NSF Product Category Rule
for Environmental Product Declarations

NSF 1124-26

Metal Coil and Extrusion Coatings

Sub-category PCR

Program Operator: NSF
National Center for Sustainability Standards
Valid through June 30, 2031
ncss@nsf.org

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Prepared by NSF staff with assistance from the

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No participation fees were charged by NSF to interested parties. NSF ensured that reasonable representation among the members of the PCR committee was achieved and potential conflicts of interest were resolved prior to commencing this PCR development. Each member has signed a legal document stating that they have no conflicts of interest.

PCR revision history

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1.0	Initial publication	June 2026

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For inquiries regarding this PCR, please reference the designation: “NSF 1124-26.”

Unit abbreviations

The following table is provided as a reference for unit abbreviations for common forms of measurement used within NSF documents.

Time	second	s
	minute	min
	hour	h
	day	d
	week	wk
	month	mo
	year	yr
Length	inch	in.
	foot	ft
	yard	yd
	micrometer	µm
	nanometer	nm
	millimeter	mm
	centimeter	cm
	meter	m
	kilometer	km
	mi	mi
Liquid measure	milliliter	mL
	liter	L
	liters per day	LPD
	liters per minute	LPM
	ounce	oz
	pint	pt
	quart	qt
	gallon	gal
	gallons per minute	GPM
	gallons per day	GPD
Weight	microgram	µg
	picogram	pg
	nanogram	ng
	milligram	mg
	centigram	cg
	gram	g
	kilogram	kg
	pound	lb
	ton	t
	metric ton	mt

Miscellaneous	megajoule	MJ

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Foreword

This sub-category PCR documents the goal and scope of LCAs for this product category in order to produce environmental product declarations according to ISO 14025, ISO/TS 14027 and ISO 21930:2017. The PCR includes all life cycle phases in order to obtain the raw materials, manufacture, transport, use, and disposal of coil and extrusion coating products for interior or exterior applications.

This is the first edition of the PCR.

Suggestions for improvement of this guideline are welcome. Comments should be sent to NCSS@nsf.org, or c/o NSF, National Center for Sustainability Standards, PO Box 130140, Ann Arbor, Michigan 48113-0140, USA.

About the American Coatings Association

The American Coatings Association (ACA) is a voluntary, nonprofit trade association working to advance the needs of the paint and coatings industry and the professionals who work in it, including: manufacturers, raw materials suppliers, distributors, and technical professionals. ACA serves as an advocate and ally for members on legislative, regulatory and judicial issues, and provides forums for the advancement and promotion of the industry and coatings science.

About the NSF National Center for Sustainability Standards

Through the NCSS, NSF develops life cycle-based, multi-attribute sustainability standards, protocols, and PCRs for various industries including building products and materials, furniture, carpet and flooring, fabrics, wallcoverings, roofing membranes, green chemicals, electronics, and water and wastewater.

The NCSS will continue to add to its growing portfolio while providing education, outreach, and innovation support to private industry, trade associations, government and academia to foster a consensus-based approach toward conformity assessment in the sustainability field. Visit nsfsustainability.org or contact NCSS@nsf.org.

NSF Product Category Rule
for Environmental Product Declarations –

Metal Coil and Extrusion Coatings
Sub-category PCR

1 Scope

Per ISO 21930:2017 [1] Clause 1, with the following additions.

This sub-category PCR documents the goal and scope of LCAs for this product category in order to produce EPDs according to ISO 14025, ISO/TS 14027, and ISO 21930:2017. The PCR includes all life cycle phases in order to obtain the raw materials, manufacture, transport, use, and disposal of coil and extrusion coating products for interior or exterior applications. The definition of coil and extrusion coating is specifically outlined below and in Section 1.1.

Extrusion coatings occur as part of the method of manufacturing a metal part, typically aluminum or steel, using an extrusion process. In this process, the coating is applied via an electrostatic spray process to a metal extrusion.

Coil coatings are applied to continuous coil of metal, typically aluminum or steel, that is unwound, cleaned, surface-treated, coated, heat-cured, and rewound in one operation. The coated coil is subsequently unwound and formed into any number of products, such as house siding, venetian blinds and automotive and appliance parts.

The scope excludes powder coatings, which are covered under the ACA *PCR for Powder Coatings, v2.0*. [2] Finally, this PCR does not include coatings that fall under the ACA *PCR for Architectural Coatings*, [3] including wood stains.

While this PCR will likely be used primarily in North America, it may be used in other regions where program operators deem it appropriate.

This PCR is valid through June 30, 2031.

1.1 Coil and extrusion coating industry classification

The product description shall include the name of the product system, product manufacturer, product model number, a general description (including all components and layers), and a picture of the packaged product as sold in North America the US. If the EPD covers a range of products or multiple SKUs of the same product, the general description needs to cover all of them while the picture should be labeled as an example and clearly identify the specific product being displayed. Since the product system is not conventionally packaged for sale in a retail store, a related image such as one of the final, cured products in a building setting may be used instead.

[1] International Organization for Standardization. Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland. <iso.org>

[2] Program Operator: Sustainable Minds. One Broadway, Kendall Square, Cambridge, MA 02142. <sustainableminds.com>

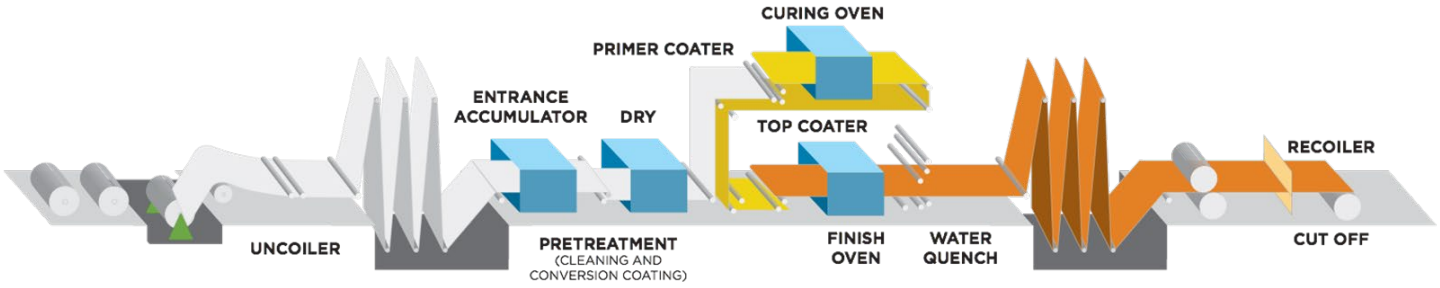
[3] Program Operator: NSF. 789 N Dixboro Road, Ann Arbor, MI 48105. <nsf.org>

The coil and extrusion coatings industry, as represented by the ACA, has developed a definition for coil coatings. Coil coatings provide both aesthetic and protective benefits to metal substrates. For the purposes of this PCR, the definitions of coil and extrusion coatings are described below.

- Extrusion coatings occur as part of the method of manufacturing a metal part, typically aluminum or steel, using an extrusion process. In this process, the coating is applied via an electrostatic spray process to a metal extrusion.
- Coil coatings are applied to continuous coil of metal that is unwound, cleaned, surface-treated, coated via machine roller or slot die technology, heat-cured, and rewound in one operation. The coated coil is subsequently unwound and formed into any number of products, such as house siding, venetian blinds, and automotive and appliance parts.

Figure 1

Example of a coil coating system



Extrusion-coated products are three-dimensional aluminum profiles that receive a liquid spray. Extrusions may be used to create window systems, such as curtain walls and window walls, and screening systems, such as sunshades, fins, and perforated panels. Other extrusion components include louvers, canopies, and plate panels. Extrusion coatings are spray-applied to pre-formed aluminum extrusions. Large aluminum billets are heated to 800 °F or more and forced through a die to produce a precise profile. Profiles are then hung horizontally or vertically on a coating line, depending on the profile type. The most common application of extrusion coatings is in the design and arrangement of fenestrations on building surfaces, such as windows and doors. These types of metal building products include storefronts, curtain walls, skylight framing, and exterior sunshades.

There are three key stages in the extrusion process:

1. **Cleaning and pre-treatment**: Pre-treatment is the process of removing grease, oil, and dirt from the aluminum surface. This occurs prior to coating application to strengthen adhesion. The pre-treatment process will differ depending on whether the manufacturer uses a chrome conversion coating or a chrome-free coating.

