Environmental Product Declaration – Inver MP Hybrid Epoxy-Polyester Powder Coating[1]

Inver MP is the premier hybrid epoxy-polyester powder coatings brand in Europe, setting the industry standard in terms of innovation, quality and service. Inver MP offers a wide range of Industrial Powder Coatings formulated to decorate and protect steel and other metal surfaces in indoor areas.

The product image to the right is an example of one of the formulas covered by the EPD. A list of all relevant Inver MP hybrid epoxy-polyester powder formulas is shown in Table 1 on page 2 of the EPD.

Program Operator	NSF Certification, LLC
Declaration Holder	The Sherwin-Williams Company 101 W. Prospect Ave., Cleveland, OH, 44115
Declaration Prepared by	Seth Jackson (sjackson@sherwin.com)
Declaration Number	EPD10671
Product Category and Subcategory	Powder Coatings
Reference PCR	NSF PCR for Powder Coatings – 6/2020

Date of Issue	11/17/2021
Period of Validity	5 Years

Contents of the Declaration	– Product definition and material characteristics – Overview of manufacturing process – Information about in-use conditions – Life cycle assessment results – Testing verifications

The PCR review was conducted by	Thomas P. Gloria, Ph. D. t.gloria@industrial-ecology.com

This EPD was independently verified by NSF International in accordance with ISO 21930:2017 and ISO 14025. ☐ **Internal** ☒ **External**	Tony Favilla afavilla@nsf.org
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by	Jack Geibig - EcoForm jgeibig@ecoform.com

Declared Unit:	1 kg of product
System Boundary	Cradle-to-Gate (A1-A3 only)
Data Quality Assessment Score	Very Good
Manufacturing Location(s)	Various Plants Throughout the United States and Europe
Software Program Used	GaBi (most recent version available at time of report)

[1] *In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers or programs, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the construction works level per ISO 21930:2017 guidelines including use of the same sub-category PCR, the same relevant information modules, and are based on the same equivalent scenarios. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis. In addition, only EPDs using a functional unit are eligible for comparison. Since this EPD uses a declared unit,*

ISO21930:2017 – serves as the core PCR PCR for Powder Coatings PCR review was conducted by: Thomas P. Gloria, Ph. D., Mr. Bill Stough, Mr. Jack Geibig NSF International – National Center for Sustainability Standards, ncss@nsf.org
Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 ☐ internal **X** external
Jack Geibig - EcoForm

Product Definition:

Inver MP Hybrid epoxy – polyester powder coating is a family of powder coatings manufactured by The Sherwin-Williams Company, headquartered in Cleveland, Ohio. Inver MP Hybrid epoxy – polyester powder coating is manufactured in a number of Sherwin-Williams facilities across Europe and the data used by the LCA were representative of all Sherwin-Williams facilities in which Inver MP Hybrid epoxy – polyester powder coating was produced. These Sherwin-Williams powder coatings are 100% solids coatings designed to cover and protect a variety of architectural surfaces such as shelving, wall panels, etc. and are applied off-site by the end-user. For information about specific products, please visit www.sherwin.com.

Product Classification and Description:

The Inver MP Hybrid epoxy – polyester powder coating products listed below are included within this assessment. For information on other attributes of each of the specific formulations, please visit www.sherwin.com.

Table 1. List of Inver MP Hybrid epoxy – polyester powder coating Formulas Assessed by LCA Model and Report.

Product Name	Class	Product Codes
Inver MP Hybrid epoxy – polyester powder coating	Class 1	EP103009G.90, EP110218SG.90, EP809143SM.90, FCN9194.90, EP100995SGLT.90, 47024, 88985, 83885, 9853/R, 18396

comparisons with other EPDs are not possible.

