

ENVIRONMENTAL PRODUCT DECLARATION

IN ACCORDANCE WITH ISO 14025 AND EN 15804:A2:2019/AC:2021

SmartEPD-2025-075-0548-01

STRONGIRT®



Date of Issue:
Jun 20, 2025

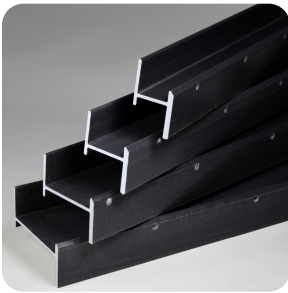
Expiration:
Jun 20, 2030

Last updated:
Jun 20, 2025

General Information

Strongwell

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Product Name:	STRONGIRT®
Declared Unit:	1 kg Strongwell produces a large number of sizes of STRONGIRT® varying in depth and thickness to accommodate a range of insulation thicknesses. Since the composition of STRONGIRT® material is consistent regardless of the dimensions of the product size, these amounts may be used to normalize the results within this report to a specific STRONGIRT® product.
Declaration Number:	SmartEPD-2025-075-0548-01
Date of Issue:	June 20, 2025
Expiration:	June 20, 2030
Last updated:	June 20, 2025
EPD Scope:	Cradle to grave A1 - A3, A4, A5, B1 - B7, C1 - C4, D
Market(s) of Applicability:	North America

General Organization Information

Founded in 1956, Strongwell is the recognized world leader in pultrusion technology and pultruded fiber reinforced polymer (FRP) composites. With three facilities in the U.S. and one in Mexico, the company manufactures a wide variety of products for its diverse customer base, including structural shapes, grating, handrail, structural building panels, decking systems, composite armor, ladder rail, and many OEM products.

Further information can be found at: www.strongwell.com

Limitations, Liability, and Ownership

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number up) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterization factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO14025.

Strongwell has the sole ownership, liability and responsibility of this STRONGIRT EPD.

Reference Standards

Standard(s): ISO 14025 and ISO 21930:2017

Core PCR:	EPD International PCR for Construction Products 2019:14 (EN 15804:A2:2019/AC:2021) v1.3.4 Date of issue: April 30, 2024 Valid until: June 20, 2025
Sub-category PCR review panel:	 Contact Smart EPD for more information.
General Program Instructions:	 Smart EPD General Program Instructions v.1.0, November 2022

Verification Information

LCA Author/Creator:	 Melissa Huff  melissa.huff@erg.com
EPD Program Operator:	 Smart EPD  info@smartepd.com  www.smartepd.com  585 Grove St., Ste. 145 PMB 966, Herndon, VA 20170, USA
Verification:	Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071: External  Terrie Boguski  tboguski@harmonyenviro.com Independent external verification of EPD, according to ISO 14025 and reference PCR(s): External  Terrie Boguski  tboguski@harmonyenviro.com

Product Information

Declared Unit:	1 kg Strongwell produces a large number of sizes of STRONGIRT® varying in depth and thickness to accommodate a range of insulation thicknesses. Since the composition of STRONGIRT® material is consistent regardless of the dimensions of the product size, these amounts may be used to normalize the results within this report to a specific STRONGIRT® product.
Mass:	1 kg
Product Specificity:	☒ Product Average ☒ Product Specific
Supply Chain Specific Data:	31 %

Product Description

Strongwell's STRONGIRT is an all-FRP continuous insulation (CI) cladding attachment support system. This fiberglass pultruded composite uses a custom fire-retardant resin system and unique laminate design to offer superior pull out strength, excellent thermal efficiency, and the ability to work with any non-proprietary insulation (no routing or fabricating of rigid insulation is required). The geometry of STRONGIRT offers self-draining to clear rainwater, and weep holes can be pre-fabricated or added in the field for additional drainage needs. The product has been engineered for strength and stiffness to support cladding, insulation, and wind loads, while offering a simple, durable, cost-effective solution for installers. Although the STRONGIRT cladding carries a warranty of 10 years, it is expected to last the lifetime of the structure on which it is installed.

Further information can be found at: <https://www.strongirt.com/>

Product Specifications

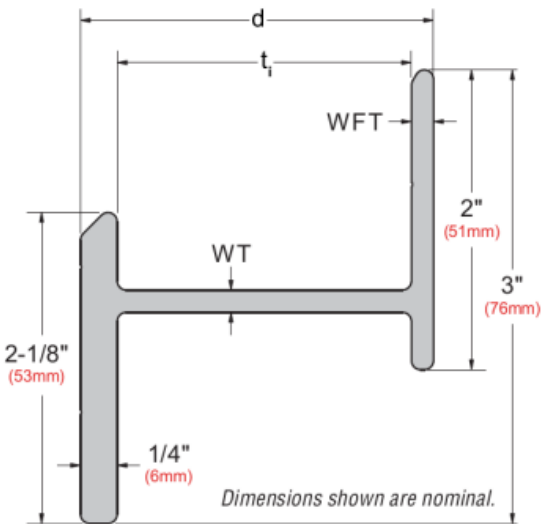
Product Classification Codes:	EC3 - Cladding
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Product Composition Diagram

Dimensions:

STRONGIRT profiles are available in various depths to accommodate insulations of thickness 1" to 6" in ½" increments and 8".

- Insulation Thickness, t_i
- STRONGIRT® Depth (nom.), d
- Web Thickness (nom.), WT
- Wall Flange Thickness (nom.), WFT



Material Composition

Material/Component Category	Origin	% Mass
Unsaturated Polyester Resin	U.S.	34.2
Styrene	U.S.	0.6
Glass Fibers	U.S.	56.2
Aluminum Trihydrate	U.S.	7.8
Other Materials	U.S.	1.2

Packaging Material	Origin	kg Mass
Cardboard	U.S.	0.0022
Wooden Pallet	U.S.	0.025
Stretch Wrap	U.S.	0.0006

Biogenic Carbon Content	kg C per kg
Biogenic carbon content in product	None
Biogenic carbon content in accompanying packaging	0.013

Hazardous Materials
N/A

EPD Data Specificity

- Primary Data Year:2021
- Manufacturing Specificity:

✗

 Industry Average

✗

 Manufacturer Average

✓

 Facility Specific

Averaging:
Averaging was not conducted for this EPD.

