would pass through the body unchanged in the event of ingestion, and as such would not be toxic via ingestion. These considerations apply to both organic and inorganic pigments.

Although these considerations are valid for ideal pigments only, it can simplify the toxicity assessment of pigments actually in use. For these, only deviations from this non-toxic ideal are considered with respect to assessing their toxicological impact. As a result, the primary questions that drive the assessment are:

- Can the pigment be dissolved, without changing its chemical structure, under any realistic and probable circumstances during its life cycle?, and
- Is the pigment chemically unstable and may it form, release, or cleave-off any toxic substance under any realistic and probable circumstances during its life cycle?

11 Wiley: ULLMANN'S Encyclopedia of Industrial Chemistry. John Wiley and Sons, Inc. NY 2014
12 Herbst W, Hunger K: Industrial Organic Pigments – Production, Properties, Applications. WILEY-VCH Verlag GmbH & Co. KGaA Weinheim 2004
13 Herbst W, Hunger K: Industrial Organic Pigments – Production, Properties, Applications. WILEY-VCH Verlag GmbH & Co. KGaA Weinheim 2004

In addition, all probable chemical impacts on the pigment during its life cycle need to be considered:

- Elevated temperature (e.g., during extrusion of colored plastics)
- Acidic conditions (e.g., after ingestion of pigmented materials)
- Alkaline conditions (e.g., during reductive bleaching in paper recycling)
- Reductive conditions (e.g., during reductive bleaching in paper recycling)
- Oxidative conditions (e.g., during combustion of pigmented products)

The last of these probable life-cycle conditions, oxidation, deserves special considerations. Organic pigments completely degrade during combustion and the main oxidation products are usually carbon dioxide, water, and nitrogen. However, if a pigment contains other elements as well, further combustion products are formed. In particular, if a pigment contains halogens, small amounts of volatile organohalogen compounds will be formed during combustion. These combustion products are likely to be persistent, bioaccumulative, and toxic. For these reasons, halogen-containing pigments should be excluded from use.

4.3 ASSESSMENT METHODOLOGY

4.3.1 Molecular Structure Screening

The first step when assessing pigments is to establish whether they are chemically stable (i.e., like an 'ideal' pigment) or whether they have the potential to form hazardous reaction products. Based on the common chemistries of pigments that are in use, the vast majority of pigments with the potential to form hazardous reaction products can be captured by screening against the following three endpoints, which are based on the molecular structure of the pigment:

- organohalogens
- toxic elements
- reductively cleavable aromatic amines

While pigments are generally subject to review at any concentration, these three screening endpoints are applied only for pigments used at a concentration of 100 ppm or greater in a homogenous material of the finished product:

1. *Organohalogens* – A pigment containing a covalent fluoro-carbon, chloro-carbon, bromo-carbon or iodo-carbon bond will have a single chemical risk rating of 'x'.

2. *Toxic Elements* – A pigment containing lead, cadmium, mercury, vanadium, chromium(VI), cobalt, nickel, arsenic, antimony or selenium will have a single chemical risk rating of 'x'.

   An exception to this rule is made for inert complex inorganic color pigments with a rutile, spinel, inverse spinel, or hematite structure [14]. These pigments show high chemical, light,

14 Buxbaum G (ed.): Industrial Inorganic Pigments. WILEY-VCH Verlag GmbH Weinheim; New York; Singapore 1998

and temperature stability and several contain toxic elements (e.g. antimony, cobalt, nickel). However, on a molecular level these potentially hazardous atoms are fixed firmly in a crystal lattice structure and cannot be released under normal use conditions, in alkaline or acidic media, or even during waste incineration [15,16]. Consequently, these pigments in their pure form do not pose any risk to human health or the environment, leading to a single chemical risk rating of c.

Inorganic pigments with differing crystal structures that are of similar stability as the above-mentioned ones may receive a single chemical risk rating of c as well. However, in these cases proof of their stability in all possible exposure scenarios connected with the considered application – during and after use – has to be provided. This can take place either by scientific literature or by dissolution tests.

A dissolution test under standardized, worst-case conditions, intended to emulate leaching via gastric fluid upon accidental pigment ingestion (GST, pH 1.5), may show whether a pigment is stable or not. For many pigments such tests have been performed. The results can be found in major toxicological databases, e.g. in the ECHA chemical database [17].

If the values are not documented by ECHA and no other data are available about the solubility under worst-case conditions, a new dissolution test has to be performed. No internationally agreed OECD guideline exists for testing with artificial gastric fluid; however, within the REACH framework, bioavailability under such conditions was determined on the basis of OECD 29 [18]. Therefore, a test according to the conditions described in OECD 29 is required, with the following modifications: the test media selected must include artificial gastric fluid (GST, pH 1.5) and test temperature must be 37 ± 2°C.

The amount of toxic metals that can be dissolved under such conditions reveals whether the toxic metal is bioaccessible or not. All pigments for which less than 1 mg of metals are dissolved for every g pigment (pigment to solvent loading ratio is 100 mg/L) tested for 24h or more at pH1.5 can be assumed to be practically insoluble and therefore non-toxic. This threshold value was derived based on conservative estimates regarding the approximate trace amounts of toxic metals that may safely be released from pigments under worst-case exposure conditions, without causing any negative impacts on human and environmental safety. Therefore, pigments which release less than 1 mg/g of toxic metal under such worst-case exposure conditions can practically be considered as insoluble and non-toxic for the purpose of this assessment.

The metal dissolution ratio is calculated as a ratio as follows: mass of metal dissolved at pH1.5 after 24 hours (= analyzed value) divided by total mass of used pigment (= initial weight).

If the ratio is smaller than 1 mg of dissolved toxic metal per g of pigment, the pigment receives a ‘c’ rating.

15 Ullmann's Encyclopedia of Industrial Chemistry, "Pigments, Inorganic", Vol. A20; VCH, 1992.
16 Bomhard, E. et al. Subchronic oral toxicity and analytical studies on Nickel Rutile Yellow and Chrome Rutile Yellow with rats. Toxicol. Lett. 1982, **14,**189–194.
17 https://www.echa.europa.eu/information-on-chemicals/registered-substances (accessed on March 16, 2017)
18 http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2001)9&doclanguage=en (accessed on March 16, 2017)

If the ratio is higher than 1 mg of dissolved toxic metal per g of pigment, the pigment receives an 'x' rating.

It should be stressed that this approach is based on solubility of the pigment and does not consider the specific toxicity of the pigment.

3. *Reductively Cleavable Aromatic Amines* – An azo pigment containing one or more carcinogenic aromatic amines as defined in European regulation 76/769/EEC (Annex / Point 43) [19] will have a single chemical risk rating of 'x'. This means that a product containing a homogeneous material with ≥100 ppm of such a pigment cannot achieve a certification level higher than Bronze.

4.3.2 Full Assessment

A pigment that has not received an x-assessment as a result of a functional group of concern in its molecular structure and does not belong to the complex inorganic pigment group (i.e., a pigment that has passed the screening described in section 4.3.1) must then be assessed following the general Standard Methodology. However, as a result of the considerations described in section 4.2, any endpoint data gaps remaining in the pigment's hazard profile after the assessor has exhausted all available resources (i.e., GREY ratings) may be ignored when deriving the pigment's single chemical risk rating. The single chemical risk rating assigned to the pigment is then rolled into the final assessment rating for the homogenous material in which it is present, as described in the Cradle to Cradle Certified Material Health Assessment Methodology.

4.3.3 Limitations

This modified approach for assessing pigments has the following limitations:

1. It is only valid for pure pigments, meaning pure chemical substances with a single CAS number. Contamination of commercially available pigments with synthesis by-products is not considered in the approach and must be verified separately by the assessor. For example, inorganic pigments may contain toxic metal impurities depending on the origin and quality of raw materials and the production processes used for their manufacture. Such contaminants, if present at a concentration that makes them subject to review in a product, require a case-by-case review based on additional information from the specific pigment manufacturer. In such cases, contaminants are to be assessed separately following the general Standard Methodology.
2. It is not valid for pigments in the form of nano-particles, as nano-sized pigment particles could pass biological membranes in some cases and their toxicological effect could be fundamentally different. Specific assessment rules for nano-particles may be developed at a future time, but for the time being they are to be assessed following the general Standard Methodology, not the modified approach described in this document. The availability of

19 Point 43 of Annex I of Council Directive of 27 July 1976 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (76/769/EEC) (OJ L 262, 27.9.1976, p. 201) lastly amended on 21.11.2008. Available in consolidated form at: http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1976L0769:20081211:EN:PDF

toxicity information for nano-particles is relatively poor at present, even when compared to other pigment types. Thus, nano-sized pigments are very likely to obtain a single chemical risk rating of GREY.

3. It does not cover exposure by inhalation. In cases where dust loads are high, even dust from generally low-hazard substances may lead to toxic effects. For products in which pigments in an inhalable form are used as part of the final manufacturing stage, inhalation hazard and exposure needs to be assessed separately from the rules included in the methodology above. Any relevant inhalation exposure to inhalable pigments based on insufficient protection or unsafe operating procedures at the facility will result in a single chemical risk rating of 'x' for the pigment in that product, unless the pigment has received a YELLOW or GREEN hazard for Inhalation Toxicity and any other hazard endpoint for which inhalation exposure may be relevant (i.e. GREY ratings may not be ignored in this case).

Biological Materials Assessment Methodology

Last Revision: October 2020

Copyright

Trademark

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

METHODOLOGY FOR THE ASSESSMENT OF BIOLOGICAL MATERIALS REVISION HISTORY

REVISION DATE	SECTION	TYPE OF CHANGE	AUTHORIZED BY
June 2016	Initial Release		S. Klosterhaus
July 2016	2.3.2	Clarified that when the pesticides used are known to the assessor, only the active ingredient(s) need to be assessed (not all substances in the mixture)	S. Klosterhaus
July 2016	2.3.2	Clarified what is to be done for animal-based fibers if information on the pesticides used can be obtained	S. Klosterhaus
May 2017	2.3.2	Expanded scope of substances that may be considered grey if there is evidence for their safety to include those in which the traditional use is food	S. Klosterhaus
May 2017	2.3.2	Öeko-tex 100 certification included, with boundaries, as basis for C-assessment of plant-based materials.	S. Klosterhaus
May 2017	2.3.2	Coatings added to scope of tree-based substances eligible for a B-assessed rating.	S. Klosterhaus
May 2017	2.3.2	Clarified requirements for assessing plant, animal, and microbe-derived materials	S. Klosterhaus
May 2017	2.3.2	Bleaching agents added to the scope of plant-based materials as subject to review at any level	S. Klosterhaus
March 2018	2.3.2	Clarified the pesticide testing protocol for other bast fibers such as flax, hemp, jute, and ramie.	S. Klosterhaus
March 2018	2.3.2	Clarified that detection limits only apply to pesticides listed in either GOTS or the EU Ecolabel Textile Standard.	S. Klosterhaus
September 2018	2.3.2	Clarified the list of pesticides and insecticides/ectoparasiticides that are in scope for testing of certain animal-based materials	S. Klosterhaus
October 2020	2.3.2	Clarified that assessment requirements for live microorganisms and products containing these will be determined by C2CPII on a case by case basis.	S. Klosterhaus
October 2020	2.3.2	Clarified that potential exposure to wood dust during all use stages, including installation, must be considered when assessing tree-based materials. Clarified that if dust is likely produced, an X-assessment is required unless workers are protected and installers and/or users are informed (as applicable).	S. Klosterhaus

October 2020	2.3.2	Clarified when testing for insecticides/ectoparasiticides is required in animal-based materials and deleted bifenthrin from the table of insecticides/ectoparasiticides to test for.	S. Klosterhaus
October 2020	2.3.2	Clarified that soil is assessed separately from plants	S. Klosterhaus

1 OVERVIEW

1.1 PURPOSE AND CONTENT

This document outlines a customized methodology for the Material Health assessment of biological materials in the Cradle to Cradle Certified Product Standard. Biological materials include live microorganisms, live plants, plant tissues, animal tissues, microbial tissues, and plant, animal, and microbe-derived materials.

1.2 SUPPORTING DOCUMENTS

The following documents are to be used in conjunction with this document:

- Cradle to Cradle Certified™ Product Standard
- Cradle to Cradle Certified™ Material Health Assessment Methodology
- Any additional Cradle to Cradle Certified standard documents and methodology documents posted on the C2CPII website.

