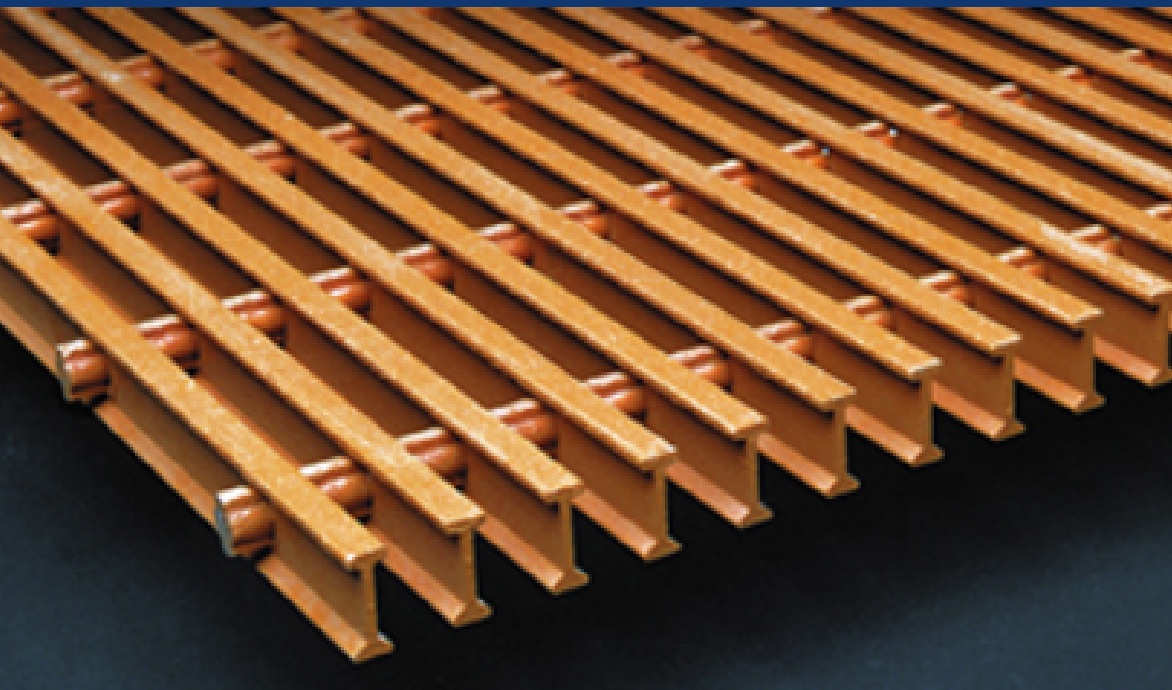


ENVIRONMENTAL PRODUCT DECLARATION

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

SmartEPD-2025-075-0547-01

DURAGRID® Grating



Date of Issue:
Jun 20, 2025

Expiration:
Jun 20, 2030

Last updated:
Jun 20, 2025

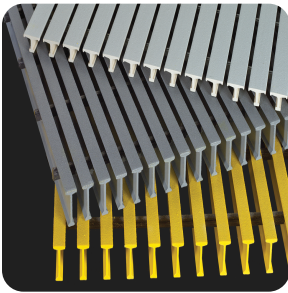
General Information

Strongwell

400 Commonwealth Ave., Bristol, VA 24201

1 276-645-8078

bmutnuri@strongwell.com strongwell.com



Product Name:	DURAGRID® Grating
Declared Unit:	1 kg Strongwell produces various sizes of the DURAGRID® grating varying in heights and widths to accommodate individual projects. A table is provided in this EPD with the most common sizes of DURAGRID® grating and the weight per linear foot of each. Since the composition of DURAGRID® 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 DURAGRID® product.
Declaration Number:	SmartEPD-2025-075-0547-01
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, Korea, Europe, Brazil, China, United Kingdom of Great Britain and Northern Ireland

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) 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 ISO 14025.

