COMPOSITE FIBRE TECHNOLOGY

ENVIRONMENTAL PRODUCT DECLARATION

IN ACCORDANCE WITH ISO 14025:2006 AND EN 15804:2012+A2:2019/AC:2021 FOR:

SQUARE HOLLOW PULTRUDED GFRP SECTION WGN-S1000

FROM

WAGNERS- COMPOSITE FIBRE TECHNOLOGY PTY LTD.

AUSTRALASIA EPD®
ENVIRONMENTAL PRODUCT DECLARATION

ECO PLATFORM EPD VERIFIED

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Mersey River Bridge, Canada

GENERAL INFORMATION

PROGRAMME INFORMATION

Program:	EPD Australasia
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Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): Construction products PCR 2019:14 v1.2.5; Construction products (EN 15804+A2); UN CPC Code: 379
PCR review was conducted by: *The Technical Committee of the International EPD® System.* A full list of members available on *www.environdec.com for a list of members. The review panel may be contacted via info@environdec.com. Review chair: Claudia A. Peña, University of Concepción, Chile.*
Life Cycle Assessment (LCA)
Pasindu Samarakkody and Sazal Kundu *Edge Environment Pty Limited* *Level 5. 39 East Esplanade, Manly NSW 2095 Australia* *W: www.edgeenvironment.com* *E: info@edgeenvironment.com*
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier Third-party verifier: *Epsten Group, Inc.* *101 Marietta St. NW, Suite 2600, Atlanta, Georgia 30303, USA* *www.epstengroup.com* Approved by: EPD Australasia

Procedure for follow-up of data during EPD validity involves third party verifier:

☒ Yes ☐ No

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

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 characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

COMPANY INFORMATION

Table 1 Company Information

Owner of the EPD	Wagners CFT Pty Limited
Headquarters	11 Ballera Court, Wellcamp, QLD 4350
Contact Person	Parminder Jaj, Product Engineer
Contact information	cftsales@wagner.com.au

DESCRIPTION OF THE ORGANISATION:

Wagners Composite Fibre Technology (Wagners-CFT) is a civil and infrastructure organisation leading innovation in advanced material for civil applications. Wagners CFT design and manufacture Glass Fibre Reinforced Polymer Structural Composites (GFRP) with their proprietary pultrusion pull-winding technology.

Since founded in 2002, Wagners products are widely used in different civil and electrical infrastructure applications. All Wagners products are manufactured in Australia and comes in different shapes and sizes. The products are designed for 100 years of design life and have a proven track record of its low maintenance, superior mechanical, and weathering performance.

Continuously innovating pultrusion technology, Wagners CFT is committed to transform FRP manufacturing and further reduce product footprint by exploring new materials and technologies to become carbon neutral.

Product-related or management system-related certifications:
ISO 14001 Environment, ISO 45001 Occupational health & Safety Management System, ISO 17025 Testing and Calibration Laboratories, ISO 9001:2015 Quality Management System.

UN CPC code: 379

Geographical scope: Asia Pacific (Australia, New Zealand, South-East Asia).

PRODUCT INFORMATION

Product name: Wagners Pultruded GFRP
Geographical scope: Australia

Product description:
Wagners GFRP pultrusion composites are designed as a durable engineered alternative to traditional constriction materials like timber, steel, and concrete. Wagners products are specially designed to endure harsh environments and are a cost-effective solution for various applications in civil and infrastructure industry.

Wagners pultrusion composites typically comes in hollow profiles (Square Hollow Sections (SHS), Circular Hollow Sections (CHS), Rectangular Hollow Sections (RHS), etc). All profiles are made of Electrical and Corrosion Resistance Glass Fibre (ECR) and a thermoset material with light grey tone. The product is trimmed to desired lengths during the manufacturing process and further product is coated with advanced coating system to enhance UV performance.

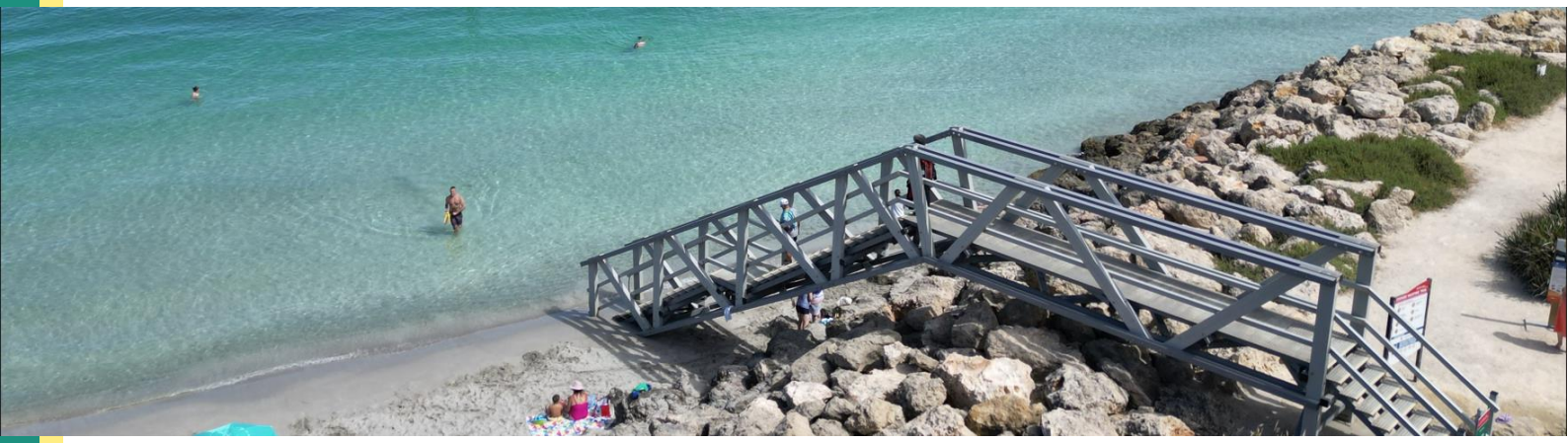
Wagners pultrusion composite comes in a range of colours. The final colour of the product is subjected to customer's requirement. The results presented in this EPD are based on dark earth which is similar to other colours in terms of raw material and preparation techniques. Dark earth is the most popular option among Wagners clients, and it was assumed that this colour option would be most suitable for this EPD.

