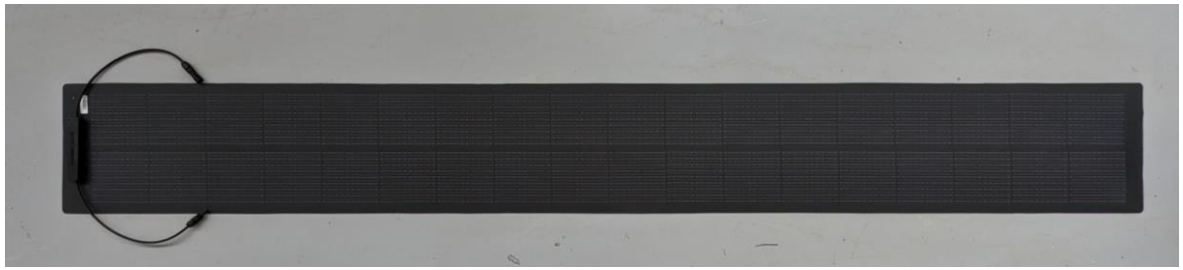
ENVIRONMENTAL PRODUCT DECLARATION

IN ACCORDANCE WITH EN 15804+A2 & ISO 14025 / ISO 21930

2 x 18 Cell Semi-flexible Solar Panel

Verditek Solar Italy srl



EPD HUB, HUB-0480

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GENERAL INFORMATION

MANUFACTURER

Manufacturer	Verditek Solar Italy srl
Address	Via Pogliano, 26 - 20045 Lainate (Milan) - Italy
Contact details	enquiries@verditek.com
Website	https://verditek.com/

EPD STANDARDS, SCOPE AND VERIFICATION

Program operator	EPD Hub, hub@epdhub.com
Reference standard	EN 15804+A2:2019 and ISO 14025
PCR	EPD Hub Core PCR version 1.0, 1 Feb 2022
Sector	Construction product
Category of EPD	Third party verified EPD
Scope of the EPD	Cradle-to-gate with modules C1-C4, D
EPD author	Sam McGarrick, Blue Marble
EPD verification	Independent verification of this EPD and data, according to ISO 14025: ☐ Internal certification ☑ External verification
EPD verifier	Magaly Gonzalez, as an authorized verifier acting for EPD Hub Limited

The manufacturer has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programs may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804 and if they are not compared in a building context.

PRODUCT

Product name	2 x 18 Cell Semi-flexible Solar Panel
Additional labels	-
Product reference	VSG01M - 2x18
Place of production	Milan, Italy
Period for data	1st January 2022 - 31st December 2022
Averaging in EPD	No averaging
Variation in GWP-fossil for A1-A3	- %

ENVIRONMENTAL DATA SUMMARY

Declared unit	1m2
Declared unit mass	2.37 kg
GWP-fossil, A1-A3 (kgCO2e)	3.43E1
GWP-total, A1-A3 (kgCO2e)	3.26E1
Secondary material, inputs (%)	38.0
Secondary material, outputs (%)	53.1
Total energy use, A1-A3 (kWh)	170.0
Total water use, A1-A3 (m3e)	3.5E-1

PRODUCT AND MANUFACTURER

ABOUT THE MANUFACTURER

Verditek is the clean technology company behind the development and production of lightweight, flexible solar panels, providing new energy solutions to cover surfaces previously never considered suitable for solar power. Ten times lighter than conventional panels, Verditek is providing a wide range of solar solutions from powering a mobile military campsite to domestic holiday caravans.

Our solar panels can be assembled and dismantled with ease. They can be installed using simple clamps, harnesses or industrial adhesives, providing solar energy on the move. Our solar panels are ultralightweight. We have integrated high-efficiency monocrystalline solar cells into a lightweight polymer laminate panel. They are 10 times lighter than conventional solar panels whilst harvesting the same amount of power.

Our solar panels are not restricted to straight surfaces. They can bend up to 35% using standard 160µ thick crystalline cells due to the use of polymer as the replacement for glass.