Powder Coatings are manufactured in a way somewhat similar to other paint and coating products, with some intermediate steps unique to powders. Raw materials are manually added in appropriate quantities into a high-speed disperser to create a consistent pre-mixed blend. This raw material blend is then moved to an extruder, which heats the resin and evenly distributes the additives and pigments within the resin blend, creating the coating. When the hot blend leaves the extruder, it proceeds onto chilled rollers which cool material, and it is subsequently mechanically broken into flakes via a grind and sieve process. The product is then moved via compressed air or gravity and filled into containers and transported to the distribution center and to the customer. Powder coatings are applied in a facility by the customer as opposed to on a construction site. The applied coating adheres to the substrate where it remains until the substrate is disposed of by the user. Any unused coating will be disposed of by the purchaser.

The typical composition of a Powder Coating is shown below.

Resin (30%-90%)
Extender Pigments (5%-25%)
Titanium Dioxide (0-15%)
Additives (5%-20%)

Aside from the ingredients present in the table below, there are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting. For additional information about product hazards, please refer to the Safety Data Sheet for the specific Inver MP Hybrid epoxy – polyester powder coating formula available on www.sherwin.com.

Table 2. List of Hazardous ingredients in the Inver MP Hybrid epoxy – polyester powder coating formulas assessed.

Ingredient	Percentage	CAS #	Reference Standard
2-Phenyl-2-imidazoline pyromellitic acid salt	<10%	54553-90-1	GHS
1-Hexanamine, 2-ethyl-N,N-bis(2-ethylh exyl)-	<1%	1860-26-0	GHS

About Sherwin-Williams:

For 150 years, Sherwin-Williams has provided contractors, builders, property managers, architects and designers with the trusted products they need to build their business and satisfy customers. Inver MP Hybrid epoxy – polyester powder coating is just one more way we bring you industry-leading coating technology — innovation you can pass on to your customers. Plus, with more than 4,000 stores and 2,400 sales representatives across North America, personal service and expert advice is always available near jobsites. Find out more about Inver MP Hybrid epoxy – polyester powder coating at your nearest Sherwin-Williams store or to have a sales representative contact you, call 800-524-5979.

Definitions:

Acronyms & Abbreviated Terms:

- **ACA:** American Coating Association
- **ASTM**: A standards development organization that serves as an open forum for the development of international standards. ASTM methods are industry-recognized and approved test methodologies for demonstrating the durability of an architectural coating in the United States.
- **ecoinvent:** a life cycle database that contains international industrial life cycle inventory data on energy supply, resource extraction, material supply, chemicals, metals, agriculture, waste management services, and transport services.
- **EPA WARM model**: Unite States Environmental Protection Agency Waste Reduction Model.
- **EPD**: Environmental Product Declaration. EPDs are form of as Type III environmental declarations under ISO 14025. They are the summary document of data collected in the LCA as specified by a relevant PCR. EPDs can enable comparison between products if the underlying studies and assumptions are similar.
- **GaBi:** Created by thinkstep, GaBi Databases are LCA databases that contain ready-to-use Life Cycle Inventory profiles.
- **LCA**: Life Cycle Assessment or Analysis. A technique to assess environmental impacts associated with all the stages of a product's life from cradle to grave (i.e., from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling).
- **NCSS**: NSF International's National Center for Sustainability Standards
- **PCR**: Product Category Rule. A PCR defines the rules and requirements for creating EPDs of a certain product category.

Terminology:

- **Adhesion:** the degree of attachment between two surfaces held together by interfacial forces.
- **Basecoats:** coatings 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, and construction.
- **Generic data:** Defined by the ILCD Handbook[2] as "a generic data set has been developed using at least partly other information than 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."
- **Failure:** The physical degradation of the surfacing material which would require substantial or complete removal in order to return the substrate to serviceable condition.

[2] European Commission, European Platform on Life Cycle Assessment, International Life Cycle Data system, available at: https://eplca.jrc.ec.europa.eu/ilcd.html

- **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.).
- **Pigment:** The material(s) that give a coating its color.
- **Powder Coating:** a 100% solids coating applied as a dry powder which, when baked at a sufficient temperature, melts out to form a continuous film.
- **Primers:** materials applied to a surface to promote adhesion between the substrate and subsequent coats.
- **Primary materials**: Resources 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).
- **Resin / Binder:** Acts as the glue or adhesive to adhere the coating to the substrate.
- **Secondary materials**: 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).