1.3 BIOLOGICAL MATERIALS

Within the Cradle to Cradle design paradigm, biological nutrients are those materials designed to stay within the biosphere, ultimately providing nutrients to microorganisms within sediment and soil. A subset of biological nutrients are biological materials which are derived from live microorganisms, live plants, plant tissues, animal tissues, microbial tissues, and plant, animal, and microbe-derived materials.

Biological materials provide a unique challenge for the Material Health evaluation, which is based on the hazard profiles of individual chemical substances. These materials tend to be chemically heterogeneous in and off themselves and chemical composition may also vary significantly between batches. Additionally, the primary metrics for evaluation, human and environmental health hazard endpoints, are rarely determined for raw materials of biological origin. However, hazards, and therefore risks, can still be associated with the use of these materials, often through the presence of contaminants or by-products. A well-defined method for assessing these materials in the absence of toxicity data and complete chemical composition information is essential for consistent evaluation of materials used in Cradle to Cradle Certified™ products.

1.4 SCOPE OF MATERIAL HEALTH ASSESSMENT FOR BIOLOGICAL MATERIALS

The Material Health evaluation for any material and/or product is limited to the chemicals contained within that product as it leaves the final manufacturing facility. Materials that are of biological origin may have variable composition and may be contaminated with problematic metals and/or other compounds such as residual pesticides. Other biological materials may be derived from organisms that produce allergens or toxins during their normal metabolic activities. In order to ensure that these substances (if present) are below levels likely to impact human or environmental health, biological materials must be analyzed according to the methodology outlined in section 2.

2 DERIVING FINAL MATERIAL ASSESSMENT RATINGS

2.1 OVERVIEW

Biological materials are materials that consist of, or are derived from living organisms such as plants or animals. They are classified as biological nutrients and will enter the biosphere either directly during use or after one or more use cycles. Given the lack of toxicity data for these materials, the conventional Material Health Assessment Methodology as applied in the Cradle to Cradle Certified Products Program would lead to 'Grey' assessments in the majority of cases. In order to not limit the use of biological materials within the Cradle to Cradle Certified program, the following supplemental methodology has been developed to assign Material Health assessment ratings to biological materials for the purpose of Cradle to Cradle certification.

The following classes of biological materials are addressed by this methodology:

- Live microorganisms – this category includes live fungi, bacteria, and other microorganisms
- Live plants – any member of the kingdom Plantae in its live state
- Tree-based materials – wood planks/strips/pieces, bark, wood chips, and other wood products
- Plant-based materials – plant based fibers such as cotton, hemp, ramie, rice husks, and coconut fiber
- Animal-based materials – animal based fibers such as wool, silk, mohair, cashmere, and leather/skins
- Microbial tissue based materials – e.g., fungal mycelium
- Plant, animal, and microbe-derived mixtures – e.g., essential oils, natural rubber latex, and waxes

The protocol for deriving the final assessments of biological materials will vary depending on the class of material in question as defined by the classes listed above.

2.2 INFORMATION SOURCES

The information sources for the Material Health assessment of biological materials are consistent with those used for a typical Material Health assessment. Please see the Cradle to Cradle Certified Material Assessment Methodology for a detailed description. In addition, research papers, journal articles, and technical specification/data sheets will be helpful in identifying the typical composition of biological materials and/or contaminants such as pesticides that might be present in or on the biological material. Other sources focusing on the toxicity of natural materials (e.g., naturalmedicines.com) may also be helpful.

2.3 ASSESSMENT PROCESS

2.3.1 GENERAL REQUIREMENTS

- The materials must be pure and contain no other additives or colorants. If additives or colorants are present then these must be assessed separately following the general Material Health Assessment Methodology.

- Banned List requirements must still be met. In this case the Biological Nutrient Banned List is used. As per the Cradle to Cradle Certified Product Standard and methodology documents, these requirements pertain to substances *intentionally added* or mixtures/materials *known to contain* these substances. Assuming no Banned List substances are intentionally added to the biological material in question (this may be confirmed through signed Banned List declarations by the supplier) the only remaining issue is to determine whether or not the biological material being assessed is “known to contain” any Banned List substances. As they are all naturally occurring materials, the only Banned List substances they could reasonably be expected to contain are toxic metals. If the organism is known to be a hyper-accumulator of metals, or if there is any reason to believe metals may be present in/on the organism above background soil concentrations (i.e., by asking the supplier(s) to provide information on any substances that were applied to the material), analytical testing of the five Banned List metals (arsenic, cadmium, chromium VI, mercury, and lead) is required. If any of the five banned metals are detected at a concentration in excess of the allowable levels, the material will be banned from use in a Cradle to Cradle Certified product.

- Once it has been determined that the biological material in question is pure and does not contain toxic metals above the allowable Biological Nutrient Banned List thresholds, the next step is to determine the category or class of biological material from the list provided in section 2.1.

2.3.2 ADDITIONAL REQUIREMENTS FOR SPECIFIC CLASSES OF BIOLOGICAL MATERIALS

Live Microorganisms

At a minimum, it must be evaluated whether the organism in question is pathogenic or has the potential to produce any toxic substances during its normal metabolic activity. This will require identification by genus, species, and strain, and a review of the microbiological and medical literature available on the organism by the material health assessor. Any organism with the potential to produce x-assessed substances or with the potential for pathogenicity will receive an X-rating; any organism for which insufficient studies are available will receive a Grey rating. The assessor must also be able to show that the organism strain is pure and is not contaminated by other organisms. This must include the use of laboratory and production best practices to avoid strain contamination.

Additional requirements for assessing products containing live organisms (including spores) will be handled on a case by case basis. Please contact C2CPII prior to conducting any assessment work for a product of this type.

Live Plants

As above, it must be evaluated whether the organism in question produces any toxic substances during normal metabolic activities. This will require identification by genus and species and a review of all relevant literature available on the plant by the material health assessor. If the species is well studied in the botanical literature and none of the available publications indicate potential to produce any allergens/toxins, it will receive a “B” assessment. If toxins/allergens are produced, the assessor must assess them using the standard Material Health Assessment Methodology. Any x-assessed substance produced by the organism and found in the finished product will result in an X assessment for that organism. Note that any soil in which the plant is growing must be assessed as a separate homogeneous material.

Tree-Based Materials

The most common tree-based materials are wood- and bark-based materials/products. All stains, treatments, and other coatings on the wood-based materials must be identified in terms of their constituent chemical substances, and these substances are then assessed according to the conventional Material Health Assessment Methodology. The single chemical risk ratings of these substances will factor into the material assessment rating for the treated material as described in the general methodology. Furthermore, the base wood material must be identified in terms of species and genus of the organism of origin. In the absence of c, x, or grey assessed substances in any applied stains, coatings, or treatments, tree-based materials will then receive a B rating unless one or more of the following conditions apply:

- The tree-based material is from a species that is known to have sensitizing effects (e.g., certain species of blackwood or rosewood). The assessor must identify the species of tree from which the material originates and check for known sensitizing effects. The book, ‘List of MAK and BAT Values’ (Deutsche Forschungsgemeinschaft), is a good resource for this. If the tree-based material comes from a species with known sensitization effects the material will receive an X assessment, unless it can be demonstrated that there is no relevant route of exposure during the intended or likely unintended use and end-of-use scenarios for the material in question.

- The assessor will need to determine if wood dust exposure is a concern during the product’s final manufacture, installation, as well as intended and likely unintended use and end-of use scenarios. Oak and beech dusts are MAK 1 carcinogens and other types of wood dust are also potentially carcinogenic. If final manufacture includes processes that may result in the release of wood dust, the requirements as detailed in the Exposure Assessment Methodology for the protection of workers (section 3.2.1) apply. If installation or use are likely to include processes that may result in the release of wood dust (e.g. sawing, sanding) the applicant must demonstrate that installers and/or users (as applicable) are adequately informed about the hazard of wood dust and appropriate protective measures during such processes are taken. If dust exposure is a concern (i.e. dust is likely produced and final manufacturing stage workers are not adequately protected or installers and/or users are not informed, as applicable), then the material will receive an X assessment. If not, the material receives a B rating.

- If others recognized hazards exist, the assessor must also consider these in their evaluation using the conventional Material Health Assessment Methodology.

Plant-Based Materials

This is potentially the largest category of biological materials as it includes all plant-based fibers, as well as plant-based materials coming from agricultural primary or secondary materials. All of the plant-based fibers can be considered polymers, and are largely polysaccharides that consist of monomer building blocks such as glucose and others.

Using the polymer rules that are part of the Cradle to Cradle Material Health Assessment Methodology, the pure polymer is assessed based on the hazards of the constituent monomer(s). In this case the monosaccharide components (the monomers) are not hazardous so the base "polymer" or plant-based fiber will be assessed as B. However, all plant-based materials have the potential to be contaminated with residual pesticide chemicals, and fibers are no exception.

Plant-based fibers with Global Organic Textile Standard (GOTS) or an equivalent organic certification receive a "B" assessment for the base fiber since the restrictions on pesticide use for GOTS certification are very rigorous (equivalence to GOTS must be demonstrated by the assessor and pre-approved by C2CPII). However, any dyes, auxiliaries, treatments or other chemical additives present on the fiber must be assessed separately according to the conventional Material Health Assessment Methodology.

Plant-based materials with Öeko-tex 100 certification may be considered C-assessed if the sum pesticides in the material are < 0.5 ppm. If sum pesticides are > 0.5 ppm, the material must be X-assessed.

If the fibers come from plants that were not grown according to organic farming practices and do not have GOTS or an equivalent organic certification, the following must occur. First, the assessor must attempt to determine the source of the fiber and request a list of pesticides used from the grower. Once the assessor has this list, the active ingredient(s) in each pesticide mixture must be assessed according to the conventional Material Health Assessment Methodology.

- If one or more pesticide(s) receives an x assessment, the raw fiber must be tested by an ISO 17025 accredited lab to determine if residues from the x assessed pesticide(s) are present. The detection limit for pesticides listed by either GOTS or EU Ecolabel criteria for textiles must be < 0.1 ppm. If the sum concentration of the x assessed pesticide(s) is > 0.5 ppm, the fiber receives an X assessment. If the sum concentration of the x assessed pesticide(s) is < 0.5 ppm, the fiber receives a C assessment.

- If one or more pesticide(s) receives a c assessment, the applicant has the option of testing the raw fiber. If an overall C assessment for the fiber is acceptable, no testing is required. If an overall B assessment for the fiber is desired, it must be shown via analytical testing (same lab and analytical testing requirements as above) that the sum of any residual c assessed pesticide(s) is < 0.5 ppm.

- If one or more pesticide(s) receive a grey risk rating, analytical testing on the raw fiber must be conducted (same lab and analytical testing requirements as above). If the sum concentration of the grey assessed pesticide(s) is < 0.5 ppm, the fiber receives a C assessment. If the sum concentration of the grey assessed pesticide(s) is > 0.5 ppm, the fiber receives a Grey assessment.

If it is not possible to determine the source of the fiber and obtain a list of pesticides used from the grower (which is common for conventionally grown crops like cotton), the raw fiber must be

tested for the list of pesticides applying to conventional and IPM cotton as required by the most recent version of criteria for obtaining the EU Ecolabel for Textile Products (http://ec.europa.eu/environment/ecolabel/documents/User_manual_textile.pdf). Testing must be conducted by an ISO 17025 accredited laboratory and the detection limit for pesticides listed by either GOTS or EU Ecolabel criteria for textiles must be < 0.1 ppm. If the sum concentration of all x assessed pesticides is > 0.5 ppm, the fiber receives an X assessment. If the sum concentration of the x assessed pesticide(s) is < 0.5 ppm, the material can be assessed C. In addition, all other additives used on the plant-based material (such as dyes, spin finishes/lubricants, and soil/stain protection for fibers) will need to be assessed according to the conventional Material Health assessment methodology. If any bleaching agents were used in processing, such as with cotton materials, these will also be subject to review at any level.

Bast fibers such as flax, hemp, jute, and ramie are subject to the above requirements for pesticides, unless the assessor can justify that a different list of pesticides should be tested based on the research of the common pesticides used on the specific fiber plant in the region where the plant was grown, or it can be demonstrated through chain of custody documents that no pesticides were used on the fiber plant.

