LUXWALL
SEE BEYOND™

Enthermal™
Environmental Product Declaration

In Accordance with EN 15804 + A2 & ISO 14025
EPD HUB, **HUB-5803**

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One Click LCA EPD Hub ECO PLATFORM

Enthermal™

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LUXWALL

Life Cycle Assessment study has been performed in accordance with the requirements of EN 15804, EPD Hub PCR version 1.2 (24 Mar 2025) and JRC characterization factors EF 3.1.

GENERAL INFORMATION

Manufacturer	LuxWall Inc.
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Website	www.luxwall.com

EPD STANDARDS, SCOPE AND VERIFICATION

This EPD is intended for business-to-business and/or business-to-consumer communication. 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.

Low Thermal Conductance, LuxWall Enthermal™ product has a U_g-value as low as 0.28 versus a standard argon filled double pane insulating glass unit with a U_g-value of 1.3, or triple pane insulating glass unit with a Ug-value of 0.8. Enthermal products' low thermal conductance significantly increase the expansion and contraction of glass, which requires additional guidelines and practices relative to double pane and triple pane insulating glass products.

Program Operator	EPD Hub, hub@epdhub.com
Reference Standard	EN 15804:2012+A2:2019/AC:2021 and ISO 14025
PCR	EPD Hub Core PCR Version 1.2, 24 Mar 2025
c-PCR	EN 17213:2020: Windows and doors–Environmental product declarations–Product category rules for windows and pedestrian doorsets
Sector	Construction Product
EPD Category	Design Phase EPD
Parent EPD Number	N/A
EPD Author	Prabhu Megharaj (LuxWall Inc.)
EPD Verification	Independent verification of this EPD and data, according to ISO 14025: ☐ Internal Verification ☑ External Verification
EPD Verifier	Sarah Curpen as an authorized verifier for EPD Hub

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LuxWall Enthermal Transparent Insulation has a U_g-value as low as 0.28 W/m^{2}K versus a standard argon filled, double-pane insulating glass units with a U_g-value of 1.3 W/m^{2}K or argon filled, triple-pane insulating glass unit with a U_g-value of 0.8 W/m^{2}K. Enthermal's elimination of convection and low thermal conduction and radiative heat transfer performance significantly reduces the energy consumption of buildings thereby reducing operating costs and carbon emissions.

PRODUCT DETAILS

Product name	Enthermal
Product reference	10mm Enthermal
Product Thickness	10mm
Place(s) of raw material origin	United States, Mexico, Germany, Italy, France, India
Place of production	Litchfield, Michigan, United States
Place(s) of installation and use	United States, Canada, Europe and United Kingdom
Period for data	11/18/2025 to 12/17/2025
Averaging in EPD	No Grouping
Variation in GWP-fossil for A1-A3 (%)	N/A
A1 - A3 Specific Data %	16.7%

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ENVIRONMENTAL DATA SUMMARY

Declared Unit	1m² of Enthermal Transparent Insulation
Declared Unit Mass	23.474 kg
Mass of Packaging	1.363 kg
GWP-Fossil, A1-A3 (kg CO_2e/m^2)	38.6
GWP-Total, A1-A3 (kg CO_2e/m^2)	38.4
Secondary Material, Inputs (%)	0.33
Secondary Material, Outputs (%)	0
Total energy use, A1-A3 (kWh)	212
Net freshwater use, A1-A3 (m^3)	0.28

PRODUCT AND MANUFACTURER

About the Manufacturer

LuxWall, Inc. is a manufacturer of Transparent Insulation technology and products. The company has developed patented, proprietary technologies to produce Enthermal Transparent Insulation products that deliver superior thermal insulation values up to R-18 (0.3 W/m²K), outperforming traditional double-pane glass by up to five times and triple-pane glass by up to three times. The company's innovative edge-sealing technology, cavity evacuation processes, and fully tempered unit construction represent a breakthrough in addressing one of the built environment's most persistent challenges — windows and doors are the single largest source of energy loss in buildings. The company opened the world's first high-volume vacuum insulating glass production facility in Litchfield, Michigan USA.