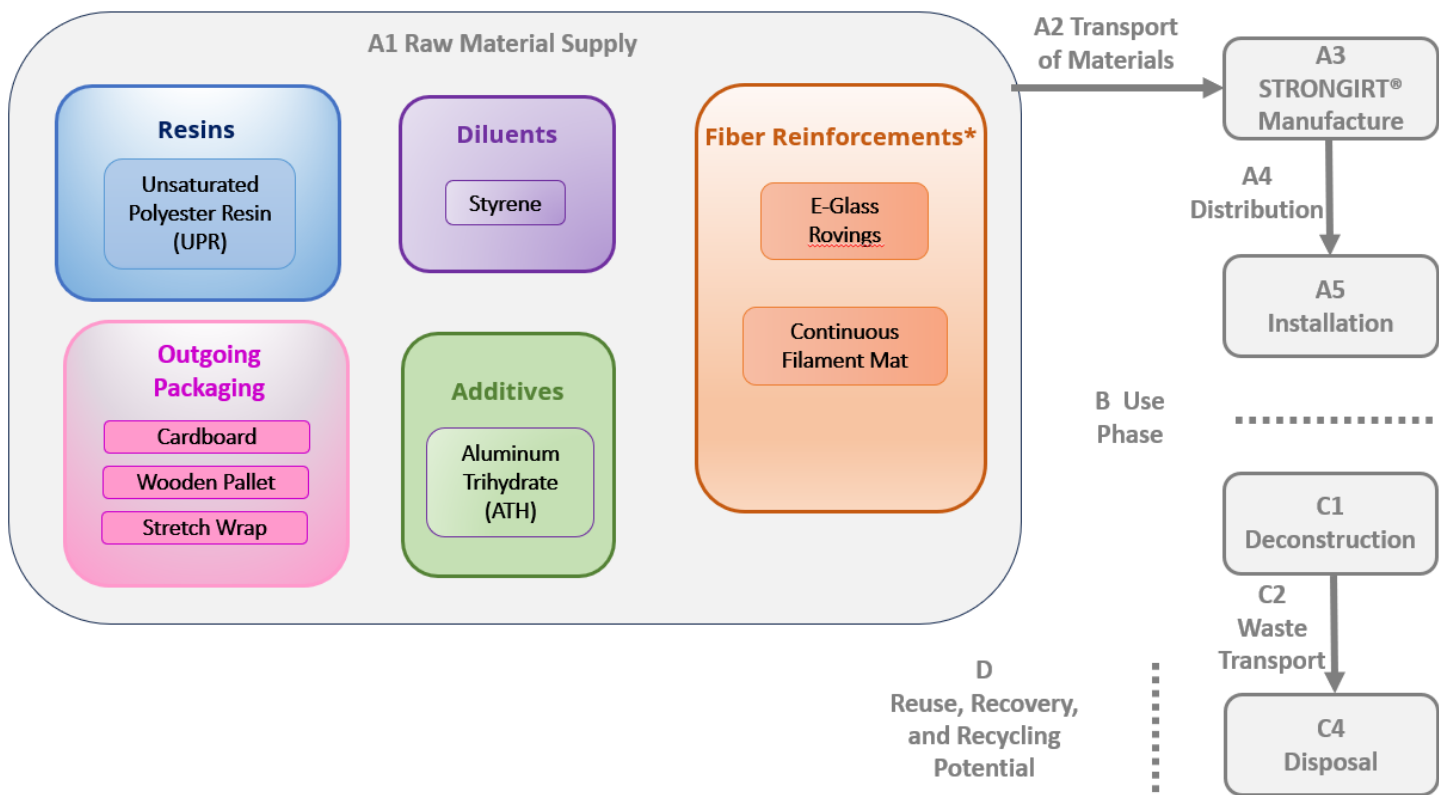
System Boundary

Production	A1	Raw material supply	✓
	A2	Transport	✓
	A3	Manufacturing	✓
Construction	A4	Transport to site	✓
	A5	Assembly / Install	✓
Use	B1	Use	✓
	B2	Maintenance	✓
	B3	Repair	✓
	B4	Replacement	✓
	B5	Refurbishment	✓
	B6	Operational Energy Use	✓
	B7	Operational Water Use	✓
End of Life	C1	Deconstruction	✓
	C2	Transport	✓
	C3	Waste Processing	✓
	C4	Disposal	✓
Benefits & Loads Beyond System Boundary	D	Recycling, Reuse Recovery Potential	✓

Plants

 Strongwell Bristol, VA Plant
400 Commonwealth Ave, Bristol, Virginia 24201, USA

Product Flow Diagram



Software and Database

LCA Software:	 SimaPro v. 9.6
LCI Foreground Database(s):	 US LCI v. FY21.Q3.01  United States  NA
LCI Background Database(s):	 US LCI v. FY21.Q3.01  United States  Varies by material used and type of allocation  Ecoinvent v. 3.10  Europe/Global  Varies by material used and type of allocation

Data Quality

The reported impact assessment values in this EPD give no sufficient reason to believe that any of the employed generic material or process LCI data is not representative of the STRONGIRT product and therefore should not introduce error to the reported impact category.

Data Sources

Material/Process Category	Module	Material/Process Name	Inventory Dataset Name	Dataset Geographic Region	Reporting Period/Year Dataset Represents	Reference	Amount (if relevant)	Unit
None	A1	Unsaturated Polyester Resin	None	United States	2012/2015	Life Cycle Inventory of Polymer Composites, ACMA , 2012	None	None
None	A1	Aluminum Trihydrate	None	Europe	2007 source	Life Cycle Inventories of Metals/2007/Althaus H.-J.	None	None
None	A1	Styrene	Styrene, at plant	United States	2015	ACC Plastics Database	None	None
None	A1	Glass Fiber	None	United States	2012/2015	Life Cycle Inventory of Polymer Composites, ACMA, 2012	None	None
None	A1	LLDPE Stretch wrap	None	United States	2015	ACC Plastics Database	None	None
None	A1	Cardboard	None	United States	2017/2014	2014 Life Cycle Assessment of US Average Corrugated Product-Final Report . NCASI 2017.	None	None
None	A1	Wooden Pallet	None	United States	2009/2007	Private data from Peer-reviewed Pallet LCA for Private client	None	None
None	A3	Electricity mix	None	Bristol, VA	2021	eGRID 2021, Adapted to be estimate for residual electricity.	None	None
None	A3	Pultrusion	None	Bristol, VA	2021	Primary data collected	None	None

Life Cycle Module Descriptions

A1: Cradle-to Incoming Material Production. The table below provides a list of the incoming materials and amounts for each for the STRONGIRT system. The data sources for each of these materials are provided in the table. A loss rate of 0.94 percent was applied in the model. Each of these materials includes all raw materials

and intermediate materials required to manufacture each of the incoming materials from cradle-to-incoming material manufacture. The incoming materials include packaging required to distribute the pultruded product.