Underlying Life Cycle Assessment Methodology:

Declared Unit:

Per the reference PCR, the declared unit for the study was 1 kg of product.

Allocation Rules:

In accordance with the reference PCR, allocation was avoided whenever possible, however if allocation could not be avoided, the following hierarchy of allocation methods was utilized:

- Mass, or other biophysical relationship; and
- Economic value.

In the LCA models, mass allocation was ONLY used during packaging and end of life-stages.

Treatment of Biogenic Carbon:

In accordance with the reference PCR, biogenic carbon was not disclosed as there were no significant sources or impacts from the product system or packaging.

CO2 from calcination and carbonation, as well as, CO2 from combustion of waste from non-renewable sources used in product process are indicators listed in the PCR. These values were not recorded as they did not contribute to the Global Warming Potential due to the fact that bio-materials are not present and waste was specifically taken to landfill and not combusted.

System Boundary:

This LCA included all relevant steps in the coating manufacturing process as described by the reference PCR. Raw materials are manually added in appropriate quantities into a high-speed disperser to create a consistent pre-mixed blend. This raw material blend is then moved to an extruder, which heats the resin and evenly distributes the additives and pigments within the resin blend, creating the coating. When the hot blend leaves the extruder, it proceeds onto chilled rollers which cool material, and it is subsequently mechanically broken into flakes via a grind and sieve process. The product is then moved via compressed air or gravity and filled into containers and transported to the distribution center and to the customer. Powder coatings are applied in a facility by the customer as opposed to on a construction site. The applied coating adheres to the substrate where it remains until the substrate is disposed of by the user. Any unused coating will be disposed of by the purchaser. The system boundary ends with the final powder coating product at the production gate before it is distributed to the end-user's facility. This can be seen in Figure 1, below.

All impacts were assessed using a 100-year time horizon as required by ISO 21930:2017.

All significant resource extraction, raw material transportation, and manufacturing for the creation of Powder Coatings were included. All relevant processes were accounted in the LCA models.

As described in the reference PCR, the following items were excluded from the assessment and they were expected to not substantially affect the results.

- personnel impacts;
- research and development activities;
- business travel;
- any secondary packaging (pallets, for example); and
- all point of sale infrastructure;

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE			
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction/ demolition	Transport	Waste processing	Disposal of waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4

Figure 1. Diagram of System Boundary Covered by LCA Models and Report. Modified from ISO 21930:2017. Module A1-A3, the Product Stage, were included in this study. All other modules were omitted.

Cut-Off Rules:

The cut-off rules prescribed by the reference PCR required a minimum of 95% of the total mass, energy, and environmental relevance to be captured by the LCA models. Any unit process shall use a maximum 1% cut-off of renewable primary resource usage, nonrenewable primary resource usage, total mass or environmental impact. The formulas that were included for testing were all modeled to at least 99.7% of their material content by weight. No significant flows were excluded from the LCA models and the 5% total maximum threshold prescribed by the PCR and ISO 21930:2017 was not exceeded. Any gaps that did occur in assessing material content were due to materials being a trade secret or LCI data (and suitable proxies) being unavailable.

Data Sources & Quality:

When primary data was unavailable, data was taken from either thinkstep, ecoinvent, or CEPE's coating industry life cycle inventory. The data from thinkstep and ecoinvent are widely accepted by the LCA community and the CEPE database has been built using those databases as a foundation. A brief description of these databases is below:

Table 3. Overview of Databases used in LCA Models.

Database	Comments
Sherwin-Williams	Primary source data taken as an average monthly value over a 12-month average of 2019 relevant facilities operation metrics.
thinkstep/GaBi	DB Version 8.7
ecoinvent	Version 3.3 – Most recent version available in GaBi.
CEPE LCI	Most recent version of industry LCI. Last revised in 2016. Made up of refined data from thinkstep and ecoinvent to make it more representative to coatings manufacturing. Primarily limited to EU data, although some processes are global.