Product Description

LuxWall Enthermal is a Transparent Insulation building envelope product with a total thickness of 10mm consisting of two panes of tempered float glass - one pane of clear glass and one pane of Low-E coated glass - that are hermetically sealed together using inorganic sealing materials. Between the two glass panes, an ultra-high vacuum layer is maintained using micro-pillars for structural support and getter material for vacuum lifetime preservation. Each Enthermal contains an evacuation port at a single, designated location, consistent across all product sizes. LuxWall Enthermal energy-efficient technology delivers exceptional thermal insulation performance, achieving R-18 insulation values, U_g of 0.3 W/m²K, comparable to opaque wall insulation. Enthermal has obtained voluntary CE marking certification (ETA - 25/0363), making it the first tempered vacuum glazing solution with these thermal insulation values to carry the certification, validating its performance and quality standards.

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Characteristics	Value
Enthermal Thermal Performance, U-Value (U_g)	0.3 W/m^2. K
Enthermal Thermal Performance, U-Value (U_f)	0.055 BTU/hr.ft^2°F
Enthermal Thermal Performance, R-Value (R_v)	18.2 hr.ft^2.°F/BTU
Light Transmittance (τ_v)	64%
Light Reflectance (L_e)	13%
Solar Factor (g)	0.30
Solar Heat Gain Coefficient (SGHC)	0.26

Further information can be found on: wwww.luxwall.com

PRODUCT RAW MATERIAL MAIN COMPOSITION

Raw Material Category	Amount, Mass %	Material Origin
Metals	0.0107 %	France, Italy, India
Minerals	99.9890 %	United States, Mexico, Germany
Fossil Materials	0.0003 %	United States
Bio-based Materials	-	-

BIOGENIC CARBON CONTENT

Biogenic Carbon Content in Product, kg C	-
Biogenic carbon content in packaging, kg C	0.117

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FUNCTIONAL UNIT AND SERVICE LIFE

Declared Unit	1m² of Enthermal Transparent Insulation
Declared Unit Mass	23.474 kg
Functional unit	1m² of Enthermal Transparent Insulation with thermal insulation of 0.3 W/m²K
Reference service life	30 years

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.

STAGE	Product Stage			Construction Stage		Use Stage							End of Life Stage				Benefits & Loads Beyond the System Boundary
Modules	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Declared Modules	X	X	X	X	X	ND	X	ND	ND	ND	ND	ND	X	X	X	X	X
Description Of Modules	Raw Materials Supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy	Operational Water Use	Deconstruction/ Demolition	Transport	Waste Processing	Disposal	Reuse - Recovery

Not declared = ND.

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.

A market-based approach is used in modelling the electricity mix utilized in the factory.

The product stage (A1-A3) encompasses all processes from raw material extraction through manufacturing of the Enthermal Transparent Insulation, representing a cradle-to-gate assessment. This stage is subdivided into three distinct modules:

A1 – Raw Material Supply: This module includes the extraction and processing of raw materials required for Enthermal production, including float glass manufacturing, Low-E coating materials, inorganic sealing frit components, micro-pillars, getter materials, vacuum-port caps, and adhesives. These upstream processes occur prior to arrival at the manufacturing facility.

A2 – Transport to Manufacturer: This module accounts for the transportation of raw materials and semi-finished products to the LuxWall manufacturing facility in Litchfield, Michigan, via road, rail, ocean, and/or air freight routes.

A3 – Manufacturing: This module covers all on-site manufacturing processes including glass cutting, preparation, tempering, micro-pillar placement, hermetic sealing, vacuum evacuation through the designated port, port sealing, and product finishing. This stage also encompasses packaging production and use, manufacturing waste generation and disposal, and energy consumption associated with all manufacturing operations. Electricity consumption for the manufacturing of Enthermal Transparent Insulation products at LuxWall's Factory 1 facility in Litchfield, Michigan is supplied as medium voltage electricity from the utility provider Consumers Energy. LuxWall has purchased Renewable Energy Certificates (RECs) covering 100% of the electricity consumed at the Litchfield facility. These RECs represent renewable electricity generation from wind energy facilities located in Michigan. The environmental impact assessment for electricity consumption in module A3 is based on the electricity mix corresponding to the purchased RECs. The carbon dioxide equivalent emissions factor of 0.0139 kg CO_2e/kWh has been applied, based on the ecoinvent database version 3.11 dataset for wind power generation in the relevant geographic region. LuxWall has procured RECs from Consumers Energy under a contract extending through 2031, at which point the renewable energy procurement arrangement shall be renewed.