Our technology is less than 3mm thick and can be applied to a surface to minimize or eliminate wind load. We work where conventional PV cannot.

PRODUCT DESCRIPTION

Lightweight and semi-flexible solar module with front-sheet containing two rows of 18 bifacial high-efficiency mono-crystalline silicon cells.

Further information can be found at https://verditek.com/.

PRODUCT RAW MATERIAL MAIN COMPOSITION

Raw material category	Amount, mass- %	Material origin
Metals	2	EU
Minerals	13	China
Fossil materials	85	EU and China
Bio-based materials	-	-

BIOGENIC CARBON CONTENT

Product's biogenic carbon content at the factory gate

Biogenic carbon content in product, kg C	0
Biogenic carbon content in packaging, kg C	0.529

FUNCTIONAL UNIT AND SERVICE LIFE

Declared unit	1m2
Mass per declared unit	2.37 kg
Functional unit	-
Reference service life	-

SUBSTANCES, REACH - VERY HIGH CONCERN

The product does not contain any REACH SVHC substances in amounts greater than 0,1 % (1000 ppm).

PRODUCT LIFE-CYCLE

SYSTEM BOUNDARY

This EPD covers the life-cycle modules listed in the following table.

Product stage			Assembly stage		Use stage							End of life stage				Beyond the system boundaries		
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D		
x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	x	x	x	x	x		
Raw materials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstr./demol.	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling

Modules not declared = MND. Modules not relevant = MNR.

MANUFACTURING AND PACKAGING (A1-A3)

The environmental impacts considered for the product stage cover the manufacturing of raw materials used in the production as well as packaging materials and other ancillary materials. Also, fuels used by machines, and handling of waste formed in the production processes at the manufacturing facilities are included in this stage. The study also considers the material losses occurring during the manufacturing processes as well as losses during electricity transmission.

The flexible solar module is made of a number of assemblies consisting of a Backsheet, Encapsulant, Solar Cells, Frontsheet, G-wire, Bussing-ribbons, Back-ribbons, Junction box, Glue, Sealant and EPE. The components are manufactured in different countries and assembled together at the manufacturing facility. Main materials present in the components include Polyethylene terephthalate, polyolefin encapsulant and low density polyethylene. The manufacturing process requires electricity for the different equipment - lay-up table and lamination. There are 10% production losses recorded from lamination and trimming to size of the frontsheet, backsheet & encapsulant. The plastic manufacturing waste produced at the plant is directed to landfill. No wastewater is generated. A wooden pallet, cardboard box and packaging film are used as a packaging material for transporting the product from the factory gate.

TRANSPORT AND INSTALLATION (A4-A5)

Transportation impacts occurred from final products delivery to construction site (A4) cover fuel direct exhaust emissions, environmental impacts of fuel production, as well as related infrastructure emissions.

All industrial processes from raw material acquisition and pre-processing, production and end-of-life management are included. Product distribution and installation are not included.

PRODUCT USE AND MAINTENANCE (B1-B7)