Precision and Completeness:

Annual averages from the 2019 calendar year of primary data was used for all gate-gate processes and the most representative inventories were selected for all processes outside of Sherwin-Williams' direct operational control. Secondary data was primarily drawn from the most recent GaBi and ecoinvent databases and CEPE's 2016 coating life cycle inventory. All of these databases were assessed in terms of overall completeness.

Assumptions relating to application and disposal were conformant with the reference PCR. All data used in the LCA models was less than five years old. Pigment and resin data were taken from both ecoinvent v3.3 and GaBi databases.

Consistency and Reproducibility:

In order to ensure consistency, primary source data was used for all gate-to-gate processes in coating manufacturing. All other secondary data were applied consistently and any modifications to the databases were documented in the LCA Report.

This assessment was completed using an EPD calculator tool that has been externally verified by NSF Certification, LLC. This tool was not altered in any way from its original and verified form to generate the LCA results described in this EPD, and the results from the calculator were translated into the EPD by hand. Reproducibility is possible using the verified EPD Calculator tool or by reproducing the LCIs documented in the LCA Report.

Temporal Coverage:

Primary data was collected from the manufacturing facilities from the 2019 calendar year. Secondary data reflected the most up-do-date versions of the LCA databases mentioned above.

Geographic Coverage:

Inver MP Hybrid epoxy – polyester powder coating is manufactured by the Sherwin-Williams Company primarily within Europe. Given that the facilities making Inver MP Hybrid epoxy – polyester powder coating are spread across Europe, the average European grid mix was used in the LCA models as a conservative estimate. Inver MP Hybrid epoxy – polyester powder coating products are purchased, used, and the unused portions are disposed by the customer throughout Europe and the Middle East.

Life Cycle Impact Assessment:

The purpose of the Life Cycle Impact Assessment (LCIA) is to show the link between the life cycle inventory results and potential environmental impacts. As such, these results are classified and characterized into several impact categories which are listed and described below. The CML method was used and the LCIA results are conformant with the PCR, which was based on ISO 21930:2017. The CML method is widely accepted for use in Europe. This method is also listed in the reference PCR.

Table 4. Overview of Impact Categories[3]

Overview of LCA Impact Categories	
Impact Category Name	**Description of Impact Category**
Global Warming Potential	*"Global warming is an average increase in the temperature of the atmosphere near the Earth's surface and in the troposphere, which can contribute to changes in global climate patterns. Global warming can occur from a variety of causes, both natural and human induced. In common usage, "global warming" often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities" (US Environmental Protection Agency 2008b).* *Biogenic carbon was excluded from the analysis as stipulated by the PCR..*
Ozone Depletion Potential	*Ozone within the stratosphere provides protection from radiation, which can lead to increased frequency of skin cancers and cataracts in the human populations. Additionally, ozone has been documented to have effects on crops, other plants, marine life, and human-built materials. Substances which have been reported and linked to decreasing S-10637-OP-1-0 REVISION: 0 DATE: 6/22/2012 Page 13 | 24 Document ID: S-10637-OP-1-0 Date: 7/24/2012 the stratospheric ozone level are chlorofluorocarbons (CFCs) which are used as refrigerants, foam blowing agents, solvents, and halons which are used as fire extinguishing agents (US Environmental Protection Agency 2008j).*
Acidification Potential	*Acidification is the increasing concentration of hydrogen ion (H+) within a local environment. This can be the result of the addition of acids (e.g., nitric acid and sulfuric acid) into the environment, or by the addition of other substances (e.g., ammonia) which increase the acidity of the environment due to various chemical reactions and/or biological activity, or by natural circumstances such as the change in soil concentrations because of the growth of local plant species n (US Environmental Protection Agency 2008q).*
Smog Formation Potential	*Ground level ozone is created by various chemical reactions, which occur between nitrogen oxides (NOx) and volatile organic compounds (VOCs) in sunlight. Human health effects can result in a variety of respiratory issues including increasing symptoms of bronchitis, asthma, and emphysema. Permanent lung damage may result from prolonged exposure to ozone. Ecological impacts include damage to various ecosystems and crop damage. The primary sources of ozone precursors are motor vehicles, electric power utilities and industrial facilities (US Environmental Protection Agency 2008e).*
Eutrophication Potential	*Eutrophication is the "enrichment of an aquatic ecosystem with nutrients (nitrates, phosphates) that accelerate biological productivity (growth of algae and weeds) and an undesirable accumulation of algal biomass" (US Environmental Protection Agency 2008d).*