The complete product stage represents the cradle-to-gate system boundary from upstream raw material extraction and processing, through transportation, to the manufacture of the finished Enthermal product at the LuxWall facility in Litchfield, Michigan.

The use of green energy in manufacturing is demonstrated through contractual instruments, and its use is ensured throughout the validity period of this EPD.

TRANSPORT AND INSTALLATION (A4-A5)

Transportation (A4) encompasses product delivery to the construction site (A4) including fuel direct exhaust emissions, environmental impacts of fuel production, as well as related infrastructure emissions. The construction process stage (A4-A5) addresses transportation to the customer and installation processes for the Enthermal Transparent Insulation product.

A4 – Transport to Construction Site: This module accounts for the transportation of finished Enthermal units from the LuxWall manufacturing facility in Litchfield, Michigan to the construction site. An average transport distance of 1,000 km is assumed, utilizing freight semi-trucks (16-32 metric ton, EURO5 – World standard) for delivery. Enthermal units are transported in their final configuration, ready for installation. Transportation of the finished product is calculated on a scenario with parameters described in the table.

Parameter	Value
Vehicle Type	Freight, Truck 16-32 metric ton, EURO5
Distance	1000 km
Capacity Utilization (including empty return)	100%
Bulk Density of Transported Products	24.8
Volume Capacity Utilization Factor	1

A5 – Installation: Referring to EN 17213:2020 and EN 17074:2019, this stage covers the installation of the product into the building, excluding ancillary installation materials. Energy consumption associated with the installation process is included. The units are delivered to site in their final configuration and do not require any additional on-site processing or modification.

Parameter	Value
Input for Installation	N/A
Waste Materials at building site before waste processing	Product Packaging Waste
Energy Type and Consumption for Installation	Market for Regional Mix Medium Electricity, 0.3 kWh
Direct Emission to ambient air, soil and water	None

No waste other than packaging waste is generated during installation. Packaging waste consists primarily of rubber padding, tightening straps and wooden pallets. The wooden pallets are waste management is modelled according to typical U.S. waste handling practices: 67.2% landfill disposal, 17.1% recycling, and 15.7% incineration, based on EPA data for wood materials (2018).

PRODUCT USE AND MAINTENANCE (B1-B7)

The use stage (B1-B7) encompasses all processes that occur during the in-service life of the Enthermal Transparent Insulation product.

B1 – Use: Not applicable (no direct emissions during use).

B2 – Maintenance: Periodic cleaning with water and cleaning detergent. For maintenance, the Enthermal product requires periodic cleaning with water and cleaning detergent. Referring to EN 17213:2020 and EN 17074:2019, only maintenance by cleaning the glass surface with water and cleaning agent is included in this study. Air, soil, and water impacts during the use phase have not been studied.

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PARAMETER	VALUE
Maintenance Process	Cleaning of the Enthermal with water and detergent.
Water Consumption	0.200 kg
Detergent Consumption	0.001 kg

B3 – Repair: Not applicable.

B4 – Replacement: Not applicable.

B5 – Refurbishment: Not applicable.

B6 – Operational Energy Use: Not applicable

B7 – Operational Water Use: No Applicable, only Water consumption for periodic cleaning maintenance.

The Enthermal product has a declared EPD service life of 30-years, based on compliance with rigorous testing standards per ISO19916-1:2018, ASTM 2188/2189/2190, and other international test standard for Transparent Insulation product. The product is assumed to remain in service throughout this period with no requirements for repair, replacement, or refurbishment. For maintenance, the Enthermal product requires periodic cleaning with water and cleaning detergent.