   Manufacturers may use different pretreatment approaches, but pretreatment typically involves five to ten steps. There are common steps across methods. Profiles will be dipped into a series of tanks. Each tank contains a different solution. These typically include tanks of cleaner, etchant, rinse, and the appropriate pretreatment coating. An example of a standard five-stage pre-treatment process would be:

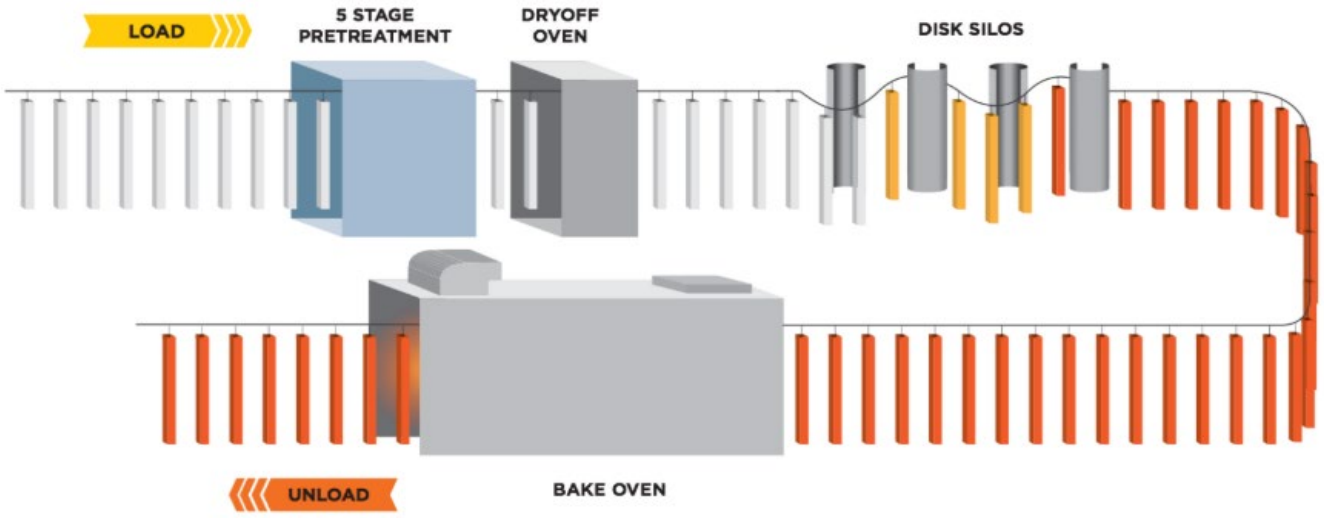
   1) cleaner
   2) rinse

3) pre-treatment coating
4) rinse
5) acid rinse.

2. **Coating applicatW** Most often, the coating process uses an electrostatic disk painting bell. This involves atomizing paint into fine particles using a high-speed rotating disk, then electrically charging the particles to promote adhesion to a grounded workpiece. This method is highly efficient, produces a uniform, high-quality finish, and minimizes paint waste from overspray.

3. **Curing by baking in an oven**: US coil coaters generally have oxidizing units that burn VOCs generated during the coating process and return the heat to their curing ovens (reducing their natural gas requirements) or to heat their factories and offices.

Figure 2
Example of an extrusion system



Coil and extrusion coatings shall be assessed as a product system as opposed to individual coatings or layers. For example, coil coatings are typically made up of at least a basecoat and a topcoat, but may include multiple basecoats or additional coats such as a backer. As such, EPDs shall consider all coatings needed to achieve the desired coating coverage and performance and not just one of these components.

Uncoated metal products are not eligible for inclusion under this PCR.

Eligible products will be further classified by specific functionality in Section 1.2.

1.2 Information

This document specifies the requirements for the LCA study as well as the format and content of the EPD itself. Recognizing the regional nature of LCA and the coatings industry, this PCR was designed to be applicable for North America but could be utilized elsewhere if desired. EPDs representative of regions outside of North American shall clearly state the sub-category PCR was not designed for their region.

The PCR Committee reviewed existing coating PCRs published by the ACA, [4] UL Environment, [5] and the Institut Bauen und Umwelt e.V. [6] These PCRs for coatings were found not to meet the specific scope of this PCR. This PCR improves the classification for coil and extrusion coating product categories, the functional unit of coil and extrusion coatings, and various regional assumptions. For example, existing PCRs assumed a functional unit of 1 kg which is improper given the various performance differences between products or included products such as carpeting and vinyl planks under the same product category. The PCR Committee used the ACA *PCR for Architectural Coatings* [3] as a foundation for this PCR as it represented a reasonable foundation that fit for coil and extrusion products, but modified assumptions surrounding functional unit, application, performance, and composition to be specifically relevant for coil and extrusion coatings. This reflects that the ACA *PCR for Architectural Coatings* has been embraced by the coatings industry as a whole and much of its framework could be leveraged into this PCR. It is worth noting that the same approach was successfully completed by the RCMA PCR, [7] which was published in 2016.

The PCR Committee also referenced and utilized findings from LCAs and EPDs conducted by members of the Committee to inform its assumptions. While these LCAs were not necessarily specific to coil and extrusion coatings, strong similarities do exist between these LCAs/EPDs and the manufacturing, composition, and application of certain coil and extrusion coating types. For example, epoxy coil and extrusion coatings are chemically similar to certain paints. As such, these were a crucial resource and helped inform key assumptions and identify hotspots.

The PCR document was prepared by NSF (the program operator) and the ACA Product Category Work Group in accordance with ISO 14025. [1] An open enrollment period was provided to seek out stakeholders interested in being part of the PCR creation. A multi-stakeholder group composed of coatings industry personnel, material manufacturers, and other experts worked to create the PCR.

The PCR at hand was formally developed by a panel of representatives of ACA members and North American coatings manufacturers, raw material suppliers, standards development groups, regulators, and other interested parties and conforms to ISO 21930:2017 requirements. This panel interacted with NSF and members of the ACA. Additional requirements lie in the validation of coating service life by conforming to the requirements of various testing standards described in this PCR. Appropriate LCIA methodologies were selected based on manufacturing region and will be addressed herein.

1.3 Product description

Eligible products are those that would be defined as a coil or extrusion coating as described under Section 1.1 and that confer protective benefits to substrate to which they are applied in addition to any decorative purpose that they may serve. These benefits include excellent corrosion and UV resistance, protection from weathering and wear, and improved performance of metal components. The coatings must also fall under one of the class categories defined in Tables 1 and 2.

Expected lifetimes are based on industry consensus given different application settings (interior or exterior). For general coil applications, the chemistry type shall dictate the RSL, as shown in Tables 1 and 2. Products within the same product lines (for example, items that share the same product name, but have differing colors) may be included in the same declaration, provided that the impacts for each of the different product variations are also included within the EPD. This will allow for more effective dissemination of EPD results.

[4] American Coatings Association. 901 New York Avenue NW, Suite 300 West, Washington, DC 20001. <paint.org>

[5] UL Solutions. 333 Pfingsten Road, Northbrook, IL 60062. <ul.com>

[6] Instut Bauen und Umwelt e.V. Hegelplatz 1, 10117 Berlin, Germany. <ibu-epd.com>

[7] Roof Coatings Manufacturers Association. 2551 Lake Road, Ontario, NY, 14519. <roofcoatings.org>

Coil and extrusion coatings are not typically formulated to be tinted at point-of-sale or in the field. As such, pigment/colorant impacts will already be captured in the LCA model of the formula itself. This is a key difference between conventional architectural coatings and coil/extrusion coatings.

2 Normative references

The following documents are referred to in the text. For undated references, the latest edition of the referenced document (including any amendments) applies.

AAMA 2605-22, *Voluntary specification, performance requirements and test procedures for superior performing organic coatings on aluminum extrusions and panels (with coil coating appendix)* [8]

ACLCA, Guidance for Assessing Data Quality of Background Life Cycle Inventory (LCI) Datasets [9]

ASHRAE 189.1 2023, *Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings* [10]

ASTM D2244-21, *Standard practice for calculation of color tolerances and color difference from instrumentally measured coordinates* [11]

ASTM D4214-07(2015), *Standard test methods for evaluating the degree of chalking of exterior paint films* [11]

ASTM G7/GM7-21, *Standard Practice for Natural Weathering of Materials* [11]

ICC, *International Green Construction Code (IgCC)*, 2018 [12]

ISO 14020:2022, *Environmental statements and programmes for products – Principles and general requirements* [1]

ISO 14025:2006, *Environmental labels and declarations – Type III environmental declarations – Principles and procedures* [1]

ISO/TS 14027:2017, *Environmental labels and declarations – Development of product category rules* [1]

ISO 14040:2006/AMD 1:2020, *Environmental management – Life cycle assessment – Principles and framework* [1]

ISO 14044:2006/AMD 1:2007/AMD 2:2020, *Environmental management – Life cycle assessment – Requirements and guidelines* [1]

ISO 21930:2017, *Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services* [1]

[8] American Architectural Manufacturers Association (part of the Fenestration and Glazing industry Alliance (FGIA)). 1900 E Golf Road, Suite 1250, Schaumburg, IL 60173. <fgiaonline.org>

[9] American Center for Life Cycle Assessment. 6900 Wisconsin Avenue, Unit 30953, Bethesda, MD 20824. <aclca.org>

[10] ASHRAE. 180 Technology Parkway NW, Peachtree Corners, Georgia 30092. <ASHRAE.org>

[11] ASTM International. 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428. <ASTM.org>

[12] International Code Council. 200 Massachusetts Avenue NW, Suite 250, Washington, DC 20001. <iccsafe.org>

3 Terms and definitions

Per ISO 21930:2017 [1] Clause 3, with the following additions.

adhesion: The degree of attachment between two surfaces held together by interfacial forces.

backing coat (backer): A thin, functional coating applied to the back or unexposed side of coil coated metal. The backing coat is applied for such reasons as appearance, durability, lubrication during roll forming operations, insulation, bonding, and protection of the topcoat. (NCCA, Tool Kit #9 [14])

basecoat: A coating applied to the surface after preparation and before the application of a finish coat.