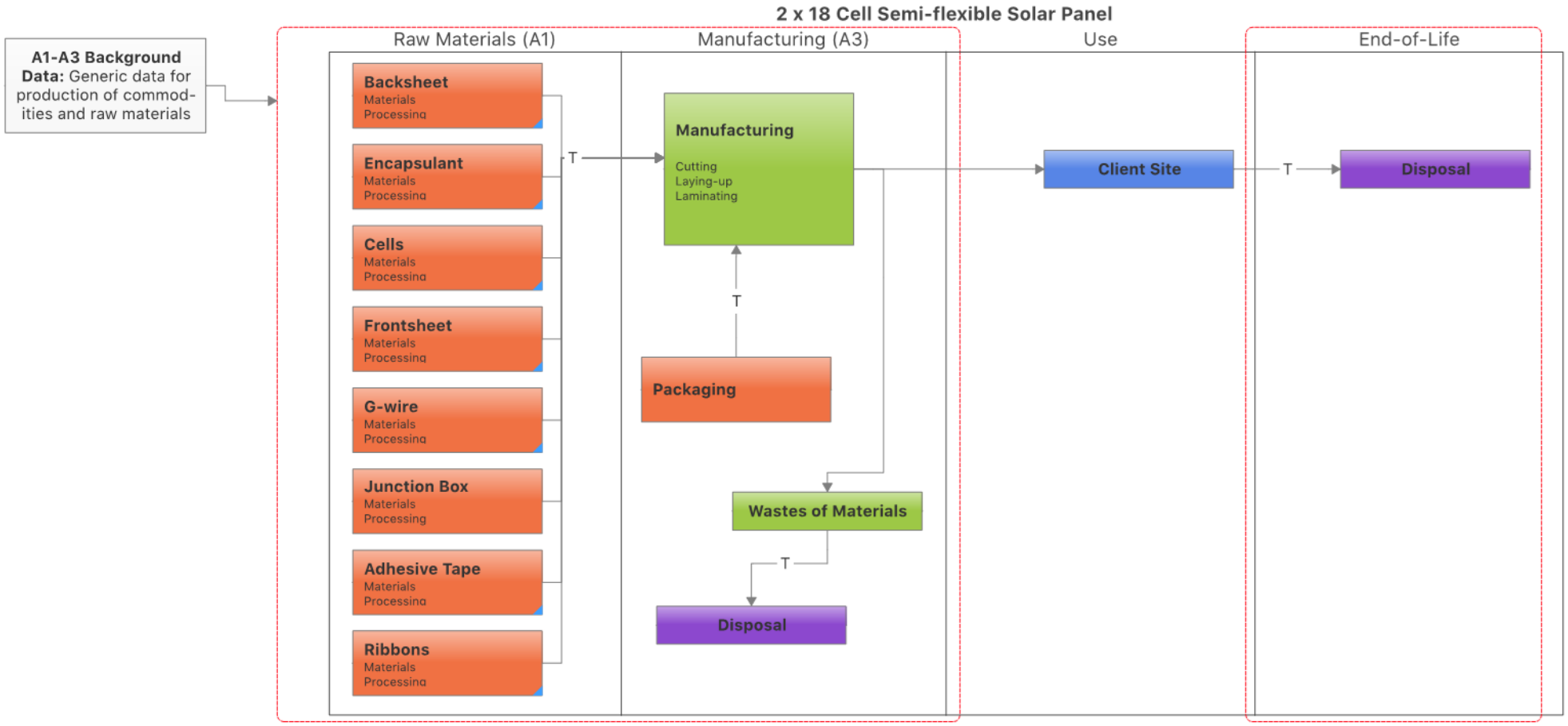
In this LCA study the use phase is not covered, assuming there are no use emissions or replacements.
Air, soil, and water impacts during the use phase have not been studied.

PRODUCT END OF LIFE (C1-C4, D)

Consumption of energy in de-construction process is considered. It is assumed that the waste is collected separately and transported to the waste treatment center (assumed to be in the UK). Transportation distance to treatment is assumed as 100 km and the transportation method is assumed to be lorry (C2). Due to the absence of specific data in this study, conservative estimations have been made involving landfill of the product. Packaging components are assumed to be incinerated or recycled. Module C3 accounts for energy and resource inputs for sorting

and treating these waste streams for recycling and incineration with energy recovery with efficiency greater than 60%. Additionally, waste that is incinerated without energy recovery or landfilled is included in Module C4 while the flow not included in Module D for benefits. Due to the material and energy recovery potential of parts in the end of life packaging, recycled raw materials lead to avoided virgin material production, while the energy recovered from incineration displaces electricity and heat production (D). The benefits and loads of incineration and recycling are included in Module D.

MANUFACTURING PROCESS



LIFE-CYCLE ASSESSMENT

CUT-OFF CRITERIA

The study does not exclude any modules or processes which are stated mandatory in the reference standard and the applied PCR. The study does not exclude any hazardous materials or substances. The study includes all major raw material and energy consumption. All inputs and outputs of the unit processes, for which data is available for, are included in the calculation. There is no neglected unit process more than 1% of total mass or energy flows. The module specific total neglected input and output flows also do not exceed 5% of energy usage or mass.