Material Inputs	1 kg	Comments/Data Sources
Unsaturated polyester resin (UPR)	0.342 kg	Updated for 2022 electricity grid and updated input material data as possible using ACC Plastics Database (2015 data) and updated ecoInvent data/ UPR manufacturing data from Life Cycle Inventory of Polymer Composites, ACMA, 2012
Aluminum Trihydrate (ATH)	0.078 kg	EcoInvent data (2003) was adapted to US conditions. This includes transport and use of US incoming materials and fuels from U.S. LCI Database or the ACC Plastics Database (2015 data)
Styrene (Diluent)	0.006 kg	Cradle-to-Gate Life Cycle Analysis of General Purpose Polystyrene (GPPS) Resin, ACC, 2022. (2015 data)
Glass fiber, (E-Glass as surrogate)	0.562 kg	Updated for 2022 electricity grid and updated input material data as possible using ACC Plastics Database (2015 data) and updated ecoInvent data/Glass Fiber manufacturing data from Life Cycle Inventory of Polymer Composites, ACMA, 2012
Other Materials/Additives	0.012 kg	These materials were not included in the model due to the 1% cut-off rule that total to less than 5% of product.
Cardboard	0.0022 kg	National Council for Air and Stream Improvement, Inc. (NCASI). (2017). 2014 Life Cycle Assessment of U.S. Average Corrugated Product – Final Report. Prepared for the Corrugated Product Alliance (CPA)
Wooden pallet	0.025 kg	Peer-reviewed pallet LCA conducted by Franklin Associates for a private client in 2009 and "Pallet Recovery, Repair and Remanufacturing in a Changing Industry: 1992 to 2006." by Robert J. Bush and Philip A. Araman, 2009 Pallet Enterprise. This data was used as it was known to be representative of the pallets used. Comparisons were made to sections of a newer dataset (weight, wood/steel ratio, electricity use) and result differences were small when compared to the small amounts of pallets compared to other materials in A1.
Stretch Wrap	0.0006 kg	Linear Low-Density Polyethylene (LLDPE) Resin, ACC, Rev. 2022. Extrusion: Franklin Associates Private Database.

A2--Transportation of Incoming Materials to Product Manufacture. All incoming materials were produced in the U.S. and transported to Strongwell by truck. All transport modes and mileages were provided by Strongwell. The mileages are provided in the table below.

Incoming Material	STRONGIRT® (kilometers)
Glass Fiber	1109
UPR	1109
Styrene	26
ATH	407
Cardboard	32
Stretch wrap	32
Wooden Pallets	80

A3--STRONGIRT Manufacture. Life Cycle inventory data was collected from Strongwell's Bristol, VA plant for the year 2021. For this process, fibers are pulled through a liquid resin bath until the fibers are sufficiently impregnated with the resin. Fillers may be added to the mixture to improve the strength and thermal stability of the resin. The coated fibers are then formed to the desired shape and pulled through a heated die to cure the resin. The pultruded composite product exits the die as a continuous profile with the desired-cross sectional shape.

The STRONGIRT product does include glass fiber, unsaturated polyester resin, a diluent, and ATH in the inputs. Some additives were not included as they were small amounts (<1 percent of the incoming materials). Plant data from Strongwell is considered confidential and not provided in this EPD.

A4--Distribution of STRONGIRT. The STRONGIRT is only sold in the United States. Strongwell provided a list of cities and the weights of shipping where the STRONGIRT products were sent for 2023. An average distance was calculated by summing the distances after multiplying the distance by the percent of the weights of STRONGIRT sent to each customer. Only combination trucks were used as a transport mode for STRONGIRT in the U.S. The average distance from the data provided was 2,027 km.

A5--Construction Installation. This phase includes the production and transport of the hardware to the site, as well as the energy it takes to install STRONGIRT. No human energy is considered; only the energy required for machinery to attach the product. A guide was provided by Strongwell on installation practices for STRONGIRT; however, the required hardware depended on the size of the products. Hardware amounts were estimated from the guide for 1 kg of STRONGIRT installed. The required number of screws and washers for a common size were normalized to 1 kg of pultruded product, from which 2.25 screws/washers per 1 kg were calculated. The screw size used is 1/4 inch screws (3.5 g per screw) with a #14 washer (5 g per washer). The data source for the screws/washers is a report by the World Steel Association from February, 2018. The finished cold rolled coil steel is used from this source; no cutting or forming of the screw was included. The average distance from purchase of the hardware to the site was assumed to be 20 km.

B1-B7--Use Stage. Phases B1 through B7 include use, maintenance, repair, replacement, refurbishment, operational energy use, and operational water use. Strongwell states that STRONGIRT is unlikely to need replacement during the lifetime of the buildings and structures on which they will be used. These phases are estimated to be zero.

C1--Deconstruction. The deconstruction phase includes only the energy required to remove the hardware and pultruded product. This energy is assumed to be the same as for Installation (see Phase A-5). It should be noted that it is possible that the removal of the product may not happen in a demolition situation.

C2--Transportation to End-of-Life. This phase only includes the transport required to remove the deconstructed STRONGIRT from the site. A hauling truck is assumed to transport STRONGIRT to a landfill at the end of life. An estimate of 50 km was assumed for each product system. The weight hauled included both STRONGIRT and the hardware used to install it.

C3--Waste Processing for Product. No waste processing is expected for STRONGIRT. The results for this phase is estimated to be zero.

C4--Disposal. The disposal phase only includes energy to use landfill equipment for removing The disposal phase only includes energy to use landfill equipment for removing the STRONGIRT/hardware from the truck and placement at a landfill, as well as the solid waste inventory amount for the postconsumer solid waste including the STRONGIRT/hardware.

