ENVIRONMENTAL PRODUCT DECLARATION

PRESTRESSED CONCRETE STEEL WIRE STRAND (PC STRAND) PRODUCTS

EPOXY-COATED PC STRAND

Programme:	The International EPD® System
Programme operator:	EPD International AB
EPD registration number:	EPD-IES-0016845
Publication Date:	2024-10-01
Valid Until:	2029-10-01

This EPD was done in accordance with ISO 14025 and ISO 21930.
This EPD does not comply with EN15804+A2.

SUMIDEN WIRE PRODUCTS CORPORATION

Sumiden Wire is a United States-based manufacturer of a variety of high-quality wire products including uncoated, epoxy-coated and stainless steel PC strand.

This Epoxy-Coated PC Strand Environmental Product Declaration (EPD) document is just one of many actions that back our responsible stance. It is a standardized, internationally recognized tool containing data to help you evaluate our products' impact from a comprehensive level. Further, our EPDs are third-party verified based on an ISO-compliant assessment of our products' complete life cycle, from cradle to gate.

For more details, visit
https://www.sumidenwire.com

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THE NORTH AMERICAN EPD® SYSTEM

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ENVIRONMENTAL PRODUCT DECLARATION

SUMIDEN WIRE PRODUCTS CORPORATION

EPOXY-COATED PC STRAND

North American Product Category Rule for Designated Steel Construction Products

According to ISO 14025 and ISO 21930:2017

EPD Program and Program Operator Name, Address, Logo, and Website	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com as provided by EPD North America
General Program Instructions and Version Number[1]	General Programme Instructions for the International EPD® System. Version 4.0. 2021-03-29
Manufacturer Name and Address	Sumiden Wire | 710 Marshall Stuart Drive, Dickson, TN 37055
Declaration Number	EPD-IES-0016845
Declared Product & Declared Unit	ASTM A882 Filled Epoxy-Coated Seven-Wire Steel Prestressing Strand (a.k.a. Epoxy-Coated PC Strand); 1 metric ton
Reference PCR and Version Number[2]	UL Part A: Life Cycle Assessment Calculation Rules and Report Requirements, v4.0 (2022) Part B: Steel Construction Product EPD Requirements, v2.0 (2020)
Description of Product Application/Use	Epoxy-Coated PC Strand for Structural Construction
Markets of Applicability	North America
Date of Issue	2024-10-01
Period of Validity	5 years from date of issue
EPD Type	Product-specific Type III
EPD Scope	Cradle to Gate
Year(s) of reported primary data	November 2021 - October 2022
LCA Software & Version Number	Sphera Managed LCA Content Database 2023.2 (formerly GaBi Database)
LCI Database(s) & Version Number	Sphera LCA for Experts 10.7 (formerly GaBi)
LCIA Methodology & Version Number	TRACI 2.1, IPCC AR5 GWP_{100}, CML 2001-Jan 2016 ADP_{fossil}

Part A PCR review was conducted by:	Lindita Bushi, PhD, Chair Hugues Imbeault-Tétrault, Eng., M.A. Sc. Jack Geibig
The sub-category PCR review was conducted by:	Dr. Tom Gloria (Chair) Brandie Sebastian James Littlefield
Independent third-party verification of the declaration and data, according to ISO 14025:2008	☐ EPD Process Ceritification ☒ EPD Verification ☐ Pre-Verified Tool
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v4.0, based on CEN Norm EN 15804 (2012) and ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017). ☐ INTERNAL ☒EXTERNAL	Dr. Freddy Navarro Pineda, LCACHECK S.A.S. de C.V. Approved by: The International EPD® System
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Dr. Freddy Navarro Pineda, LCACHECK S.A.S. de C.V.
The procedure for follow-up of data during EPD validity, as defined by the GPI, involves third party verifier:	☐ Yes ☒ No

SUMIDEN WIRE PRODUCTS CORPORATION

EPOXY-COATED PC STRAND

North American Product Category Rule for Designated Steel Construction Products

According to ISO 14025 and ISO 21930:2017

[1]Not all requirements in the GPI are fulfilled, particularly the requirement, for construction products, to follow EN 15804 for certain aspects of the LCA method.
[2]This EPD is based on a PCR that satisfies procurement rules at the federal, state, and municipal levels which call for EPDs based on the UL Part B PCR. The UL Part B PCR was used to meet regulatory (example: Buy Clean California Act, etc.) and market expectations (example: Building Transparency EC3 comparisons, LEED and existing vendor procurement requirements, product scoring programs, etc.). The EPD should not be used outside of this context.