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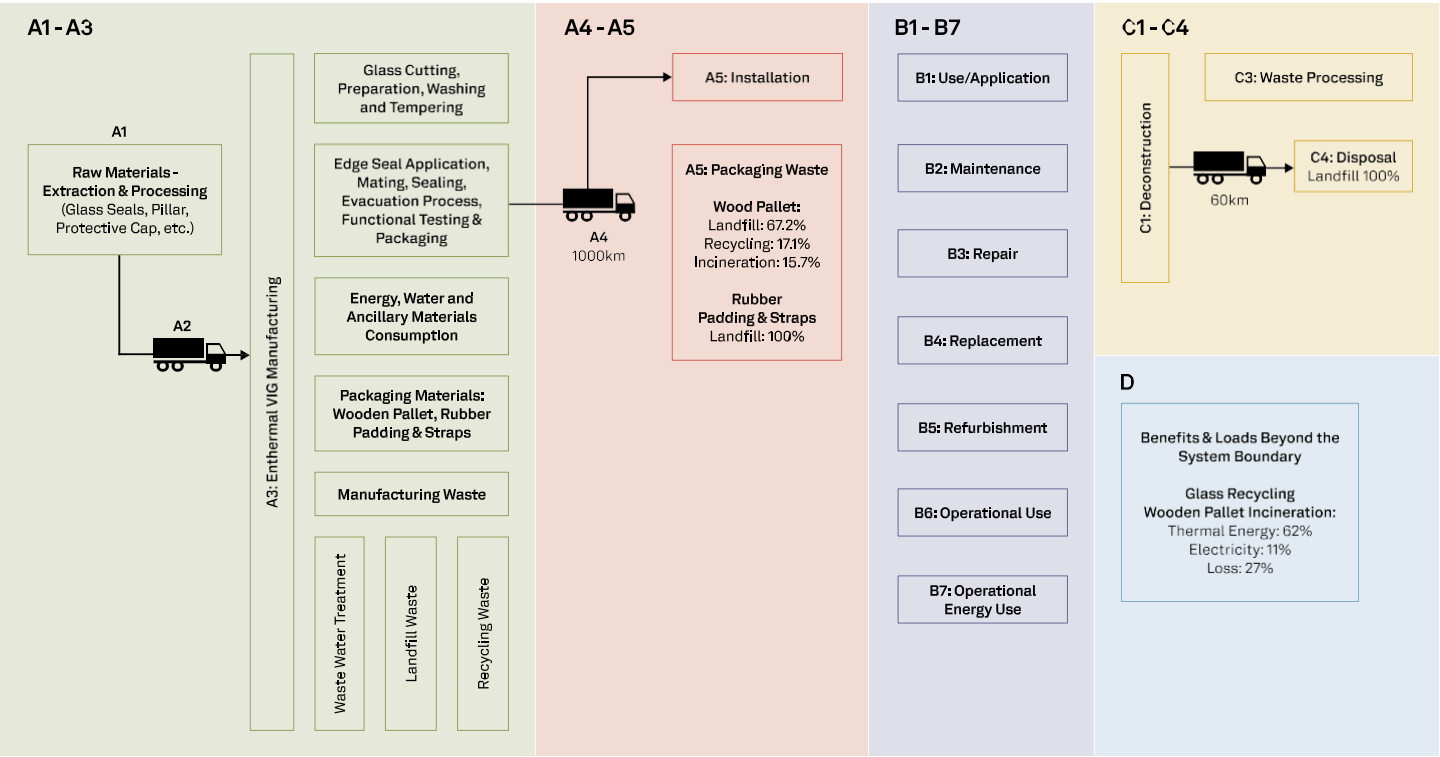

ENTHERMAL VACUUM INSULATED GLASS – LIFECYCLE STAGES

PRODUCT END OF LIFE (C1-C4, D)

The end-of-life stage (C1-C4) addresses the processes following the removal of Enthermal vacuum insulated glazing units from service. For the Enthermal product, only modules C1, C2 and C4 are applicable.

C1 – Deconstruction/Demolition: This module only involves the energy use for dismantling or deconstructing the product.

C2 – Transport to Disposal: This module accounts for the transportation of end-of-life Enthermal units from the demolition or deconstruction site to the landfill facility. An average transport distance of 60 km is assumed.

C3 – Waste Processing for Reuse, Recovery, and Recycling: Not applicable.

C4 – Disposal: This module accounts for the final disposal of Enthermal units in landfill facilities. 100% of the glass Enthermal units are landfilled, with no material recovery or recycling at end-of-life.