Product name: Square Hollow Pultruded GFRP Section WGN-S1000

Application:
Wagners composites are widely used in Pedestrian and Road Bridges, Boardwalks, Timber rehabilitation, Marine Structures, Stairs, Water structures, Underground Piles, Fencing, Street light poles, etc. The use of the Wagners products is not limited to specific projects, however, applications are endless depending upon the requirements.

The Square Hollow Pultruded GFRP Section WGN-S1000 is a modular structural construction component, allowing a myriad application, ranging from handrails, bridge cross-members, walkways, electrical crossarms, jetties and much more. The product is designed and manufactured as a singular structural component, enabling ease of incorporation into final structure design and manufacture through conventional joining methods such as nuts and bolts or brackets.

End of life:
Wagners products are non-toxic and does not contaminate the environment when disposed as a landfill. Furthermore, end of life of Wagners product is not just limited to landfill, but the product can be reused in different low strength applications like fence post, industrial and household furniture, park benches, etc. Wagners are also working on emerging technologies like pyrolysis that can be used to decompose the polymer and recover the glass fibres.



Product identification:
Specific product characteristics are shown in Table 2 and the content declaration in Table 4.

Table 2 Product Characteristics of Wagners Pultruded GFRP sections

Product names	Wagners Pultruded GFRP
UN CPC Code	379
Product weight	3.92 kg/m
Dimensions	5.2 mm X 100 mm X 100 mm sections
Product length	Varies by length

LCA INFORMATION

Declared unit: 1 m of produced product.

Technical service life: 100 years

Time representativeness:
The LCA study was conducted on the calendar year 2022 (01 Jan 2022 to 31 Dec 2022) production data.

Database(s) and LCA software used:
The inventory data for the process are entered into the SimaPro (v9.5) LCA software program and linked to the pre-existing data for the upstream feedstocks and services selected in order of preference from:

- For Australia, the Australian Life Cycle Inventory (AusLCI) v1.39 compiled by the Australian Life Cycle Assessment Society ((ALCAS), Australian Life Cycle Inventory (AusLCI) – v1.39, 2022) and the Australasian Unit Process LCI v2014.09. The AusLCI database at the time of this report was less than a year old, while the Australasian Unit Process LCI was 9 years old.
- Other authoritative sources (e.g., Ecoinvent v3.8, (Wernet, et al., The ecoinvent database version 3.8, 2021)), where necessary adapted for relevance to Australian conditions (energy sources, transport distances and modes and so on, and documented to show how the data is adapted for national relevance). At the time of reporting, the Ecoinvent v3.8 database was less than 2 years old.

Description of system boundaries:
The LCA scope of this EPD is cradle to gate with modules A4, C1–C4 and module D. The scope of this LCA is cradle to gate with modules A1-A3, C1-C4, module D and optional modules A4. The following modules have not been declared as they are deemed not applicable for Wagners' products: B1 – material emissions from usage, B2 - maintenance, B3 – repair, B4 – replacement, B5 – refurbishment, B6 – operational energy use and B7 – operational water use.

Module A5 – installation has not been declared as the use cases vary and hence the installation related inputs/outputs.

Module C1 – deconstruction/demolition is not calculated as the use case of the product is very varied, leading to many different installation and deconstruction methods.
D – reuse/recovery/recycling are deemed not relevant for the product.

The EPD is compliant with Product Category Rules – Construction Products (PCR 2019:14), EN 15804+A2 standard, ISO 14025 and General Programme Instructions (GPI). The target audience for this EPD are businesses who will be using Wagners' products.

Table 3– Life Cycle of building products: stages and modules included in this EPD

GPI Module		Asset life cycle stage	Information module	Declared modules	Specific data	Variation - Products	Variation - sites
Upstream	A1	Raw material supply	A1-3. Manufacturing stage	X	<10%	0%	Not applicable
Core	A2	Transport		X			
	A3	Manufacturing		X			
Downstream	A4	Transport	A4-5. Installation stage	X	>90%	-	
	A5	Construction, installation process		ND	-	-	
	B1	Material emissions from usage	B. Usage stage	ND	-	-	
	B2	Maintenance		ND	-	-	
	B3	Repair		ND	-	-	
	B4	Replacement		ND	-	-	
	B5	Refurbishment		ND	-	-	
	B6	Operational energy use		ND	-	-	
	B7	Operational water use		ND	-	-	
	C1	Deconstruction and demolition	C. End of life	X	-	-	
	C2	Transport		X	-	-	
	C3	Waste processing		X	-	-	
	C4	Disposal		X	-	-	
Resource recovery stage	D	Reuse, recycle or recovery	D. Recyclability potentials	X	-	-	

X – Module included in EPD
ND= Module not declared
The table is adapted for physical products and may have to be modified when declaring service products.

Life cycle stage A5 has not been declared as installation varies greatly based on the myriad applications Wagners Pultruded GFRP Sections are used in.