commercial project: Projects not used for residential, manufacturing, processing, or assembly purposes. Common commercial project types include education, healthcare, hospitality, entertainment, retain, and construction.

failure: The physical degradation of the metal material which would require substantial or complete removal in order to return the coil to serviceable condition.

generic data: Defined by the ILCD handbook [15] as "a generic data set has been developed using at least partly other information then those measured for the specific process. This other information can be stoichiometric or other calculation models, patents and other plans for processes or products, expert judgment, etc. Generic processes can aim at representing a specific process or system or an average situation. Both specifically measured data and generic data can hence be used for the same purpose of representing specific or average processes or systems."

hazardous waste: Waste identified as hazardous according to regulations applicable in the market for which the EPD is valid. For the US market, wastes are hazardous if they are regulated under the RCRA. [16] See also 40 CFR 261.33. [17] For products manufactured in Canada, any material or chemical agent required to be reported by Canada's NPRI. [18] For products manufactured in Mexico, any material or chemical agent required to be reported by Mexico's SEMARNAT Pollutant Release and Transfer Register. [19]

Note. Hazardous waste does not include radioactive waste. See ISO 21930:2017 [1] Clause 7.2.14.

industrial project: Any project where the primary activity includes the manufacture, production, processing, assembly, or handling of goods or materials. This could include use conditions such as heavy wheeled traffic or the use of fixed or moving machinery. For example, in a maintenance facility or as an automotive shop.

intermediate processing: The conversion of raw materials to intermediates (e.g. titanium dioxide ore into titanium dioxide pigment, etc.).

market service lifetime: The estimated lifetime of a coil coating based off the predicted use pattern of the product type.

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[14] National Coil Coating Association. 1300 Sumner Avenue, Clevalend, OH 44115. <coilcoating.org>

[15] Joint Research Centre, Institute for Environment and Sustainability. *International Reference Life Cycle Data System (ILCD) Handbook – General guide for life cycle assessment: Detailed guidance*. Publications Office of the European Union, 2010. <data.europa.eu/doi/10.2788/38479>

[16] Resource Conservation and Recovery Act, US EPA. <epa.gov/rcra>

[17] <govinfo.gov/content/pkg/CFR-2011-title40-vol26/pdf/CFR-2011-title40-vol26-sec261-33.pdf>

[18] National Pollutant Release Inventory, Government of Canada. <canada.ca/en/services/environment/pollution-waste-management/national-pollutant-release-inventory.html>

[19] Registro de Emisiones y Transferencia de Contaminantes (Emissions and Pollutant Transfer Registry). Government of Mexico. <gob.mx/semarnat%7Cretc/articulos/registro-de-emisiones-y-transferencia-de-contaminantes>

non-hazardous waste: Commercial/industrial waste that is not hazardous, e.g. leftover or waste coating materials.

pigment: The material(s) that give a coating its color.

primers: Materials applied to a surface to promote adhesion between the substrate and subsequent coats.

primary material: A resource made from materials initially extracted from nature. Examples include titanium dioxide ore, petroleum, etc., that are used to create basic materials used in the production of coatings (e.g. pigment, solvents).

renewable energy sources: Non-fossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogases.

renewable material resources: Ones that can be readily replaced by natural means on a level equal to their consumption.

resin/binder: Acts as the glue or adhesive to adhere the coating to the substrate.

secondary materials (SM): Materials that contain recovered, reclaimed, or recycled content that is used to create basic materials for the production of coatings (e.g. aluminum scrap).

technical service lifetime: The estimated lifetime of a coating based solely on its hiding and performance characteristics determined by industry consensus values.

topcoat: The final layer of coating put onto a surface over another layer(s).

4 Abbreviated terms

Per ISO 21930:2017 [1] Clause 4, with the following additions.

AAMA	American Architectural Manufacturers Association (now part of FGIA)
ACA	American Coatings Association
ACLCA	American Center for Life Cycle Assessment
ASHRAE	ASHRAE (formerly known as the American Society of Heating, Refrigerating and Air-Conditioning Engineers)
ASTM	ASTM International
CAS	Chemical Abstract Service
CFR	Code of Federal Regulations
CML	Centrum voor Milieukunde (Centre of Environmental Science)
DOT	Department of Transportation
EAC	energy attribute certificates
EPA	Environmental Protection Agency
EPD	environmental product declaration
ESL	estimated service life
FGIA	Fenestration & Glazing Industry Alliance
GWP	global warming potential
ICC	International Code Council

IgCC	International Green Construction Code
ILCD	International Reference Life Cycle Data System
ISO	International Organization for Standardization
LCA	life cycle assessment
LCI	life cycle inventory
LCIA	life cycle impact assessment
LEED	Leadership in Energy and Environmental Design
MLC	Managed LCA Content
NCCA	National Coil Coating Association
NCSS	National Center for Sustainability Standards
NPRI	National Pollutant Release Inventory
PCR	product category rules
PEF	Product Environmental Footprint
PPA	power purchase agreement
RCRA	Resource Conservation and Recovery Act
REC	renewable energy certificates
RSL	reference service life
SCTG	Standard Classification of Transported Goods
SDS	safety data sheet
SEMARNAT	Secretariat of Environment and Natural Resources
SKU	stock keeping unit
TRACI	Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts
VOC	volatile organic compound
US	United States
USGBC	US Green Building Council
WARM	Waste Reduction Model

5 General aspects

5.1 Objectives of this PCR

Per ISO 21930:2017 [1] Clause 5.1, with the following additions.

The goal of this sub-category PCR is to specify the guidelines for developing a Type III EPD in conformance with ISO 21930:2017, 14025 and ISO/TS 14027, based on an ISO 14040 and ISO 14044 conformant LCA study.

The goal of an LCA study conforming to this sub-category PCR shall be, at a minimum, to identify the potential environmental impacts of each life cycle phase of the product or enable product improvement over the full life cycle of the product and shall be presented in such a way as to be relevant to the public or for internal company use.

Any EPD comparisons derived from the use of this sub-category PCR must be conducted in respect to its utilization and function as a construction product and be conformant with ISO 21930:2017 Clause 5.5.

The scope of the LCA (see Section 7) shall include a description of the following according to this PCR:

- Functional Unit (Section 7.1.2)
- System Boundary (Sections 7.1.5 to 7.1.7)
- Criteria for inclusion of inputs and outputs (cut-off rules) (Section 7.1.8)
- Units and quantities (Section 7.1.10)
- Data quality requirements (Section 7.1.9)
- Description of data (Section 7.1.9.1)

5.2 Life cycle stages

Per ISO 21930:2017 [1] Clause 5.2, with the following clarification.

This cradle-to-grave PCR requires the following life cycle stages Production (A1 to A3), Construction (A4 to A5), Use (B1 to B7), and End-of-life (C1 to C4). Module D is optional.

> *Note.* No impacts are expected for any known scenarios for Modules B6 and B7.

Figure 3

System boundaries, required modules and life-cycle stages of building products

LIFE CYCLE STAGES	PRODUCTION (A1 to A3)			CONSTRUCTION (A4 to A5)		USE (B1 to B7)							END-OF-LIFE (C1 to C4)				BENEFITS & LOADS BEYOND SYSTEM BOUNDARY (D)	Reference Service Life
Information Modules	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	
	Raw material supply	Transport	Manufacturing	Transport to site	Assembly/Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential	
Cradle-to-gate	*Required*			*Excluded*		*Excluded*							*Excluded*				*Optional*	*Optional*
Cradle-to-gate w/end-of-life	*Required*			*Excluded*		*Excluded*							*Required*				*Optional*	*Optional*
Cradle-to-gate w/options	*Required*			*Optional*		*Optional*							*Optional*				*Optional*	*Optional* [a]
Cradle-to-grave	*Required*			*Required*		*Required*							*Required*				*Required*	*Required*

[a] RSL reporting is required if Modules B1 to B5 are reported.

5.3 Average EPDs for groups of similar products

Per ISO 21930:2017 [1] Clause 5.3.

5.4 Use of EPDs for construction products

Per ISO 21930:2017 [1] Clause 5.4, with the following clarification and addition.

This sub-category PCR is intended to be used to create EPDs for use in business-to-business (B2B) and business-to-consumer (B2C) communication. A cradle-to-grave EPD is mandatory.

5.5 Comparability of EPDs for construction products

Per ISO 21930:2017 [1] Clause 5.5.

5.6 Documentation

Per ISO 21930:2017 [1] Clause 5.6.

6 PCR development and use

Per ISO 21930:2017 [1] Clause 6, with the following additions.

The product description shall include the name of the product system, product manufacturer, product model number, a general description (including all components and layers), and a picture of the product in use, applied to a substrate in North America. If the EPD covers a range of products or multiple SKUs of the same product, the general description needs to cover all of them while the picture should be labeled as an example and clearly identify the specific product being displayed. Since the product system is not conventionally packaged for sale in a retail store, a related image such as one of the final, cured products in a building setting may be used instead.

This sub-category PCR document is effective for five (5) yr from the latest date of publication. If after five yr, relevant changes in the product category or other relevant factors have occurred (for example, evolution of LCA methodology in ISO 21930:2017), the document will be revised. See Section 5.5 for comparability.

7 PCR for LCA

7.1 Methodological framework

7.1.1 LCA modeling and calculation

Per ISO 21930:2017 [1] Clauses 7.1.1, with the following clarification.