Strongwell has the sole ownership, liability and responsibility for this DURAGRID grating 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 various sizes of the DURAGRID® grating varying in heights and widths to accommodate individual projects. A table is provided in this EPD with the most common sizes of DURAGRID® grating and the weight per linear foot of each. Since the composition of DURAGRID® 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 DURAGRID® product.
Mass:	1 kg
Product Specificity:	 Product Average  Product Specific
Supply Chain Specific Data:	25 %
Variation in GWP Result (Products):	0% to 0%
Variation in GWP Result (Facilities):	0% to 0%

Product Description

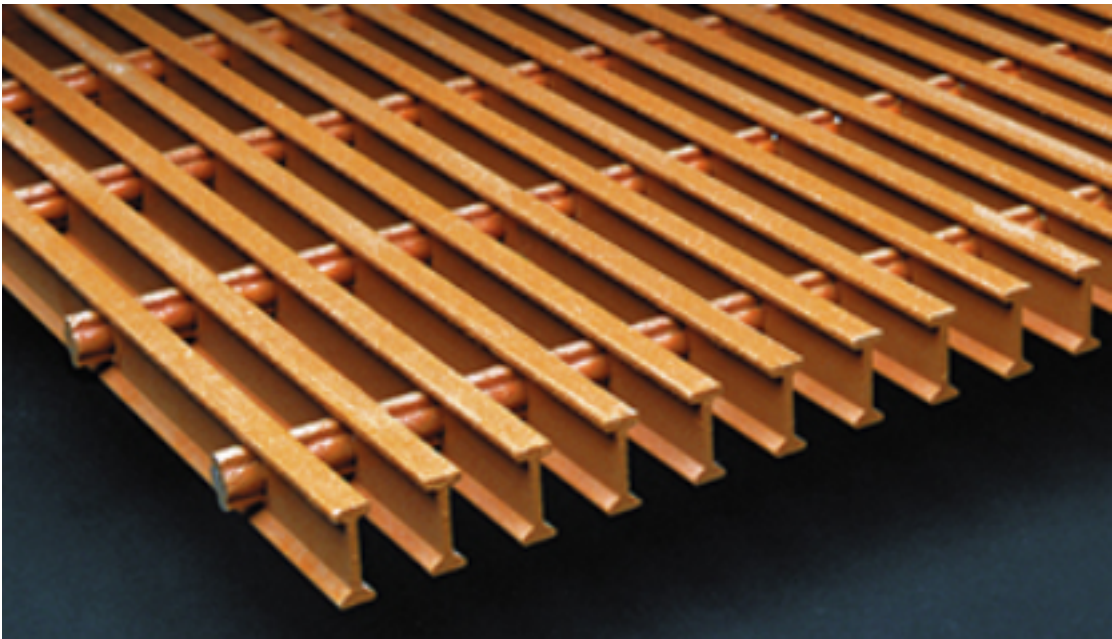
DURAGRID is high strength pultruded bar grating that can be used like traditional metal grates or fiberglass molded grating. DURAGRID custom grid or grating systems are designed to accommodate specific applications that cannot effectively be met by a standard fiberglass grating. DURAGRID offers options such as selection of open space, bar shape, and cross-rod placement. The bearing bars use both longitudinal (glass roving) and multidirectional (glass mat) reinforcements, as well as a synthetic surfacing veil. The densely packed core of continuous glass rovings gives the bar strength and stiffness in the longitudinal direction while the continuous glass mat provides strength in the transverse direction and prevents chipping, cracking and lineal fracturing. Although the DURAGRID grating carries a warranty of one (1) year, it is expected to last the lifetime of the structure on which it is installed.

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

Product Specifications

Product Classification Codes: EC3 - CastDecksAndUnderlayment

Product Composition Diagram



Material Composition

Material/Component Category	Origin	% Mass
Glass fiber	U.S.	0.79
Phenolic Resin	U.S.	0.21

Packaging Material	Origin	kg Mass
Cardboard	U.S.	0.002
Wooden Pallet	U.S.	0.019

Biogenic Carbon Content	kg C per kg
Biogenic carbon content in product	None
Biogenic carbon content in accompanying packaging	0.0099

Hazardous Materials
NA

EPD Data Specificity

- Primary Data Year:2022
- Manufacturing Specificity:

✗

 Industry Average

✗

 Manufacturer Average

✓

 Facility Specific

Averaging:
Averaging was not conducted for this EPD.