[3] See EPA TRACI References for Additional Detail

The LCA results are documented and grouped separately below into the following stages as defined by ISO 21930:2017.

- Total Impact (across the entire cradle-gate lifecycle)
- Product Stage (Modules A1-A3)
  - A1 Extraction and Upstream Production
  - A2 Transport to Factory
  - A3 Manufacturing

No weighting or normalization was done to the results. At this time, it is not recommended to weight the results of the LCA or the subsequent EPD. It is important to remember that LCA results show potential and expected impacts and these should not be used as firm thresholds/indicators of safety and/or risk. As with all scientific processes, there is uncertainty within the calculation and measurement of all impact categories and care should be taken when interpreting the results.

Results:

The Results of the impact categories were run for Inver MP Hybrid epoxy – polyester powder coating and shown below in Tables 5-6 and resource metrics in Tables 7-8.

Table 5. Total LCIA Results

	EP103009G.90	EP110218SG.90	EP809143SM.90	FCN9194.90	EP100995SGLT.90
GWP (kg CO2e)	5.29	5.94	4.5	5.62	5.37
Acidification (kg SO2e)	0.0815	0.0575	0.0711	0.0255	0.0712
Eutrophication (kg Phosphate e)	4.62E-03	5.42E-03	4.00E-03	5.61E-03	3.74E-03
Ozone Depletion (kg R-11 e)	2.74E-07	3.17E-05	2.34E-07	3.79E-07	1.49E-07
Photochemical Ozone Formation (kg NOx eq.)	0.0114	0.0126	9.89E-03	1.18E-02	0.0112
	47024	**88985**	**83885**	**9853/R**	**18396**
GWP (kg CO2e)	5.58	4.84	4.61	5.36	6.21
Acidification (kg SO2e)	0.0434	0.0774	0.0752	0.056	0.0818
Eutrophication (kg Phosphate e)	5.62E-03	5.08E-03	5.45E-03	6.02E-03	3.96E-03
Ozone Depletion (kg R-11 e)	2.73E-07	3.10E-07	3.41E-07	1.84E-05	2.99E-05
Photochemical Ozone Formation (kg NOx eq.)	0.012	0.0108	0.0101	0.0115	0.0122