In the case of agricultural materials (either primary or secondary) such as rice hulls, corn or corn stalks, or coconut fibers, the main concern is also potential pesticide residues in the final material. The same procedure outlined above for fibers must also be followed for all other agricultural materials.

When applicable, analytical testing is required prior to initial certification and on an annual basis after that for ‘B’ and ‘C’ assessed materials.

For plant-based materials that have been modified on a molecular level (e.g., starch derivatives), the assessment method described in this section may need to be modified based on the expert judgment of the material health assessor.

Animal-Based Materials

The vast majority of materials in this category are fibers from animal sources (e.g., wool, mohair, silk, and cashmere). There are generally no concerns with the pure fiber itself, but rather with the residues that could be present on the fiber. Pesticides and other additives such as shrink-proofing treatments, bleaching agents, and dyestuffs are the major concerns.

Just like plant-based fibers, animal-based fibers with Global Organic Textile Standard (GOTS) or an equivalent organic certification receive a “B” assessment for the base fiber since the restrictions on pesticide use for GOTS certification are very rigorous (equivalence to GOTS must be demonstrated by the assessor and pre-approved by C2CPII). However, any dyes, auxiliaries, treatments or other chemical additives present on the fiber must be assessed separately according to the conventional Material Health Assessment Methodology. The assessor must determine whether these treatments have occurred in the supply chain, especially as it relates to the application of insecticides/ectoparasiticides.

If the fibers come from animals that were not raised according to organic farming practices and do not have GOTS or an equivalent organic certification **OR** insecticides/ectoparasiticides were

or may have been applied to the material at any point in its production[1], the following must occur. First, the assessor must attempt to determine the source of the fiber and request a list of pesticides used by the grower/farmer including any insecticides applied before and/or after harvest (shearing, etc.). Additionally, the assessor must obtain a list of any insecticides/ectoparasiticides applied during subsequent manufacturing steps if this has occurred. Once the assessor has these list(s), the active ingredient(s) in each pesticide/insecticide/ectoparasiticide must be assessed according to the conventional Material Health Assessment Methodology.

- If one or more pesticide(s) receives an x assessment, the raw fiber must be tested by an ISO 17025 accredited lab to determine if residues from the x assessed pesticide(s) are present. The detection limit for pesticides listed by either GOTS or EU Ecolabel criteria for textiles must be < 0.1 ppm.

- If the sum concentration of at least one of the classes of insecticides/ectoparasiticides is above the allowed sum total limits listed in the following table for insecticides/ectoparasiticides (derived primarily from EU Ecolabel for Textile Products[2], and Blue Angel Standard RAL-UZ-128[3]) **OR** the sum concentration of pesticides listed in EU Ecolabel for Textile Products is > 0.5 ppm, the fiber receives an X assessment. If the sum concentration of all of the classes of insecticides/ectoparasiticides is below the allowed sum total limits in the following table **AND** the sum concentration of x-assessed pesticides listed in the EU Ecolabel for Textile Products Standard is ≤ 0.5 ppm, the fiber receives a C assessment.

Class of insecticides/ecoparasiticides	**Sum total limit value**	**Source of value**
Permethrin	3 ppm	BlueAngel[3]
Furmecyclox, piperonyl butoxide, tetramethrin, cyfluthrin, cypermethrin, fenvalerate, deltamethrin	0.5 ppm	BlueAngel[3], EU Ecolabel[2]– sum total limit value corresponds to more conservative EU Ecolabel value
Diazinon, propetamphos, chlorfenvinphos, dichlofenthion, chlorpyriphos, fenchlorphos	2 ppm	EU Ecolabel[2]
Diflubenzuron, triflumuron, dicyclanil	2 ppm	EU Ecolabel[2]

[1] This means that if it can be determined that insecticides/ectoparasiticides were not applied, either by obtaining information directly from the relevant farms and/or processing facilities, or based on evidence of pesticides/ectoparasiticides used for the material type in question, then testing is not required.

[2] 2014/350/EU: Commission Decision of 5 June 2014 establishing the ecological criteria for the award of the EU Ecolabel for textile products (notified under document C(2014) 3677) Text with EEA relevance. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014D0350

[3] Der Blaue Engel. Basic Criteria for Award of the Environmental Label: Low-Emission Textile Floor Coverings, RAL-UZ 128. http://www.eco-institut.de/wp-content/uploads/2017/04/128-1602-e.pdf

- If one or more pesticide(s) receives a c assessment, the applicant has the option of testing the raw fiber. If an overall C assessment for the fiber is acceptable, no testing is required. If an overall B assessment for the fiber is desired, it must be shown via analytical testing (same lab and analytical testing requirements as above) that the sum of any residual c assessed pesticide(s) is ≤ 0.5 ppm.

- If one or more pesticide(s) and/or insecticide(s)/ecoparasiticide(s) receives a grey risk rating, analytical testing on the raw fiber must be conducted (same lab and analytical testing requirements as above). If the sum concentration of the grey assessed pesticide(s) is ≤ 0.5 ppm **AND** if the sum concentration of grey assessed insecticides/ecoparasiticides is below the sum total limit values in the above table for all classes, the fiber receives a C assessment. If the sum concentration of the grey assessed pesticide(s) is > 0.5 ppm **OR** the sum concentration of grey assessed insecticide(s)/ecoparasiticide(s) is above the sum total limit values for at least one class in the above table, the fiber receives a Grey assessment.

If insecticides/ectoparasiticides were or may have been applied to the material at any point in its production and it is not possible to determine the source of the fiber and obtain a list of the specific pesticides used, the raw fiber (for wool the raw fiber is greasy wool) must be tested for the insecticides/ectoparasiticides listed in the table above:

- If residual insecticide(s)/ectoparasiticide(s) are detected, but the sum total concentration is ≤ the sum total limit values for all of the classes in the table above, AND the sum total for any additional residual pesticide(s)/insecticide(s)/ectoparasiticide(s) that are detected is ≤ 0.5 ppm the fiber will receive a “C” assessment.

- If residual insecticide(s)/ectoparasiticide(s) are detected and the sum total is above the sum total limit values for at least one of the classes in the above table, OR any additional residual pesticide(s)/insecticide(s)/ectoparasiticide(s) are detected and the sum total is above 0.5 ppm they must be assessed according to the conventional Material Health Assessment Methodology.

- If the sum total of “x” assessed pesticide(s) or insecticide(s)/ectoparasiticide(s) not contained in the table above is present above 0.5 ppm, this will lead to an “X” assessment for the fiber. If the sum total of any of the classes of insecticides/ectoparasiticides in the table above is above the respective sum total limit values, the fiber will also receive an “X” assessment.

All analytical testing:

- Must be done by an ISO 17025 accredited lab. Wool testing must be conducted in accordance with the International Wool Textile Organization method DTM59-04. Testing on other materials must be conducted in accordance with the analytical methods prescribed in the EU Ecolabel for Textile Products, GOTS, Blue Angel Standard RAL-UZ 128, or equivalent.

- Must be conducted on the raw fiber (for wool the raw fiber is greasy wool), as the scouring process removes much of the pesticide residue. **NOTE**: Insecticides/ectoparasiticides that are intentionally applied as part of the manufacturing process for performance reasons (e.g. mothproofing) are applied during or after the scouring step. Thus, it is required the

assessor determine whether this has occurred, since testing the raw fiber will not account for insecticide/ectoparasiticide intentionally applied after scouring.

In the case of silk, another animal based fiber, the concern is not so much around the fiber itself, but rather the treatments that can occur. “Weighting” of the fiber is a common practice that introduces metal salts into the silk fiber. Commonly used metals include chromium, tin, lead, barium, magnesium and iron. Some have major toxicity concerns while others do not. The assessor must determine if the fiber has been weighted or not, and if so what metal salts were used.

- If the fiber has been weighted with a metal from the Biological Nutrient Banned List, testing must be done to determine the concentration. As these metal salts are intentional inputs, if detected above the allowable threshold, the silk fiber will be banned for use in Cradle to Cradle Certified products.

- If the fiber has been weighted with one or more non-banned, but x assessed, metals (e.g. antimony, barium, cobalt), testing must be done to determine the concentration. If detected in excess of 100 ppm, the silk fiber will be assessed X ***regardless of exposure scenarios,*** as these materials will always find their way back to the biosphere***.***

Another potential issue with silk is the use of pesticides on the mulberry leaves. As is the case with the other fibers, GOTS or an equivalent organic certification will lead to a “B” assessment for the silk fiber (equivalence to GOTS must be demonstrated by the assessor and pre-approved by C2CPII). If no organic certifications are present, the raw fiber must be tested using the same target pesticide list and analytical procedure indicated above for plant-based fibers, unless the assessor can justify that a different list of pesticides should be tested based on research of the common pesticides used on mulberry leaves in the region where the mulberry/silk was grown, or it can be demonstrated through chain of custody documents that no pesticides were used on the mulberry leaves. The assessor must also be sure to identify all additives used in the processing of the silk including dyes, auxiliaries, and finishing chemicals. Any x assessed pesticide or additive present at 100 ppm or higher will lead to an overall X assessment for the silk.

Other animal-based materials such as leather and other hides are essentially cross-linked polymers of protein building blocks in their “pure” state and are therefore “B” assessed based on the polymer rules. However, the vast majority of these materials do not exist in their pure state but must be “tanned” or treated so they will not degrade too quickly. Therefore all chemicals used in this preservation process must be assessed according to the traditional Material Health Assessment Methodology. The individual risk ratings of these substances will determine the overall rating for the material.

Microbial Tissue-Based Materials

This category includes materials such as fungal mycelium. The mycelium is comprised of hyphae, which are long chain, polymeric, materials typically comprised of cellulose/fatty acid complex with a chitin skin. None of these building blocks are considered problematic for human or environmental health, so applying the polymer assessment methodology part of the conventional Material Health Assessment Methodology leads to a “B” assessment for the pure mycelium. However, it is possible for the mycelium to contain toxins or allergens from spores, as well as pesticide residues, since fungal mycelium has been known to filter and break down certain synthetic pesticides. Therefore, to adequately assess these materials the assessor must do the following:

- Identify the species of the fungal mycelium in use and research any known toxins or allergens associated with it. If the species of fungi is found to produce toxins or allergens, the mycelium must be tested for these. The presence of any “x” assessed toxin or allergen above 100 ppm will render the material X. Likewise, the presence of any “c” assessed toxin or allergen above 100 ppm (in the absence of x substances) render the material C.

- Trace the mycelium back to the source, if possible. Once the source has been identified, request information on pesticide use. Follow the process for testing pesticides for plant-based materials from this point on. If the mycelium cannot be traced back to the source, it will be assumed that pesticides were used and analytical testing must be done for commonly used pesticides (i.e., the list of pesticides applying to conventional and IPM cotton as required by the most recent version of criteria for obtaining the EU Ecolabel for Textile Products).

- The assessor can only assess the mycelium as “B” if it can be shown that the fungi species does not produce any toxins or allergens, OR there are no residual toxins or allergens present in the mycelium material above 100 ppm AND it can be documented that there were no pesticides used during the growing of the fungi OR the mycelium does not contain any pesticide residues listed by either GOTS or EU Ecolabel criteria for textiles above the detection limit.

Plant, Animal, and Microbe-Derived Materials

These materials tend to be mixtures rather than pure chemicals. Examples are essential oils, waxes, natural-based fragrances, natural rubber, plant extracts, and seaweed extract. In many cases there will be a CAS number, or set of CAS numbers, that define the substance or mixture. The key in all of these cases is for the assessor to understand the purity and composition of the material in question as well as possible, including substances originating from the organism and added contaminants. For example, Basil Oil (CAS 8015-73-4) will sometimes carry an H351 (suspected of causing cancer) label even though Basil Oil in its pure form is actually used in certain instances to treat cancer. The reason for the H351 label has to do with the presence of other substances such as Estragole (CAS140-67-0), which is a suspected carcinogen. The different contents of something like Basil Oil is indicative of the challenges inherent in assessing these types of materials.

The following section outlines steps for the assessor to take in order to come to an accurate assessment for these types of materials:

- Identify the mixture or homogenous material (using CAS numbers if available), the genus and species from which the material is sourced, the part of the organism (e.g. root of the plant), and the method of extraction or processing. Also identify the source of the organism (e.g. agriculture, organic agriculture, wild collection)

- Perform a review of the information about the mixture or homogenous material, using standard sources, as well as sources dedicated to natural materials (e.g. botanical extracts) and their use.