The resource metrics listed above shall be determined by assessing their totals across the LCIs used in the LCA models. LCA tools such as SimaPro [20] and Sphera LCA for Experts [21] or similar, make such metrics available in the balance of the LCA.

[20] SimaPro B.V. PRé Sustainability, Stationsplein 121, 3818 LE Amersfoort, The Netherlands. <simapro.com>

[21] Sphera. 130 East Randolph Street, Suite 2900, Chicago, IL 60601. <sphera.com>

7.1.2 Functional unit

Per ISO 21930:2017 [1] Clause 7.1.2, with the following additional requirements:

The functional unit shall be 1 m^2 of covered and protected metal substrate [22] for a period of 75 yr, the ESL of the building, per ASHRAE 189.1 [10] (2023, Section 9.5.11.2.b) and International Green Construction Code [12] (2018, Section 901.5.1.2). Coil and extrusion coatings shall exhibit an appropriate thickness of film (based on its technology type and defined by the manufacturer's published application guidelines) and desired performance attributes after curing.

7.1.3 Declared unit

ISO 21930:2017 [1] Clause 7.1.3 does not apply.

7.1.4 Reference service life

Per ISO 21930:2017 [1] Clause 7.1.4, with the following clarification.

The reference flow shall be the amount of product needed to satisfy the above functional unit. In order to satisfy the functional unit, multiple coats or recoats may be needed. If the selected lifetime of a coating does not cleanly divide into the functional unit (e.g. a coating lasts 25 yr), repaints shall be rounded up to the nearest tenth. As such, a coating with a RSL of 20 yr would require two repaints to satisfy the 75-yr ESL of the building for a total three applications. It is also common for coil and extrusion coating systems to be made up of multiple coating layers (see Figure 1). If this is the case, then the entire coating system needed to achieve full performance and coverage shall be included and disclosed in the EPD.

Expected lifetimes are based on industry consensus given different application settings (interior or exterior). For general coil applications, the chemistry type shall dictate the estimated service lifetime, as demonstrated in Tables 1 and 2. However, for certain types of exterior coil coatings, several ASTM [11] test methods (or equivalent methods) on key performance attributes shall be used to determine its performance class. These test methods shall be run in accordance with South Florida exposure per ASTM G7/G7M-21 that has a new title "*Standard Practice for Natural Weathering of Materials*." [23] All lifetime values in Tables 1 and 2 were developed through industry consensus and are consistent with values found in publicly available literature and manufacturer claims.

Table 1
Reference service life by coating type and product class

Coating type	Class I product	Class II Product	Class III product
exterior accessory/ancillary coil coating	10 yr	20 yr	40 yr
exterior sidewall coil coating	N/A	20 yr	40 yr
exterior roof coil coating	N/A	15 yr	25 yr
interior coil coating	N/A	N/A	60 yr
extrusion coating	10 yr	15 yr	25 yr

[22] Coverage and protection attributes are defined in Section 1.3.

[23] ASTM G7 states: "Exposures can be conducted in any type of climate. However, in order to get more rapid indications of outdoor durability, exposures are often conducted in locations that receive high levels of solar radiation, temperature, and moisture. Typically, these conditions are found in hot desert and subtropical or tropical climates." According to ASTM G7, South Florida is considered a subtropical climate, which is why Fort Myers is particularly well-suited for an exterior exposure site of this nature to test to achieve the most severe UV.

Table 2
Product class color fade and chalk rating requirements

Test	Class I product	Class II Product	Class III product
exterior accessory/ancillary coil coating	polyester	urethane/shape memory polyurethane	fluoropolymer
Sidewalls			
Color Fade ΔE – ASTM D2244	N/A	5 ΔE	5 ΔE
Chalk Rating – ASTM D4214	N/A	8	8
Roofing			
Color Fade ΔE – ASTM D2244	N/A	8 ΔE	5 ΔE
Chalk Rating – ASTM D4214	N/A	6	8

Alternative testing applicable to the region may be used, justification shall be provided and disclosed in the EPD. The EPD shall provide information for the entire coating system. The product or range of products shall denote which RSL of coil and extrusion coating function that the unit represents.

7.1.5 System boundary with nature

Per ISO 21930:2017 [1] Clause 7.1.5, with the following additions.

The system boundary of EPDs shall at a minimum be conformant with ISO 21930:2017 Clause 5.2.2. EPDs shall include all life cycle stages, from cradle-to-grave: Production (A1 to A3), Construction (A4 to A5), Use (B1 to B7), including scenarios for Operational energy use, Operational water use, and End-of-life (C1 to C4). Module D is optional.

All relevant inputs shall be included in LCA models with the exception of:

- personnel activities
- research and development activities
- business travel
- any secondary packaging (pallets, for example)
- all point-of-sale infrastructure
- the coating applicator machinery.

The rationale for excluding these areas is that they have been determined by LCAs conducted by ACA member companies to represent a negligible environmental impact in the overall life-cycle performance of a coating. These assumptions are also consistent with other LCA frameworks such as the PEF [24] program under development by the European Commission in the European Union.

[24] Environment Footprint Methods, European Commission. 1049 Bruxelles/Brussel, Belgium <green-forum.ec.europa.eu/green-business/environmental-footprint-methods_en>

In the case of the coating applicator machinery, it is not practically feasible to estimate impacts given the variety of application techniques. Screening LCAs conducted by coatings manufacturers estimate that this impact is minimal relative to the overall lifecycle impacts of coatings and would not significantly impact EPD results. For these reasons, the PCR committee excluded the applicator from the LCA model.

Figure 4 illustrates which processes are relevant for completion of the cradle-to-grave EPD.

7.1.6 System boundary between products systems

Per ISO 21930:2017 [1] Clause 7.1.6.

7.1.7 System boundaries and technical information for scenarios

Per ISO 21930:2017 [1] Clause 7.1.7, with the following addition.

Figure 4

Required cradle-to-grave system boundaries, information modules and life-cycle stages of building products

Production stage			Construction stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
Raw material extraction	Transport	Manufacturing	Transportation to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operation energy use	Operation water use	De-construction	Transport	Waste processing	Disposal	Reuse/recycle
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O

Note. X = module declared, O = optional declaration

7.1.7.1 General

Per ISO 21930:2017 [1] Clause 7.1.7.1.

7.1.7.2 A1 to A3, production stage

7.1.7.2.1 General

Per ISO 21930:2017 [1] Clause 7.1.7.2.1.

7.1.7.2.2 A1, extraction and upstream production

Per ISO 21930:2017 [1] Clause 7.1.7.2.2, with the following clarification.

The material acquisition, pre-processing, intermediate processing, and processing stage (production stage) starts when the raw materials are extracted from nature (e.g. titanium dioxide ore), and ends when the intermediate materials (e.g. butyl acrylate, titanium dioxide pigment, etc.) reach the gate of the production facility and are processed into the final coating product and packaged for shipping. During production, the product undergoes the transformation from intermediate material to the final coating product; additionally, any co-products or wastes formed during production shall be accounted for in this stage. Processing differs depending on the coil and extrusion coating technology.

7.1.7.2.3 A2, transport to factory

Per ISO 21930:2017 [1] Clause 7.1.7.2.3, with the following clarification.

If primary data is not feasibly obtainable, transport distances listed in Table 3 shall be used for inbound raw material transports to facilities located in North America. Sources outside of North America shall use the appropriate regionally or nationally representative transportation distance and mode(s) where primary data is unavailable. If different vehicle classes or more than one transportation mode is required, then the LCA model shall use multiple transportation datasets to represent these, provided that separate LCI datasets are available for these vehicles, modes, or both.

Primary data for Module A2 shall be used, if available, otherwise secondary data shall be used. Secondary data may come from any credible and relevant national or regional databases, or from commercially available LCI data such as Sphera's MLC Database, [21] ecoinvent, [25] or similar. See Section 7.2 for information relating to data quality guidelines.

[25] ecoinvent. Technoparkstrasse 1, 8005 Zurich, Switzerland. <ecoinvent.org>

Table 3

North American default material transport distances from 2017 US DOT Shipment Characteristics by SCTG Commodity Code

Raw material/ Classification grouping		Distance (kilometers)		
		Rail	Truck [a]	Water [b]
raw materials	any material used where no primary source data is available	579 mi (932 km)	412 mi (412 km)	525 mi (845 km)
plastics (including polymer-based materials; excluding textiles)		592 mi (953 km)	332 mi (542 km)	842 mi (1,355 km)
metals (for frames, etc.)	32 base metal in primary or semi-final forms and in finished basic shapes	550 mi (885 km)	390 mi (627 km)	538 mi (932 km)

Note 1. *Geographic Area Series: Shipment Characteristics by Origin Geography by Destination Geography by Commodity by Mode: 2017* <data.census.gov/cedsci/table?q=cf1700a21&hidePreview=true&tid=CFSAREA2017.CF1700A21>

Note 2. This table is not meant to represent all materials that may be found in coil coatings.

[a] Truck distances represent round trip distances, as the assumption is made that the delivery truck returns empty after making the delivery.

[b] Water distances were approximated based on available data and may represent water, deep sea, or multiple waterway distances.

7.1.7.2.4 A3, manufacturing

Per ISO 21930:2017 [1] Clause 7.1.7.2.4, with the following clarification.