Processes	STRONGIRT®
Collection process specified by type	1.0191 kg assumed collected with mixed construction waste
Recovery system specified by type	0 kg for reuse/recycling/energy recovery
Disposal specified by type	1 kg STRONGIRT® and 0.0191 kg hardware
Assumptions for scenario development	C2: Assumed Diesel combination truck due to construction waste in US. Estimated 50 km to landfill
	C4: Assumed Diesel industrial Equipment at landfill.

D--Reuse, Recovery, Recycling Potential. As this product is inert at End-of-Life and currently not recycled, Module D has been estimated to be zero.

LCA Discussion

Allocation Procedure

The guidelines as shown in the ISO 14044:2006 standard on life cycle assessment requirements and guidelines were followed for the LCA. In this standard, the preferred hierarchy for handling allocation is (1) avoid allocation where possible, (2) allocate flows based on direct physical relationships to product outputs, (3) use some other relationship between elementary flows and product output. No single allocation method is suitable for every scenario. No coproducts are created during the STRONGIRT manufacture. Any trim or scrap from the products are landfilled.

Some processes lend themselves to physical allocation because they have physical parameters that provide a good representation of the environmental burdens of each co-product. If system expansion is not possible, simple mass and enthalpy allocation have been chosen as the common forms of allocation in this analysis. However, these allocation methods were not chosen as a default choice but made on a case-by-case basis after consideration of the chemistry and basis for production. Material coproducts were created in many of the intermediate chemical process steps in the incoming materials of this analysis, such as olefins. In some cases, small amounts of off-spec or lower quality materials were considered products, and the inputs/outputs of the product/coproduct were allocated on a mass basis.

Some of the unit processes for intermediate chemicals for the incoming materials produce energy either as a fuel coproduct or as steam created from the process that is sent to another plant for use. To the extent possible, system expansion to avoid allocation was used as the preferred approach in the ISO 14044:2006 standard. Fuels or steam exported from the boundaries of the system would replace purchased fuels for another process outside the system. System expansion credits were given to avoid the energy-equivalent quantity of fuel production and combustion displaced by the exported coproduct energy.

Cut-off Procedure

The STRONGIRT system include at least 95 percent of all inflows of mass and energy per stage. The LCA elects to use the one percent by mass cut-off criteria. Some additives within this inventory have been excluded due to being less than 1 percent of the product. It was determined that these additives, if summed, are less than 5 percent total of the STRONGIRT system as required.

No specific model testing was done for the additives less than 1% of the system as these were pigments and other materials not provided by Strongwell. Testing was done on incoming packaging for the materials and from this testing, the addition would change the results less than 1%.

Renewable Electricity

Energy Attribute Certificates (EACs) such as Renewable Energy Certificates (RECs) or Power Purchase Agreements (PPAs) are included in the baseline reported results:

✗ No

Scenarios

Transport to the building/construction site (A4)

A4 Module

Fuel Type:	Diesel
Liters of Fuel:	44.4 l/100km
Vehicle Type:	Combination Truck
Transport Distance:	2027 km
Capacity Utilization:	50% %
Packaging Mass:	0.0278 kg
Weight of products transported:	1 kg
Capacity utilization volume factor:	=1

Installation in to the building/construction site (A5)

A5 Module

Installation Scrap Rate Assumed:	0 %
Ancillary Materials:	0.0191 kg

Net Fresh Water Consumption Specified by Water Source and Fate:	0 m3
Electricity Consumption:	0.005 kWh
Other Energy Carriers:	0 MJ
Product Lost per Declared/Functional Unit:	0 kg
Waste Materials at the Construction Site Before Waste Processing:	0 kg
Output Materials Resulting from On-site Waste Processing:	0 kg
Mass of Packaging Waste Specified by Type:	0.0278 kg
Biogenic Carbon Contained in Packaging:	0.013 kg
Direct Emissions to Ambient Air, Soil and Water:	0 kg
VOC Emissions:	0 ug/m3
Assumptions for scenario development:	The required number of screws and washers for a common size were normalized to 1 kg of pultruded product, from which 2.25 screws/washers per 1 kg were calculated. The screw size used is ¼ inch screws (3.5 g per screw) with a #14 washer (5 g per washer). The data source for the screws/washers is a report by the World Steel Association from February, 2018 . The finished cold rolled coil steel is used from this source; no cutting or forming of the screw was included. The distance from purchase of the hardware to the site was assumed to be 20 km. The assumptions for the energy required to install the product using the hardware are as follows: •600 watt drill (0.6 kwh hourly), •30 seconds of time to apply the 2.25 screws/washers per kg product, and •Electricity grid choice depended on location of the distribution of the product. Packaging used to transport the products to the installation site are assumed to be landfilled as a worst-case scenario. Potentially the cardboard or pallets could be recycled or incinerated, but that would depend on the user and is unknown.

End of Life (C1 - C4)

C1 - C4 Modules

Collection Process

Collected with Mixed Construction Waste: 1.0191 kg

Recovery

Reuse: 0 kg

Recycling: 0 kg

Landfill: 1.0191 kg

Incineration: 0 kg

Incineration with Energy Recovery: 0 kg

Energy Conversion: 0 kg

Disposal

Product or Material for Final Disposal: 1 kg

Removals of Biogenic Carbon: 0 kg CO2

Assumptions for scenario development:

The deconstruction phase includes only the energy required to remove the hardware and pultruded product. This energy is assumed to be the same as for Installation (see Phase A-5). This was included as a worst case scenario that the STRONGIRT® would be removed; however, as it is likely the cladding will be removed at demolition, it could likely be removed with mixed construction waste.

A hauling truck is assumed to transport the STRONGIRT® to a landfill at the end of life. An estimate of 50 km was assumed. The weight hauled included both the STRONGIRT® and the hardware used to install it.

The disposal phase only includes energy to use landfill equipment for removing the STRONGIRT®/hardware from the truck and placement at a landfill, as well as the solid waste inventory amount for the postconsumer solid waste including the STRONGIRT®/hardware.