The following life cycle stages have not been declared, as they are deemed not applicable for Wagners Square Hollow Pultruded GFRP Section WGN-S1000: Material emissions from usage (B1); Maintenance (B2); Repair (B3); Replacement (B4); Refurbishment (B5), Operational energy use (B6) and Operational water use (B7).

SYSTEM DIAGRAM:

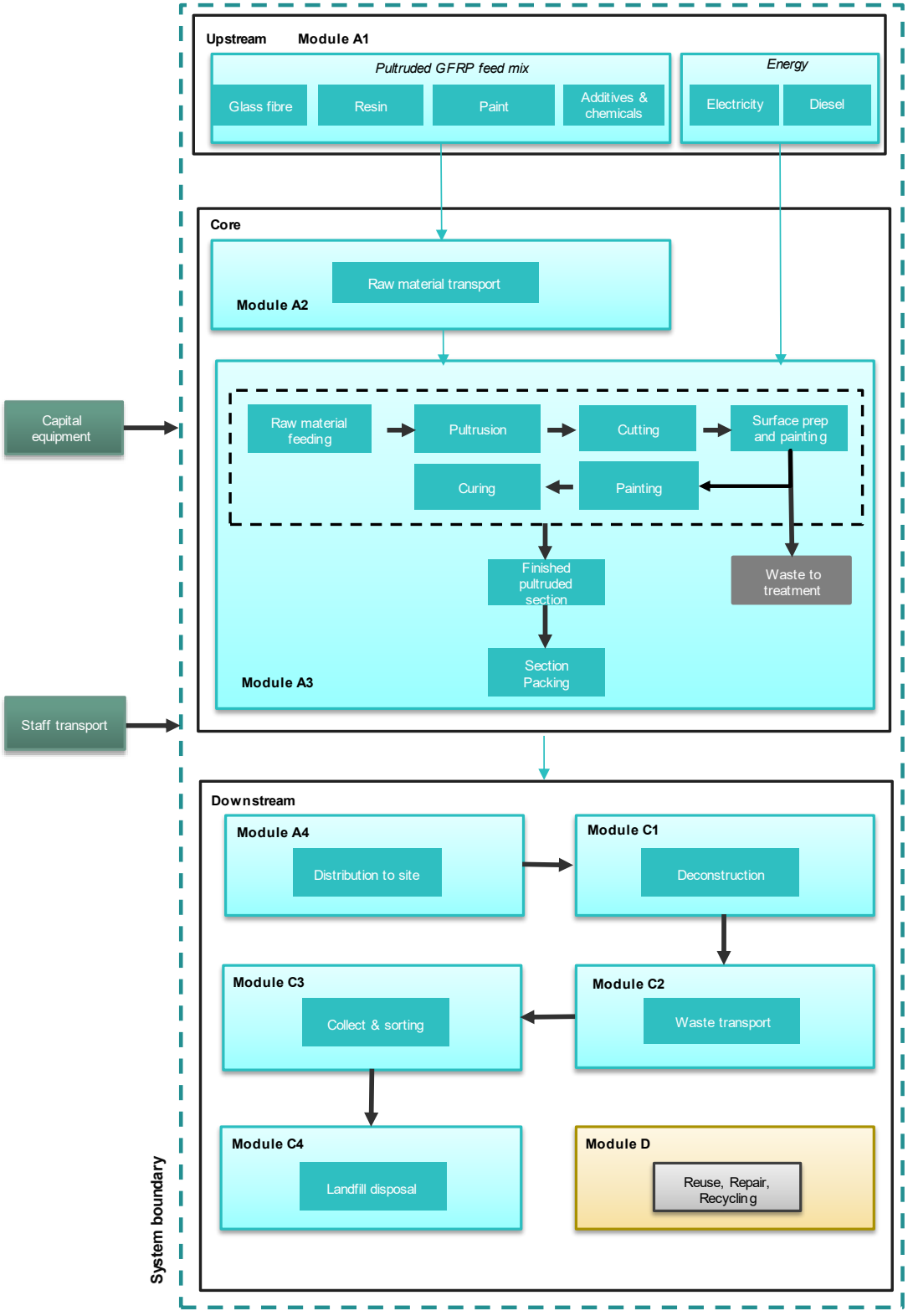


Figure 1 Wagners Pultruded GFRP EPD system boundary

Upstream processes

The upstream processes include those involved in Module A1 – Raw material supply. This module includes:

- Extraction, transport and manufacturing of raw materials.
- Generation of electricity from primary and secondary energy resources, also including their extraction, refining and transport for Modules A1 and A3.
- Processing up to the end-of-waste state or disposal of final residues including any packaging not leaving the factory gate with the product

Core Processes

The core processes include those involved in Module A2 and Module A3, including:

- External transportation of materials to the core processes and internal transport.
- Manufacturing of the Wagners Pultruded GFRP Sections.
- Packaging materials

Wagners Pultruded GFRP sections are manufactured in Wellcamp, Queensland. The raw matrials, the additives and chemicals are mixed in the resin, the resin-mixture then envelops the glass fibres and the entire composite is pultruded through a die that gives it the 5.2 mm x 100 mm x 100 mm cross sectional shape. The section is then cut to size, prepped, painted and cured. The finished product is checked and quality assured prior to packaging.

Downstream Processes

The downstream processes include those involved in Module A4 to C4, including:

- Transportation from the production gate to the construction site.
- Transport of equipment and use of materials for deconstruction at the end of life.
- Transport of waste generated at the end of life.
- Treatment of waste generated at the end of life.