- Identify the purity of the mixture from the supplier and obtain any other analytical information they may possess detailing potential contaminants and other chemical

substances present in the mixture (e.g. residues of solvents used in the processing). Assess these substances using the conventional Material Health Assessment methodology and assign the overall corresponding risk rating.

- Ensure that the toxic metals on the Biological Nutrient Banned List are not present in the mixture above the allowable thresholds following the procedure described in Section 2.3.1.

- Based on the purity analysis conducted in step 3, if the mixture or homogenous material is otherwise assessed as B or C and there is evidence related to the safe use of the mixture or homogenous material in traditional medicine, cosmetics, or food for 25 years or more (i.e. in Chinese medicine or similar applications), use the available literature toward establishing the overall risk rating as follows:

    - B-assessed – otherwise B-assessed AND the literature highlights the safety of the mixture or compound and affirms the lack of hazardous components or effects (without performing a detailed composition review).
    - C-assessed – otherwise B- or C-assessed AND a hazard or hazardous component was identified, but no significant risk is expected based on traditional use.
    - X-assessed – a hazard or hazardous component was identified and there is reason to believe a significant risk will occur in the current scenario.

- If evidence related to the safe use of the mixture or homogenous material is not found in the available literature, based on information gathered in steps 1-3 above and additional research done by the assessor for substances likely to exist in the mixture, list components that may be present above 100 ppm.

- If the organism-derived derived mixture/material is a component of a different mixture/homogeneous material in the final product, determine which, if any, of the substances (or mixtures with available hazard data) identified in the mixture are above the 100 ppm threshold for the homogeneous material and are therefore subject to review.

- Assess those listed substances identified in step 6 above using the conventional Material Health Assessment Methodology.

- If there are grey endpoints for human or environmental health for either the main substance or any additional substances present and subject to review in the mixture, QSAR tools and/or read across methods must be used to try and derive a non-grey hazard rating.

Geological Materials Assessment Methodology

Last Revision: October 2020

Copyright

Trademark

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

METHODOLOGY FOR THE ASSESSMENT OF GEOLOGICAL MATERIALS REVISION HISTORY

REVISION DATE	SECTION	TYPE OF CHANGE	AUTHORIZED BY
June 2017	Initial Release		S. Klosterhaus
March 2018	2.3.1	Interpretation of limits of toxic metals to correspond to migration limits according to Toy Directive (DIN EN 71-3:2013-07)	S. Klosterhaus
March 2018	2.3.2	Added that testing must be in compliance with the Toy Directive (DIN EN 71-3:2013-07). Other testing procedures may be accepted at C2CPII's discretion.	S. Klosterhaus
September 2018	1.3	Clarified that some industrial by-products with geological material like composition are also defined as geological materials (e.g. coal fly ash, phosphogypsum, blast furnace slag).	S. Klosterhaus
September 2018	2.3.1	Clarified that if a geological material is a biological nutrient then it must meet the biological nutrient limits.	S. Klosterhaus
September 2018	2.3.1	Clarified that tests measuring total concentration or migration may be used to demonstrate compliance with the limits for banned and other toxic metals.	S. Klosterhaus
September 2018	2.3.1	Added that for food contact substances, food contact limits take precedence if lower.	S. Klosterhaus
September 2018	2.3.1	Added that other test methods and associated limits may be used with pre-approval from C2CPII.	S. Klosterhaus
September 2018	2.3.1	Clarified that testing for radionuclides is only required for indoor use products.	S. Klosterhaus
September 2018	2.3.1	Added an alternative to testing for radionuclides based on literature review and/or provision of historical data.	S. Klosterhaus
September 2018	2.3.2	Added information regarding the use of test method DIN EN 71-3:2013-07. Moved information regarding testing frequency from 2.3.1 to this section and clarified that it applies to all required testing.	S. Klosterhaus

March 2019	2.3.1	Added an exception to the radioactive element testing requirement for several rock types.	S. Klosterhaus
November 2019	1.3 & 2	Added an interpretation regarding the assessment of tar, bitumen, and other complex/variable fossil-derived distillation residues	S. Klosterhaus
October 2020	2.3.1	Clarified when CMRs above detection limits per VOC testing are acceptable.	S. Klosterhaus
October 2020	2.3.1	Clarified activity index differentiation between bulk and superficial materials	S. Klosterhaus

1 OVERVIEW

1.1 PURPOSE AND CONTENT

This document outlines a customized methodology for the Material Health assessment of geological materials in the Cradle to Cradle Certified Product Standard. Geological materials include all materials extracted from earth in rock or sediment form.

1.2 SUPPORTING DOCUMENTS

The following documents are to be used in conjunction with this document:

- Cradle to Cradle Certified™ Product Standard
- Cradle to Cradle Certified™ Material Health Assessment Methodology
- Any additional Cradle to Cradle Certified standard documents and methodology documents posted on the C2CPII website.

1.3 GEOLOGICAL MATERIALS

Geological materials include rocks, clays, sands, limestone, and other industrial minerals. For the purposes of this assessment methodology, geological materials also include industrial by-products such as coal fly ash, tar, bitumen, and other complex/variable fossil-derived distillation residues, blast furnace slag, and phosphogypsum that are used in place of natural geological material due to the similarity in composition. Materials derived from geological inputs, but processed in such a way that their chemical composition is fully defined and not variable, are not considered geological materials for the purpose of the C2C certification program (e.g. industrial glass, precipitated calcium carbonate, and metal alloys). Raw materials derived from rock or sediment can be part of the technical cycle, or they can return to nature as inert materials. They are not typically considered biological nutrients as they tend to be inorganic and inert, and therefore cannot be utilized by living systems. These materials provide valuable physical and chemical properties to products; however, they also provide a unique challenge to Material Health assessments. Geological materials are generally inert, yet some may pose hazards to human or environmental health. As with any Material Health assessment in the Cradle to Cradle Certified program, constituent chemical substances must be identified and evaluated to derive an overall material assessment rating.

1.4 SCOPE OF MATERIAL HEALTH ASSESSMENT FOR GEOLOGICAL MATERIALS

Like the conventional standard methodology, the Material Health evaluation is to be conducted on the chemical substances contained within each homogeneous material in the finished product as it leaves the final manufacturing facility. Geological materials have variable chemical composition and

may contain toxic metals, radioactive substances, or other compounds. To help ensure that these substances, if present, are below levels likely to impact human or environmental health, geological materials must be analyzed according to the methodology outlined in section 2.

2 DERIVING FINAL MATERIAL ASSESSMENT RATINGS

2.1 OVERVIEW

Given the lack of toxicity data and variable composition of geological materials, the conventional Material Health Assessment Methodology as applied in the Cradle to Cradle Certified Products Program would lead to 'Grey' assessments in the majority of cases. In order to not limit the use of geological materials within the Cradle to Cradle Certified program, the following methodology has been developed to assign Material Health assessment ratings to geological materials for the purpose of Cradle to Cradle certification.

2.2 INFORMATION SOURCES

The information sources for the Material Health assessment of geological materials are consistent with those used for a typical Material Health assessment. Please see the Cradle to Cradle Certified Material Assessment Methodology for a detailed description. In addition, research papers, journal articles, and technical specification/data sheets will be helpful in identifying the typical composition of geological materials.

2.3 ASSESSMENT PROCESS

2.3.1 GENERAL REQUIREMENTS

Geological materials must be assessed using the following process:

- Research on the geological material must be conducted to understand the origin, typical composition (if available), and potential presence of toxic metals and other hazardous substances. In this methodology, toxic metals are defined as antimony, arsenic, cadmium, chromium VI, cobalt, lead, mercury, nickel, thallium, tin, uranium, and vanadium.

- The geological materials must be pure and contain no other additives, colorants, or finish (e.g. coating, plating, paint). If additives, colorants, or finishes are present on the geological material then these must be assessed separately following the conventional Material Health Assessment Methodology or material-specific methodology if applicable (e.g. colorants,

polymer, or recycled content assessment methodology). This includes meeting all banned list requirements for technical or biological nutrients as relevant.

- Homogeneous materials subject to review that are or that contain geological materials as defined above, must meet the Banned List limits for geological materials per table 1.[1] The limits refer to the amount of metal or metalloid (in mg) that leaches or migrates from a sample of material (in kg) via an extraction methodology. For the purposes of this assessment methodology, the limits may also be applied to the total amount of each listed metal within the homogeneous material.

Table 1 – Banned List Limits for Geological Materials

Banned List Metal	**Banned if total concentration OR migration exceeds this limit:**
Arsenic	47 ppm or mg/kg
Cadmium	17 ppm or mg/kg
Chromium VI (not total Chromium)	0.2 ppm or mg/kg
Lead	160 ppm or mg/kg
Mercury	94 ppm or mg/kg

Tests that measure total concentration and/or the test method indicated for Category III threshold limits in the Toy Directive (DIN EN 71-3:2013-07) may be used to demonstrate compliance[2]. See testing requirements in Section 2.3.2 for further information. Exception: For food contact materials, including food contact ceramics, the relevant EU migration limits and test methods take precedence if lower than those listed in Table 1 above. Other extraction tests and associated limits[3] may be accepted at the discretion of and with pre-approval from the certification body if appropriate to the product type, use, and end of use.

- In addition to the five Banned List Metals (Table 1), the geological materials must also be tested for the presence of other toxic metals if the assessor has deemed that appropriate

[1] If a geological material is also a biological nutrient (for example, if the material abrades into the environment or is in a wet applied product), then the limits for biological nutrients (BNs), when lower, take precedence. Where the geological limits are lower, those will take precedence. Therefore, for a geological material that is a BN, the following limits apply at the homogeneous material level: arsenic: 10 mg/kg, cadmium: 2 mg/kg, total chromium: 100 mg/kg, chromium VI: 0.2 mg/kg, lead: 90 mg/kg, mercury: 1 mg/kg.

[2] For example, if the total concentration is found to be above the limits indicated, the assessor may then decide to follow up with migration testing. If migration is found to be within the allowable limits noted in Table 1, then the material is in compliance with the geological materials banned list limits. ALTERNATIVELY, the assessor may select one of the suggested methods (total concentration or migration testing) and apply the results to the assessment without being required to conduct a second test.

[3] Pre-requisites for accepting other limits: (1) Limits must have been assigned for at least those metals included in Table 1, and (2) the limits must have been set based on safety consideration relevant to the product's use and end of use as opposed to technical feasibility.

based on research to understand the material composition (see testing requirements in Section 2.3.2). If any toxic metals (antimony, cobalt, nickel, thallium, tin, uranium, and vanadium) are detected at a concentration or migration >100 ppm, the material will be assessed X, unless the metal can be shown to be embedded in stable crystal structures from which it is unlikely to leach in any intended or likely unintended use and end-of-use scenarios (this can be shown through dissolution tests, as described in section 4.3.1 point 2 of the Colorants Assessment Methodology, on the homogeneous material in the finished product). As for the banned list metals, conformance with this requirement may be demonstrated via tests that measure total concentration or via migration testing.

Note: An X-assessment due to toxic metal content will also render a material ineligible for use in products at the Silver level or above in the Material Health category if the corresponding metal has a red rating in the endpoints of carcinogenicity, mutagenicity, or reproductive toxicity (which most of them do).

- Bitumen, tar, and other complex/variable fossil-derived distillation residues must be tested for PAHs. The test method used must be able to detect the PAHs covered by REACH Annex XVII Article 50 at a minimum. If the sum concentration of tested PAHs exceeds 100 ppm the material will be X assessed and ineligible for use in products at the Silver level or above in the Material Health category.

  Bitumen, tar, and other complex/variable fossil-derived distillation residues may be associated with CASRNs that are in and of themselves associated with hazard ratings. In such cases, any hazard information available for the relevant CASRNs must also be considered and may lead to an X-assessment independent of testing. If it is clear that the mixture will receive an X-assessment and render the product ineligible for use in products at the Silver level or above in the Material Health category based on hazard information available on the mixture itself (i.e. classified as carcinogenic, mutagenic, or reproductively toxic), no analytical testing beyond the banned list metal testing must be conducted.