Reuse, Recovery and / or Recycling Potentials & Relevant Scenario Information (D)

D Module

Recycling Rate of Product:	0 %
Recycled Content of Product:	0 %
Net Energy Benefit from Energy Recovery from Waste Treatment Declared as Export Energy in C3:	0 MJ
Net Energy Benefit from Thermal Energy Due to Treatment of Waste Declared as Exported Energy in C4:	0 MJ
Net Energy Benefit from Material Flow Declared in C3 for Energy Recovery:	0 MJ
Further assumptions for scenario development:	Module D has been included due to the product being inert at end-of-life and currently not recycled; therefore, Module D impacts are estimated to be zero.

Results

Environmental Impact Assessment Results

IPCC AR6 GWP 100, EF3.1

per 1 kg of product Strongwell produces a large number of sizes of STRONGIRT® varying in depth and thickness to accommodate a range of insulation thicknesses. Since the composition of STRONGIRT® material is consistent regardless of the dimensions of the product size, these amounts may be used to normalize the results within this report to a specific STRONGIRT® product. .
LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Impact Category	Method	Unit	A1	A2	A3	A1A2A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-total	IPCC AR6 GWP 100	kg CO2 eq	2.11	0.273	0.68	3.07	0.185	0.0081	ND	ND	ND	ND	ND	ND	ND	0.00266	0.00465	ND	0.00954	ND
GWP-fossil	IPCC AR6 GWP 100	kg CO2 eq	2.06	0.273	0.68	3.02	0.185	0.0561	ND	ND	ND	ND	ND	ND	ND	0.00266	0.00465	ND	0.00954	ND
GWP-biogenic	IPCC AR6 GWP 100	kg CO2 eq	0.0511	ND	ND	0.0511	ND	-0.048	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ODP	EF3.1	kg CFC11 eq	1.34e-8	7.51e-10	8.46e-11	1.43e-8	5.09e-10	9.93e-12	ND	ND	ND	ND	ND	ND	ND	2.18e-13	1.28e-11	ND	2.64e-11	ND
AP	EF3.1	mol H+ eq	0.00663	0.000891	0.00491	0.0124	0.000604	0.000205	ND	ND	ND	ND	ND	ND	ND	0.0000153	0.0000152	ND	0.0000694	ND
PM	EF3.1	disease incidence	8.24e-8	8.79e-9	3.15e-8	1.23e-7	5.96e-9	1.62e-9	ND	ND	ND	ND	ND	ND	ND	1.08e-10	1.5e-10	ND	2.55e-9	ND
IRP	EF3.1	kBq U235 eq	0.00000319	5.16e-20	5.45e-21	0.00000319	3.5e-20	8.98e-7	ND	ND	ND	ND	ND	ND	ND	1.39e-23	8.8e-22	ND	1.82e-21	ND
POCP	EF3.1	kg NMVOC eq	0.00517	0.00124	0.00264	0.00906	0.000843	0.00016	ND	ND	ND	ND	ND	ND	ND	0.00000697	0.0000212	ND	0.0000971	ND
EP-fw	EF3.1	kg P eq	3.67e-7	6.93e-8	1.18e-8	4.48e-7	4.7e-8	1.18e-8	ND	ND	ND	ND	ND	ND	ND	4.61e-11	1.18e-9	ND	2.44e-9	ND
EP-marine	EF3.1	kg N eq	0.00162	0.000436	0.000651	0.00271	0.000295	0.0000556	ND	ND	ND	ND	ND	ND	ND	0.00000238	0.00000743	ND	0.0000349	ND
EP-terrestrial	EF3.1	mol N eq	0.0177	0.00478	0.00712	0.0296	0.00324	0.000606	ND	ND	ND	ND	ND	ND	ND	0.000026	0.0000815	ND	0.000382	ND
SQI	EF3.1	dimensionless	0.11	ND	ND	0.11	ND	0.00043	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WDP	EF3.1	m3 world eq deprived	0.0304	0.000172	0.0022	0.0328	0.000116	0.00564	ND	ND	ND	ND	ND	ND	ND	0.0000134	0.00000293	ND	0.00000604	ND
ADP-fossil	EF3.1	MJ, net calorific value	21.9	3.21	7.21	32.3	2.18	0.389	ND	ND	ND	ND	ND	ND	ND	0.0324	0.0548	ND	0.113	ND
ADP-minerals&metals	EF3.1	kg Sb eq	0.00000533	ND	ND	0.00000533	ND	-2.74e-7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	EF3.1	CTUe	1.21	0.0084	0.122	1.34	0.0057	0.0652	ND	ND	ND	ND	ND	ND	ND	0.00058	0.000143	ND	0.000328	ND
HTP-c	EF3.1	CTUh	2.49e-10	1.95e-11	6.05e-10	8.73e-10	1.33e-11	3.25e-12	ND	ND	ND	ND	ND	ND	ND	7.08e-14	3.33e-13	ND	1.45e-12	ND
HTP-nc	EF3.1	CTUh	5.19e-9	2.8e-10	1.66e-9	7.14e-9	1.9e-10	1.45e-10	ND	ND	ND	ND	ND	ND	ND	4.87e-12	4.77e-12	ND	1.02e-11	ND

Note:

Not all abbreviated indicators listed below may be present in the results above. The inclusion of indicators varies based on PCR requirements.

Abbreviations:

GWP = Global Warming Potential, 100 years (may also be denoted as GWP-total, GWP-fossil (fossil fuels), GWP-biogenic (biogenic sources), GWP-luluc (land use and land use change)), ODP = Ozone Depletion Potential, AP = Acidification Potential, EP = Eutrophication Potential, SFP = Smog Formation Potential, POCP = Photochemical oxidant creation potential, ADP-Fossil = Abiotic depletion potential for fossil resources, ADP-Minerals&Metals = Abiotic depletion potential for non-fossil resources, WDP = Water deprivation potential, PM = Particular Matter Emissions, IRP = Ionizing radiation, human health, ETP-fw = Eco-toxicity (freshwater), HTP-c = Human toxicity (cancer), HTP-nc = Human toxicity (non-cancer), SQI = Soil quality index.

The impact category GWP-luluc (land use and land use change) is not provided separately in this analysis as it contributes less than 5% of the GWP-total.

The IRP impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

The results of the following environmental impact indicators shall be used with care as the uncertainties of these results are high or as there is limited experience with these indicators: ADP-minerals and metals, ADP-fossil, WPD, PM, IRP, ETP-fw, HTP-c, HTP-nc, and SQP.

Users of this EPD are discouraged from using the results of Modules A1-A3 without considering the results of Module C.