Waste and scrap created within Module A3 shall be included in the LCA model. Primary data on process yields and scrap rates shall be used if available. If waste materials are recycled, landfilled, combusted, or composted, the transportation distances shall use the appropriate regionally or nationally representative value outside of North America unless primary data has been obtained, in which case the primary data shall be used.

Material recycling percentages for the US shall be based on US EPA Municipal Solid Waste, *2018 Facts and Figures Fact Sheet*. [26] Outside North America, regionally or nationally appropriate recycling rates shall be used.

7.1.7.2.5 Input of secondary materials or recovered energy

Per ISO 21930:2017 [1] Clause 7.1.7.2.5, with the following clarification.

Materials can be considered either “primary” or “secondary.”

[26] <epa.gov/sites/default/files/2020-11/documents/2018_ff_fact_sheet.pdf>

- Primary raw materials are made from materials initially extracted from nature. Examples include titanium dioxide ore, petroleum, etc., that are used to create basic materials used in the production of coil and extrusion coatings (e.g. pigment, solvents).
- Secondary raw materials are recovered, reclaimed, or recycled content that is used to create basic materials for the production of coil and extrusion coatings.
- Intermediate processing is the conversion of raw materials to intermediates (e.g. titanium dioxide ore into titanium dioxide pigment, etc.).
- The following shall include the materials and energy use:
    - production of the final coating by mixing of the ingredients or intermediates
    - catalysts or other ancillary materials used during production
    - primary packaging of the final product.

7.1.7.2.6 Co-products leaving the system

Per ISO 21930:2017 [1] Clause 7.1.7.2.6.

7.1.7.2.7 Output of waste

Per ISO 21930:2017 [1] Clause 7.1.7.2.7.

7.1.7.2.8 End-of-life scenarios for packaging

Per ISO 21930:2017 [1] Clause 7.1.7.2.8.

7.1.7.3 A4 to A5, construction stage

Per ISO 21930:2017 [1] Clause 7.1.7.3, with the following additions.

The construction stage starts with the packaged and finished coating leaving the production site and ends with the finished coating being installed/applied and cured onto the metal substrate at the customer application facilities only. Touch-ups and repairs may occur at the building site.

During this stage, the finished coil or extrusion coating product is transported through a distribution network which may involve a series of transport legs (e.g. distribution center, installer warehouse, retail locations), before eventually being shipped to a point of sale. This stage ends at the application site after the coating has been applied and is fully cured on the substrate.

7.1.7.3.1 General

Per ISO 21930:2017 [1] Clause 7.1.7.3.1.

7.1.7.3.2 A4, transport to site

Per ISO 21930:2017 [1] Clause 7.1.7.3.2, with the following clarification.

All shipping from point of manufacture to point of sale (see Table 4 for default US values).

Transportation mode(s) and distances shall be based on primary data. If primary source data is not feasibly obtainable, the distances in Table 4 shall be used in the LCA study. Outside of the US, regionally or nationally appropriate transport distances and modes shall be used.

Table 4

Transport Distances in Design and Construction Process Stage: US DOT Shipment Characteristics by SCTG Commodity Code

Raw material/ classification grouping		Distance			
		Rail	Truck [a]	Passenger vehicle (single-trip)	Water
finished products to distribution center	any finished product where no primary source data is available	0 mi	250 mi (402.3 km)	0 mi	0 mi
finished products from distribution center to point of sale	any finished product where no primary source data is available	0 mi	500 mi (804.7 km)	0 mi	0 mi
finished products from point of sale to application site	any finished product where no primary source data is available	0 mi	0 mi	5 mi (8.0 km)	0 mi

[a] Truck distances represent round trip distances, as the assumption is made that the delivery truck returns empty after making the delivery.

Extrusion and coil coatings are initially applied to a suitable substrate in a manufacturing setting using specialized equipment and under controlled conditions. Therefore, emissions associated with the initial application and curing of these coatings are to be considered part of the installation process, and as such shall be reported in Module A5.

It shall be assumed that 2% of the wet mass of the coating remains unused and is properly disposed. [27] Since coil and extrusion coatings are generally formulated to be shop-applied, an application-efficiency shall be estimated and disclosed in the EPD as well as used for all relevant calculations.

7.1.7.3.3 A5, installation

Per ISO 21930:2017 [1] Clause 7.1.7.3.3, with the following clarification.

The model should include:

- method of coating application
- estimated efficiency of application

[27] US EPA, *Quantifying the Disposal of Post-Consumer Architectural Paint* (April 2007). <archive.epa.gov/sectors/web/pdf/paint_quantity_report.pdf>

- method of curing
- heat used in curing
- energy used in curing
- emissions capture and control technology – type and description
- heat used in capture and control of emissions
- energy used in capture and control of emissions
- all waste produced during application and curing process, including physical filter material used in capture and control technology when applicable

Emissions released from the drying of the coating will generally be captured/destroyed in control devices. For coil coatings in particular, neither VOCs nor semi-VOCs are expected to remain after the forced curing process according to technical staff consulted. This destruction shall be considered and modelled as part of the LCA and any emissions that are not destroyed/captured shall be assumed to be released to the environment.

7.1.7.3.4 End-of-life scenarios for packaging

Per ISO 21930:2017 [1] Clause 7.1.7.3.4, with the following clarification.

In the absence of primary location-specific data on end-of-life treatment for the packaging materials, the most recent release of US EPA Municipal Solid Waste, *2018 Fact Sheet* [26] shall be used to determine the percentages of the remaining (i.e. after reclaim) product that are to be recycled and landfilled, US EPA WARM model, [28] or surrogate (shall be identified in the EPD) for North America, or another regionally or nationally appropriate data source shall be used outside of North America to determine the percent of each material in the packaging that can be recycled versus landfilled. The amount of each material in the packaging that can be assumed to be recycled versus disposed of is determined by multiplying the EPA Municipal Solid Waste within North America, or other appropriate regionally or nationally applicable model, recycling rate (by percentage) by the amount of each homogenous material type that is disassembled. Per EPA Municipal Solid Waste, the remaining materials that are not recycled should be modeled for end of life using 88% landfill and 12% incineration.

7.1.7.4 Use stage

7.1.7.4.1 General

Per ISO 21930:2017 [1] Clause 7.1.7.4.1, with the following clarification.

It may be possible that certain products may not have impacts in Modules B3 and B5 to B7, but this shall be assessed on a case-to-case basis.

7.1.7.4.2 B1 to B5, use stage (related to the use of construction works)

7.1.7.4.2.1 General

Per ISO 21930:2017 [1] Clause 7.1.7.4.2.1.

[28] Waste Reduction Model, US Environmental Protection Agency. 1200 Pennsylvania Avenue NW, Washington, DC 20004. <epa.gov/waste-reduction-model>

7.1.7.4.2.2 B1, use or application of the installed product

Per ISO 21930:2017 [1] Clause 7.1.7.4.2.2, with the following additions.

As appropriate, include:

- expected product loss due to weathering and any resultant releases to the environment (exterior coatings)
- test method used to determine effects of weathering on the coating (if weathering is expected)
- a statement that no impacts are expected if such is the case, with reasoning given for this expectation.

7.1.7.4.2.3 B2, maintenance

Per ISO 21930:2017 [1] Clause 7.1.7.4.2.3, with the following additions.

- impacts of expected cleaning processes, including water and energy
- cleaning implements and products used.

It may be possible that the impacts reported in Module B2 may be the same between product lines for a company, but the impacts reported in B2 should be recalculated for each EPD given constantly improving inventory data and LCA assumptions in general. Finally, the impact of manufacturing, transporting, packaging, etc., cleaning implements themselves shall not be included within as it may be used for other cleaning purposes beyond the coated area, lack of primary data, and overall difficulty in relating its impacts back to the functional unit stated in this PCR. As such, only the impact of the usage of the cleaning implement shall be considered in Module B2.

7.1.7.4.2.4 B3, repair

Per ISO 21930:2017 [1] Clause 7.1.7.4.2.4, with the following additions.

The following shall be included:

- all upstream impacts (A1 to A4) of applied touch up coatings
- type of applicator used (brush, roller, sprayer, etc.)
- estimated application efficiency (if spray applied)
- end of life processes of unused coating and ancillary materials.

7.1.7.4.2.5 B4, replacement

Per ISO 21930:2017 [1] Clause 7.1.7.4.2.5, with the following additions.

Replacement of a coil or extrusion coating consists of application of the coil coating to a metal substrate identical to the initial manufacturing and application process. Therefore, should replacement be necessary to fulfill the requirements of the 75-yr functional unit, all elements of production, transport, and application (Modules A1 to A5) must once again be accounted for in each required incidence of replacement.

7.1.7.4.2.6 B5, refurbishment

Per ISO 21930:2017 [1] Clause 7.1.7.4.2.6, with the following additions.

Refurbishment of a coil or extrusion coating on a product is not expected – replacement would be expected instead. See notes on B4.

Multiple coats/recoats may be needed to satisfy the RSL stated in Section 7.1.4 and the functional unit identified in Section 7.1.2.

7.1.7.4.3 B6 to B7, use stage

7.1.7.4.3.1 General

Per ISO 21930:2017 [1] Clause 7.1.7.4.3.1.