- For indoor use products: Homogeneous materials subject to review that are or that contain rock or stone-based material (e.g. granite, etc.) or industrial by-products defined as geological materials (e.g. coal fly ash, phosphogypsum, blast furnace slag[4]) must be evaluated for the presence of radioactive elements[5].

  These materials must be tested for the presence of radioactive elements, namely radium, thorium, and potassium 40 (K40) (see testing frequency requirements in section 2.3.2). Since radioactive elements are not listed on either the technical or biological nutrient Banned Lists,

[4] Radiological Protection Principles concerning the Natural Radioactivity of Building Materials. Directorate-General Environment, Nuclear Safety and Civil Protection. 1999. https://ec.europa.eu/energy/sites/ener/files/documents/112.pdf

[5] The material will receive an x-assessment and be limited to products certified at the Basic or Bronze levels by default if testing is not conducted OR the alternative literature review and historical data approach employed and approved by C2CPII.

the presence of radioactive elements on their own will not prevent a material from being used in a certified product.

For these materials, an activity concentration index (I), as outlined in the European Union Council Directive 2013/59/Euratom[6], must be calculated as follows:

$$\mathbf{I = C_{Ra226}/300\ Bq/kg + C_{Th232}/200\ Bq/kg + C_{K40}/3{,}000\ Bq/kg}$$

where C_{Ra226}, C_{Th232} and C_{K40} are the activity concentrations in Bq/kg of the corresponding radionuclides in the building material. As noted in the European Union Council Directive 2013/59/Euratom[1], an activity concentration index value of 1 can be used as a conservative screening tool for identifying materials that may cause the reference level provided in Article 75(1) of the Directive (i.e., the reference level applying to indoor external exposure to gamma radiation emitted by building materials, 1 mSv a^{-1}) to be exceeded. However, the calculation of dose needs to take other factors related to the intended use of the material into account. As noted in the European Commission's technical guidance[7], the most important factor to consider is whether a material is used in bulk (e.g. concrete) or for superficial and other restricted uses (e.g. tiles, boards). For the latter material types, an activity concentration index of 6 or less will ensure the reference level of 1 mSv a^{-1} will not be exceeded. Therefore, if the index is >1 for bulk materials (e.g. concrete, bricks) or >6 for superficial materials (e.g. tiles, boards), the material will receive an "X" assessment.

ALTERNATIVE: If it can be demonstrated, based on a comprehensive literature search and/or historical data for multiple years relevant to the extraction/production locations in question, that it is highly unlikely for the activity concentration index to exceed 1 for the material in question, then testing is not required. Estimates of radioactivity at the homogeneous material level may be made in cases where the rock, stone, or industrial by-product material makes up only a portion of the homogeneous material subject to review. C2CPII will review the documentation provided and accept this alternative approach on a case by case basis.

The alternate approach has already been accepted for the materials listed below. For these materials, it may be assumed that the activity index is less than 1 without testing for

[6] COUNCIL DIRECTIVE 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom

7 European Commission, 1999, Radiation protection 112 - Radiological Protection Principles concerning the Natural Radioactivity of Building Materials

radioactive elements unless there is reason to believe that the specific material under review has a high degree of radioactivity compared to the norm.

- Limestone/calcium carbonate
- Natural gypsum
- Dolomite
- Marble

This list will be extended as new comprehensive literature searches are provided and accepted.

Bitumen, tar, and other complex/variable fossil-derived distillation residues do not require testing for radioactive elements.

- If used in indoor use products, bitumen, tar, and other complex/variable fossil-derived distillation residues must undergo VOC emissions testing as described in section 3.9 of the standard (regardless of achievement level). VOC tests must be conducted at a temperature that is representative of the upper temperature limit that may be experienced by the product the material is in during the use phase. If the material fails the VOC emissions testing, it will be X-assessed. If the failure is due to one or more CMR substances being emitted above the detection limit, the material will be ineligible for use in products at the Silver level or above in the Material Health category unless they are below (0.01) x [the lower of the TLV or MAK value]. (See Guidance for the Cradle to Cradle Certified Product Standard, Version 3.1, section 3.9, sub-section titled 'VOC Emission Limits Related to Whether or Not a TLV or MAK Value is Known for the VOC of Relevance' for further information).

- If no banned metal has been detected above the allowable threshold, other toxic metals have not been detected in excess of 100 ppm (or it can be demonstrated via dissolution tests as described in section 4.3.1 point 2 of the Colorants Assessment Methodology that these metals are contained in stable crystal structures), and the levels of radium, thorium, and K40 are below the thresholds (i.e. I < 1), the following modified version of the conventional Material Health Assessment Methodology must be used to assess the substances known to be present in the material based on its typical chemical composition. With the exception of toxic metals and radioactive elements, for which the subject-to-review criteria are specified above, substances are subject to review if expected to be present in the material at a concentration of 1% or higher.

  For example, research shows that kiln fired clay bricks typically consist of the following:
  - 50 – 60% silica (sand)
  - 20 – 30% alumina (clay)
  - 2 – 5% lime
  - <= 7% iron oxide

- < 1% magnesia

In this case, all substances believed to be present above the subject to review threshold (1%) in the brick must be researched and evaluated following the conventional Material Health Assessment Methodology to see if they are associated with any known human or environmental health hazards. Relevant routes of exposure to these individual hazards are then considered. Frequently, no relevant routes of exposure may exist as assessed substances are interfused in the matrix. A common exception to this is exposure via inhalation if the materials are cut or ground during installation or use, thus releasing dust or inhalable particles.

Because of the physical nature of geological materials, toxicological data for all hazard endpoints is frequently unavailable. Therefore, the following criteria are used to assign a B, C, or X rating to the material. Note that grey ratings for hazard endpoints are permitted if the assessor has conducted a thorough review of available resources to identify any known hazards,

- If one or more hazard endpoints (other than bioaccumulation and persistence) for a substance subject to review within the material receive a red rating and there is a relevant route of exposure to the substance for the endpoint(s), the material receives an X assessment.
- If one or more hazard endpoints (other than bioaccumulation and persistence) receive a red rating and there is no relevant route of exposure for the endpoint(s), the material receives a C assessment.
- If no red hazard ratings have been identified, but one or more hazard endpoints (other than bioaccumulation and persistence) receive a yellow rating and there is a relevant route of exposure for the endpoint(s), the material receives a C assessment.
- If no red hazard ratings have been identified, but one or more hazard endpoints (other than bioaccumulation and persistence) receive a yellow rating and there is no relevant route of exposure for the endpoint(s), the material receives a B assessment.
- If no red or yellow hazard ratings have been identified, the material receives a B assessment.

2.3.2 TESTING REQUIREMENTS

The following testing procedures must be used:

- All testing must be conducted by an ISO 17025 accredited laboratory.
- Toxic metals: DIN EN 71-3:2013-07 is accepted. Sample preparation should be in accordance with section 7.3.3.1 *Coatings of paint, varnish, lacquer, printing ink, polymer and*

similar coatings: There should be at least 10 mg of material that is able to pass through a sieve with aperture of 0.5 mm. However, if it is possible to obtain 100 mg of material that can pass through a sieve with aperture of 0.5 mm from a single product, then 100 mg must be used, even if the material is not obtained from a coating. The migration procedure described in section 7.4.3.1 must be followed. To prevent interconversion of Chromium III and Chromium VI, the migration solution must be neutralized directly after the migration step.

- VOC emissions testing: follow the procedures as outlined in section 3.9 of the standard.
- Other testing procedures may be accepted at C2CPII's discretion.

Frequency: All analytical testing must be conducted at the time of initial certification, at recertification, and if or when the quarry or extraction area changes, whichever comes sooner. Note: if it is not possible to trace the material back to a specific extraction area, a minimum of three samples from three separate shipments and batches must be tested for each analyte. If there is any variability in the results, the applicant must work with the analytical testing laboratory to establish a statistical testing plan that accounts for variation in the concentrations of all target analytes and will ensure that based on the number and frequency of samples taken, compliance with the relevant thresholds can statistically be expected for all batches and shipments.

Polymer Assessment Methodology

Last Revision: May 2017

Copyright

Trademark

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

REVISION LOG

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
May 2017	All	The entire section 6 of the *Supplemental Guidance for the Cradle to Cradle Certified Product Standard Material Health Assessment Methodology, Version 3.0*, dated March 2015, entitled Guidance for Assessing Polymers, has been transferred into this document for clarity. Note that the section numbers between the v3.0 document and this document do not correspond. Section numbers listed to the left within the SECTIONS column of this table are for this document.	S. Klosterhaus
May 2017	2.2	This section has been clarified to indicate that, if available, toxicity data on the polymer itself should be used in completing the hazard profile for the polymer. The prior language made it sound as if data on monomers was to be used exclusively. The following clarification has also been added: Plausible exposure is assumed for any residual monomers subject to review, except via the route of inhalation (i.e. an exposure assessment may be completed for the inhalation route).	S. Klosterhaus

1 OVERVIEW

1.1 Purpose and Content

This document describes the methodology used to assign an A, B, C, X, or GREY material assessment rating to polymeric materials subject to review in a finished product that is applying for Cradle to Cradle certification. Due to their large molecular weight and limited solubility, toxicity data for polymers are generally not available. Polymeric materials in products being assessed for Cradle to Cradle certification are therefore assessed following this customized methodology, rather than the conventional Material Health Assessment Methodology.

1.2 Supporting Documents

The following documents are to be used in conjunction with this document:

- Cradle to Cradle Certified™ Product Standard
- Cradle to Cradle Certified™ Material Health Assessment Methodology
- Any additional supporting documents and guidance posted on the C2CPII website

Visit the Cradle to Cradle Products Innovation Institute website to download the Standard documents and obtain the most current information regarding the product Standard (http://www.c2ccertified.org/product_certification/c2ccertified_product_standard).

2 ASSESSMENT OF POLYMERS

2.1 Chemicals subject to review

The chemicals subject to review in a polymeric material are:

- the base polymer (e.g., PET, polyethylene, polycarbonate)
- residual monomers, when present above the relevant threshold (see below)
- oligomers of known concern (e.g. styrene trimers and dimers)
- all additives, residual catalyst, etc., when present at a concentration ⩾ 100 ppm (the subject to review threshold for nearly all other chemicals in a homogenous material).
- intentionally added lead, mercury, hexavalent chromium, cadmium, halogenated organic compounds, phthalates, blowing agents, or colorants, when present at any concentration

All residual monomers other than formaldehyde are subject to review if present at a concentration ⩾ 1000 ppm in the polymeric material. Formaldehyde monomers are subject to review if present

at a concentration ⩾ 100 ppm in the polymeric material. Residual monomer concentrations in the polymeric material can be determined from supplier statements or analytical measurements.

2.2 Assessment Methodology

The methodology used to assign A, B, C, X or GREY ratings to polymers is the same as the conventional Material Health Assessment Methodology with the following exceptions and special considerations:

Base polymer – Hazard ratings for the base polymer are assigned to each endpoint based on toxicity data for the polymer itself when available, toxicity data for chemical analogs or the relevant polymer class, or toxicity data for the monomer(s) used in its production when data on the base polymer and/or analogs are not available. For copolymers (i.e., polymers composed of more than one type of monomer), when basing the assessment on the monomers, the hazard rating in each endpoint is based on the lowest hazard rating received by any of its constituent monomers for the endpoint (lowest in order of: 'red', 'grey', 'yellow', 'green').

When deriving risk flags for the base polymer, exposure is assumed to be not plausible and thus any red or grey hazard ratings translate to yellow risk flags, and yellow and green hazard ratings translate to green risk flags.

Residual monomers – If present above their relevant subject to review thresholds, residual monomers are assigned separate hazard ratings, risk flags, and single chemical risk ratings. Plausible exposure is assumed for any residual monomers subject to review, except via the route of inhalation (i.e. an exposure assessment may be completed for the inhalation route).

2.3 X Assessed Polymers

Bisphenol-A (BPA)-based polymers or coatings (e.g., polycarbonate, etc.) used in toys, skin contact furniture applications, food contact applications, and baby applications are always assessed as X, regardless of residual monomer content.

All halogenated polymers will be either X assessed or banned (if present on the Banned List).