Limitations:
Environmental declarations from different programs (ISO 14025) may not be comparable.
Comparison of the environmental performance of construction works and construction products using EPD information shall be based on the product's use and impacts at the construction works level. In general, EPDs may not be used for comparability purposes when not considered in a construction works context. Given this PCR ensures products meet the same functional requirements, comparability is permissible provided the information given for such comparison is transparent and the limitations of comparability explained.

When comparing EPDs created using this PCR, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

The EPD owner has the sole ownership, liability, and responsibility of the EPD.

1. Product Definition and Information

1.1. Description of Company/Organization

Sumiden Wire is a United States-based manufacturer of a variety of high-quality wire products including uncoated, epoxy-coated and stainless steel PC strand. Sumiden Wire was established in 1979 in Stockton, CA. Today, the company is headquartered in Dickson, TN with the following manufacturing sites:

Manufacturing Sites:

- Stockton, CA (Location: 1412 El Pinal Drive Stockton, CA 95205)
- Dickson, TN (Location: 710 Marshall Stuart Drive Dickson, TN 37055)
- Dayton, TX (Location: 1800 Highway 146 Dayton, TX 77535)

1.2. Product Description

Product Identification
This EPD covers Epoxy-Coated PC Strand. Sumiden Wire manufactures ASTM A882 epoxy-coated PC strands in the same size range as uncoated PC strands, offering three different surface finishes depending on the required strand-to-concrete bond performance i.e., no grit, fine grit, and coarse grit. The epoxy-coated PC strand not only covers the outside of the strand but also all internal voids are completely filled. These are used in the production of post-tension slabs, prestressed girders, prestressed piling, segmental bridges, doubles tees, rock and soil anchors, hollow core slabs, stay cables, and a variety of other applications.

This EPD covers products under UN CPC Codes 42941 - Stranded wire, ropes, cables, plaited bands, slings and the like, of iron or steel, not electrically insulated.

For comprehensive product list reference: https://www.sumidenwire.com/products/epoxy-coated-pc-strand/

Flow Diagram and System Boundary

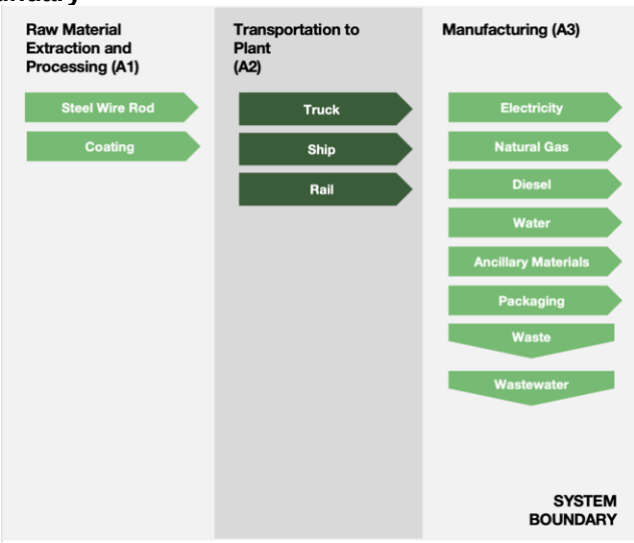

Figure 1. System boundary for the study

Note: The effect of infrastructure/capital goods and long-term emissions are excluded from the study.

1.3. Application

These are used in the production of post-tension slabs, prestressed girders, prestressed piling, segmental bridges, doubles tees, rock and soil anchors, hollow core slabs, stay cables, and a variety of other applications.

1.4. Declaration of Methodological Framework

The EPD has been created strictly in accordance with the standards and norms below:

- ISO 14025: Environmental labels and declarations- Type III environmental declarations- Principles and procedures. (ISO, 2006)
- ISO 21930: Sustainability in building and construction- Environmental declaration of building products, International Organization for Standardization, Geneva, Switzerland (ISO, 2017).
- Product Category Rule (PCR) Guidance for building-related products and services- Part A: Life Cycle Assessment Calculation Rules and Report Requirements (UL, 2022)
- Product Category Rule (PCR) Guidance for building-related products and services- Part B: Designated steel construction product EPD requirements (UL, 2020)

This LCA uses an attributional approach.