7.1.7.4.3.2 B6, operational energy use

Per ISO 21930:2017 [1] Clause 7.1.7.4.3.2.

No expected impacts based on known scenarios.

7.1.7.4.3.3 B7, operational water use

Per ISO 21930:2017 [1] Clause 7.1.7.4.3.3.

No expected impacts based on known scenarios.

7.1.7.5 C1 to C4, end-of-life-stage

Per ISO 21930:2017 [1] Clause 7.1.7.5, with the following additions.

The end-of-life stage includes:

- C1, deconstruction/demolition
- C2, transportation to waste processing or disposal
- C3, waste processing
- C4, disposal of waste.

When any applied or unused coil or extrusion coating is ready for disposal, recycling, reuse, etc., through when these products are landfilled, returned to nature (deterioration), or transformed to be recycled or reused. Module C4 addresses the processes that occur as a result of the disposal are also included within the end-of-life stage. End-of-life processes may include:

- collection of post-consumer product, other unused product
- incineration
- landfilling, landfill maintenance, decomposition emissions.

Any coating system applied to the substrate shall be treated as incremental mass at end-of-life; the mass of the coatings shall be accounted for, with the mass of the substrate excluded, and disposed of with the substrate. Residual paint within packaging should be modeled in a similar fashion, with primary source data

determining end-of-life channel for the residual coating mass. If data is not feasibly obtainable or is unavailable, it shall be assumed that the waste coating is sent to landfill. This reflects that once a surface is coated, it is rarely removed through chemical or mechanical means and instead is coated-over and then eventually disposed with the substrate. Transportation distances shall be taken from the default values from the most recent version of the US EPA WARM model. [28]

See Figure 5 for additional information for modeling recycling processes.

7.1.7.6 Benefits and loads beyond the system boundary in optional supplementary Module D

Per ISO 21930:2017 [1] Clause 7.1.7.6, with the following clarification.

Although not a formal life cycle stage, if a product system has potential benefits outside of the system boundary such as from recycling, reuse, energy recovery, etc., it may be reported here. This does not include impacts from allocated co-products.

Documentation shall be provided to ensure any process or activity identified as contributing to potential benefits outside the system boundary have taken place. Additionally, since Module D is not considered a life cycle stage, its results do not affect the overall/total LCIA metrics reported in the EPD but instead shall be reported separately for purpose of transparency.

7.1.8 Criteria for the inclusion and exclusion of inputs and outputs

Per ISO 21930:2017 [1] Clause 7.1.8.

7.1.9 Selection of data and data quality requirements

Per ISO 21930:2017 [1] Clause 7.1.9, with the following additions.

Primary data (site specific or representative averages) shall be used for facilities and processes under operational control of the reporting company. However, generic data may be used for facility operations that contribute less than 10% of the total production output of the product being reported by the EPD. If unable to meet this threshold, justification for the inability to obtain primary data shall be disclosed in the EPD. For facilities and processes outside of the operational control of the reporting company, secondary data may be used. For products that are manufactured wholly or largely outside of the reporting company's control (e.g. contracted products or significant assemblies), primary data are highly encouraged; however, representative secondary data may be used in lieu of primary data.

7.1.9.1 Data quality

A data quality assessment shall be made for the system under study and included in the EPD. All data shall be accurate, complete, and representative of the manufacturing process, current technology and current measurement capability. The data shall be consistent with the following requirements:

- The information obtained from the manufacturing process(es) shall be average annual values per functional unit, and it shall have been updated with the last five yr. Any secondary data that is used shall have been updated within the last ten yr, as per ISO 21930:2017. [1] If data older than ten yr is used from a secondary source, justification should be included to address why newer data, if available, are not used.
- Data quality assessment should, at a minimum, address the following:
    - time-related coverage: age of data and the minimum length of time over which data was collected

  - geographical coverage: geographical area from which data for unit processes was collected to satisfy the goal of the study
  - technology coverage: specific technology or technology mix
  - uncertainty of the information (e.g. data, models and assumptions):
    - may include quantitative estimation of uncertainty (optional).

- Suitable data quality assessment frameworks include (but are not limited to):
  - USLCI *Data Guidelines* [30]
  - ILCD *Handbook* [15]
  - ACLCA *Guidance for Assessing Data Quality of Background Life Cycle Inventory (LCI) Datasets* [9]
- The data quality assessment framework used shall be stated, as shall an average data quality score assessed in keeping with the selected framework.

7.1.9.2 Data sources

Primary data and secondary LCI datasets used to create the EPD shall be documented and disclosed in the LCA report and in the EPD. In addition, given their prominence in the environmental impact of a coating, sources of LCI data sets used to represent the manufacturing of raw, intermediate, or both types of materials in the pigment and binder(s) manufacturing processes shall be disclosed separately.

If the most recent version of an LCA database is not used to create the EPD, written justification for its exclusion shall be provided and properly reflected in the data quality assessment. Any use of generic data shall be justified, consistent with ISO 21930:2017 [1] Clause 7.1.9.

7.1.9.3 Electricity modeling

To avoid double-counting, regional (i.e. sub-country level) or national average consumption mixes, which account for power imports into the respective region, should be used to model electricity consumption. If this data is unavailable, then production mixes at the regional or national level can be used as long as the implications are properly reflected in the data quality assessment consistent with ISO 21930:2017 [1] Clause 7.1.9.

Inclusion of EACs, including RECs, PPAs, etc., shall follow the guidance provided in the most recent version of ACLCA *Guidance for Quantifying Renewable Electricity Instruments in EPDs*. [9]

On-site renewable energy from solar cells or other renewable energy sources may only be accounted for in the inventory if the generated electricity is used in the production system used to produce the coil coating that is the subject of the study.

Finally, any delayed emissions from a temporary carbon sequestration (through a biopolymer that eventually degrades, for example) shall follow the rules in ISO 21930:2017 Clause 7.2.9, and this information only reported under “Additional Environmental Information.”

7.1.10 Units

Per ISO 21930:2017 [1] Clause 7.1.10.

[30] National Laboratory of the Rockies, US Department of Energy, Office of Critical Minerals and Energy Innovation. 15013 Denver West Parkway, Golden, CO 80401. <nlr.gov>

7.2 Inventory analysis

Per ISO 21930:2017[1] Clause 7.2, with additional guidance as follows:

Where possible, allocation should be avoided by dividing unit processes into two or more sub-processes (as specified in ISO 14044:2006, Clause 4.3.4: *Allocation*). Additionally, the co-product allocation guidance provided in ISO 21930:2017 Clause 7.2.5, shall be followed.

Deviation from these allocation rules shall be documented and justified.

For allocation due to recycling or energy recovery, the avoided burden approach shall be applied as "net scrap." This equation shall only apply to packaging end-of-life streams and shall be reported in a way consistent with Table 4 in ISO 21930:2017.

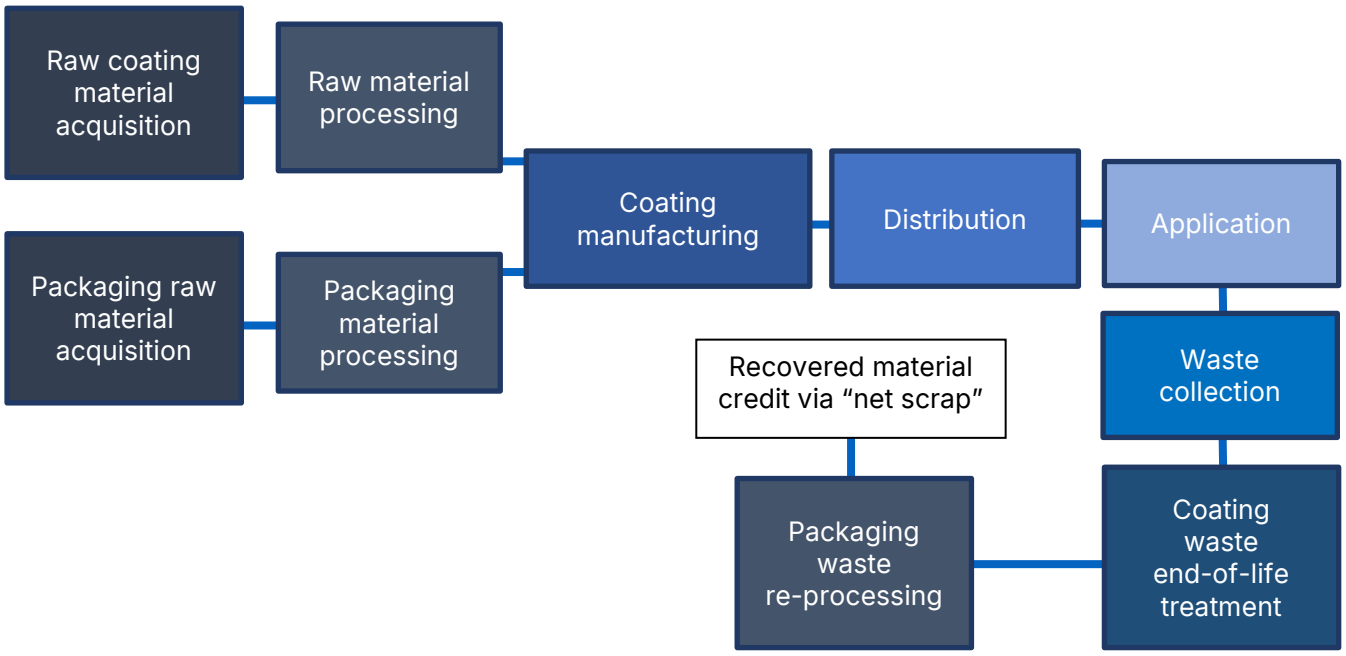
Figure 5 illustrates a simplified process map for a product that uses the Avoided Burden Method as it relates to coating manufacturing.