OTHER ASSESSMENT METHODOLOGIES

Methodology for Applying the Final Manufacturing Stage Requirements

Methodology for Defining Homogeneous Materials

Methodology for Applying the Final Manufacturing Stage Requirements

Last Revision: October 2020

Copyright

Trademark

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

METHODOLOGY FOR APPLYING THE FINAL MANUFACTURING STAGE REQUIREMENTS REVISION HISTORY

REVISION DATE	SECTION	TYPE OF CHANGE	AUTHORIZED BY
October 2015	Initial Release		S. Klosterhaus
April 16, 2017	3.2	Added "Drying" to the processes for the "Builder's Joinery and Carpentry of Wood" category.	S. Klosterhaus
April 16, 2017	3.2	Clarified definition of "Finished Metal Products" category	S. Klosterhaus
April 16, 2017	3.2	Added "Extrusion" and "Pelletizing" to the processes for the "Primary Forms" Plastics category.	S. Klosterhaus
April 16, 2017	3.2	Added "Printing" and "Washing/Laundering (prior to shipment/sale)" to the processes for the "Apparel" category.	S. Klosterhaus
April 16, 2017	3.2	Deleted sorting and grating from the processes for Yarn.	S. Klosterhaus
April 16, 2017	3.2	Clarified the processes for Apparel to include all finishing processes (except for yarn dyeing).	S. Klosterhaus
March 2018	3.2	Added new Table for Raw Textile Materials.	S. Klosterhaus
March 2018	3.2	Added "Aluminum Lighting Columns" to product examples of Finished Metal Products.	S. Klosterhaus
March 2018	3.2	Clarified definition of Finished Metal Products to refer to single *metal* material types	S. Klosterhaus
October 2020	3.2	Clarified that mixing at point of sale is not included in the final manufacturing for formulated products.	S. Klosterhaus
October 2020	3.2	Clarified that processes occurring during logging are not required to be included for Builder's Joinery and Carpentry of Wood.	S. Klosterhaus
October 2020	3.2	Added several final manufacturing stage processes for Paper and Cardboard Packaging.	S. Klosterhaus
October 2020	3.2	Added Insulated Panels to the table for Metals and Metal Products.	S. Klosterhaus
October 2020	3.2	Added several final manufacturing stage processes for Rubber and Plastic Products	S. Klosterhaus

1 OVERVIEW

1.1 PURPOSE AND CONTENT

The purpose of this document is to provide a methodology for applying the final manufacturing stage requirements in the Cradle to Cradle Certified Product Standard (the 'Standard'). This document defines the processes that constitute the final manufacturing stage by product type and describes how information from the facility or facilities at which these processes occur is to be used during the assessment of an applicant product.

1.2 SUPPORTING DOCUMENTS

The following documents are to be used in conjunction with this guidance document:

- *Cradle to Cradle Certified™ Product Standard*
- *Any additional supporting documents and guidance posted on the C2CPII website*

Visit the Cradle to Cradle Products Innovation Institute website to download the Standard documents and obtain the most current information regarding the product Standard (http://www.c2ccertified.org/product_certification/c2ccertified_product_standard).

2 FINAL MANUFACTURING STAGE REQUIREMENTS

A number of requirements in the Standard necessitate defining the processes that constitute the final manufacturing stage of a product in order to assess the product for certification. The sections below list the requirements for which the final manufacturing stage definitions must be applied.

2.1 MATERIAL HEALTH

Bronze level and above: A product's use, production, and end-of-use scenarios must be defined as part of the exposure assessment during the material health assessment process. The production scenarios must consider all relevant routes of exposure during the following processes:

(1) The processes that occur at the main final manufacturing facility. If there is more than one final manufacturing facility, the assessor determines which facility is the "main" facility based on which one performs the most significant manufacturing processes. The assessment summary submitted to C2CPII must explain how the assessor made this determination.

(2) Select additional manufacturing processes, regardless of where they occur. These select additional processes are those for which exposure concerns are considered exceptionally high. They are marked with a '*' in the final manufacturing stage definitions in Section 2.

Note that the processes that must be considered during the exposure assessment are the same as those that require a site visit. The site visit requirement is described further in Section 1.3.5.

Platinum level: The requirement states that all process chemicals are assessed and none have received a single chemical risk score of 'x.' This requirement applies to the process chemicals that are not subject to review in the materials of the final product, but come into direct contact with the product or any of its components or material inputs during any of the processes that are part of the final manufacturing stage.

2.2 RENEWABLE ENERGY AND CARBON MANAGEMENT

Basic level and above: When calculating the product-attributable purchased electricity and direct on-site emissions, only those processes that constitute the final manufacturing stage of the product are considered, rather than all of the product-relevant processes that may be used at a facility. If the processes that constitute the final manufacturing stage of the product occur at multiple facilities, then electricity and emissions data will need to be compiled from all of the facilities. This includes both situations in which the final manufacturing stage processes are distributed among multiple facilities, and situations in which the same processes occur in parallel at multiple facilities. The processes to include in the final manufacturing stage are those outlined in Section 2 of this document, as well as quality control, packaging and storage of final products, and on-site treatment of process wastes.

The total product-relevant renewable electricity is the sum of the product-relevant renewable electricity used at all facilities that are involved in the final manufacturing stage. The total product-relevant carbon offsets are the sum of the product-attributable carbon offsets purchased by the applicant or any contract manufacturers involved in the final manufacturing stage. The percentages of renewable electricity used and direct on-site emissions offset are based on these values and the total product-attributable purchased electricity and direct on-site emissions.

2.3 WATER STEWARDSHIP

Basic level: All three requirements at the Basic level necessitate addressing water stewardship at the product's manufacturing facilities. These requirements apply to each facility at which the processes that constitute the final manufacturing stage occur.

Bronze level: The requirement is for a facility-wide water audit to be completed. Audits are required for each facility at which the processes that constitute the final manufacturing stage occur.

Silver level: The requirement is that product-related process chemicals in effluent are characterized and assessed. The requirement applies to process chemicals used in the processes that constitute the final manufacturing stage.

Gold level: The requirement is that product-related process chemicals in effluent are optimized. The requirement applies to process chemicals used in the processes that constitute the final manufacturing stage.

Platinum level: The requirement is that all water leaving the manufacturing facility meets drinking water quality standards. The requirement applies to each facility at which the processes that constitute the final manufacturing stage occur.

2.4 SOCIAL FAIRNESS

Basic level: The requirement is for a streamlined self-audit to be conducted for each final manufacturing facility and tier one supplier facility. Tier one supplier facilities are defined as facilities that supply product-relevant materials, parts, or components to any of the final manufacturing stage facilities.

Bronze level: The requirement is for a full audit to be conducted by the applicant. If the UN Global Compact Tool is used, responses should be based on the conditions and practices at the final manufacturing stage facilities, even if the applicant does not own them. The applicant should work with any contract manufacturing facilities to collect the appropriate responses. If the B Impact Assessment is used instead, the applicant may complete the assessment based on its own operations, as the questions are more relevant to the applicant than to any contract manufacturing facilities.

Platinum level: The requirement is that a third-party audit must be completed against an internationally recognized social responsibility program. Where applicable, the audit program requirements must focus on all final manufacturing facilities.

2.5 SITE VISIT

Bronze requirement: A site visit is required for the main final manufacturing facility and any other facilities involved in select manufacturing processes for which exposure concerns are considered exceptionally high. These select manufacturing processes are marked with a '*' in the final manufacturing stage definitions in Section 2. If there is more than one final manufacturing facility, the assessor determines which facility is the "main" facility to be visited based on which one performs the most significant manufacturing processes. The assessment summary submitted to C2CPII must explain how the assessor made this determination.

Unless the product's final manufacture involves a process marked with a '*' in Section 2, only one site visit is required, regardless of how many individual facilities are included in the final manufacturing stage. For example, if five facilities are involved in the final manufacturing stage, and none of them performs a process marked with a '*,' only one of them needs to be visited.

3 FINAL MANUFACTURING STAGE DEFINITIONS

3.1 SCOPE OF THE FINAL MANUFACTURING STAGE PROCESSES

Due to the variability of manufacturing processes, this document is not intended to be an exhaustive list of processes to include in the final manufacturing stage of each product. It serves instead as an outline of the basic processes to include (when applicable) during the assessment, to be supplemented with any other relevant production processes employed as per the assessor's professional judgment.

If a product does not appear to fit into any of the categories, the assessor must send a proposed list of final manufacturing stage processes to the Cradle to Cradle Products Innovation Institute (certification@c2ccertified.org). Where applicable, the proposed list should be based on the processes

included in the "Other" field for the relevant industry. The Institute will review and approve proposed lists of processes and add the new product types to future revisions of this document.

3.2 FINAL MANUFACTURING STAGE PROCESSES

The processes that constitute the final manufacturing stage are defined by industry category in Tables 1-8 below. The definitions were developed using the data sources referenced in Section 4 and the experience of the founding accredited assessment bodies in the certification program (MBDC and EPEA Internationale Umweltforschung GmbH).

Table 1: Multi-Component Products

Products that are assemblies of several components are considered "multi-component products." Examples include (but are not limited to) office chairs and other furniture. When assessing a multi-component product that does not fit into any of the categories outlined in Tables 2 – 8, please follow the general instructions in the table below.

Category	Final Manufacturing Processes	Product Examples	Reference #
Multi-Component Products	All Operations for Final Assembly (excluding operations occurring at the purchaser's site). "Final assembly" usually refers to assembly occurring at the last facility before the product is shipped to the customer. The assessor is responsible for determining the appropriate scope in cases in which the most significant assembly processes do not occur in the last facility or in which assembly processes are distributed among several facilities.	Office Systems, Tables, Bed Frames, Mattresses, Pens, Wires, Green Walls and Roofs, Dispensing Systems, Playground Systems	31, 32, 33, 34, 35

Table 2: Formulated Products

Category	Final Manufacturing Processes	Product Examples	Reference #
Soaps and Cleaners	Mixing, Pumping, Spray Drying, Extruding (for bar soaps), Filling, Heating, Grinding, Degassing, Cooling	Body Wash, Hair Care, Soaps, Detergents, Cleaning Products	1, 2, 3, 4, 5
Paints and Coatings	Formulation, Paint-Blending*, Grinding, Mixing, Filling	Paints, Finishes, Fire-Proofing, Sealants	6
Other Formulated Products	Blending/Mixing*, Heating/Cooling (of blending vessel), Filling	Admixtures, Tanning Agents, Coloring Agents, Latex	7

*For formulated products made of discrete components that will be mixed by a professional at point of sale (e.g. paint and color concentrate mixed onsite at a paint shop), the final manufacturing stage is not required to include the final mixing of components.

Table 3: Construction Products

Category	Final Manufacturing Processes	Product Examples	Reference #
Cement	Grinding, Mixing, Forming Clinker, Milking, Bagging	Cement	7
Concrete	Pre-Cast: Mixing Concrete, Casting, Curing Ready Mix: Mixing of Concrete, Bagging	Concrete	8
Engineered Stone	Crushing, Mixing, Molding, Leveling, Compressing, Heating in Kiln, Setting, Hardening, Grinding, Finishing	Quartz Countertops	9
Insulation	Fiberglass: Finishing, Sizing, Binding, Compression, Oven Curing, Cooling, Winding, Oven Drying, Oven Cooling, Fabrication, Packaging	Fiberglass Insulation	10
Natural Stone	Block Sawing, Polishing, Sizing, Reinforcement, Finishing	Granite, Marble	11
Tiles, Flagstones, Bricks	Blending, Forming, Finishing, Heating/Drying	Clay Products, Bricks	12

Other	Any processes involved combining/assembling inputs		13

Table 4: Forestry, Wood, and Paper

Category	Final Manufacturing Processes	Product Examples	Reference #
Absorbent Hygiene Products	Adding Polymer, Formation, Lamination, Shaping, Cutting, Pressing, Bonding, Finishing	Diaper Linings, Feminine Hygiene	14
Builder's Joinery and Carpentry of Wood	Cutting, Drying*, Surfacing, Sawing, Forming, Special Cutting, Joint-Making, Finishing	Structural Wood, Shingles, Wall Guards, Hardwood Flooring	7, 15
Corrugated Paper and Paperboard	Layering, Pressing, Drying, Embossing, Impregnation, Printing and Pigment Coating, Finishing	Cartons, Boxes, Cases, Record Sleeves	16, 17
Processed Paper and Paperboard	Screening, Silting, De-Watering, Pressing, Smoothing, Drying, Cutting, Calendaring, Embossing, Impregnation, Coating, Printing, Packing, De-Inking	Toilet Paper, Copy Paper	7, 18, 19, 20, 21, 22, 23, 24, 25
Printed Materials	Printing, Binding	Journals, Books, Calendars	
Paper and Cardboard Packaging	Converting, Embossing, Impregnation, Printing and Pigment Coating, Finishing	Mailing envelopes	
Wood Particle and Fiberboard	**General:** Screening, Refining, Gluing, Layer Conformation, Boardpress, Coating, Pressing, Cutting, Sanding **Particleboard:** Raw Furnish Drying, Board Shaping by Screening, Blending, Forming, Pressing; Board Finishing by Cooling, Trimming and Sanding. **Laminate Flooring:** Bonding, Pressing, Cooling, Milling, Finishing	Fiberboard, Particleboard, Laminate Flooring	7, 25, 26, 27, 28

Other	Debarking, Cutting, Heating, Drying, Screening, Treatment, Resin Application, Pressing, Sawing, Finishing		29

*Cutting and drying refer to processes that may occur after the logging stage, not to the initial cutting and drying of trees during logging.