Table 6. LCIA Results by Module

EP103009G.90	A1	A2	A3
GWP (kg CO2e)	4.78	0.353	0.156
Acidification (kg SO2e)	0.08	1.29E-03	2.19E-04
Eutrophication (kg Phosphate e)	4.27E-03	3.20E-04	2.65E-05
Ozone Depletion (kg R-11 e)	2.74E-07	5.80E-17	2.63E-15
Photochemical Ozone Formation (kg NOx eq.)	8.96E-03	2.31E-03	1.49E-04
EP110218SG.90	A1	A2	A3
GWP (kg CO2e)	5.43	0.353	0.156
Acidification (kg SO2e)	0.056	1.29E-03	2.19E-04
Eutrophication (kg Phosphate e)	5.07E-03	3.20E-04	2.65E-05
Ozone Depletion (kg R-11 e)	3.17E-05	5.80E-17	2.63E-15
Photochemical Ozone Formation (kg NOx eq.)	0.0101	2.31E-03	1.49E-04
EP809143SM.90	A1	A2	A3
GWP (kg CO2e)	3.99	0.353	0.156
Acidification (kg SO2e)	0.0696	1.29E-03	2.19E-04
Eutrophication (kg Phosphate e)	3.66E-03	3.20E-04	2.65E-05
Ozone Depletion (kg R-11 e)	2.34E-07	5.80E-17	2.63E-15
Photochemical Ozone Formation (kg NOx eq.)	7.43E-03	2.31E-03	1.49E-04
FCN9194.90	A1	A2	A3
GWP (kg CO2e)	5.11	0.353	0.156
Acidification (kg SO2e)	0.024	1.29E-03	2.19E-04
Eutrophication (kg Phosphate e)	5.26E-03	3.20E-04	2.65E-05
Ozone Depletion (kg R-11 e)	3.79E-07	5.80E-17	2.63E-15
Photochemical Ozone Formation (kg NOx eq.)	9.34E-03	2.31E-03	1.49E-04
EP100995SGLT.90	A1	A2	A3
GWP (kg CO2e)	4.87	0.353	0.156
Acidification (kg SO2e)	0.0697	1.29E-03	2.19E-04
Eutrophication (kg Phosphate e)	3.39E-03	3.20E-04	2.65E-05
Ozone Depletion (kg R-11 e)	1.49E-07	5.80E-17	2.63E-15
Photochemical Ozone Formation (kg NOx eq.)	8.72E-03	2.31E-03	1.49E-04
47024	A1	A2	A3
GWP (kg CO2e)	5.07	0.353	0.156
Acidification (kg SO2e)	0.0419	1.29E-03	2.19E-04
Eutrophication (kg Phosphate e)	5.27E-03	3.20E-04	2.65E-05
Ozone Depletion (kg R-11 e)	2.73E-07	5.80E-17	2.63E-15

Photochemical Ozone Formation (kg NOx eq.)	9.53E-03	2.31E-03	1.49E-04
88985	A1	A2	A3
GWP (kg CO2e)	4.33	0.353	0.156
Acidification (kg SO2e)	0.0759	1.29E-03	2.19E-04
Eutrophication (kg Phosphate e)	4.73E-03	3.20E-04	2.65E-05
Ozone Depletion (kg R-11 e)	3.10E-07	5.80E-17	2.63E-15
Photochemical Ozone Formation (kg NOx eq.)	8.33E-03	2.31E-03	1.49E-04
83885	A1	A2	A3
GWP (kg CO2e)	4.1	0.353	0.156
Acidification (kg SO2e)	0.0737	1.29E-03	2.19E-04
Eutrophication (kg Phosphate e)	5.11E-03	3.20E-04	2.65E-05
Ozone Depletion (kg R-11 e)	3.41E-07	5.80E-17	2.63E-15
Photochemical Ozone Formation (kg NOx eq.)	7.67E-03	2.31E-03	1.49E-04
9853/R	A1	A2	A3
GWP (kg CO2e)	4.85	0.353	0.156
Acidification (kg SO2e)	0.0545	1.29E-03	2.19E-04
Eutrophication (kg Phosphate e)	5.67E-03	3.20E-04	2.65E-05
Ozone Depletion (kg R-11 e)	1.84E-05	5.80E-17	2.63E-15
Photochemical Ozone Formation (kg NOx eq.)	9.03E-03	2.31E-03	1.49E-04
18396	A1	A2	A3
GWP (kg CO2e)	5.7	0.353	0.156
Acidification (kg SO2e)	0.0803	1.29E-03	2.19E-04
Eutrophication (kg Phosphate e)	3.61E-03	3.20E-04	2.65E-05
Ozone Depletion (kg R-11 e)	2.99E-05	5.80E-17	2.63E-15
Photochemical Ozone Formation (kg NOx eq.)	9.76E-03	2.31E-03	1.49E-04