1.5. Technical Requirements

Applicable Product and Manufacturing Standards and Specifications per the International Building Code or as generally accepted practice in the industry if not referenced by the International Building Code. The products listed here are not intended to be all-inclusive or comprehensive. Please visit the following list for a comprehensive product list: https://www.sumidenwire.com/products/epoxy-coated-pc-strand/

Table 1. Technical data of Epoxy-Coated PC strand

Size	Standard Outer Diameter inch [mm]	Unit Weight Lb/ft [kg/m]	Yield Point at 1% Extension Lbf [kN]	Min. Ultimate Breaking Strength Lbf [kN]	Standard Area of Steel Strand In^2 [mm^2]
0.6” ECS	0.648 [16.46]	0.820 [1.220]	52,740 [234.6]	58,600 [260.7]	0.217 [140.00]
1/2” ECS	0.540 [13.72]	0.550 [0.819]	37,170 [165.3]	41,300 [183.7]	0.153 [98.71]
3/8” ECS	0.415 [10.54]	0.310 [0.461]	20,700 [92.1]	23,000 [102.3]	0.085 [54.84]

1.6. Properties of Declared Product as Delivered

The following table lists metal thicknesses and strengths for all structural, nonstructural, and finishing products:

Note: For more detailed product line information go to https://www.sumidenwire.com/products/epoxy-coated-pc-strand/

1.7. Material Composition

Epoxy-Coated PC strand products are made from steel wire rods (SAE 1080). Primary product components are as follows:

Table 2. Material composition of Epoxy coated PC strand

Component Name	Mass by % total
Base Metal	94.0%
Epoxy coating	6.0%

Recycled content in EAF steel includes both pre- and post-consumer recycled content and varies by supplier.

1.8. Manufacturing

The Epoxy-Coated PC strand is manufactured in the Dayton TX production facility of Sumiden Wire. Epoxy-Coated PC strand is produced by starting with the finished uncoated PC strand described above as the primary process input. The uncoated PC strand is then fed through an acid and water bath to remove residual wire drawing lubricants from the surface of the strand. The cleaned strand is then passed through a furnace to heat the strand. After heating, the strand is opened and exposed to electrostatically charged epoxy powder particles in the powder box. These particles are attracted to the steel strand surface because they are positively charged and the strand is grounded (negatively charged). Once in contact with the heated steel strand surface, the epoxy powder changes to a gel and immediately begins to cure (harden). After coating and prior to being fully cured, grit particles can be added to the strand surface (if desired) to make the grit-impregnated version of epoxy-coated PC strand. After applying the epoxy coating, the strand passes through a cooling bath to cool the strand prior to coiling onto a reel.

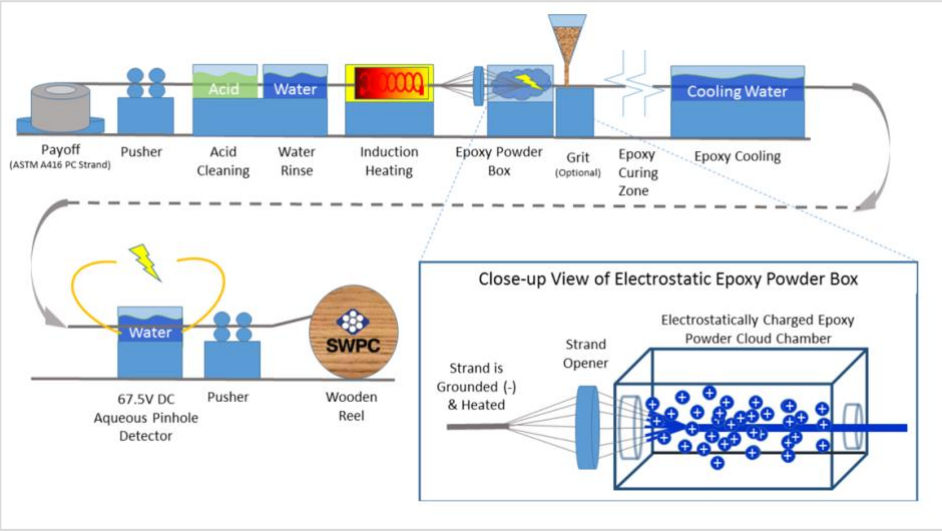

Figure 2. Production process of Epoxy-Coated PC strand

1.9. Packaging

All of the various products are packaged and shipped using Steel straps, Vapor Corrosion Inhibitor (VCI) paper (if required), Drawstring bags (if required), and Wooden pallets (if required).