Cut-off rules and Exclusion of Small Amounts

It is common practice in LCA/LCI protocols to propose exclusion limits for inputs and outputs that fall below a threshold % of the total, but with the exception that where the input/output has a “significant” impact it should be included. According to the PCR 2019:14, the Life Cycle Inventory data for a minimum of 95% of total inflows (mass and energy) per module to the upstream and core module shall be included, accounted as global warming potential (GWP) or energy consumption. Data gaps in included stages in the downstream modules shall be reported in the EPD, including an evaluation of their significance. In accordance with the PCR 2019:14 v1.2.5, the following system boundaries are applied to manufacturing equipment and employees:

- Environmental impact from infrastructure, construction, production equipment, and tools that are not directly consumed in the production process are not accounted for in the LCI. Capital equipment and buildings typically account for less than a few percent of nearly all LCIs and this is usually smaller than the error in the inventory data itself. For this project, it is assumed that capital equipment makes a negligible contribution to the impacts as per Frischknecht et al.[1] with no further investigation.

- Personnel-related impacts, such as transportation to and from work, are also not accounted for in the LCI. The impacts of employees are also excluded from inventory impacts on the basis that if they were not employed for this production or service function, they would be employed

[1]Frischknecht et. al., International Journal of Life Cycle Assessment, 12, 1-11, 2007

for another. It is very hard to decide what proportion of the impacts from their whole lives should count towards their employment. For this project, the impacts of employees are excluded.

Besides these exclusions, no energy or mass flows were excluded.

Allocation

In a process step where more than one type of product is generated, it is necessary to allocate the environmental stressors (inputs and outputs) from the process to the different products (functional outputs) in order to get product-based inventory data instead of process-based data. An allocation problem also occurs for multi-input processes. In an allocation procedure, the sum of the allocated inputs and outputs to the products shall be equal to the unallocated inputs and outputs of the unit process.

The following stepwise allocation principles shall be applied for multi-input/output allocations:

- The initial allocation step includes dividing up the system sub-processes and collecting the input and output data related to these sub-processes.
- The first (preferably) allocation procedure step for each sub-process is to partition the inputs and outputs of the system into their different products in a way that reflects the underlying physical relationships between them.
- The second (worst case) allocation procedure step is needed when physical relationship alone cannot be established or used as the basis for allocation. In this case, the remaining environmental inputs and outputs from a sub-process must be allocated between the products in a way that reflects other relationships between them, such as the economic value of the products.

Inputs and outputs related to the manufacture of the Pultruded GFRP section are based on measurements/calculations. For distribution related impacts, allocation has been used. Here, the total tonne.kilometer value of sections distributed to each destination for the year 2022 was divided by the number of meters distributed to each destination to arrive at the tonne.kilometer value for 1 m of Pultruded GFRP section, after which, the inventory process relevant to transport has been applied to obtain the impacts related to the distribution of 1 m of Pultruded GFRP.

Impacts of recycling and energy recovery of wastes at module A3 have been economically allocated as coproducts of module A1-A3, with an economic value of zero. No credits for recycling or energy recovery of manufacturing waste have been assigned.

Data quality and validation

The primary data used for the study (core module) is based on direct utility bills or feedstock quantities from the Wagners' procurement records. Primary data was carefully reviewed in order to ensure completeness, accuracy and representativeness of the data supplied. Contribution analysis was used to focus on the key pieces of data contributing to the environmental impact categories. The data was benchmarked against relevant benchmark data in Ecoinvent. Overall, the data was deemed to be of high quality for the core module. According to EN15804 A2, the data quality ranking is as follows: geographical representativeness – very good; technical representativeness – very good and time representativeness – very good.

Compliance with standards

The LCA and EPD have been developed to comply with:

- ISO 14040:2006 and ISO14044:2006+A1:2018 which describe the principles, framework, requirements and provides guidelines for life cycle assessment (LCA) (ISO, 2006; ISO, 2018).
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations -- Principles and procedures, which establishes the principles and specifies the procedures for developing Type III environmental declaration programmes and Type III environmental declarations (ISO, 2006).
- EN 15804+A2:2019: Sustainability of construction works – Environmental product declarations - Core rules for the product category of construction products (here after referred to as EN15804+A2).
- Product Category Rules (PCR) 2019:14, v1.2.5 – Construction products – Hereafter referred to as PCR 2019:14.
- General Programme Instructions (GPI) for the International EPD System V4.0 – containing instructions regarding methodology and the content that must be included in EPDs registered under the International EPD System.
- Instructions of EPD Australasia V3.0 – a regional annex to the general programme instructions of the International EPD System.

Key assumptions and considerations

- All primary (foreground) data collected for this EPD was sourced from Wagners via a Request for Information spreadsheet. This data was collected for the CY2022.
- It is assumed that a 50km distance will be travelled by road from destination port to installation site in the calculation of the A4 module.
- A 50km road transport distance is assumed from installation site to final disposal.
- It is assumed that 100% of the sections at end-of-life will be diverted to landfill. In some regions, the sections at end-of-life may be used in waste to electricity generation. This has been modelled as a separate scenario within the LCA. Product environmental impacts furnished in this EPD are for the more likely landfill at end-of-life scenario.

Of the assumptions above, only the end-of-life treatment related assumption is considered to have a greater than minor impact on the results. For this reason, the waste to energy end-of-life route has been modelled as a separate scenario. A separate set of results are provided for this scenario. All other assumptions are considered minor.

CONTENT INFORMATION

Content declaration

The following table provides a summary of the materials included in Wagners Square Hollow Pultruded GFRP Section WGN-S1000 and their relative composition by weight. There are no substances within the product that are listed in the Candidate List of Substances of Very High Concern.