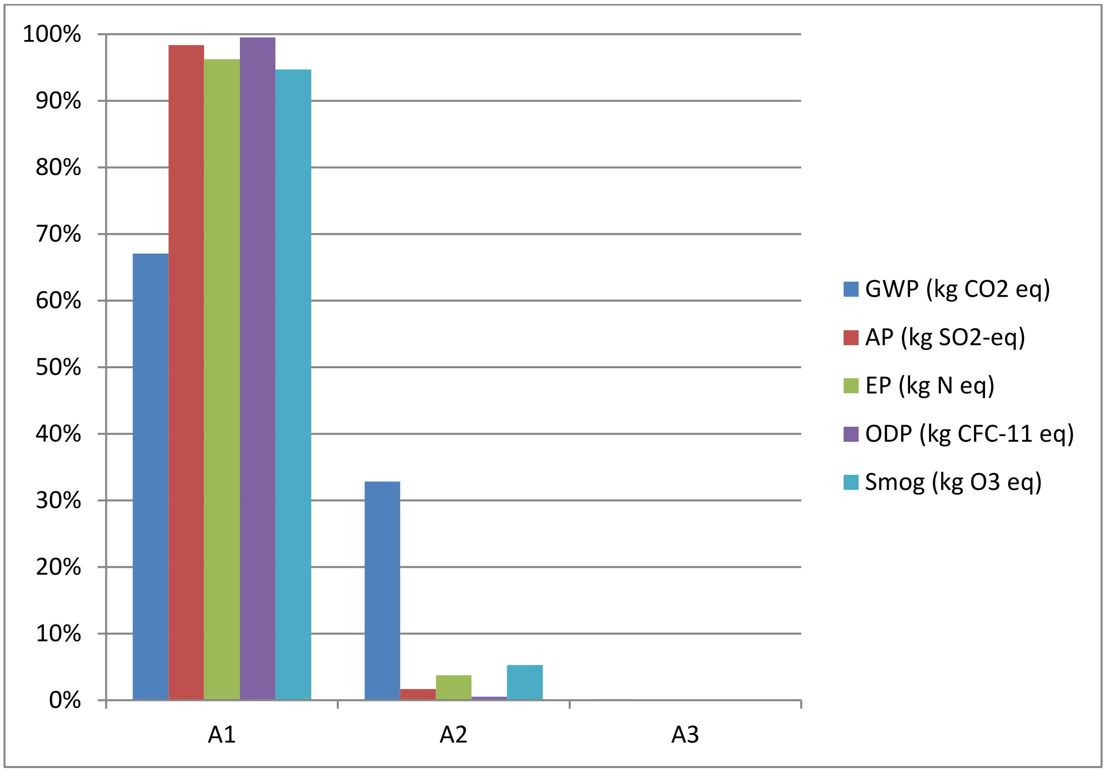

Figure 2. Averaged Coating LCIA Impact Distribution by ISO 21930 Modules

Resource Metric	Total	A1	A2	A3
$NRPR_E$ (MJ)	101.62	93.5	5.19	2.91
$NRPR_M$ (kg)	2.28	2.10	0.12	0.068
RPR_E (MJ)	4.72	3.75	0.27	0.70
RPR_M (KG)	0.023	0.023	3.84E-10	6.12E-09
Recovered Energy from disposal of waste in previous systems (MJ)	0	0	0	0
Abiotic Depletion Potential for Fossil Resources Used as Energy (MJ)	86.22	79.30	4.82	2.10
Abiotic Depletion Potential for Fossil Resources Used as Materials (kg)	2.64E-05	2.53E-05	2.99E-08	3.33E-08
Consumption of Freshwater (m^3)	3.50	3.50	3.14E-04	8.30E-04
SM (kg)	0	0	0	0
Recycled Material (kg)	0	0	0	0
RSF (MJ)	0	0	0	0
Non-renewable secondary fuels (MJ)	0	0	0	0
High-level radioactive waste (kg)	4.19E-07	2.24E-07	5.82E-09	1.89E-07
Intermediate and low-level radioactive waste (kg)	-1.22E-07	-1.22E-07	0	0

Table 7. Resource Metrics

Table 8. Waste Generation Values and Data Sources[4]

Waste Generation		
Non-Hazardous Waste	.0059 kg/kg of product	Primary Data taken from average waste creation during Powder Coating manufacturing Plants in 2019.
Hazardous Waste	.0026 kg/kg of product	Primary Data taken from average waste creation during Powder Floor Coating manufacturing Plants in 2019.