As required per ISO 21930 and the Part A PCR, information on packaging is provided to specify the end-of-life scenarios used for packaging or to support the development of the end-of-life scenarios for packaging at the construction works level where the A5 module is not declared. These data are provided per metric ton of product in the table below.

Table 3. End-of-Life scenarios for packaging

Packaging waste	Value	Unit
Plastic packaging waste to Recycling	2.02E-02	kg
Plastic packaging waste to Landfill	1.53E-01	kg
Plastic packaging waste to Incineration	3.82E-02	kg
Metal packaging waste to Recycling	8.81E-01	kg
Metal packaging waste to Landfill	5.26E-01	kg
Metal packaging waste to Incineration	1.39E-01	kg
Paper packaging waste to Recycling	1.59E-02	kg
Paper packaging waste to Landfill	4.67E-03	kg
Paper packaging waste to Incineration	1.17E-03	kg
Wood packaging waste to Recycling	4.82E-01	kg
Wood packaging waste to Landfill	1.42E-01	kg
Wood packaging waste to Incineration	3.55E-02	kg

1.10. Transportation

Transportation from suppliers to Sumiden Wire's sites was calculated using primary data on the mode of transport, and distances were calculated based on the supplier location and the location of manufacturing.

1.11. Product Installation

Product Installation is not declared in this EPD.

1.12. Use

Use of product is not declared in this EPD.

1.13. Reference Service Life and Estimated Building Service Life

As the declared system boundary is A1-A3, a reference service life is not declared.

1.14. Reuse, Recycling, and Energy Recovery

Reuse, Recyling, and Energy Recovery of products is not declared in this EPD.

1.15. Disposal

Disposal of product is not declared in this EPD.

2. Life Cycle Assessment Background Information

2.1. Functional or Declared Unit

The declared unit of calculation is one metric ton of Epoxy-Coated PC strand product (1,000 kg).

Table 4. Declared unit details

Name	Required Unit	Value
Declared Unit	Metric Ton	1
Density	kg/m^3	7,850

2.2. System Boundary

The declared system boundary is cradle-to-gate. Cradle-to-gate includes the PCR life cycle modules A1, A2, and A3.

2.3. Estimates and Assumptions

All estimates and assumptions are within the requirements of ISO 14040/44. The primary energy and ancillary material data were collected as annual totals including all utility usage and production information. For the LCA, the energy and ancillary usage information was divided by the production to use per metric ton.

Assumptions and limitations to the study have been identified as follows:

- The valid EPDs were available for 3 suppliers out of all the wire rod suppliers. For modeling all the other suppliers, appropriate considerations were made based on their recycled content and steel production technology.
- All the supplier EPDs had different impact methodologies, hence only GWP from the EPDs was considered as it is deemed an appropriate choice since the GWP of CO_2 is equal to 1 in all the methodologies. For all other impact categories, resource and waste indicators, secondary datasets were used.
- The only waste flows relevant to the manufacturing process are steel waste sent to external recycling. As it is related to the process, the waste occurring in production is accounted for in A1 (raw materials) and A2 (transportation of raw materials), where impacts are modeled for sourcing and transporting the materials that are lost in production.
- The availability of geographically more accurate secondary MLC datasets would have improved the accuracy of the study.

- Only known and quantifiable environmental impacts are considered.
- Due to the assumptions and value choices listed above, these do not reflect real-life scenarios and hence they cannot assess actual and exact impacts, but only potential environmental impacts.

2.4. Cut-off Criteria

Input and output flows of mass and energy greater than 1% (based on the total mass final product and total energy usage of the product system) or greater than 1% of environmental impacts were included within the scope of analysis. Flows less than 1% are included with sufficient data available to warrant inclusion and/or the flow was thought to have a significant environmental impact. Where data gaps were identified, they are filled by conservative assumptions with average, generic, or proxy data, and assumptions are documented. No known flows relevant to the product system are deliberately excluded from this LCA and EPD.