PARAMETER	VALUE
Mass of the collected waste	23.474 kg
Energy Type and Consumption for deconstruction	Market for Regional Mix Medium Electricity, 0.3 kWh
Disposal Mode and Proportion	Landfill – 100%
Distance to Landfill	60 km

Module D accounts for the potential environmental benefits and loads that occur beyond the defined system boundary of the Enthermal product life cycle. This module captures the net environmental impacts associated with material recovery, recycling, and energy recovery processes that extend beyond the end-of-life stage. For the Enthermal product, Module D includes the benefits derived from the recycling of wood packaging materials and the energy recovery from incinerated wood pallets, as well as any potential glass recycling that occurs outside the primary product. The benefits from the recycling of glass result from the glass sent for recycling from production losses. These benefits are reported separately from the core life cycle stages (A1-C4) to provide transparency regarding the environmental credits associated with recovered materials and energy that may offset primary resource consumption in other product systems.

SCENARIO DOCUMENTATION

The Scenario Documentation chapter provides transparent, detailed assumptions and parameters used to model the life cycle stages of the Enthermal Transparent Insulation glass that are not based on primary data from LuxWall's manufacturing operations. This chapter fulfills the requirements of EN 15804:2012+A2:2019 and EN 17213:2020 by documenting all scenario-based modeling assumptions for modules A4-A5 (Construction Process Stage), B1-B7 (Use Stage), C1-C4 (End-of-Life Stage), and Module D (Benefits and Loads Beyond the System Boundary). These scenarios represent industry-average conditions, conservative assumptions, or regionally appropriate practices where site-specific or product-specific data are not available or where standardization is necessary for comparability.

PARAMETER	VALUE
Manufacturing Energy Scenario Documentation	
Electricity production, wind, 1-3MW turbine, onshore, Delaware, Ecoinvent	0.0140 kg CO_2 e/kWh
Market for propane, burned in building machine, World, Ecoinvent	0.0945 kg CO_2 e/MJ
Transportation Scenario Documentation – A4	
Transport, freight, lorry 16-32 metric ton, EURO5 World	1000 km
Capacity utilization (including empty return)	100%
Bulk density of transported products	2.48E+01
Volume capacity utilization factor	1
Installation & Installation Waste Scenario Documentation – A5	
Market group for electricity, medium voltage, Ecoinvent	0.3 kWh
Treatment of wood ash mixture, pure, municipal incineration, Ecoinvent, Materials for energy recovery	0.135 kg
Exported Energy: Electricity, Ecoinvent	2.396 MJ
Exported Energy: Thermal, Ecoinvent	1.039 MJ
Paper production, woodfree, uncoated, 100% recycled content, at non-integrated mill, Ecoinvent, Materials for recycling	0.27 kg
Treatment of residues, MSWI, waste rubber, unspecified, residual material landfill, Ecoinvent	0.00417 kg
Treatment of waste wood, untreated, sanitary landfill, Ecoinvent	0.946 kg
Treatment of waste yarn and waste textile, unsanitary landfill, Ecoinvent	0.00691 kg
Use Stage Scenario Documentation – B2 Maintenance process: Cleaning of Glass Surface with water and cleaning agent	
Tap water production, underground water without treatment, Ecoinvent	6.0 kg per RSL
Cleaning consumables, without water, in 13.6% solution state, Ecoinvent	0.03 kg per RSL
Maintenance cycle / Number per RSL	30
End of Life Scenario Documentation C1 – C4	
Market group for electricity, medium voltage, Ecoinvent	0.3 kWh
Treatment of waste glass, sanitary landfill, Ecoinvent	23.474 kg
Disposal Mode and Proportion	Landfill - 100%
Distance to Landfill	60 km

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 that is 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.

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.
Due to the cut-off rules established in ISO 21930 and EN 15804, minimally used accessories and consumables that represent less than 1% of the cumulative mass have been included in the analysis to the extent practicable. The following maintenance items used in Enthermal Transparent Insulation production have been accounted for:

Lubricants and greases for production equipment, machine cutting oil for glass processing operations, vacuum system maintenance parts including filters, and O-rings for vacuum chamber sealing, and general factory maintenance components such as cutting and grinding wheels for glass edge processing, cutting blades, bearings and bushings for conveyor systems, gears and sprockets for material handling equipment, electrical components including fuses and circuit breakers, and wiring, cables, and connectors for production control systems.