[4] Significant data limitations currently exist within the LCI data used to generate waste metrics for Life Cycle Assessments and Environmental Product Declarations. The waste metrics were calculated in a way conformant with the requirements of ISO 21930:2017, but these values represent rough estimates and are for informational purposes only. As such, no decisions regarding actual cradle-gate waste performance between products should be derived from these reported values.

Interpretation:

The majority of the environmental impact was from the raw materials used to make the coatings (Module A1) The raw materials with the largest impacts were the resins and primary pigment (often titanium dioxide). This was not surprising given the amount of resources needed to manufacture these intermediate products and also that they typically represent a substantial portion of the formulation (typically >60%).

Since the raw materials were responsible for the largest portion of the impact that the manufacturer could potentially optimize, product performance and durability will be critical important.

Generally speaking, the longer a coating lasts, the better its environmental performance will be.

Study Completeness:

Completeness estimates are somewhat subjective, as it is impossible for any LCA or inventory to be 100% complete. However, based on expert judgment, it is believed that given the overall data quality that the study is at least 95% complete. As such, at least 95% of system mass, energy, and environmental relevance were covered.

Uncertainty:

Because a large number of data sets are linked together in the LCA models, it is unknown how much of the data sets have goals that are dissimilar to this LCA. As such, it is difficult to estimate overall uncertainty of the LCA models. However, primary source data was used whenever possible and the most appropriate secondary data sources were used throughout the models. The thinkstep and ecoinvent databases are widely accepted by the LCA community and CEPE's LCI Database is based off thinkstep and ecoinvent data, just being optimized/corrected for coating manufacturing processes.

Since the reference PCR stipulated the majority of the crucial LCA assumptions, Sherwin-Williams is comfortable with the methodology of the LCA and feel they reflect current best-practices.

Limitations:

LCA is not a perfect tool for comparisons and impact values are constantly changing due to shifts in the grid mix, transportation, fuels, etc. Because of this, care should be taken when applying or interpreting these results. This being said, the relative impacts between products should be more reliable and less sensitive versus the specific impact category and metric values.

There were cases where analogue chemicals had to be used in the LCA models. This occurred when no LCI data was available for an intermediate chemical/material. This was typically limited to additives representing a very small amount of the overall formula (less than a percent) but may still impact the results. Likewise, there were cases where data had to be used from a different region or technology.

These instances were uncommon and noted in the Data Quality section of the LCA report and were not expected to have a serious effect on the results, but still may limit the study.

Emissions to Water, Soil, and to Indoor Air:

Since powder coatings are 100% solids, they do not contain VOC and therefore no expected emissions typically associated with coatings will occur. In addition, powder coatings are generally applied in a controlled factory setting where overspray can be captured and reutilized.

Critical Review:

Since the goal of the LCA was to generate an EPD, it was submitted for review by NSF Certification, LLC. NSF has commissioned Mr. Jack Geibig of EcoForm to conduct the formal review of the LCA report.

Additional Environmental Information:

Product Performance:

Although a declared unit was utilized for this EPD, it should be noted that higher quality powder coatings will generally last longer and/or require less coating to achieve the same hide as a more conventional powder coating. As such, coatings with higher performance may be characterized by significantly lower environmental impacts across the life cycle if less product needs to be used. Given this, users of this EPD data should consider product performance when making sustainability decisions.

Preferred End-of Life Options for Powder Coatings

Safe and proper disposal of excess materials shall be done in accordance with applicable federal, state, and local codes.

References:

American Coating Association Product Category Rule for Powder Coatings. Available at via NSF International. Published June 2020.

ISO 14025:2006 *Environmental labels and declarations – Type III environmental declarations – Principles and procedures.*

ISO 14040:2006 *Environmental management - Life cycle assessment – Principles and framework.*

ISO 14044:2006 *Environmental management - Life cycle assessment – Requirements and guidelines.*

ISO 21930:2017 *Sustainability in building construction – Environmental declaration of building products.*