2.5. Data Sources

Primary data were collected by facility personnel and from utility bills and were used for all manufacturing processes from November 2021 to October 2022. Whenever available, supplier data were used for raw materials used in the production process. When primary data do not exist, secondary data for raw material production were utilized from Sphera Managed LCA Content (fka GaBi) Database 2023.2.

Electricity mixes used in A3 vary per production site and are modeled per the EPA eGRID region, and the corresponding GaBi dataset, that covers each production site for Epoxy-coated PC strand is Dayton TX: SRMV

2.6. Data Quality

The geographical scope of the manufacturing portion of the life cycle is the United States. All primary data were collected from the manufacturer. The geographic coverage of primary data is considered excellent.

The primary data provided by the manufacturer represents all information for November 2021 to October 2022. Using this data meets the PCR requirements. Time coverage of this data is considered excellent. Primary data provided by the manufacturer are specific to the technology that Sumiden Wire uses in manufacturing its product. They are site-specific and considered of good quality.

Supplier EPD consistency is considered good. The EPDs report global warming impacts using different methodologies. Though different impact methodologies are used and combined here for global warming, this is deemed an appropriate choice since the GWP of CO_2 is equal to 1 in all the methodologies, and CO_2 is the main contributor to global warming impacts in steel life cycle assessments.

It is worth noting that the electricity and thermal energy used in manufacturing the product includes overhead energy such as lighting and heating. Sub-metering would improve the technological coverage of data quality. Data necessary to model cradle-to-gate unit processes were sourced from Sphera Managed LCA Content (fka GaBi) datasets and critically reviewed LCAs.

2.7. Period under Review

Period under review for Sumiden Wire's LCA study is defined as November 2021 to October 2022.

2.8. Allocation

General principles of allocation were based on ISO 14040/44. The PC strand is uncoated initially and later epoxy-coated as per the requirement. This required the allocation between the primary product and associated products manufactured

at the facility. Allocation of manufacturing inputs and outputs such as electricity, thermal energy, packaging, water, and waste are allocated between co-products by total production mass at each site, with additional allocation methods described below for select manufacturing flows.

3. Life Cycle Assessment Results

Table 5. Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCT-ION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

3.1 Life Cycle Impact Assessment Results

LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. These six impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

Table 6. North American Impact Assessment Results, per metric ton of product

IPCC AR5	Unit	A1	A2	A3	A1-A3
GWP	kg CO_2 eq	1.68E+03	9.72E+01	2.33E+02	**2.01E+03**
TRACI 2.1					
AP	kg SO_2 eq	3.66E+00	7.26E-01	3.92E-01	**4.78E+00**
EP	kg N eq	1.73E+00	5.08E-02	3.34E-02	**1.81E+00**
ODP	kg CFC 11 eq	4.02E-05	2.34E-13	2.06E-10	**4.02E-05**
SFP	kg O_3 eq	4.38E+01	1.96E+01	6.85E+00	**7.02E+01**
CML 2001-Jan 2016					
ADP_{fossil}	MJ	2.01E+04	1.31E+03	3.29E+03	**2.47E+04**

Comparability: Comparisons cannot be made between product-specific or industry-average EPDs at the design stage of a project, before a building has been specified. Comparisons may be made between product-specific or industry-average EPDs at the time of product purchase when product performance and specifications have been established and serve as a functional unit for comparison. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted.

Any comparison of EPDs shall be subject to the requirements of ISO 21930. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparison can be inaccurate and could lead to erroneous selection of materials or products which are higher-impact, at least in some impact categories.