Table 4 - Materials used for manufacturing of Pultruded GFRP section

Item	Mass (%)	Post-consumer material (%)	Renewable material (%)
Glass fibre	73.7%	0	0
Vinyl ester resin	15.6%	0	0
Monomer	2.0%	0	0
Additive 1	2.0%	0	0
Colour	0.2%	0	0
Additive 2	0.1%	0	0
Additive 3	0.2%	0	0
Mould release	0.0%	0	0
Surface Veil	0.2%	0	0
Base (Paint)	0.5%	0	0
Tint (Paint)	1.2%	0	0
Hardener (Paint)	0.1%	0	0
Thinner (Paint)	0.3%	0	0
Acetone	0.2%	0	0

Electricity mix

Background dataset from AusLCI was used in the LCA. The electricity mix in this dataset accounts coal-based power, natural gas, hydropower, photovoltaic power with contributions of 71%, 12%, 1%, 9%, respectively as well as minor contributions from coal seam methane, basasse, and oil based power generation systems.

Additional information on release of dangerous substances to indoor air, soil and water

The products are highly inert and are used predominantly in outdoor applications. They do not release any dangerous substances to indoor air, soil, or water.

Biogenic carbon

Table 5 – Biogenic carbon content in Pultruded GFRP system

Results per m of Pultruded GFRP section		
Biogenic carbon content	**Unit**	**Quantity**
Biogenic carbon content in product	Kg C	0.00E+00
Biogenic carbon content in packaging	Kg C	4.58E-01

Distribution Stage

Pultruded GFRP sections are distributed across the globe. Distances were calculated based on the proportion of total products distributed to each city and the estimated distance by truck and ship to each of these cities. The weighted average was 412 km by truck and 4102 km by ship.

Deconstruction and End of Life (Module C1-C4)

Two scenarios were assessed to ensure a comprehensive lifecycle analysis if the product:

1. Landfill at end-of-life
2. Waste to energy at end-of-life

The lifecycle of the Pultruded GFRP section depends on the respective structural design and use case. The use phase for the sections is not depicted as they involve maintenance free and generally durable products. The internal engineering team at Wagners confirms a Technical Service Life of 100 years for the Pultruded GFRP under harsh conditions.

Benefits and loads beyond the system boundary (Module D)

No recycling benefits have been claimed in this EPD as the product is considered to be landfilled at end-of-life.

ENVIRONMENTAL INFORMATION

The potential environmental impacts, use of resources and waste categories included in this EPD were calculated using the SimaPro v9.5 tool and are listed in Table 5. All tables from this point will contain the abbreviation only. The LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds and safety margins or risks.

Table 6 – Life cycle impact, resource and waste assessment categories, measurements and methods in accordance with EN15804+A2

Impact Category	Abbreviation	Measurement Unit	Assessment Method and Implementation
Potential Environmental Impacts			
Global warming potential (fossil)	GWP - Fossil	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2013
Global warming potential (biogenic)	GWP - Biogenic	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2013
Land use/ land transformation	GWP - Luluc	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2013
Total global warming potential	GWP - Total	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2013
Acidification potential	AP	mol H^+ eq.	Accumulated Exceedance, Seppälä et al. 2006, Posch et al., 2008
Eutrophication – aquatic freshwater	EP - freshwater	kg P equivalent	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe[2]
Eutrophication – aquatic marine	EP - marine	kg N equivalent	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
Eutrophication – terrestrial	EP – terrestrial	mol N equivalent	Accumulated Exceedance, Seppälä et al. 2006, Posch et al.
Photochemical ozone creation potential	POCP	kg NMVOC equivalents	LOTOS-EUROS, Van Zelm et al., 2008, as applied in ReCiPe
Abiotic depletion potential (elements)*	ADPE	kg Sb equivalents	CML (v4.1)
Abiotic depletion potential (fossil fuels)*	ADPF	MJ net calorific value	CML (v4.1)
Ozone depletion potential	ODP	kg CFC 11 equivalents	Steady-state ODPs, WMO 2014
Water Depletion Potential*	WDP	m^3 equivalent deprived	Available Water Remaining (AWARE) Boulay et al., 2016
Global warming potential, excluding biogenic uptake, emissions and storage	GWP-GHG	kg CO_2 equivalents (GWP100)	CML (v4.1)
Resource use			
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ, net calorific value	ecoinvent version 3.6 and expanded by PRé Consultants[3]

[2] EN 15804:2012+A2:2019 specifies that the unit for the indicator for Eutrophication aquatic freshwater shall be kg PO4 eq, although the reference given ("EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe") uses the unit kg P eq. This is likely a typographical error in EN 15804, which is expected to be corrected in a future revision. Until this has been corrected, results for Eutrophication aquatic freshwater shall be given in both kg PO4 eq and kg P eq. in the EPD.

[3] Method to calculate Cumulative Energy Demand (CED), based on the method published by Ecoinvent version 2.0 and expanded by PRé Consultants for raw materials available in the SimaPro database.