All energy usage related to the operation and maintenance of equipment requiring these parts and consumables is fully included in the life-cycle inventory under the production-stage (A3) energy consumption data.

Validation of Data

Data collection for production, transport, and packaging was conducted using time and site-specific information, as defined in the general information section on page 1 and 2. Upstream process calculations rely on generic data as defined in the Bibliography section. Manufacturer-provided specific and generic data were used for the product's manufacturing stage. The analysis was performed in One Click LCA EPD Generator, with the 'Cut-Off, EN 15804+A2' allocation method, and characterization factors according to EN 15804:2012+A2:2019/AC:2021 and JRC EF 3.1.

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ENVIRONMENTAL IMPACT DATA

The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.

CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, EF 3.1

Impact Category	Unit	Product Stage				Construction - Installation		Use Stage							End of Life Stage				Reuse, Recover, Recycling
		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	3.22E+01	3.97E+00	2.28E+00	3.84E+01	4.85E+00	7.02E-01	ND	2.89E-01	ND	ND	ND	ND	ND	1.41E-01	1.52E-01	0.00E+00	2.55E-01	-3.48E-01
GWP - fossil	kg CO_2e	3.19E+01	3.97E+00	2.71E+00	3.86E+01	4.85E+00	2.45E-01	ND	3.36E-01	ND	ND	ND	ND	ND	1.41E-01	1.52E-01	0.00E+00	2.53E-01	-3.46E-01
GWP – biogenic	kg CO_2e	2.26E-01	8.34E-04	-4.37E-01	-2.10E-01	1.06E-03	4.42E-01	ND	-7.24E-02	ND	ND	ND	ND	ND	5.38E-05	3.43E-05	0.00E+00	1.04E-03	-8.71E-04
GWP - LULUC	kg CO_2e	1.25E-02	1.76E-03	2.59E-03	1.68E-02	2.15E-03	1.62E-02	ND	2.55E-02	ND	ND	ND	ND	ND	7.16E-05	6.78E-05	0.00E+00	1.50E-04	-2.60E-04
Ozone depletion pot.	kg $CFC_{-11}e$	3.43E-07	5.56E-08	3.46E-08	4.34E-07	6.78E-08	6.47E-09	ND	8.14E-09	ND	ND	ND	ND	ND	8.95E-10	2.24E-09	0.00E+00	6.45E-09	-2.41E-09
Acidification potential	mol H+e	3.13E-01	1.35E-02	1.36E-02	3.40E-01	1.62E-02	1.16E-03	ND	2.29E-03	ND	ND	ND	ND	ND	3.93E-04	5.17E-04	0.00E+00	1.76E-03	-1.16E-03
EP-freshwater[2])	kg Pe	3.99E-03	3.14E-04	6.78E-04	4.98E-03	3.77E-04	1.34E-04	ND	1.17E-04	ND	ND	ND	ND	ND	8.67E-05	1.18E-05	0.00E+00	2.56E-05	-1.99E-04
EP-marine	kg Ne	5.07E-02	4.37E-03	3.54E-03	5.86E-02	5.24E-03	7.07E-04	ND	6.95E-04	ND	ND	ND	ND	ND	8.01E-05	1.70E-04	0.00E+00	6.81E-04	-2.86E-04
EP-terrestrial	mol Ne	6.13E-01	4.76E-02	3.76E-02	6.98E-01	5.70E-02	2.74E-03	ND	4.86E-03	ND	ND	ND	ND	ND	6.94E-04	1.85E-03	0.00E+00	7.41E-03	-2.75E-03
POCP ("smog")[3])	kg NMVOCe	1.70E-01	1.87E-02	1.42E-02	2.03E-01	2.25E-02	8.18E-04	ND	1.47E-03	ND	ND	ND	ND	ND	2.77E-04	7.62E-04	0.00E+00	2.59E-03	-9.54E-04
ADP-minerals & metals[4])	kg Sbe	4.25E-04	1.36E-05	4.23E-05	4.81E-04	1.59E-05	1.73E-06	ND	4.38E-06	ND	ND	ND	ND	ND	1.90E-07	4.23E-07	0.00E+00	4.84E-07	-5.43E-07
ADP-fossil resources	MJ	3.36E+02	5.56E+01	3.60E+01	4.28E+02	6.80E+01	4.18E+00	ND	5.44E+00	ND	ND	ND	ND	ND	2.60E+00	2.20E+00	0.00E+00	5.68E+00	-6.21E+00
Water use[5])	m^3e depr.	7.25E+00	2.60E-01	6.27E-01	8.14E+00	3.16E-01	3.85E-01	ND	4.30E-01	ND	ND	ND	ND	ND	3.11E-02	1.09E-02	0.00E+00	2.50E-01	-8.51E-02

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.