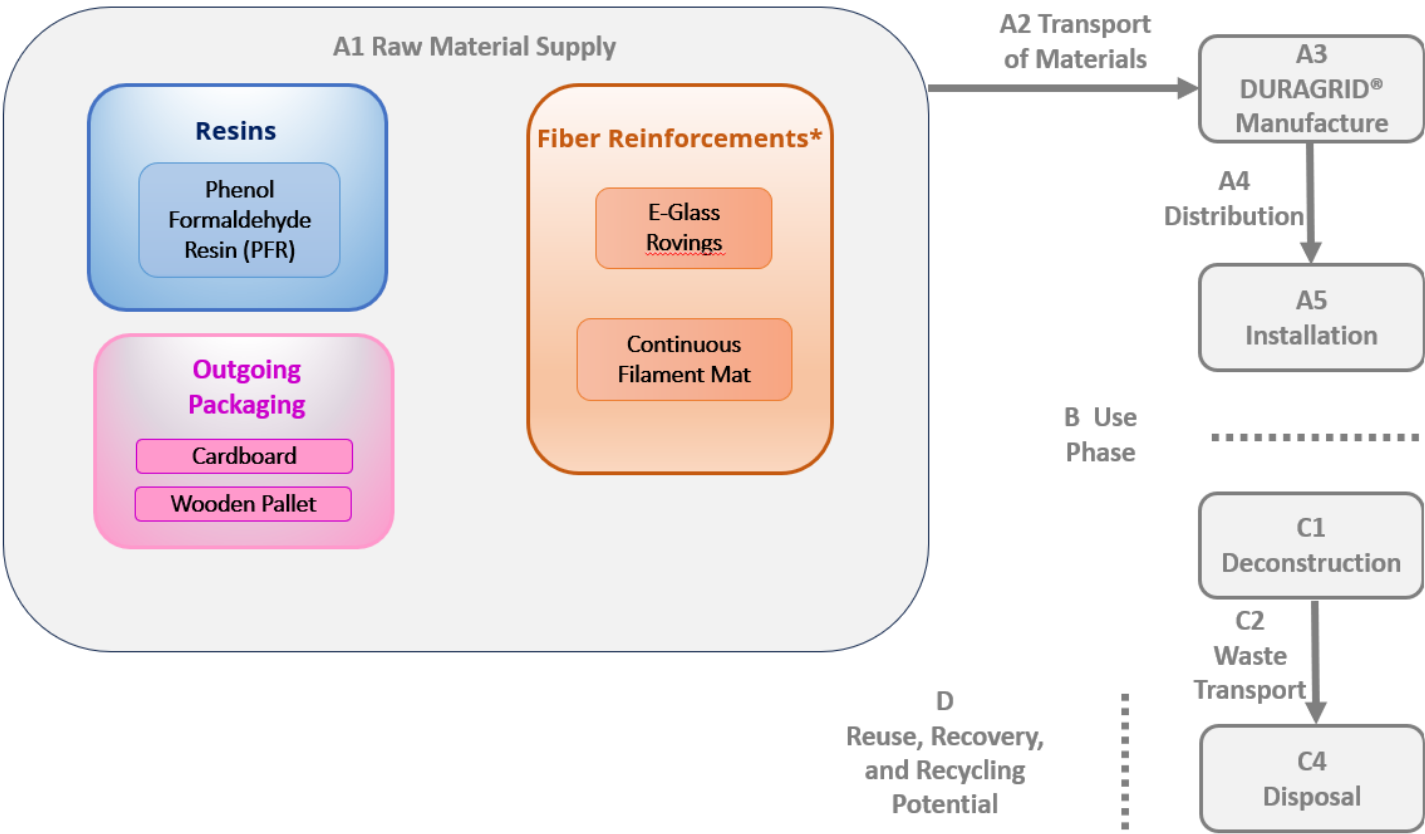
System Boundary

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 Chatfield, MN Plant
1610 U.S. 52, Chatfield, MN 55923, 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 DURAGRID 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	Glass Fiber	None	United States	2012/2015	Life Cycle Inventory of Polymer Composites, ACMA, 2012 with background data reviewed and updated to 2015 data or newer.	None	None
None	A1	Phenol Formaldehyde Resin	None	United States	2007	U.S. LCI Database sourced from a 2009 CORRIM report.	None	None
None	A1	Cardboard	None	United States	2017/2014	2014 Life Cycle Assessment of U.S. Average Corrugated Product, Final Report. NCASI 2017.	None	None
None	A1	Wooden Pallet	None	United States	2009/2007	Private data from a Peer-reviewed Pallet LCA for a private client.	None	None
None	A3	Electricity Mix	None	Chatfield, MN	2021	eGrid, 2021 adapted to be estimate for residual electricity	None	None
None	A3	Pultrusion	None	Chatfield MN	2022	Primary data collected. 2023.	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 DURAGRID system. The data sources for each of these materials are provided in the table. A loss rate of 6.09 percent was applied in the model. The incoming materials include packaging required to distribute the DURAGRID grating.