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 or EN 15804. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries. 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.

Resource Use Indicators

per 1 kg of product Strongwell produces a large number of sizes of STRONGIRT® varying in depth and thickness to accommodate a range of insulation thicknesses. Since the composition of STRONGIRT® material is consistent regardless of the dimensions of the product size, these amounts may be used to normalize the results within this report to a specific STRONGIRT® product. .

Indicator	Unit	A1	A2	A3	A1A2A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ	1.25	0.0107	0.0163	1.28	0.00728	0.00726	ND	ND	ND	ND	ND	ND	ND	0.0054	0.000183	ND	0.000378	ND
PERM	MJ	0.0183	ND	ND	0.0183	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PERT	MJ	1.27	0.0107	0.0163	1.3	0.00728	0.00726	ND	ND	ND	ND	ND	ND	ND	0.0054	0.000183	ND	0.000378	ND
PENRE	MJ	25.5	3.5	11.7	40.7	2.37	0.761	ND	ND	ND	ND	ND	ND	ND	0.0454	0.0597	ND	0.123	ND
PENRM	MJ	15.3	ND	ND	15.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PENRT	MJ	40.8	3.5	11.7	56	2.37	0.761	ND	ND	ND	ND	ND	ND	ND	0.0454	0.0597	ND	0.123	ND
SM	kg	0.0011	ND	ND	0.0011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
RSF	MJ	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NRSF	MJ	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FW	m3	0.0105	0.000176	0.000152	0.0108	0.000119	0.0000899	ND	ND	ND	ND	ND	ND	ND	0.0000216	0.00000299	ND	0.00000617	ND

Note:

Not all abbreviated indicators listed below may be present in the results above. The inclusion of indicators varies based on PCR requirements.

Abbreviations:

RPRE or PERE = Renewable primary resources used as energy carrier (fuel), RPRM or PERM = Renewable primary resources with energy content used as material, RPRT or PERT = Total use of renewable primary resources with energy content, NRPRE or PENRE = Non-renewable primary resources used as an energy carrier (fuel), NRPRM or PENRM = Non-renewable primary resources with energy content used as material, NRPT or PENRT = Total non-renewable primary resources with energy content, SM = Secondary materials, RSF = Renewable secondary fuels, NRSF = Non-renewable secondary fuels, RE = Recovered energy, ADPF = Abiotic depletion potential, FW = Use of net freshwater resources, VOCs = Volatile Organic Compounds.

Waste and Output Flow Indicators

per 1 kg of product Strongwell produces a large number of sizes of STRONGIRT® varying in depth and thickness to accommodate a range of insulation thicknesses. Since the composition of STRONGIRT® material is consistent regardless of the dimensions of the product size, these amounts may be used to normalize the results within this report to a specific STRONGIRT® product. .

Indicator	Unit	A1	A2	A3	A1A2A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	kg	0.000216	ND	ND	0.000216	ND	-1.76e-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NHWD	kg	0.343	0.00351	0.0845	0.431	0.00238	0.00387	ND	ND	ND	ND	ND	ND	ND	0.000202	0.0000598	ND	1.02	ND
RWD	kg	2.86e-13	ND	ND	2.86e-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CRU	kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MFR	kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MER	kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MNER	kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

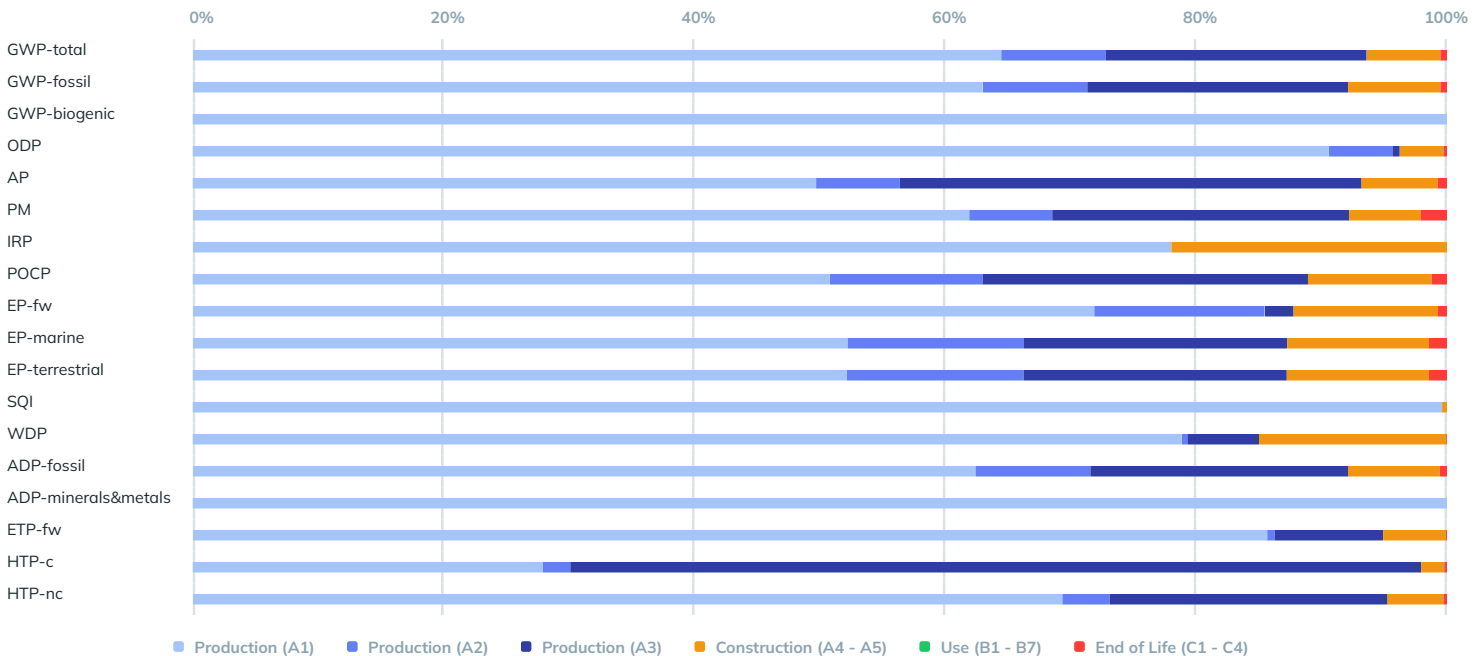
Note:
Not all abbreviated indicators listed below may be present in the results above. The inclusion of indicators varies based on PCR requirements.