Sensitivity analysis

Given the relevance of the coating's assumed durability, most assumptions in this PCR will have a minimal impact on the overall results of the EPD. Since the industry has gone to great lengths to define the crucial assumptions using industry best practices and requiring multiple lifetimes be considered and reported in the EPD, no additional sensitivity analyses are required for the creation of the EPD. However, they should be conducted and included when warranted.

Figure 5

Process map illustrating avoided burden approach to recycling



7.2.1 Data collection

Per ISO 21930:2017 [1] Clause 7.2.1.

7.2.2 Calculation procedures

Per ISO 21930:2017 [1] Clause 7.2.2.

7.2.3 Allocation situations

Per ISO 21930:2017 [1] Clause 7.2.3.

7.2.4 Principles for allocation for both allocation situations

Per ISO 21930:2017 [1] Clause 7.2.4.

7.2.5 Allocation for co-products

Per ISO 21930:2017 [1] Clause 7.2.5.

7.2.6 Allocation between product systems (across the system boundary)

Per ISO 21930:2017 [1] Clause 7.2.6.

7.2.7 Accounting of biogenic carbon uptake and emissions during the life cycle

Per ISO 21930:2017 [1] Clause 7.2.7.

7.2.8 Carbonation

Per ISO 21930:2017 [1] Clause 7.2.8.

7.2.9 Accounting of delayed emissions

This clause is not applicable to this PCR.

7.2.10 Inventory indicators describing resource use

Per ISO 21930:2017 [1] Clause 7.2.10, with the following clarification.

The following LCI analysis results shall be reported by module (Figure 2) and in total:

- depletion of non-renewable energy (MJ)
- use of renewable primary energy (MJ)
- depletion of non-renewable material resources (kg)
- use of renewable material resources (kg)
- consumption of freshwater (m^3)

The resource metrics listed above shall be determined by assessing their totals across the LCIs used in the LCA models. LCA tools such as SimaPro [20] and Sphera LCA for Experts [21] make such metrics available in the balance of the LCA.

Renewable energy sources are defined as renewable non-fossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

Renewable material resources are defined as ones that can be readily replaced by natural means on a level equal to their consumption.

ISO 21930:2017 Clause 3.6.10 also requires the reporting of:

- secondary materials (kg)
- renewable secondary fuels (MJ)
- non-renewable secondary fuels (MJ).

These shall be disclosed by module and in total in the EPD.

The waste allocated to the building product for the foreground system (the operations under direct control of the product manufacturer) shall be classified in the EPD as either:

- hazardous waste [33]
- non-hazardous waste.

Finally, quantities of high-level or intermediate/low-level radioactive waste shall be reported by module and as totals per ISO 21930:2017.

7.2.11 Greenhouse gas emissions from land-use change

Per ISO 21930:2017 [1] Clause 7.2.11.

7.2.12 Additional inventory indicators describing emissions and removals of carbon

Per ISO 21930:2017 [1] Clause 7.2.12.

7.2.13 Inventory indicator describing consumption of freshwater

Per ISO 21930:2017 [1] Clause 7.2.13.

7.2.14 Environmental information describing waste categories and output flows

Per ISO 21930:2017 [1] Clause 7.2.14.

[33] As defined by an appropriate authority per region.

- **US**: Hazardous materials as defined under RCRA, 40 CFR 261.33. <ecfr.gov/current/title-40/chapter-I/subchapter-I/part-261/subpart-D/section-261.33>
- **Canada**: Any material or chemical agent required to be reported under NPRI. <canada.ca/en/services/environment/pollution-waste-management/national-pollutant-release-inventory.html>
- **Mexico**: Any material or chemical agent required to be reported under the Pollutant Release and Transfer Register. <gob.mx/semarnat%7Cretc/articulos/registro-de-emisiones-y-transferencia-de-contaminantes>

7.3 Impact assessment indicators describing main environmental impacts derived from LCA

Per ISO 21930:2017 [1] Clause 7.3, with the following additions.

LCIA category indicator results shall be reported separately by module, additionally the total may be reported for clarity. Users may also report impact category indicatory results by individual coating layer if desired, although impacts for product system by module shall still be reported, additionally the total may be reported for clarity.

Impact categories shall use the characterization models specified below. The impact category indicator results shall be reported separately by module and in total.

The following environmental impact categories shall be disclosed in the EPD per functional unit:

- **Global Warming Air, excl. biogenic CO_2 [kg CO_2 eq.]**: (GWP 100 yr) [kg CO_2-eq.] IPCC [34] (AR5, or most recent version) in and outside North America. Biomass carbon uptake and its re-release of CO_2 and CH_4 shall be reported separately based on the biogenic carbon content of the product to be declared.
- **Global Warming Air, incl. biogenic CO_2 [kg CO_2 eq.]**: IPCC (AR5, or most recent version)
- **Acidification Air [kg SO_2 eq.]**: TRACI 2.2 [35] (or most recent version) for North America, EN 15084 for Europe
- **Photochemical Oxidation Formation [kg O_3 eq.]**: TRACI 2.2 (or most recent version) for North America, EN15804 for Europe
- **Eutrophication – freshwater [kg P eq.]**: TRACI 2.2 (or most recent version) for North America, or regionally applicable methodologies outside North America
- **Eutrophication – marine [kg N eq.]**: TRACI 2.2 (or most recent version) for North America, EN 15084 for Europe
- **Ozone Depletion Air [kg CFC 11 eq.]**: TRACI 2.2 (or most recent version) for North America, EN 15084 for Europe:
    - **optional indicator and methodology**: This additional analysis may be completed in order to align and comply with the requirements found in USGBC's LEED program for EPD optimizations.

Where TRACI 2.2 is referenced, TRACI 2.2, or the latest TRACI methodology available, shall be used at the time of EPD creation, similarly for reference to CML 2001. [36]

EPDs developed using this PCR shall include, where relevant, additional information related to environmental issues, other than the environmental information derived from LCA, LCI or information modules. This information shall be separated from the information described in ISO 21930:2017 Clauses 8.2, 8.3, and 8.4. Identification of the significant environmental aspects should conform to ISO 21930:2017 Clause 8.4 and ISO 14025 Clause 7.2.4. EPDs may also include the potential effects of emissions on human health and toxicity as described below.

[34] Intergovernmental Panel on Climate Change, UN Environment Programme. C/o World Meteorological Organization, 7 bis Avenue de la Paix, CP 2300, CH-1211 Geneva 2, Switzerland. <ipcc.ch>

[35] Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI), US Environmental Protection Agency. 1200 Pennsylvania Avenue NW, Washington, DC 20004. <epa.gov>

[36] Leiden University Institute of Environmental Sciences (CML). PO Box 9500, 2300 RA Leiden, The Netherlands. <universiteitleiden.nl>

8 Additional environmental information

8.1 General

Per ISO 21930:2017 [1] Clause 8.1, with the following clarification.

If more than one primary data point is available for inbound transportation distances of a raw material, an average distance weighted by the transported mass may be calculated, and the methodology disclosed in the EPD.

Specifications as contained in the manufacturer's Technical Specification Data Sheet, or if unavailable, as required by SDS, such as reporting certain aspects of material composition of the assessed coating product(s), shall be disclosed in percentage of total weight in the LCA project report.

8.2 Additional LCA-related information not included in the pre-set LCIA indicators

Per ISO 21930:2017 [1] Clause 8.2.

8.3 Additional environmental information not derived from or related to LCA

Per ISO 21930:2017 [1] Clause 8.3, with the following clarification.

EPDs shall report impacts related to human health, the environment, or both using the USEtox model, [37] and shall be reported in the LCIA section and reported by life cycle module and as a total.

The decision to make human, ecotoxicity, or both, reporting optional reflects that the PCR committee believes that such metrics are important; however, it also recognizes that there is a large degree of uncertainty surrounding toxicity and hazard assessment methods. [38] The industry will continue to monitor all available toxicity reporting methods and may make such reporting mandatory in future revisions of this PCR.

An EPD shall also include:

- any data on building product performance (where environmentally significant)
- instructions and limits for efficient use
- organization's adherence to any environmental management system, including a statement showing where an interested party can find additional information on the system
- other environmental certification programs applied to the building product and a statement on where an interested party can find details of the certification program
- other environmental activities of the organization, such as participation in recycling or recovery programs, provided details of these programs are readily available to the purchaser or user and contact information is provided
- preferred waste management option for unused coating.