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 mileage in km are provided in the table below.

Incoming Material	DURAGRID® Grating (kilometers)
Glass Fiber	337
Phenolic Resin	538
Cardboard	64
Wooden Pallets	82

A3 - DURAGRID Grating Manufacture. Life Cycle Inventory data was collected for the Chatfield, MN Strongwell plant for 2022 in this analysis to represent the DURAGRID grating pultrusion. For this process, fibers are pulled through a liquid resin bath until the fibers are sufficiently impregnated with 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. Plant Life Cycle Inventory data from Strongwell is considered confidential and not provided in this EPD.

The DURAGRID grating model includes glass fiber and phenolic resin in the inputs. The Strongwell staff at Chatfield were able to estimate the VOCs emitted at the plant. As these were estimates and expected to be provided as the high-end limit release of these VOCs, a sensitivity analysis was done. Some impact category results, including smog formation which has a methodology dependent on VOCs, decreased as the estimate was decreased. The smog formation total results decreased by 18 percent when the estimated was decreased by 50 percent.

In the DURAGRID grating pultrusion, some phenolic resin liquid is unable to be used and is considered a hazardous solid waste, which is sent off-site to a waste-to-energy incineration. The solid waste was considered an inventory category as it was sent off-site, and no energy credit was given to the system.

A4 - Distribution of DURAGRID Grating. The DURAGRID grating is sold in both the United States and globally. Global distribution data was provided by Strongwell. The global information provided was an estimate of the percentage of the product sent to each of the largest countries with Strongwell Customers for 2023. The product was assumed to be trucked to a main port town on the East Coast (Norfolk VA) to be loaded on an ocean freighter. Estimates were used for shipping to a main port in each of the customer countries. Only Global distribution was included here as a conservative assumption; likely these amounts would be less when the U.S. distribution is included. Within the LCA, a sensitivity analysis has been conducted to estimate the difference if U.S. modes and distances were included as half the distribution amount. This sensitivity analysis made clear that the impact categories total results decreased by no more than 4 percent if the distribution data included U.S. distribution.

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 the pultruded product. No human energy is considered; only the energy required for machinery to attach the product. Guides were provided by Strongwell on installation practices for the DURAGRID grating; however, the required hardware depended on the size of the products. No packaging of the hardware was included in this analysis.

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 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 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.

B1 through B7 - Use Stage. Strongwell states that the DURAGRID grating 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 and not included in the analysis.

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 pultrusion product from the site. A hauling truck is assumed to transport the pultruded product to a landfill at the end of life. An estimate of 50 km was assumed for each product system. The weight hauled included both the pultruded product and the hardware used to install it.

C3 - Waste Processing for Product. No waste processing is expected for these pultruded products. 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 pultruded product/hardware from the truck and placement at a landfill, as well as the solid waste inventory amount for the postconsumer solid waste including the pultruded product/hardware.

Processes	DURAGRID® Grating
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 DURAGRID® and 0.0191 kg hardware
Assumptions for scenario development	C2: Assumed Diesel combination truck (US) due to construction waste globally. Estimated 50 km to landfill
	C4: Assumed Diesel industrial Equipment at landfill. Estimated from US data.

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 production of the DURAGRID 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 DURAGRID grating system includes at least 95 percent of all inflows of mass and energy per stage. This LCA elects to use the one percent by mass cut-off criteria.

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:	1960 km
Capacity Utilization:	50 %
Packaging Mass:	0.021 kg
Weight of products transported:	1 kg
Capacity utilization volume factor:	=1

Assumptions for scenario development:

The information above is for the truck hauling the product to port and from port to the construction site. An ocean freighter is used to move the product globally. The global information provided was an estimate of the percentage of the product sent to each of the largest countries with Strongwell Customers for 2023. The product was assumed to be trucked to a port town on the East Coast (Norfolk VA) to be loaded on an ocean freighter. Estimates were used for shipping to a main port in each of the customer countries. Only Global distribution was included here as a conservative assumption; likely these amounts would be less when the U.S. distribution is included. The US LCI Database was used for the ocean freighter; however since the LCA was completed, the ocean freighter module was updated in the US LCI Database. It is likely that the newer data would decrease the results for A4 if used. A split of 90% heavy fuel oil (residual oil)/10% diesel were used as fuels. The same fuel use was used whether for residual oil or diesel—0.00049 liters/100 km moving 1 kg at 100% capacity utilization of the freighter. The distance used was 10,850 km.