Abbreviations:
HWD = Hazardous waste disposed, NHWD = Non-hazardous waste disposed, RWD = Radioactive waste disposed, HLRW = High-level radioactive waste, ILLRW = Intermediate- and low-level radioactive waste, CRU = Components for re-use, MFR or MR = Materials for recycling, MER = Materials for energy recovery, MNER = Materials for incineration, no energy recovery, EE or EEE = Recovered energy exported from the product system, EET = Exported thermal energy.

Interpretation

The figure below provides an illustration of the impact results by percentage of module. As can be seen in the figure, the greatest part of the impact results come from the incoming materials (A1). A1 accounts for at least 50% of the total results for all impact categories except one, HTP-C. This is due to some VOC releases at the plant, stemming from the use of the diluent in the composite. The emissions from modules A2 and A4 are mostly due to the combustion of fuels in trucks to transport incoming materials or the product to the use site.

The greatest percentage of GWP-total is due to the cradle-to-incoming materials at 63 percent of the total system, mainly from the glass fiber and unsaturated polyester resin. The STRONGIRT pultrusion plant releases 21 percent of the GWP-total, which is due overall to the fuels used to create electricity for the plant. The transportation of the incoming materials and distribution of the product comprise much of the remaining GWP-total; while the end-of-life module accounts for less than 1 percent of the total GWP.



Other Environmental Impacts

Impact Category	Unit	Method	A1	A2	A3	A1A2A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-GHG	kg CO2 eq	IPCC AR5 GWP 100	2.06	0.27	0.68	3.01	0.18	0.056	ND	ND	ND	ND	ND	ND	ND	0.003	0.005	ND	0.01	ND

Note:

Not all abbreviated indicators listed below may be present in the results above. The inclusion of indicators varies based on PCR requirements.

Abbreviations:

GWP-IOBC/GWP-GHG = Climate change indicator with instantaneous oxidation of biogenic carbon. The GWP-IOBC indicator has zero contribution to GWP from biogenic carbon temporary stored in products and packaging. The GWP-IOBC indicator, also called GWP-GHG, is identical to GWP-total except that the characterization factor (CF) for biogenic CO2 is set to zero.

Further Information

Product Specifications

Strongwell produces a large number of sizes of STRONGIRT varying in depth and thickness to accommodate a range of insulation thicknesses. The Table below provides common sizes of STRONGIRT cladding and the weight per linear foot of each. Since the composition of STRONGIRT material is consistent regardless of the dimensions of the product size, these amounts may be used to normalize the results within this report to a specific STRONGIRT product.

Insulation Thickness (inch)	STRONGIRT® Depth (inch)	Web Thickness (inch)	Wall Flange Thickness (inch)	Kg/linear foot (Approx)	Lb/linear foot (Approx)
1.5	1.9	0.15	0.15	0.39	0.86
2	2.4	0.15	0.15	0.41	0.9
2.5	2.9	0.15	0.15	0.44	0.96
3	3.4	0.15	0.15	0.46	1.02
3.5	3.9	0.15	0.15	0.49	1.08
4	4.4	0.15	0.15	0.52	1.14
4.5	4.9	0.15	0.15	0.54	1.2
5	5.4	0.15	0.15	0.58	1.27
5.5	5.9	0.15	0.15	0.6	1.33
6	6.4	0.15	0.15	0.63	1.39
5 (Ultra)	5.5	0.25	0.25	0.83	1.84
5.5 (Ultra)	6	0.25	0.25	0.88	1.94
6 (Ultra)	6.5	0.25	0.25	0.93	2.04
8 (Ultra)	8.5	0.25	0.25	1.14	2.52

Electricity Grid Fuel Profile

For Strongwell's products, only module A3 is directly affected as the manufacturer does not have direct control over modules A1 nor A5, nor modules for C. In these cases, the generation of electricity uses the U.S. consumption mix on the market.

For module A1, all raw materials are assumed to be produced in the US or Canada and so the US/Canadian average electricity grid consumption mix is used as discussed above. For A5 and C1, small amounts of electricity (electrically charged drill) are required for installation and deconstruction of the STRONGIRT cladding. Installation occurs throughout the United States and Canada, so an average electricity grid for those areas has been assumed.

Residual electricity grids are not commonly available in the U.S.; therefore, an estimate is used. As Strongwell has direct control over their plant, an estimated residual electricity mix is used for the Bristol, VA plant. Generation of electricity used in modules A3 is modeled based on the region where the process occurs. For the US, electricity consumption mix modeling uses 2021 subregion data from the US EPA eGRID database for the Strongwell Bristol, VA plant. Residual electricity for the RFCW region has been estimated by removing the renewables from the consumption mix on the market. The table below provides the grids used.

Resource	US and Canada Avg. 2021 eGRID Consumption	US and Canada Avg. 2021 eGRID Emissions	US and Canada Avg. 2021 eGRID Emissions	US and Canada Avg. 2021 eGRID Emissions
Coal	20.4%	10.4%	10.4%	10.4%
Gas	37.4%	10.4%	10.4%	10.4%
Natural Gas	37.4%	10.4%	10.4%	10.4%
Nuclear	18.4%	10.4%	10.4%	10.4%
Hydro	8.4%	10.4%	10.4%	10.4%
Wind	10.4%	10.4%	10.4%	10.4%
Solar	3.4%	10.4%	10.4%	10.4%
Geothermal	0.4%	10.4%	10.4%	10.4%
Biomass	1.4%	10.4%	10.4%	10.4%
Other	0.4%	10.4%	10.4%	10.4%
US and Canada Avg. 2021 eGRID Consumption	100.0%	10.4%	10.4%	10.4%

Reporting of Modules Declared, Geographic Scope, Share of Specific Data (in GWP-GHG results), and Variation of Data (in GWP-GHG results)