Table 5: Glass and Ceramics

Category	Final Manufacturing Processes	Product Examples	Reference #
Glass and Ceramics	Batching, Melting, Coloring, Forming, Stretching, Chemical Treatments, Tempering, Annealing, Grinding, Polishing, Washing, Cutting, Finishing	Glass, Glass Products, Ceramics, Other Non-Metallic Products, Architectural Glass	7

Table 6: Metals and Metal Products

Category	Final Manufacturing Processes	Product Examples	Reference #
Metal Alloys	Processing, Melting, Mixing, Separation, Finishing	Steel Alloys	30
Finished Metal Products (products that are predominantly [~95-100 %] a single homogeneous metal material, except for coatings, fasteners, and labels)	Fabrication (e.g. welding, cutting, bending, hammering, machining, etc.), Spinning, Blanking, Stamping, Annealing, Die-Casting, Molding, Calendaring, Coating, Blowing, Pressing, Forming, Finishing	Mechanical Systems, Structural Metals, Sheet Metals, Metal Products, Aluminum Lighting Columns	7
Insulated Panels	Embossing, De-coiling, Profiling, Edge detailing, Chemical laydown, Lamination, Cutting, Cooling, Stacking		63

Table 7: Plastics

Category	Final Manufacturing Processes	Product Examples	Reference #

Primary Forms	Polymer Production, Compounding, Extrusion, Pelletizing	Resins, Plastic Filament	7, 36
Rubber and Plastic Products (products that are a single plastic type (e.g. PET), except for coatings, fasteners, and labels)	Molding, Mixing (e.g. mixing polymer pellets with a colorant), Extruding, Fabricating, Calendaring, Blowing, Pressing, Spinning, Blending, Thermoforming, Labeling, Foaming, Kneading, Cooling, Powdering, Rolling, Vulcanisation (special pressing), Grinding, Blanking, Finishing	Membranes, Plastic Flooring, Wall Guards, Rubber Carpet Pads, Foam Carpet Pads, Composite Products	37, 63

Table 8: Textiles

Category	Final Manufacturing Processes	Product Examples	Reference #
Carpet and Artificial Turf	Tufting, Carpet Dyeing* (yarn dyeing excluded), Coating*, Shearing, Weaving, Finishing, Tile or Roll Cutting	Carpet Rolls, Carpet Tiles, Artificial Turf	38
Apparel	Cutting, Sewing, Dyeing/Printing/Finishing* (yarn dyeing excluded, but includes textile dying that occurs prior to cutting/sewing), Washing/Laundering (prior to shipment/sale)	Garments	
Leather Footwear	Assembly of Footwear-Specific Components (Upper, Sole, Laces, etc.)	Suede Shoes	39
Nonwoven Textiles	Formation (Spun, Staple, Airlaid, Web etc.), Textile Dyeing* (fiber dyeing excluded), Lamination, Finishing	Nonwoven Upholstery, Sponges	40, 41
Plush Toys	Cutting, Sewing, Stuffing, Finishing	Stuffed Animals	42
Textiles (Woven, Knit, Crocheted)	Weaving, Knitting, Warping, Sizing, Ennoblement, Scoring, Thermofinishing, Fabric Formation, Wet Processing, Textile Dyeing* (yarn dyeing excluded), Printing*, Steaming, Chemical*/Mechanical Finishing	Shadecloths, Fiber Carpet Pads, Towels, Blankets, Polyester	7, 43, 44, 45, 46, 47, 48
Yarn	Scouring, Spinning, Drawing, Extrusion, Texturing, Blending, Multiplying/ Folding/Cabling, Dyeing*	Natural and Synthetic Yarns	7, 49, 50

Table 9: Raw Textile Materials

Category	Final Manufacturing Processes	Product Examples	Reference #
Wool Handling	Shearing, pick-up, wool rolling, pen-up, pressing	Wool bale	51, 52
Silk Production	Silk reeling, twisting	Raw silk	53, 54, 55
Cotton Production	Cotton fiber separation (cotton gin)	Cotton bale	56
Flax Fiber Production	Rippling, retting, washing and drying, decortication, breaking, scutching, hackling	Flax Fiber	57, 58
Jute Fiber Production	Rippling, retting, washing and drying, Decortication, breaking, extraction of fiber, grading	Jute Fiber	59, 60
Hemp Fiber Production	Rippling, retting, washing and drying, decortication, breaking, scutching, hackling	Hemp Fiber	61, 62

4 REFERENCES

1. The Sustainability Consortium. (2014). *Laundry detergent: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/73158299/Dossier%20-%20Laundry%20Detergent%20v2.0.2%20-%2017%20Jan%202014.pdf

2. The Sustainability Consortium. (2014). *Leave-on skin products: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/72847793/Dossier%20-%20Leave-On%20Skin%20Products%20-%2013%20Jan%202014.pdf

3. The Sustainability Consortium. (2014). *Makeup: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/73703567/Dossier%20-%20Makeup%20-%20v1.0.3%2026%20Jan%202014.pdf

4. The Sustainability Consortium. (2014). *Showering products: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/73160771/Dossier%20-%20Showering%20Products%20v2.0.2%20-%2017%20Jan%202014.pdf

5. The Sustainability Consortium. (2014). *Surface cleaners: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/73161209/Dossier%20-%20Surface%20Cleaners%20v2.0.2%20-%2017%20Jan%202014.pdf

6. The Sustainability Consortium. (2014). *Paint: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/73786181/Dossier%20-%20Paint%20-%20v1.0.2%2027%20Jan%202014.pdf

7. Bralla, J. (2006). *Handbook of Manufacturing Processes.* New York: Industrial Press.

8. WBCSD Cement Sustainability Initiative. (2013). *Concrete PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=8108#.UvQJEfbHJto

9. International Surface Fabricators Association. (2009). *The manufacture of engineered stone and installation of quartz surfacing countertops.* Retrieved from www.isfanow.org/wp-content/uploads/2012/02/quartz-manufac.pdf

10. U.S. Environmental Protection Agency. (2002). *Ap-42 compilation of air pollutant emission factors: glass fiber manufacturing.* (5th ed., Vol. 1, pp. 11.13.1-11.13.16). Research Triangle Park, NC: U.S. EPA. Retrieved from www.epa.gov/ttnchie1/ap42/ch11/final/c11s13.pdf

11. López-Buendía, A.M., Guillem, C., Cuevas, J.M. Mateos, F., Montoto, M. (2013). Natural stone reinforcement of discontinuities with resin for industrial processing. *Engineering Geology, 166,* 39-51. http://www.sciencedirect.com/science/article/pii/S0013795213002524

12. LCA-lab SRL, Associazione Produttori Tegole in Cemento. (2011). *Tiles, flagstones, bricks and similar articles of cement, concrete or artificial stone PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=8109#.UvQJrPbHJto

13. The International EPD System. (2010-2014). *Construction products and construction services (combined PCR & PCR basic module)*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=8098#.UvQHvvbHJto

14. The Absorbent Hygiene Manufacturing Committee of EDANA. (2007). *Sustainability report 2007-2008: absorbent hygiene products. (p.44). Retrieved from* www.edana.org/docs/default-source/default-document-library/sustainability-report-absorbent-hygiene-products-2007-2008.pdf?sfvrsn=2

15. The Sustainability Consortium. (2013). *Wooden toys: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/71127422/Dossier%20-%20Wooden%20Toys%20Revised%20v1.0.2%20-%2025%20Nov%202013.pdf

16. TÜV Rheinland Energy and Environment GmbH. (2013). *Corrugated paper and paperboard PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=8714#.UvQKJfbHJto

17. IVL Swedish Environmental Research Institute, BillerudKorsnäs AB. (2010). *Processed paper and paperboard PCR. Retrieved from* www.environdec.com/en/PCR/Detail/?Pcr=5948#.UvQKW_bHJto

18. IVL Swedish Environmental Research Institute, The European Carton Makers Association. (2010). *Containers of paper and paperboard PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=5960#.UvQNcPbHJto

19. The Sustainability Consortium. (2013). *Books and magazines: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/72005882/Dossier%20-%20Books%20and%20Magazines%20-%20Draft%201.pdf

20. The Sustainability Consortium. (2013). *Copy paper: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/page/67844920/Copy%20Paper%20Version%202%20Dossier

21. The Sustainability Consortium. (2012). *Facial tissue: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/page/57921679/Facial%20Tissue%20Dossier%20Current

22. The Sustainability Consortium. (2012). *Greeting cards: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/page/57921692/Greeting%20Cards%20Dossier%20Current

23. The Sustainability Consortium. (2012). *Paper towels: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/page/57922616/Paper%20Towels%20Dossier%20Current

24. The Sustainability Consortium. (2013). *Stationery paper: product category dossier*. Retrieved from https://sustainabilityconsortium-

tscalpha.pbworks.com/w/file/fetch/71121074/Draft%202%20Dossier%20-%20Stationery%20Paper%20-%2026%20Nov%202013.pdf

25. The Spanish National Association of Wood Board Manufacturers, CO2 Consulting, SL, FINSA INTERBON, LOSÁN, SONAE INDUSTRIA, Tableros Tradema (Grupo Sonae Indústria)... UTISA. (2012). *Wood particle and fibreboards PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=7843#.UvQKv_bHJto

26. The Sustainability Consortium. (2013). *Fibrous wood panels: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/71120300/Draft%202%20Dossier%20-%20Fibrous%20Wood%20Panels%20-%2026%20Nov%202013.pdf

27. The Sustainability Consortium. (2013). *Toilet tissue: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/page/66093972/Toilet%20Tissue%20Version%202%20Batch%205%20Dossier

28. World Floor Covering Association. (2013). *How laminate flooring is made.* Retrieved from www.wfca.org/Pages/How-Laminate-Flooring-Is-Made.aspx

29. U.S. Environmental Protection Agency. (1985). *Ap-42 compilation of air pollutant emission factors: engineered wood products manufacturing.* (5th ed., Vol. 1, pp. 10.9.1-10.9.24). Research Triangle Park, NC: U.S. EPA. Retrieved from www.epa.gov/ttnchie1/ap42/ch10/final/c10s09.pdf

30. The International EPD System. (2002). *Steel products PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=5660#.UvQLHvbHJto

31. IVL Swedish Environmental Research Institute, RH Form. (2009). *Seats PCR.* Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=5816#.UvQNz_bHJto

32. The International EPD System. (2010). *Furniture; other transportable goods not elsewhere classified PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=5834#.UvQN_fbHJto

33. APTAR Chieti. (2013). *Dispensing systems PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=8995#.UvQOVPbHJto

34. The Sustainability Consortium. (2013). *Small appliances: product category dossier.* Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/71552420/Dossier%20-%20Small%20Appliances%20-%2014%20Dec%202013.pdf

35. The Sustainability Consortium. (2013). *Board games: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/page/67321276/Board%20Games%20Dossier%20%28Version%201%29

36. Quota Sette, Studio Fieschi. (2012). *Plastics in primary forms PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=5864#.UvQPdvbHJto

37. The Sustainability Consortium. (2013). *Plastic toys: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/71127101/Dossier%20-%20Plastic%20Toys%20Revised%20v2.0.2%20-%2025%20Nov%202013.pdf