Impact Category	Abbreviation	Measurement Unit	Assessment Method and Implementation
Use of renewable primary energy resources used as raw materials	PERM	MJ, net calorific value	Manual for direct inputs[4]
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PERT	MJ, net calorific value	ecoinvent version 3.6 and expanded by PRé Consultants
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ, net calorific value	Manual for direct inputs[5]
Use of non- renewable primary energy resources used as raw materials	PENRM	MJ, net calorific value	ecoinvent version 3.6 and expanded by PRé Consultants
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PENRT	MJ, net calorific value	ecoinvent version 3.6 and expanded by PRé Consultants [6]
Use of secondary material	SM	kg	Manual for direct inputs
Use of renewable secondary fuels	RSF	MJ, net calorific value	Manual for direct inputs
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value	Manual for direct inputs
Use of net fresh water	FW	m^3	ReCiPe 2016
Waste categories			
Hazardous waste disposed	HWD	kg	EDIP 2003 (v1.05)
Non-hazardous waste disposed	NHWD	kg	EDIP 2003 (v1.05) [7]
Radioactive waste disposed/stored	RWD	kg	EDIP 2003 (v1.05)
Additional environmental impact indicators			
Particulate matter	Potential incidence of disease due to PM emissions (PM)	Disease incidence	SETAC-UNEP, Fantke et al. 2016
Ionising radiation - human health**	Potential Human exposure efficiency relative to U235 (IRP)	kBq U-235 eq	Human Health Effect model
Eco-toxicity (freshwater)*	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	CTUe	USEtox
Human toxicity potential - cancer effects*	Potential Comparative Toxic Unit for humans (HTP-c)	CTUh	USEtox

[4] Calculated based on the lower heating value of renewable raw materials.
[5] Calculated based on the lower heating value of non-renewable raw materials.
[6] Calculated as sum of *Non-renewable, fossil*, *Non-renewable, nuclear* and *Non-renewable, biomass*.
[7] Calculated as sum of *Bulk waste* and *Slags/ash*.

Impact Category	Abbreviation	Measurement Unit	Assessment Method and Implementation
Human toxicity potential - non cancer effects*	Potential Comparative Toxic Unit for humans (HTP-nc)	CTUh	USEtox
Soil quality*	Potential soil quality index (SQP)	dimensionless	Soil quality index (LANCA®)

Table 7 – Environmental impact indicators in accordance with EN15804+A1

Impact Category	Abbreviation	Measurement Unit (eq. = equivalence)	Assessment Method and Implementation
Global warming potential (GWP100)[8]	GWP	kg CO_2 eq.	CML (v4.02) based on IPCC AR4
Ozone depletion potential	ODP	kg CFC 11 eq.	CML (v4.02) based on WMO 1999
Acidification potential	AP	kg SO_2 e eq.	CML (v4.02)
Eutrophication potential	EP	kg PO_4^{3-} eq.	CML (v4.02)
Photochemical ozone creation potential	POCP	kg C_2H_4 eq.	CML (v4.2)
Abiotic depletion potential for non-fossil resources	ADPE	kg Sb eq.	CML (v4.2)
Abiotic depletion potential for fossil resources	ADPF	MJ net calorific value	CML (v4.2)

[8] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero.

ENVIRONMENTAL INFORMATION – WAGNERS PULTRUDED GFRP SECTION – LANDFILL AT END OF LIFE

Table 8 – Environmental impacts per metre of Pultruded GFRP produced (results are in accordance with EN15804+A2:2019)

ABR	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - F	kg CO_2 eq.	1.63E+01	3.07E-01	0.00E+00	1.36E-02	0.00E+00	1.50E-02	0.00E+00
GWP – B**	kg CO_2 eq.	2.93E-02	2.13E-05	0.00E+00	1.02E-06	0.00E+00	1.01E-05	0.00E+00
GWP - Luluc	kg CO_2 eq.	1.16E-01	5.95E-06	0.00E+00	6.33E-09	0.00E+00	6.19E-09	0.00E+00
GWP – T	**kg CO_2 eq.**	**1.64E+01**	**3.07E-01**	**0.00E+00**	**1.36E-02**	**0.00E+00**	**1.50E-02**	**0.00E+00**
ODP	kg CFC 11 eq.	6.99E-07	2.26E-08	0.00E+00	2.11E-09	0.00E+00	2.05E-09	0.00E+00
AP	mol H^+ eq.	1.01E-01	6.33E-03	0.00E+00	8.65E-05	0.00E+00	3.92E-05	0.00E+00
EP - F2	kg P eq.	3.19E-03	1.07E-06	0.00E+00	1.38E-09	0.00E+00	1.72E-08	0.00E+00
EP - M	kg N eq.	2.16E-02	1.57E-03	0.00E+00	2.01E-05	0.00E+00	7.02E-06	0.00E+00
EP - T	mol N eq.	2.26E-01	1.74E-02	0.00E+00	2.24E-04	0.00E+00	7.66E-05	0.00E+00
POCP	kg NMVOC eq.	7.20E-02	4.57E-03	0.00E+00	5.53E-05	0.00E+00	2.04E-05	0.00E+00
ADP*	kg Sb eq.	8.67E-04	2.04E-09	0.00E+00	1.55E-11	0.00E+00	1.51E-11	0.00E+00
ADPF*	MJ	2.18E+02	3.89E+00	0.00E+00	1.83E-01	0.00E+00	2.06E-01	0.00E+00
WDP*	m^3	3.34E+00	1.30E-02	0.00E+00	1.18E-03	0.00E+00	1.41E-03	0.00E+00
Acronyms	GWP-F= Global Warming Potential fossil fuels; GWP-B = Global Warming Potential biogenic; GWP-Luluc = Global Warming Potential land use and land use change; GWP-Total = Global Warming Potential total; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption							

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

*** As per Annex 2 of the PCR 1.2.5, the biogenic CO_2 of packaging material within A1-A3 has been balanced out within the product stage.*

Table 9 – Use of resources per metre of Pultruded GFRP produced (results are in accordance with EN15804+A2:2019)

Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	4.27E+01	6.09E-03	0.00E+00	2.64E-04	0.00E+00	2.72E-03	0.00E+00
PERM	MJ	1.14E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	**5.41E+01**	**6.09E-03**	**0.00E+00**	**2.64E-04**	**0.00E+00**	**2.72E-03**	**0.00E+00**
PENRE	MJ	1.55E+02	3.89E+00	0.00E+00	1.83E-01	0.00E+00	-3.58E+01	0.00E+00
PENRM	MJ	6.33E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.60E+01	0.00E+00
PENRT	MJ	**2.18E+02**	**3.89E+00**	**0.00E+00**	**1.83E-01**	**0.00E+00**	**2.06E-01**	**0.00E+00**
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	7.55E-02	4.07E-04	0.00E+00	4.38E-05	0.00E+00	5.96E-04	0.00E+00

Table 10 – Waste generated per m*etre* of *Pultruded GFRP produced* (results are in accordance with EN15804+A2:2019)

Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste disposed	kg	5.41E-04	1.06E-05	0.00E+00	4.36E-08	0.00E+00	4.27E-08	0.00E+00
Non-hazardous waste disposed	kg	1.11E+00	2.08E-04	0.00E+00	8.32E-06	0.00E+00	3.90E+00	0.00E+00
Radioactive waste disposed	kg	1.67E-04	9.08E-08	0.00E+00	1.13E-11	0.00E+00	1.14E-11	0.00E+00

Table 11 – Output flows generated per metre of Pultruded GFRP produced (results are in accordance with EN15804+A2:2019)

Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	2.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFRE	kg	3.98E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE - e	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE - t	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 12 – Additional environmental impact per metre of Pultruded GFRP produced (results are in accordance with EN15804+A2:2019)

Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-GHG	kg CO2 eq	1.46E+01	3.00E-01	0.00E+00	1.34E-02	0.00E+00	1.49E-02	0.00E+00
PM	disease incidence	8.10E-07	1.66E-08	0.00E+00	1.32E-09	0.00E+00	2.38E-10	0.00E+00
IRP	kBq U-235 eq	6.81E-01	4.57E-04	0.00E+00	3.21E-07	0.00E+00	3.15E-07	0.00E+00
ETP - fw	CTUe	3.37E+02	1.36E+00	0.00E+00	5.34E-02	0.00E+00	5.24E-02	0.00E+00
HTP - c	CTUh	8.01E-09	7.35E-12	0.00E+00	4.55E-13	0.00E+00	6.33E-13	0.00E+00
HTP - nc	CTUh	2.21E-07	6.68E-10	0.00E+00	3.25E-11	0.00E+00	5.08E-11	0.00E+00
SQP	Pt	1.68E+02	1.08E-02	0.00E+00	8.25E-04	0.00E+00	7.47E-03	0.00E+00

Table 13 – Environmental impacts per metre of Pultruded GFRP produced (results are in accordance with EN15804+A1:2013)

Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP (A1)	kg CO_2 eq	1.50E+01	3.02E-01	0.00E+00	1.34E-02	0.00E+00	1.49E-02	0.00E+00
ODP (A1)	kg CFC-11 eq	5.67E-07	1.79E-08	0.00E+00	1.67E-09	0.00E+00	1.62E-09	0.00E+00
AP (A1)	kg SO_2 eq	7.83E-02	4.82E-03	0.00E+00	4.39E-05	0.00E+00	2.63E-05	0.00E+00
EP (A1)	kg PO_{4}-- eq	1.76E-02	5.50E-04	0.00E+00	8.16E-06	0.00E+00	3.72E-06	0.00E+00
POCP (A1)	kg C_2H_4 eq	3.71E-03	1.43E-04	0.00E+00	2.81E-06	0.00E+00	1.36E-06	0.00E+00
ADPE (A1)	kg Sb eq	8.67E-04	2.05E-09	0.00E+00	1.57E-11	0.00E+00	1.70E-11	0.00E+00
ADPF (A1)	MJ	2.46E+02	3.79E+00	0.00E+00	1.79E-01	0.00E+00	2.08E-01	0.00E+00

ENVIRONMENTAL INFORMATION – WAGNERS PULTRUDED GFRP SECTION – WASTE TO ENERGY AT END OF LIFE

Table 8 – Environmental impacts per metre of Pultruded GFRP produced (results are in accordance with EN15804+A2:2019)

ABR	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP - F	kg CO_2 eq.	1.63E+01	3.07E-01	0.00E+00	1.36E-02	9.58E+00	0.00E+00	-2.08E+00
GWP – B**	kg CO_2 eq.	2.93E-02	2.13E-05	0.00E+00	1.02E-06	1.57E-02	0.00E+00	-4.82E-03
GWP - Luluc	kg CO_2 eq.	1.16E-01	5.95E-06	0.00E+00	6.33E-09	2.04E-03	0.00E+00	-1.62E-07
GWP – T	**kg CO_2 eq.**	**1.64E+01**	**3.07E-01**	**0.00E+00**	**1.36E-02**	**9.59E+00**	**0.00E+00**	**-2.08E+00**
ODP	kg CFC 11 eq.	6.99E-07	2.26E-08	0.00E+00	2.11E-09	6.26E-07	0.00E+00	-1.49E-08
AP	mol H^+ eq.	1.01E-01	6.33E-03	0.00E+00	8.65E-05	1.19E-02	0.00E+00	-1.52E-02
EP - F2	kg P eq.	3.19E-03	1.07E-06	0.00E+00	1.38E-09	2.56E-03	0.00E+00	-3.46E-06
EP - M	kg N eq.	2.16E-02	1.57E-03	0.00E+00	2.01E-05	2.99E-03	0.00E+00	-3.32E-03
EP - T	mol N eq.	2.26E-01	1.74E-02	0.00E+00	2.24E-04	2.86E-02	0.00E+00	-3.59E-02
POCP	kg NMVOC eq.	7.20E-02	4.57E-03	0.00E+00	5.53E-05	1.02E-02	0.00E+00	-9.00E-03
ADP*	kg Sb eq.	8.67E-04	2.04E-09	0.00E+00	1.55E-11	1.02E-06	0.00E+00	-2.13E-10
ADPF*	MJ	2.18E+02	3.89E+00	0.00E+00	1.83E-01	4.31E+01	0.00E+00	-4.78E+00
WDP*	m^3	3.34E+00	1.30E-02	0.00E+00	1.18E-03	1.15E+00	0.00E+00	-7.41E-01
Acronyms	GWP-F= Global Warming Potential fossil fuels; GWP-B = Global Warming Potential biogenic; GWP-Luluc = Global Warming Potential land use and land use change; GWP-Total = Global Warming Potential total; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption							