Installation in to the building/construction site (A5)

A5 Module

Installation Scrap Rate Assumed:	0 %
Ancillary Materials:	0.019 kg
Net Fresh Water Consumption Specified by Water Source and Fate:	0 m3
Other Resources:	0 kg
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:	0.021 kg
Biogenic Carbon Contained in Packaging:	0.0099 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. In the DURAGRID® grating system, the EU electricity grid was used in place of all global regions. The total results for GHG for the electricity used for the drilling in A5 of the DURAGRID® grating system is 0.06% of the GHG-total; therefore, no sensitivity analysis was added.

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 CO ₂

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 DURAGRID® grating would be removed; however, it is possible that the removal of the product may happen in a demolition situation.

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

The disposal phase only includes energy to use landfill equipment for removing the DURAGRID®/hardware from the truck and placement at a landfill, as well as the solid waste inventory amount for the postconsumer solid waste including the DURAGRID®/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
Process and Conversion Efficiencies:	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 various sizes of the DURAGRID® grating varying in heights and widths to accommodate individual projects. A table is provided in this EPD with the most common sizes of DURAGRID® grating and the weight per linear foot of each. Since the composition of DURAGRID® 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 DURAGRID® 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	1.98	0.0391	0.948	2.96	0.384	0.0193	ND	ND	ND	ND	ND	ND	ND	0.00182	0.00465	ND	0.00954	ND
GWP-fossil	IPCC AR6 GWP 100	kg CO2 eq	1.94	0.0391	0.948	2.92	0.384	0.0553	ND	ND	ND	ND	ND	ND	ND	0.00182	0.00465	ND	0.00954	ND
GWP-biogenic	IPCC AR6 GWP 100	kg CO2 eq	0.0385	ND	ND	0.0385	ND	-0.036	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ODP	EF3.1	kg CFC11 eq	1.1e-9	1.08e-10	9.93e-11	1.3e-9	1.03e-9	9.95e-12	ND	ND	ND	ND	ND	ND	ND	2.41e-13	1.28e-11	ND	2.64e-11	ND
AP	EF3.1	mol H+ eq	0.00686	0.000128	0.00806	0.015	0.00791	0.0002	ND	ND	ND	ND	ND	ND	ND	0.000011	0.0000152	ND	0.0000694	ND
PM	EF3.1	disease incidence	8.9e-8	1.26e-9	1.18e-7	2.08e-7	7.64e-8	1.6e-9	ND	ND	ND	ND	ND	ND	ND	8.09e-11	1.5e-10	ND	2.55e-9	ND
IRP	EF3.1	kBq U235 eq	3.81e-8	7.4e-21	6.29e-21	3.81e-8	7.05e-20	8.98e-7	ND	ND	ND	ND	ND	ND	ND	1.57e-23	8.8e-22	ND	1.82e-21	ND
POCP	EF3.1	kg NMVOC eq	0.00458	0.000178	0.0107	0.0155	0.00629	0.000157	ND	ND	ND	ND	ND	ND	ND	0.00000485	0.0000212	ND	0.0000971	ND
EP-fw	EF3.1	kg P eq	1.51e-7	9.94e-9	1.2e-8	1.73e-7	9.47e-8	1.18e-8	ND	ND	ND	ND	ND	ND	ND	3.83e-11	1.18e-9	ND	2.44e-9	ND
EP-marine	EF3.1	kg N eq	0.00144	0.0000625	0.000971	0.00248	0.00228	0.0000548	ND	ND	ND	ND	ND	ND	ND	0.00000164	0.00000743	ND	0.0000349	ND
EP-terrestrial	EF3.1	mol N eq	0.0158	0.000686	0.0106	0.0271	0.025	0.000598	ND	ND	ND	ND	ND	ND	ND	0.000018	0.0000815	ND	0.000382	ND
SQP	EF3.1	dimensionless	0.0899	ND	ND	0.0899	ND	0.00043	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WDP	EF3.1	m3 world eq deprived	0.0467	0.0000246	0.00172	0.0485	0.000234	0.00563	ND	ND	ND	ND	ND	ND	ND	0.00000838	0.00000293	ND	0.00000604	ND
ADP-fossil	EF3.1	MJ, net calorific value	20.2	0.461	4.66	25.3	4.39	0.384	ND	ND	ND	ND	ND	ND	ND	0.0271	0.0548	ND	0.113	ND
ADP-minerals&metals	EF3.1	kg Sb eq	7.72e-14	ND	ND	7.72e-14	ND	-2.74e-7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	EF3.1	CTUe	1.82	0.00121	5.11	6.93	0.0117	0.065	ND	ND	ND	ND	ND	ND	ND	0.000433	0.000143	ND	0.000328	ND
HTP-c	EF3.1	CTUh	2.41e-10	2.8e-12	1.46e-8	1.48e-8	2.67e-11	3.24e-12	ND	ND	ND	ND	ND	ND	ND	5.61e-14	3.33e-13	ND	1.45e-12	ND
HTP-nc	EF3.1	CTUh	3.39e-9	4.01e-11	4.47e-9	7.91e-9	3.88e-10	1.43e-10	ND	ND	ND	ND	ND	ND	ND	3.49e-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 = Particulate Matter Emissions, IRP = Ionizing radiation, human health, ETP-fw = Eco-toxicity (freshwater), HTP-c = Human toxicity (cancer), HTP-nc = Human toxicity (non-cancer), SQP = Soil quality index.