38. World Floor Covering Association. (2013). *How carpet is made.* Retrieved from www.wfca.org/Pages/How-Carpet-Is-Made.aspx

39. Synesis Consortium, ITIA-CNR, Industrial partners from the footwear chain, accessories and components partners, final producers. (2013). *Leather footwear PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=8495#.UvQUWfbHJt2

40. MIKO S.r.l. (2011). *Nonwovens for clothing, protective clothing and upholstery PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=7929#.UvQVAPbHJto

41. The Freudenberg Politex Group. (2010). *Nonwovens for other purposes than clothing PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=5932#.UvQUtPbHJto

42. The Sustainability Consortium. (2013). *Plush toys: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/71127425/Dossier%20-%20Plush%20Toys%20Revised%20v2.0.2%20-%2025%20Nov%202013.pdf

43. Centre for the Development of Product Sustainability. (2013). *Floor-cloths, dish-cloths, dusters and similar cleaning cloths PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=9327#.UvQVy_bHJto

44. Centro Tessile Cotoniero e Abbigliamento Spa, Eurojersey S.p.A. (2012). *Woven fabrics of man-made filaments and staple fibres PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=8796#.UvQWS_bHJto

45. The International EPD System. (2010). *Basic module: knitted or crocheted fabrics; wearing apparel PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=7063#.UvQWovbHJto

46. The International EPD System. (2010). *Basic module: textile articles other than apparel PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=7184#.UvQW2vbHJto

47. The Sustainability Consortium. (2014). *Nylon textiles: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/72271427/Dossier%20-%20Nylon%20Textiles%20-%20Draft%201.pdf

48. The Sustainability Consortium. (2014). *Polyester textile: product category dossier*. Retrieved from https://sustainabilityconsortium-tscalpha.pbworks.com/w/file/fetch/72270401/Dossier%20-%20Polyester%20Textiles%20-%20Draft%201.pdf

49. Aquafill, Life Cycle Engineering, Universal Fibers, EarthShift. (2013). *Textile yarn and thread PCR*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=8443#.UvQVUPbHJto

50. RadiciGroup, QUOTA SETTLE S.r.l. (2013). *Man-made fibers (synthetic)*. Retrieved from www.environdec.com/en/PCR/Detail/?Pcr=8654#.UvQXdPbHJto

51. *The Four Pillars of Wool Handling*; Australian Wool Innovation Limited; Woolmark; V 1.0

52. *The Wool Industry Supply Chain*; International Wool Textile Organization

53. *Sericulture and Silk Production*; http://www.scienceandsociety-dst.org/Sericulture%20and%20Silk%20Production.pdf

54. Feltwell, Dr. John. *The Story of Silk*. Alan Suttun Publishing, 1990. Print. Obtained 13, March 2013.

55. Hooper, Luther. *Silk: Its Production and Manufacture*. Pitman & Sons, 1911. 126 pages. Web. Obtained 12, March 2013

56. *Introduction to a Cotton Gin*; The National Cotton Ginners Association

57. *Growing Flax*; Flax Council of Canada

58. Riitta Sinkkonen Davies; *Flax, from Seed to Linen Yarn*, Pembrokeshire Guild, Journal for Weavers, Spinners and Dyers 242, Summer 2012

59. Md. Rostom Ali; Kozan, Osamu; Rahman, Anisur; Khandakar Tawfiq Islam; Md. Iqbal Hossain; *Jute Retting Process: Present Practice and Problems in Bangladesh*, (2015), 17(2): 243-247

60. International Jute Study Group; http://jute.org/

61. *Harvesting, Retting, and Fiber Separation*, Industrial Hemp in the United States, USDA

62. *Industrial Hemp Production*, Crop Diversification & Biofuel Research & Education Center; University of Kentucky

63. Cradle to Cradle Products Innovation Institute and Cradle to Cradle Certified assessor and applicant knowledge base.

Methodology for Defining Homogeneous Materials

Last Revision: September 2018

Copyright

Trademark

For more information about the Cradle to Cradle Products Innovation Institute and the Cradle to Cradle Certified Products Program, visit www.c2ccertified.org.

TABLE OF CONTENTS

METHODOLOGY FOR DEFINING HOMOGENEOUS MATERIALS REVISION HISTORY

REVISION DATE	SECTION	TYPE OF CHANGE	AUTHORIZED BY
March 2016	Initial Release		S. Klosterhaus
March 2018	3	Addition of interpretation for “Nonwoven Textiles”	S. Klosterhaus
September 2018	3	Addition of interpretation for “Glazed Ceramics”	S. Klosterhaus

1 OVERVIEW

1.1 PURPOSE AND CONTENT

This document explains how to define a product's homogeneous materials for the purposes of applying the requirements in the Cradle to Cradle Certified™ Product Standard. Homogeneous materials are referenced in several requirements, summarized below:

- With some exceptions, homogeneous materials present in a product at weight fractions of 100 ppm or greater are subject to review.
- With some exceptions, chemical substances present in any of those homogeneous materials at 100 ppm or greater are subject to review.
- Banned list substances must not be present above designated thresholds in any of a product's homogeneous materials that are subject to review.
- For most products, the percentage assessed refers to the percentage of homogeneous materials that have been assessed.
- Each of a product's homogeneous materials is designated as a biological or technical nutrient.
- Recyclability is determined at the homogeneous material level.

The purpose of clarifying the homogeneous material definition is to improve consistency among assessments, as comparable products should be assessed in the same way regardless of the assessment body completing the work.

This document includes the homogeneous material definition and general guidance, as well as a set of interpretations indicating how the definition has been applied in ambiguous or borderline cases in the past. Assessors must apply these interpretations to their future work and contact the Institute (certification@c2ccertified.org) when assessing products with ambiguous homogenous material breakdown that do not yet appear in the list of interpretations. This document will be updated as needed to reflect such additions.

1.2 SUPPORTING DOCUMENTS

The following documents are to be used in conjunction with this guidance document:

- Cradle to Cradle Certified™ Product Standard
- Any additional supporting documents and guidance posted on the C2CPII website

Visit the Cradle to Cradle Products Innovation Institute website to download the Standard documents and obtain the most current information regarding the product Standard (http://www.c2ccertified.org/product_certification/c2ccertified_product_standard).

2 HOMOGENEOUS MATERIAL DEFINITION & GENERAL GUIDANCE

2.1 DEFINITION

Homogeneous materials are defined in the Standard as follows:

Homogeneous materials are defined as materials of uniform composition throughout that cannot be mechanically disjointed, in principle, into different materials. Examples of homogeneous materials are polypropylene, steel, shampoo, glass cleaner, nylon yarn, finish, and coating. Examples of non-homogeneous materials are powder-coated steel, a printed bottle label, plywood, laminate, and chair casters.

The definition is based on the one used in the European Union's Restriction of Hazardous Substances (RoHS) legislation, which provides some additional context:

'homogeneous material' means one material of uniform composition throughout or a material, consisting of a combination of materials, that cannot be disjointed or separated into different materials by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.[1]

Thus, a homogenous material does not necessarily possess uniform composition throughout, as long as the scale, structure, or distribution of the domains with differing composition do not allow for these domains to be separated from one another through mechanical means. Homogenous materials

[1] European Commission. Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast). 2015. http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:02011L0065-20150624&from=EN.

may be homogenous as viewed by the naked eye, but heterogeneous at a microscale.

Accordingly, assessors applying the definition to their projects must consider whether it would be possible to mechanically separate materials using one or more of these mechanical actions, regardless of whether the materials are likely to be separated in practice. For example, most layered products and coated products consist of multiple homogeneous materials because the layers/coatings could be separated, in principle, by sanding, even if this is not likely to occur.

While coated products are often more than one homogeneous material, this is not always the case because the scale of the substrate must be considered when determining whether the substrate and coating are separable. For example, a painted wooden table leg is considered two homogeneous materials because the paint could be sanded off, but a polyester fabric coated with liquid latex in conventional carpet construction is considered one homogeneous material because the latex will infuse the fabric surrounding individual threads in a way that makes it impossible to separate them from the latex matrix through mechanical means. Similarly, coated fiberglass is considered a homogenous material since individually coated fibers are too small to manipulate and remove the coating from through mechanical processes.

2.2 SCOPE

The Standard requirements pertain to the homogeneous materials in the finished product, rather than the homogeneous materials the applicant receives from suppliers and combines during the manufacturing process. For example, if the product under review is dyed fabric, the dyed fabric is a single homogeneous material, even though the dye and the fabric were separate homogeneous materials when purchased from suppliers.

3 INTERPRETATIONS BY PRODUCT TYPE

In some cases, the appropriate way of separating a product into homogeneous materials according to the definition and guidance in section 2 is unclear. To achieve greater clarity, the following table explains how to apply this definition to a variety of ambiguous cases.

Product Type	Homogeneous Materials Interpretation
Blended textiles (more than	Each yarn or thread type is its own homogeneous material. For

one thread or yarn type woven together)	example, if a fabric is composed of a polyester yarn and a cotton yarn woven together, the polyester and cotton are considered separate homogeneous materials (in principle, individual yarns could be physically separated from the fabric, e.g. by pulling them out one at a time). If fibers of different types are twisted together into yarn or different types of yarn are twisted together in a multi-ply yarn or thread, the resulting multi-ply yarn or thread is one homogeneous material, because the different fibers are not separable by any mechanical process.
Carpet backing	The primary backing fiber and precoat are considered the same homogeneous material because the primary backing fiber becomes permeated by the precoat during the manufacturing process and is thus embedded within a precoat matrix in the finished product. The secondary backing is considered a separate homogeneous material.
Composite wood products	Layered composite wood products (e.g. plywood) are considered more than one homogeneous material (each layer is a homogeneous material). Non-layered composite wood materials such as MDF or particle board, in which small wood particles or fibers are uniformly distributed within a binder matrix, are regarded a single homogeneous material. However, if such a material has a surface layers or coating (such as a veneer, varnish, or paint) then that surface layer or coating counts as a separate homogenous material.
Concrete, countertops made of glass and cement, and other mixtures of cement with structural or decorative rock or silica-based inclusions	Any mixture of cement, admixture, and/or rock or silica-based inclusions is regarded a homogenous material regardless of the size of the inclusions. While gravel and similar sizes inclusions could in principle be separated from the matrix through mechanical means, analogous geological materials (i.e. conglomerates) are treated as homogenous materials for the purpose of assessment. Additionally, assessing types of concrete differently based on aggregate size would greatly increase the challenge of ensuring consistent application of the homogenous material definition.
Dyed textiles	Dyes and their substrates usually form a single homogeneous material, though if the dyes are surface treatments only, they can

	be counted as separate homogeneous materials from their substrates. For example, if a pattern is printed onto a fabric, the print is considered a separate homogeneous material from the fabric because it is resting on top of the fabric as a distinct layer that could be separated through abrasion. If the dyes instead form a single homogeneous material with their substrate (this is the more common situation), then each colored fabric option (e.g. blue fabric, purple fabric, green fabric) is its own homogeneous material.
Fiberglass	Fiberglass is considered a single homogeneous material. While the glass fibers may be coated, and therefore the composition may not be uniform throughout at the scale of an individual fiber, the glass and coating are not separable by any mechanical process.
Glazed Ceramics	Glazed ceramic is considered a single homogeneous material. While the glaze does produce a visually distinct layer on the ceramic surface, this layer is not separable by any mechanical process. There is no discrete boundary between the glaze and the body of the ceramic as the two materials physically and chemically fuse into one another during the firing/melting process. An exception exists for product applications in which the glaze is intended as a food contact surface (e.g. glazed ceramic plates or cookware). For such applications, the glaze must be assessed as a separate homogenous material since concentrations of substances in the surface glaze will be more representative than bulk concentrations in terms of exposure during the use phase.
Nonwoven Textiles	Nonwoven fabrics require a bonding step in order to create mechanical resistance in the end product. This produces one homogeneous material, because the different fibers are not separable by any mechanical process. Known bonding processes include but are not limited to: • Thermal bonding • Hydro-entanglement • Ultrasonic pattern bonding • Needlepunching/needlefelting • Chemical bonding • Melt-blown

THE CREATORS AND AN ACCREDITED ASSESSOR OF THE
CRADLE TO CRADLE CERTIFIED® PRODUCTS PROGRAM

700 East Jefferson Street
Charlottesville, VA 22902
www.mbdc.com