[37] USEtox Team, Task Force on Toxic Impacts, UNEP/SETAC Life Cycle Initiative. <usetox.org>

[38] Uncertainty of the USETox method is discussed in following publication: Ralph K. Rosenbaum, Till M. Bachmann, Lois Swirsky Gold, Mark A. J. Huijbregts, Olivier Jolliet, Ronnie Juraske, Annette Koehler, Henrik F. Larsen, Matthew MacLeod, Manuele Margni, Thomas E. McKone, Jérôme Payet, Marta Schuhmacher, Dik van de Meent, Michael Z. Hauschild. "USEtox—the UNEP-SETAC toxicity model: recommended characterisation factors for human toxicity and freshwater ecotoxicity in life cycle impact assessment." *International Journal of LCA*. November 2008, Volume 13, Issue 7, pp 532-546.

The EPD shall also include any releases to ground- and surface-water and indoor air shall meet all relevant national standards. VOC emissions occurring during the use phase shall be declared in the EPD, measured in a way consistent with industry best-practice. The employed VOC testing method shall be disclosed in the EPD.

The waste allocated to the building product for the foreground system (the operations under direct control of the product manufacturer) shall be classified in the EPD as either:

- hazardous waste
- non-hazardous waste.

8.4 Mandatory additional environmental information

Per ISO 21930:2017 [1] Section 8.4, with the following clarification.

Any releases to ground- and surface-water and indoor air shall meet all relevant national standards. VOC and semi-VOC emissions occurring during the use phase shall be declared in the EPD, measured in a way consistent with industry best-practice. The employed VOC testing method shall be disclosed in the EPD.

9 Content of an EPD

9.1 General

Per ISO 21930:2017 [1] Clause 9.1.

9.2 Declaration of general information

Per ISO 21930:2017 [1] Clause 9.2, with the following clarification.

Table 5
Demonstration of verification

Product name	
Manufacturer name and address	
Program operator	
General program instructions and version number	
Declaration number	
Reference PCR and version number	
EPD type and scope	
Defined functional and declared thickness	
Product’s intended application and use	

Table 5
Demonstration of verification

Product RSL	
Markets of applicability	
Date of issue	
Period of validity	
Year of reported manufacturer primary data	
LCA software and version number	
LCA software report verification	
LCI database and version number	
LCIA methodology and version number	
Overall data quality assessment score	
The sub-category PCR review was conducted by:	
This declaration was independently verified in accordance with ISO 14025: 2006. ISO 21930:2017 serves as the core PCR. Sub-category PCR: **Metal and Coil Extrusion Coatings** Product Category Rule ☐ Internal ☐ External	
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	
Explanatory material can be obtained from the following:	

The PCR shall include the following statements:

- *"EPDs are only comparable if they comply with ISO 21930, this sub-category PCR, include all relevant information modules and are based on equivalent scenarios with respect to the construction works context."*
- *"Environmental declarations from different programs may not be comparable. Comparison of the environmental performance of products using EPD information shall be based on the product's use and impacts at the building or construction works level, and therefore EPDs may not be used for comparability purposes when not considering the whole building life cycle. EPD comparability is only possible when all stages of the life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background datasets may lead to differences in the results upstream or downstream of the life cycle stages declared."*
- *"The EPD Owner has sole ownership, responsibility, and liability for the content of this EPD."*

Product-specifications

- Identification of the product name, and unit size designation. A depiction of the item shall be included.
- A description of the main product components or materials that make up the product shall be given both in mass and percent of total. Mass may be reported by material using a range to protect proprietary product information.
- Description of the main product packaging materials, if applicable, shall be given in mass per functional unit. Where multiple products are represented, the packaging may be given for a representative product by category.
- Regulated hazardous materials or substances shall be identified, listed by CAS number, and identify the standard or regulation in the relevant market. When such materials are reported, the following note may be added immediately after the required information.

9.3 Declaration of the methodological framework

Per ISO 21930:2017 [1] Section 9.3, with the following additions and clarification.

A table summarizing the life cycle stages shall be included in the EPD.

Table 6
Mandatory life stages included in the EPD

Production stage			Construction stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
Raw material extraction	Transport	Manufacturing	Transportation to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operation energy use	Operation water use	De-construction	Transport	Waste processing	Disposal	Reuse/recycle
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O

Note. X = module declared, O = optional declaration

9.4 Declaration of technical information and scenarios

Per ISO 21930-2017 [1] Clause 9.4.

9.5 Declaration of environmental indicators derived from LCA

Per ISO 21930:2017 [1] Clause 9.5, with the following additions.

Use caution when interpreting data in these categories (can be listed as shown below or identified by note):

- renewable primary energy resources as energy (fuel), (RPR_E)
- renewable primary resources as material, (RPR_M)
- non-renewable primary resources as energy (fuel) ,($NRPR_E$)
- non-renewable primary resources as material ($NRPR_M$)
- secondary materials (SM)
- renewable secondary fuels (RSF)
- non-renewable secondary fuels (NRSF)
- recovered energy (RE)
- abiotic depletion potential for non-fossil mineral resources (ADP elements)
- land use related impacts, for example on biodiversity and/or soil fertility
- toxicological aspects
- emissions from land use change (GWP 100 (land-use change))
- hazardous waste [9] disposed
- non-hazardous waste disposed
- high-level radioactive waste
- intermediate and low-level radioactive waste
- components for reuse
- materials for recycling
- materials for energy recovery
- recovered energy exported from the product system.

9.6 Declaration of additional environmental information

Per ISO 21930:2017 [1] Clause 9.6.

10 Project report

Per ISO 21930:2017 [1] Clause 10.

11 Verification and validity of an EPD

Per ISO 21930:2017 [1] Clause 11.

12 Informative references

12.1 ASTM standards

ASTM D523-14 (2018), *Standard test method for specular gloss* [11]

ASTM D714-25, *Standard test method for evaluating degree of blistering of paints* [11]

ASTM D968-25, *Standard test methods for abrasion resistance of organic coatings by falling abrasive* [11]

ASTM D2247-25, *Standard practice for testing water resistance of coatings in 100% relative humidity* [11]

ASTM D2794-93 (2024), *Standard test method for resistance of organic coatings to the effects of rapid deformation (impact)* [11]

ASTM D3359-23, *Standard test methods for rating adhesion by tape test* [11]

ASTM D3363-22, *Standard test method for film hardness by pencil test* [11]

ASTM E84-26, *Standard test method for surface burning characteristics of building materials* [11]

ASTM G85-19, *Standard practice for modified salt spray (fog) testing* [11]

12.2 EN standards

EN 15804+A2:2019/AC 2021 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products [39]

12.3 ISO standards

ISO 6707-1: 2014, *Buildings and Civil Engineering Works – Vocabulary – Part 1: General Terms* [1]

12.4 Other references

ecoinvent (a life cycle database that contains international industrial LCI data on energy supply, resource extraction, material supply, chemicals, metals, agriculture, waste management services, and transport services) [25]

FTC Part 260, Green Guides [40]

[39] European Standards s.r.o. Krimicka 134, 318 00 Pilsen, Czech Republic. <en-standard.eu>

[40] Federal Trade Commission. 600 Pennsylvania Avenue, NW, Washington, DC 20580. <ftc.gov>

Hauschild, M.Z., Huijbregts, M.A.J., Jolliet, O., Macleod, M., Margni, M.D., van de Meent, D., Rosenbaum, R.K., McKone, T.E., "Building a Model Based on Scientific Consensus for Life Cycle Impact Assessment of Chemicals: The Search for Harmony and Parsimony." *Environmental Science and Technology*, 2008, 42, 19, 7032-7037. [41]

ILCD Handbook, *General Guide for Life Cycle Assessment* [15]

International EPD System, *Paints and Varnishes and Related Products* [42]

Institut Bauen und Umwelt e.V – Requirements on the EPD for Coatings with organic binders [6]

Product Environmental Footprint (PEF) [15]

Rosenbaum, R.K., Bachmann, T.M., Gold, L.S., Huijbregts, M.A.J., Jolliet, O., Juraske, R., Koehler, A., Larsen, H.F., MacLeod, M., Margni, M.D., McKone, T.E., Payet, J., Schuhmacher, M., van de Meent, D., Hauschild, M.Z., 2008. "USEtox—the UNEP-SETAC toxicity model: recommended characterisation factors for human toxicity and freshwater ecotoxicity in life cycle impact assessment." *International Journal of Life Cycle Assessment*, 2008, 13, 532-546. [43]

SimaPro [44]

UFON Nano-Chemical Corporation, *Product Category Rule for Preparing and Environmental Product Declaration for Paint* [45]

US EPA, *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008* [46]

US EPA, *Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI)* [35]

US EPA, *Waste Reduction Model* [28]

USLCI Database Project, *US LCI Database Project Development Guidelines* [47]

WRI, Draft Product Life Cycle Accounting and Reporting Standard [48]

[41] <https://doi.org/10.1021/es703145t>

[42] <environdec.com>

[43] <lifecycleinitiative.org>

[44] PRé Sustainability, Stationsplein 121, 3818 LE Amersfoort, The Netherlands. <simapro.com>

[45] UFON Nano-Chemical Corporation. 8F, No 2, Ln 348, Sec 2, Zhongshan Road, Zhonghe District, New Taipei City 235, Taiwan. <pentenswaterproof.com>

[46] <nepis.epa.gov>

[47] Life Cycle Indicators Database, US Department of Energy and Renewable Energy. 1000 Independence Avenue SW, Washington, DC 20585. <nrel.gov>

[48] World Resource Institute. 10 G Street NE, Suite 800, Washington, DC 20002. <wri.org>

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