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 the indicator: 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 various sizes of the DURAGRID® grating varying in heights and widths to accommodate individual projects. A table is provided in this EPD with the most common sizes of DURAGRID® grating and the weight per linear foot of each. Since the composition of DURAGRID® 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 DURAGRID® product..

Indicator	Unit	A1	A2	A3	A1A2A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ	1.58	0.00154	0.02	1.6	0.0143	0.0103	ND	ND	ND	ND	ND	ND	ND	0.0084	0.000183	ND	0.000378	ND
PERM	MJ	0.015	ND	ND	0.015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PERT	MJ	1.6	0.00154	0.02	1.62	0.0143	0.0103	ND	ND	ND	ND	ND	ND	ND	0.0084	0.000183	ND	0.000378	ND
PENRE	MJ	24.5	0.47	12.2	37.1	4.47	0.747	ND	ND	ND	ND	ND	ND	ND	0.0362	0.0559	ND	0.115	ND
PENRM	MJ	4.58	ND	ND	4.58	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PENRT	MJ	29	0.47	12.2	41.7	4.47	0.747	ND	ND	ND	ND	ND	ND	ND	0.0362	0.0559	ND	0.115	ND
SM	kg	0.0009	ND	ND	0.0009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FW	m3	0.0134	0.0000252	0.000156	0.0136	0.000238	0.00011	ND	ND	ND	ND	ND	ND	ND	0.0000416	0.00000299	ND	0.00000617	ND
RE	MJ	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:

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, NRPRRT 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.

It is noted that more than 50 percent of the energy and water resources are coming from the A1 module, mainly from the glass fiber and phenolic resin.

Waste and Output Flow Indicators

per 1 kg of product Strongwell produces various sizes of the DURAGRID® grating varying in heights and widths to accommodate individual projects. A table is provided in this EPD with the most common sizes of DURAGRID® grating and the weight per linear foot of each. Since the composition of DURAGRID® 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 DURAGRID® product..

Indicator	Unit	A1	A2	A3	A1A2A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	kg	0.0000497	ND	0.00204	0.00209	ND	-1.76e-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NHWD	kg	0.439	0.000503	0.131	0.57	0.00478	0.00381	ND	ND	ND	ND	ND	ND	ND	0.000146	0.0000598	ND	1.02	ND
RWD	kg	2.34e-13	ND	ND	2.34e-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:

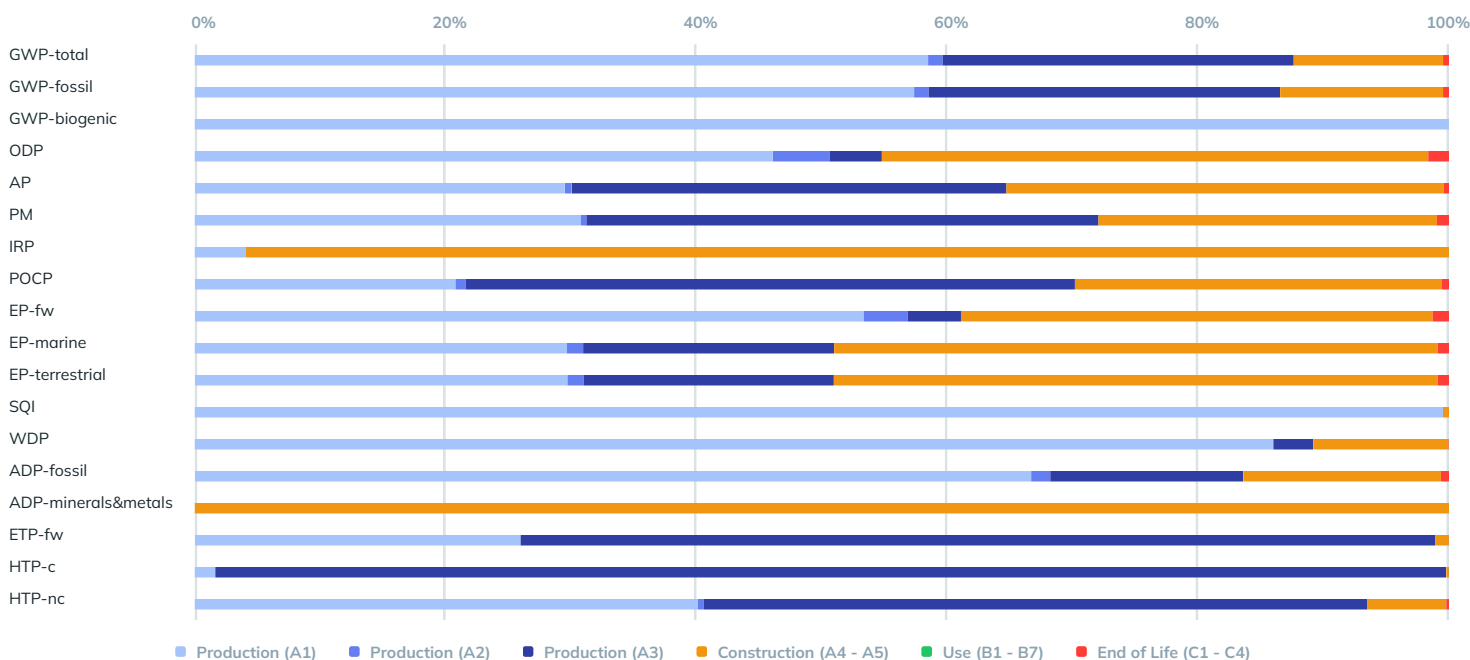
HWD = Hazardous waste disposed, NHWD = Non-hazardous waste disposed, RWD = Radioactive waste disposed, HLRW = High-level radioactive waste, ILLRW = Intermediate- and low-level radioactive waste, CRU = Components for re-use, MFR or MR = Materials for recycling, MER = Materials for energy recovery, MNER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

The largest portion of the non-hazardous waste for the DURAGRID grating system is the postconsumer disposal of the product itself. The Strongwell plant does create some hazardous waste, which is sent off-site for incineration at a waste-to-energy plant. This was included as an inventory category and no energy credit, which would have been minute due to the small amount, was applied.

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 about half of the impact results, including GWP categories, come from the incoming materials (A1). In some impact categories, the results are somewhat evenly split between the modules A1, A3, and A4/A5, such as AP and EP-marine/terrestrial. For module A3, this is due to the combustion of fossil fuels to create electricity used at the plant. The combustion of fossil fuels in ocean freighters to ship the product globally (module A4) account for between 30 and 50 percent of the AP and EP results as shown below.

The greatest percentage of GWP-total is due to the cradle-to-incoming materials at 57 percent of the total system, mainly from the glass fiber production. The DURAGRID grating pultrusion plant releases 28 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	1.94	0.039	0.95	2.93	0.38	0.055	ND	ND	ND	ND	ND	ND	ND	0.0018	0.0047	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 various sizes of the DURAGRID grating varying in heights and widths to accommodate individual projects. The table below provides the most common sizes of DURAGRID grating and the weight per linear foot of each. Since the composition of DURAGRID material is consistent regardless of the dimensions of the product size, these amounts may be used to normalize the results within this EPD to a specific DURAGRID product.

Product detail	Kg/linear foot	Lb/linear foot
DURAGRID® #5782	0.145	0.319
DURAGRID® #5783	0.178	0.392
DURAGRID® #5784	0.069	0.153
DURAGRID® #5785	0.029	0.063
DURAGRID® #5893	0.115	0.254

Electricity Grid Fuel Profile

For DURAGRID grating, 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 A1 processes and an EU average electricity mix is used to represent the global market in A5 and C1.