Table 7. Carbon Emissions and Uptake, per metric ton of product

Carbon Emission and Uptake	Unit	A1	A2	A3	A1-A3
BCRP	kg CO_2	0.00E+00	0.00E+00	1.27E+02	**1.27E+02**
BCEP	kg CO_2	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
BCRK	kg CO_2	0.00E+00	0.00E+00	1.15E+00	**1.15E+00**
BCEK	kg CO_2	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
BCEW	kg CO_2	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
CCE	kg CO_2	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
CCR	kg CO_2	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
CWNR	kg CO_2	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**

3.2 Life Cycle Inventory Results

Table 8. Resource Use, per metric ton of product

Resource Use	Unit	A1	A2	A3	A1-A3
RPR_E	MJ	1.69E+03	4.26E+01	-2.45E+02	**1.49E+03**
RPR_M	MJ	0.00E+00	0.00E+00	1.43E+03	**1.43E+03**
$NRPR_E$	MJ	2.10E+04	1.32E+03	4.28E+03	**2.66E+04**
$NRPR_M$	MJ	0.00E+00	0.00E+00	8.03E+01	**8.03E+01**
SM	kg	1.12E+03	0.00E+00	0.00E+00	**1.12E+03**
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
RE	MJ	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
FW	m^3	1.69E+01	1.43E-01	9.05E-01	**1.80E+01**

Table 9. Waste and Output Flows, per metric ton of product

Waste and Output Flow	Unit	A1	A2	A3	A1-A3
HWD	kg	1.92E-02	3.68E-09	2.21E-06	**1.92E-02**
NHWD	kg	1.18E+02	1.02E-01	3.04E+01	**1.49E+02**
HLRW	kg	4.79E-04	4.34E-06	5.48E-04	**1.03E-03**
ILLRW	kg	1.61E-01	3.65E-03	4.68E-01	**6.33E-01**
CRU	kg	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
MR	kg	7.64E-02	0.00E+00	2.75E+01	**2.76E+01**
MER	kg	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
EE	MJ	0.00E+00	0.00E+00	1.37E+00	**1.37E+00**

4. Life Cycle Assessment Interpretation

For all the impact categories, raw materials production has the highest contribution with more than 62% for all categories. The transportation of the materials from the supplier to the manufacturing site contributes more than 3% for all the categories except Ozone depletion potential. For Smog Formation Potential, transportation contribution is very high as the main sources of Smog Formation Potential are nitrogen oxides and VOCs from automobile exhausts. The manufacturing phase contributes more than 2% for all the impact categories except Ozone depletion potential.

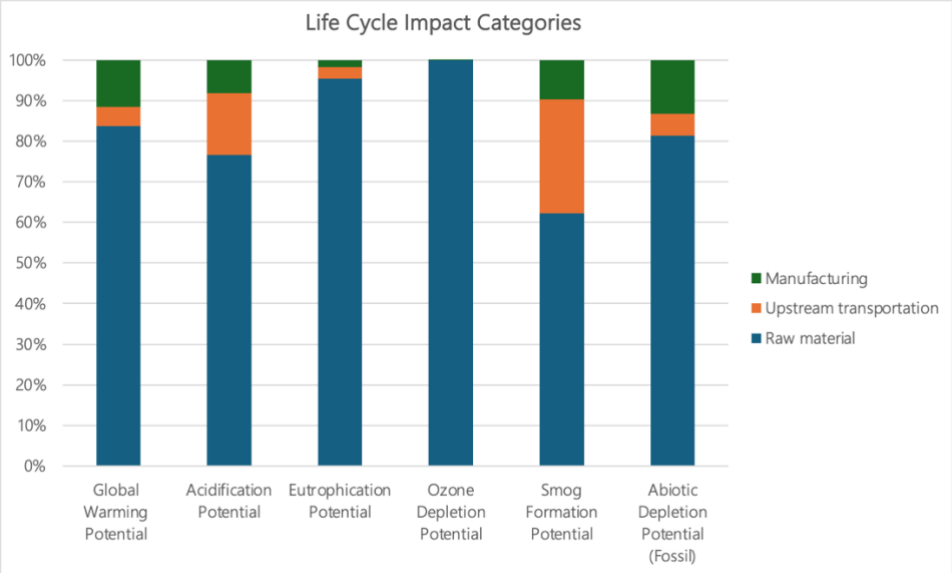

Figure 3. Life Cycle Impact Categories

The weighted average cradle-to-gate GWP of Sumiden Wire's Epoxy-coated PC strand products is 2,013 kg CO_2e/metric ton.

5. Supporting Documentation

No substances required to be reported as hazardous per the EPA's Resource Conservation and Recovery Act were identified during the LCA associated with the production or disposal of this product.

Additional information such as Safety Data Sheets (SDS) and Code Evaluation Reports may be found at https://www.sumidenwire.com/products

6. References

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