This LCA study includes the provision of all materials, transportation to factory gate, energy and emission flows, and end of life processing of product. The use phase is not covered, assuming there are no use emissions or replacements. All industrial processes from raw material acquisition and pre-processing, production, and end-of-life management are included. Product distribution and installation are not included. For easier modelling and because of lack of accuracy in available modelling resources, some constituents under 0,1% of product mass are excluded. These include some ancillary materials which are used in the product manufacturing only in very small amounts and have a negligible impact on the emissions of the product. The production of capital equipment, construction activities, and infrastructure, maintenance and operation of capital equipment, personnel-related activities, energy and water use related to company management and sales activities are excluded.

ALLOCATION, ESTIMATES AND ASSUMPTIONS

Allocation is required if some material, energy, and waste data cannot be measured separately for the product under investigation. All allocations are done as per the reference standards and the applied PCR. In this study, allocation has been done in the following ways:

Data type	Allocation
Raw materials	No allocation
Packaging materials	No allocation
Ancillary materials	No allocation
Manufacturing energy and waste	No allocation

AVERAGES AND VARIABILITY

Type of average	No averaging
Averaging method	Not applicable
Variation in GWP-fossil for A1-A3	- %

There is no average result considered in this study since this EPD refers to one specific product produced in one production plant.

LCA SOFTWARE AND BIBLIOGRAPHY

This EPD has been created using One Click LCA EPD Generator. The LCA and EPD have been prepared according to the reference standards and ISO 14040/14044. Ecoinvent v3.8 and One Click LCA databases were used as sources of environmental data.

Created with One Click LCA

ENVIRONMENTAL IMPACT DATA

CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP – total[1)]	kg CO_2e	2.55E1	3.31E0	3.86E0	3.26E1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.66E-1	3.75E-2	-1.13E0	5.26E-1	2.87E-1
GWP – fossil	kg CO_2e	2.53E1	3.3E0	5.72E0	3.43E1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.65E-1	3.75E-2	2.28E-2	2.91E-1	-5.44E-1
GWP – biogenic	kg CO_2e	1.05E-1	4.59E-4	-1.87E0	-1.77E0	0E0	MND	MND	MND	MND	MND	MND	MND	MND	3.03E-5	1.45E-5	-1.15E0	2.35E-1	8.3E-1
GWP – LULUC	kg CO_2e	3.31E-2	3.3E-4	6.6E-3	4E-2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.65E-5	1.38E-5	2.83E-5	3E-4	6.2E-4
Ozone depletion pot.	kg CFC_{-11}e	1.28E-5	7.47E-7	6.94E-7	1.43E-5	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	3.54E-8	8.63E-9	8.1E-10	8.68E-9	-4.43E-8
Acidification potential	mol H^+e	1.64E-1	2.19E-2	2.73E-2	2.13E-1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.72E-3	1.59E-4	1.15E-4	3.21E-4	-2.37E-3
EP-freshwater[2)]	kg Pe	1.07E-3	5.76E-6	1.94E-4	1.27E-3	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	5.48E-7	3.07E-7	1.08E-6	1.57E-6	-1.31E-5
EP-marine	kg Ne	2.26E-2	7.28E-3	5.91E-3	3.58E-2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	7.61E-4	4.72E-5	2.68E-5	3.35E-4	-5.92E-4
EP-terrestrial	mol Ne	2.53E-1	8E-2	5.59E-2	3.89E-1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	8.35E-3	5.21E-4	2.61E-4	1.05E-3	-6.91E-3
POCP ("smog")[3)]	kg NMVOCe	8.21E-2	2.08E-2	1.58E-2	1.19E-1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.3E-3	1.67E-4	8.39E-5	4.07E-4	-1.75E-3
ADP-minerals & metals[4)]	kg Sbe	1.77E-3	1.21E-6	1.82E-5	1.79E-3	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	8.39E-8	8.8E-8	3.03E-7	1.42E-7	-2.11E-6
ADP-fossil resources	MJ	3.98E2	4.53E1	9.32E1	5.37E2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.23E0	5.64E-1	2.42E-1	8.33E-1	-7.82E0
Water use[5)]	m^3e depr.	9.67E0	7.28E-2	3.49E0	1.32E1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	5.98E-3	2.52E-3	6.15E-3	1.11E-2	-1.66E-1