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 DURAGRID grating. Installation occurs in a number of countries globally, including approximately 2/3 to European market, so an average EU electricity grid for 2022.

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 Chatfield, MN 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 Chatfield, MN plant. Residual electricity for the MROW region has been estimated by removing the renewables from the consumption mix on the market. The table below provides the grids used.

Resource	U.S. and Canada AVG, EGRID 2021 Consumption	MROW, EGRID 2021 Consumption	MROW, EGRID 2021 Estimated Residual	EU AVG, IEA 2022 Consumption
Coal	20.40%	41.60%	67.00%	14.60%
Oil	0.80%	0.18%	0.29%	1.18%
Natural gas	34.00%	11.20%	18.10%	21.00%
Nuclear	18.00%	9.07%	14.60%	21.00%
Hydro	13.20%	4.59%	0%	16.50%
Biofuels	1.25%	0.79%	0%	5.13%
Wind	8.37%	36.30%	0%	13.20%
Solar	3.08%	0.96%	0%	5.15%
Geothermal	0.37%	0%	0%	0.63%
Other*	0.44%	0.27%	0%	1.64%
Losses^	1.13%	1.10%	1.10%	1.14%
kg CO2-eq/kwh for A3 grids			0.766	

*Includes other fossil and non-fossil sources

^Includes line loss and energy industry use

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	global	global	global	global	global	global	global	global	global	global	global	global	global	global
Share of Specific Data	25%			88%		-	-	-	-	-	-	-	-	-	-	-	-
Variation - Products	0% *			0%		-	-	-	-	-	-	-	-	-	-	-	-
Variation - Sites	0%			0%		-	-	-	-	-	-	-	-	-	-	-	-

* This amount is shown as zero due to all 5 DURAGRID product inputs through manufacturing (A1-A3) are produced identically with the only difference being product sizes (thickness). Therefore 1 kg of any of the product sizes would have the same GWP for all DURAGRID 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 product from 82 to 97% lower than the GWP on a 1 kg basis.

Exclusions from Scope

The following components of each system are not included in the 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 DURAGRID grating 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 Descriptions section; however, if extra information was excluded from 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 DURAGRID grating incoming material packaging was tested to see if the incoming packaging caused a significant change to any of the LCA results. For the DURAGRID grating 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.
- 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

• **Geographic Scope.** Data for foreign processes are generally not available. In cases such as this, the energy requirements and emissions are assumed to be the same as if the materials originated in the United States. Since foreign standards and regulations vary from those of the United States, it is acknowledged that this assumption may introduce some error. Transportation of crude oil used for petroleum fuels and resins is modeled based on the current mix of domestic and imported crude oil used. All incoming materials for the pultruded products in this analysis are produced within the U.S.

• **Adaptation of Ecoinvent Datasets.** A number of assumptions were made to adapt all Ecoinvent datasets used in this study in place of U.S. processes. These include:

- Transport distances were assumed to be equivalent to U.S. distances, but modes of transport were linked to U.S. data.
- Cooling water and other water shown that were likely not consumed were not included in the Water Consumption method.
- All inputs were changed to U.S. sources as available.

- Energy sources were reviewed for possible differences in the EU and U.S. industry. For example, EU is more likely to use oil type fuels than the U.S.; therefore, where larger amounts of oil-based fuels were used in an ecoinvent data set, the energy amount was calculated and converted to an energy-equivalent amount of natural gas.

References

PCR 2019:14. Construction Products. Version 1.3.4

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

SimaPro Craft, Release 9 .6 for the original models and 10.1 for some updates to the models.

National Renewable Energy Laboratory (2015). USLCI Database. Accessed within SimaPro. https://www.lcacommons.gov/lca-collaboration/National_Renewable_Energy_Laboratory/USLCI_Database_Public/datasets

ecoinvent Centre, ecoinvent v3.10 accessed within SimaPro.

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.

Life Cycle Inventory of Polymer Composites, ACMA, 2012. Glass fiber 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).

Peer-reviewed pallet LCA conducted by Franklin Associates/ERG for a private client in 2009

Pallet Recovery, Repair and Remanufacturing in a Changing Industry: 1992 to 2006. by Robert J. Bush and Philip A. Araman, 2009 Pallet Enterprise.