	Product Stage			Construction Process Stage		Use Stage							End-of-Life Stage				Resource Recovery Stage
	Raw Material Supply	Transport	Manufacturing	Transport	Construction/Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction/Demolition	Transport	Waste Processing	Disposal	Reuse-Recovery-Recycling Potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Geography	US	US	US	US	US	US	US	US	US	US	US	US	US	US	US	US	US
Share of Specific Data	31%			77%		-	-	-	-	-	-	-	-	-	-	-	-
Variation - Products	0% *			0%		-	-	-	-	-	-	-	-	-	-	-	-
Variation - Sites	0%			0%		-	-	-	-	-	-	-	-	-	-	-	-

* This amount is shown as zero due to all 14 STRONGIRT product inputs through manufacturing (A1-A3) are produced identically with the only difference being product sizes (depth/thickness). Therefore 1 kg of any of the product sizes would have the same GWP for all STRONGIRT products. However if a basis of 1 linear foot of product is considered, the GWP difference between the 1 kg basis and the 1 linear foot basis varies depending on which product--from 7 to 61% lower than the GWP on a 1 kg basis for 13 of the STRONGIRT products and 14 percent higher than the GWP on a 1 kg basis for 1 of the STRONGIRT products.

Exclusions from Scope

The following components of each system are not included in this LCA study:

1. Miscellaneous Materials and Additives: Selected materials such as catalysts (initiators), pigments, inhibitors, or other additives which total less than one percent by weight of the net process inputs are typically not included in assessments. Omitting miscellaneous materials and additives keeps the scope of the study focused. It is possible that production of some substances used in small amounts may be energy and resource intensive or may release toxic emissions; however, the impacts would have to be very large in proportion to their mass in order to significantly affect overall results and conclusions. For this study, no use of resource-intensive or high-toxicity chemicals or additives was identified beyond what was included in this analysis.

Therefore, the results for STRONGIRT production are not expected to be understated by any significant amount due to substances that may be used in small amounts.

2. Capital Equipment: The materials and energy inputs as well as waste outputs associated with the manufacture of capital equipment are excluded from this analysis. This includes equipment to manufacture buildings, motor vehicles, and industrial machinery. In general, these types of capital equipment are used to produce

large quantities of product output over a useful life of many years. Thus, energy and emissions associated with the production of these facilities and equipment generally become negligible.

3. **Support Personnel Requirements:** The energy and wastes associated with research and development, sales, and administrative personnel or related activities have not been included in this study. Energy requirements and related emissions are assumed to be quite small for support personnel activities.
4. **Space Conditioning:** The fuels and power consumed to heat, cool, and light manufacturing establishments are omitted from the calculations when possible. For manufacturing plants that carry out thermal processing or otherwise consume large amounts of energy, space conditioning energy is quite low compared to process energy. The data collection form developed for this project specifically requested that the data provider either exclude energy use for space conditioning or indicate if the reported energy requirements included space conditioning. Strongwell was not able to separate the space conditioning from its plant operations. Energy use for space conditioning, lighting, and other overhead activities is not expected to make a significant contribution to total energy use for the systems analyzed in this report.

Assumptions

Most of the assumptions within this EPD are stated in the Module description section; however, if extra information was overlooked in the description or the scenario sections and deemed relevant, it has been included in this section.

- The incoming packaging required for the incoming materials was not included. Some incoming materials required no packaging, while others were provided in supersacks. The LCA model for STRONGIRT incoming material packaging was tested to see if the incoming packaging caused a significant change to any of the LCA results. For the STRONGIRT product, the results changed by less than 0.02 percent, and so all incoming material packaging was excluded from the models.
- The private data used for pallets was known to be representative of the pallet type used in this analysis. Comparisons were made to sections of a newer dataset (weight, wood/steel ratio, electricity use) and result differences were small when compared to the small amounts of pallets required as compared to other materials in A1.
- The estimations from older private U.S. data for the stretch wrap extrusion were chosen over adapted EU extrusion; however a sensitivity of the use of adapted EU extrusion was reviewed and less than 1% difference was seen in impact categories results, likely due to the small amount of stretch wrap included compared to other incoming materials.
- Packaging used to transport the products to the installation site are assumed to be landfilled as a worst-case scenario. Potentially the cardboard or pallets could be recycled or incinerated, but that would depend on the user and is unknown.
- Some data, such as fuels and transportation, are used in multiple phases. The table below lists the main fuel types and transport modes used in this analysis, as well as the data sources. Fuels and transport used in Ecolnvent material data sets were adapted to US fuels and transport modes sourced from the U.S. LCI Database.

Fuel/Transport Mode	Data Source
Diesel, at industrial equipment, L/US	National Renewable Energy Laboratory(2015). USLCI Database. https://www.lcacommons.gov/lca-collaboration/National Renewable Energy Laboratory/USLCI Database Public/datasets
Liquid petroleum gas (LPG), at industrial boiler, L/US	
Natural gas, at industrial boiler, m3/US	
All fuels used to create electricity in Utility boilers for US electricity grids	
Electricity, at grid, various, kWh/US	eGRID, 2021. More information can be found in Chapter 1—Electricity Grid Fuel Profile
Electricity, at grid, 2022 IEA average, kWh/EU	International Energy Agency, 2022.
Combination truck transport, diesel, tkm/US	National Renewable Energy Laboratory(2015). USLCI Database. https://www.lcacommons.gov/lca-collaboration/National Renewable Energy Laboratory/USLCI Database Public/datasets

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EN 15804:2012+A2:2019: Sustainability for Construction Works Environmental Product Declarations Core Rules for the product category of construction products.

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European Commission Joint Research Centre (JRC). EN 15804 EF Reference Package v3.1. European Platform on Life Cycle Assessment (EPLCA).

Hot-Dip Galvanized North America LCI Report_Feb2018. Cradle to Gate, Excluding End-of-Life (EOL) Recycling. World Steel Association.

Emissions & Generation Resource Integrated Database (eGRID), 2021 regional and US average data. Data tables accessed at <https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid>

American Chemistry Council, Plastics Database, 2015 data. Various reports.

Cradle-to-Gate Life Cycle Analysis of General Purpose Polystyrene (GPPS) Resin, ACC, 2022. (2015 data)

Life Cycle Inventory of Polymer Composites, ACMA, 2012. UPR data with incoming materials updated as available.

2014 Life Cycle Assessment of U.S. Average Corrugated Product Final Report. Prepared for the Corrugated Product Alliance (CPA), National Council for Air and Stream Improvement, Inc. (NCASI). (2017).

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