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

*** As per Annex 2 of the PCR 1.2.5, the biogenic CO_2 of packaging material within A1-A3 has been balanced out within the product stage.*

Table 9 – Use of resources per metre of Pultruded GFRP produced (results are in accordance with EN15804+A2:2019)

Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	4.27E+01	6.09E-03	0.00E+00	2.64E-04	1.58E+00	0.00E+00	-1.14E+00
PERM	MJ	1.14E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	**5.41E+01**	**6.09E-03**	**0.00E+00**	**2.64E-04**	**1.58E+00**	**0.00E+00**	**-1.14E+00**
PENRE	MJ	1.55E+02	3.89E+00	0.00E+00	1.83E-01	4.31E+01	0.00E+00	-3.12E+01
PENRM	MJ	6.33E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-3.60E+01
PENRT	MJ	**2.18E+02**	**3.89E+00**	**0.00E+00**	**1.83E-01**	**4.31E+01**	**0.00E+00**	**-4.78E+00**
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	7.55E-02	4.07E-04	0.00E+00	4.38E-05	1.73E-02	0.00E+00	-1.59E-03

Table 10 – Waste generated per m*etre* of *Pultruded GFRP produced* (results are in accordance with EN15804+A2:2019)

Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste disposed	kg	5.41E-04	1.06E-05	0.00E+00	4.36E-08	2.90E-04	0.00E+00	-6.42E-07
Non-hazardous waste disposed	kg	1.11E+00	2.08E-04	0.00E+00	8.32E-06	3.90E+00	0.00E+00	-1.28E-01
Radioactive waste disposed	kg	1.67E-04	9.08E-08	0.00E+00	1.13E-11	3.56E-05	0.00E+00	-1.61E-10

Table 11 – Output flows generated per metre of Pultruded GFRP produced (results are in accordance with EN15804+A2:2019)

Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	2.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFRE	kg	3.98E-02	0.00E+00	0.00E+00	0.00E+00	3.92E+00	0.00E+00	0.00E+00
EE - e	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE - t	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 12 – Additional environmental impact per metre of Pultruded GFRP produced (results are in accordance with EN15804+A2:2019)

Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP-GHG[9]	kg CO2 eq	1.46E+01	3.00E-01	0.00E+00	1.34E-02	9.47E+00	0.00E+00	-2.04E+00
PM	disease incidence	8.10E-07	1.66E-08	0.00E+00	1.32E-09	1.26E-07	0.00E+00	-9.70E-08
IRP	kBq U-235 eq	6.81E-01	4.57E-04	0.00E+00	3.21E-07	1.37E-01	0.00E+00	-4.69E-06
ETP - fw	CTUe	3.37E+02	1.36E+00	0.00E+00	5.34E-02	1.44E+02	0.00E+00	-2.70E+00
HTP - c	CTUh	8.01E-09	7.35E-12	0.00E+00	4.55E-13	5.75E-10	0.00E+00	-3.36E-10
HTP - nc	CTUh	2.21E-07	6.68E-10	0.00E+00	3.25E-11	4.01E-08	0.00E+00	-8.65E-09
SQP	Pt	1.68E+02	1.08E-02	0.00E+00	8.25E-04	2.20E+00	0.00E+00	-5.20E+00

Table 13 – Environmental impacts per metre of Pultruded GFRP produced (results are in accordance with EN15804+A1:2013)

Indicator	Unit	A1-A3	A4	C1	C2	C3	C4	D
GWP (A1)	kg CO_2 eq	1.50E+01	3.02E-01	0.00E+00	1.34E-02	9.51E+00	0.00E+00	-2.05E+00
ODP (A1)	kg CFC-11 eq	5.67E-07	1.79E-08	0.00E+00	1.67E-09	6.26E-07	0.00E+00	-1.18E-08
AP (A1)	kg SO_2 eq	7.83E-02	4.82E-03	0.00E+00	4.39E-05	9.63E-03	0.00E+00	-5.03E-03
EP (A1)	kg PO_{4}-- eq	1.76E-02	5.50E-04	0.00E+00	8.16E-06	8.92E-03	0.00E+00	-1.23E-03
POCP (A1)	kg C_2H_4 eq	3.71E-03	1.43E-04	0.00E+00	2.81E-06	4.52E-04	0.00E+00	-1.16E-04
ADPE (A1)	kg Sb eq	8.67E-04	2.05E-09	0.00E+00	1.57E-11	1.03E-06	0.00E+00	-3.60E-09

[9] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero.

ADPF (A1)	MJ	2.46E+02	3.79E+00	0.00E+00	1.79E-01	4.38E+01	0.00E+00	-2.33E+01

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