1) GWP = Global Warming Potential; 2) EP = Eutrophication potential. Required characterisation method and data are in kg P-eq. Multiply by 3,07 to get PO4e; 3) POCP = Photochemical ozone formation; 4) ADP = Abiotic depletion potential; 5) EN 15804+A2 disclaimer for Abiotic depletion and Water use and optional indicators except Particulate matter and Ionizing radiation, human health. The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

ADDITIONAL (OPTIONAL) ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Particulate matter	Incidence	1.13E-6	4.34E-8	1.86E-7	1.35E-6	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	4.61E-8	4.32E-9	7.36E-9	6.24E-9	-5.46E-8
Ionizing radiation[6)]	kBq U235e	2.32E0	2.07E-1	7.21E-1	3.25E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.02E-2	2.68E-3	3.59E-3	3.54E-3	-5.4E-2
Ecotoxicity (freshwater)	CTUe	7.95E2	2.53E1	6.93E1	8.9E2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.34E0	5.07E-1	3.92E0	2.26E0	-2.8E1
Human toxicity, cancer	CTUh	2.38E-8	4.07E-10	3.13E-9	2.73E-8	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	5.13E-11	1.25E-11	8E-11	1.5E-9	-3.74E-10
Human tox. non-cancer	CTUh	1.07E-6	3.95E-8	5.59E-8	1.17E-6	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	9.68E-10	5.02E-10	6.8E-10	9.29E-8	-7.17E-9
SQP[7)]	-	1.03E2	6.88E0	1.4E2	2.49E2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.89E-1	6.49E-1	1.15E-1	1.91E0	-2.84E1

6) EN 15804+A2 disclaimer for Ionizing radiation, human health. This 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; 7) SQP = Land use related impacts/soil quality.

USE OF NATURAL RESOURCES

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Renew. PER as energy[8)]	MJ	1.09E2	1.63E-1	3.06E1	1.4E2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.27E-2	6.35E-3	3.2E-2	9.52E-2	-5.53E0
Renew. PER as material	MJ	0E0	0E0	1.68E1	1.68E1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	-1.68E1	1.94E1
Total use of renew. PER	MJ	1.09E2	1.63E-1	4.74E1	1.57E2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.27E-2	6.35E-3	3.2E-2	-1.67E1	1.39E1
Non-re. PER as energy	MJ	3.41E2	4.53E1	8.39E1	4.7E2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.23E0	5.64E-1	2.42E-1	8.33E-1	-7.74E0
Non-re. PER as material	MJ	5.78E1	0E0	4.68E0	6.25E1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	-6.24E1	-8.55E-2
Total use of non-re. PER	MJ	3.98E2	4.53E1	8.86E1	5.32E2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.23E0	5.64E-1	2.42E-1	-6.11E1	-7.83E0
Secondary materials	kg	5.46E-2	3.16E-3	8.43E-1	9E-1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	8.71E-4	1.56E-4	4.66E-4	3.38E-3	8.23E-2
Renew. secondary fuels	MJ	2.96E-2	3.12E-5	2.32E-1	2.61E-1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.85E-6	1.58E-6	1.82E-6	9.62E-6	1.43E-2
Non-ren. secondary fuels	MJ	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Use of net fresh water	m^3	2.49E-1	1.89E-3	9.87E-2	3.5E-1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.35E-4	7.3E-5	1.71E-4	7.67E-4	-2.85E-3

8) PER = Primary energy resources.

END OF LIFE – WASTE

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste	kg	1.8E0	1.71E-2	4.11E-1	2.23E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.98E-3	7.47E-4	2.44E-3	3.12E-1	-2.35E-2
Non-hazardous waste	kg	5.28E1	2.26E-1	7.54E0	6.06E1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.09E-2	1.23E-2	4.93E-2	2.27E0	-7.57E-1
Radioactive waste	kg	9.72E-4	3.27E-4	2.39E-4	1.54E-3	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.57E-5	3.77E-6	1.07E-6	3.92E-7	-2.05E-5

END OF LIFE – OUTPUT FLOWS

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for re-use	kg	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0
Materials for recycling	kg	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	8.26E-1	0E0	0E0
Materials for energy rec	kg	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	4.32E-1	0E0	0E0
Exported energy	MJ	0E0	0E0	0E0	0E0	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	0E0	0E0	0E0	0E0	0E0

ENVIRONMENTAL IMPACTS – EN 15804+A1, CML / ISO 21930

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Global Warming Pot.	kg CO_2e	2.47E1	3.29E0	5.66E0	3.36E1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.64E-1	3.71E-2	4.07E-2	2.41E-1	-5.37E-1
Ozone depletion Pot.	kg CFC_{-11}e	8.94E-6	5.9E-7	6E-7	1.01E-5	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.8E-8	6.84E-9	7.06E-10	7.18E-9	-3.62E-8
Acidification	kg SO_2e	1.39E-1	1.67E-2	2.22E-2	1.77E-1	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	1.23E-3	1.23E-4	9.25E-5	2.49E-4	-1.7E-3
Eutrophication	kg PO_4^3e	4.67E-2	2.85E-3	1.25E-2	6.2E-2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.84E-4	2.81E-5	2.23E-4	1.39E-2	-7.18E-4
POCP (“smog”)	kg C_2H_4e	6.98E-3	3.91E-4	1.35E-3	8.72E-3	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.68E-5	4.82E-6	1.55E-5	5.33E-5	-1.17E-4
ADP-elements	kg Sbe	1.76E-3	1.18E-6	1.72E-5	1.78E-3	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	8.26E-8	8.52E-8	3.01E-7	1.26E-7	-1.32E-6
ADP-fossil	MJ	3.98E2	4.53E1	9.31E1	5.37E2	0E0	0E0	MND	MND	MND	MND	MND	MND	MND	2.23E0	5.64E-1	2.42E-1	8.33E-1	-7.72E0

VERIFICATION STATEMENT

VERIFICATION PROCESS FOR THIS EPD

This EPD has been verified in accordance with ISO 14025 by an independent, third-party verifier by reviewing results, documents and compliancy with reference standard, ISO 14025 and ISO 14040/14044, following the process and checklists of the program operator for:

- This Environmental Product Declaration
- The Life-Cycle Assessment used in this EPD
- The digital background data for this EPD

Why does verification transparency matter? Read more online
This EPD has been generated by One Click LCA EPD generator, which has been verified and approved by the EPD Hub.

THIRD-PARTY VERIFICATION STATEMENT

I hereby confirm that, following detailed examination, I have not established any relevant deviations by the studied Environmental Product Declaration (EPD), its LCA and project report, in terms of the data collected and used in the LCA calculations, the way the LCA-based calculations have been carried out, the presentation of environmental data in the EPD, and other additional environmental information, as present with respect to the procedural and methodological requirements in ISO 14025:2010 and reference standard.

I confirm that the company-specific data has been examined as regards plausibility and consistency; the declaration owner is responsible for its factual integrity and legal compliance.

I confirm that I have sufficient knowledge and experience of construction products, this specific product category, the construction industry, relevant standards, and the geographical area of the EPD to carry out this verification.

I confirm my independence in my role as verifier; I have not been involved in the execution of the LCA or in the development of the declaration and have no conflicts of interest regarding this verification.

Magaly Gonzalezvazquez, as an authorized verifier acting for EPD Hub Limited
02.06.2023

VERIFIED ISO 14025