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ADDITIONAL (OPTIONAL) ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, EF 3.1

Impact category	Unit	Product Stage				Construction - Installation		Use Stage							End of Life Stage				Reuse, Recover, Recycling
		A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Particulate matter	Incidence	3.41E-06	3.15E-07	2.54E-07	3.98E-06	3.85E-07	1.17E-08	ND	2.50E-08	ND	ND	ND	ND	ND	2.04E-09	1.52E-08	0.00E+00	4.12E-08	-1.05E-08
Ionizing radiation[6])	kBq U235e	5.64E-01	4.66E-02	9.17E-02	7.02E-01	5.51E-02	6.09E-02	ND	2.23E-02	ND	ND	ND	ND	ND	5.51E-02	1.92E-03	0.00E+00	4.39E-03	-1.23E-01
Ecotoxicity (freshwater)	CTUe	2.39E+02	8.77E+00	1.29E+01	2.61E+02	1.08E+01	1.85E+00	ND	4.46E+00	ND	ND	ND	ND	ND	2.65E-01	3.11E-01	0.00E+00	5.70E+00	-7.87E-01
Human toxicity, cancer	CTUh	4.50E-09	8.08E-10	4.47E-09	9.78E-09	8.25E-10	5.05E-11	ND	4.05E-10	ND	ND	ND	ND	ND	1.69E-11	2.50E-11	0.00E+00	5.62E-11	-1.11E-10
Human tox. non-cancer	CTUh	1.79E-07	3.48E-08	1.23E-07	3.37E-07	4.26E-08	2.80E-10	ND	3.96E-09	ND	ND	ND	ND	ND	7.47E-10	1.42E-09	0.00E+00	1.20E-09	-2.41E-09
SQP[7])	-	1.13E+02	3.26E+01	8.49E+01	2.30E+02	4.06E+01	1.51E+00	ND	5.34E+00	ND	ND	ND	ND	ND	3.75E-01	2.22E+00	0.00E+00	1.35E+01	-4.30E+00

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	Product Stage				Construction - Installation		Use Stage							End of Life Stage				Reuse, Recover, Recycling
		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	1.79E+01	7.83E-01	3.18E+02	3.37E+02	9.33E-01	-1.81E+01	ND	1.29E+00	ND	ND	ND	ND	ND	2.90E-01	3.01E-02	0.00E+00	7.32E-02	-1.18E+00
Renew. PER as material	MJ	0.00E+00	0.00E+00	3.84E+00	3.84E+00	0.00E+00	-3.84E+00	ND	0.00E+00	ND	ND	ND	ND	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-03
Total use of renew. PER	MJ	1.79E+01	7.83E-01	3.22E+02	3.41E+02	9.33E-01	-2.20E+01	ND	1.29E+00	ND	ND	ND	ND	ND	2.90E-01	3.01E-02	0.00E+00	7.32E-02	-1.18E+00
Non-re. PER as energy	MJ	3.36E+02	5.56E+01	3.51E+01	4.27E+02	6.80E+01	3.94E+00	ND	4.88E+00	ND	ND	ND	ND	ND	2.60E+00	2.20E+00	0.00E+00	4.58E+00	-6.22E+00
Non-re. PER as material	MJ	1.34E-04	0.00E+00	5.90E-01	5.90E-01	0.00E+00	-5.90E-01	ND	0.00E+00	ND	ND	ND	ND	ND	0.00E+00	0.00E+00	0.00E+00	-1.22E-04	0.00E+00
Total use of non-re. PER	MJ	3.36E+02	5.56E+01	3.57E+01	4.27E+02	6.80E+01	3.35E+00	ND	4.88E+00	ND	ND	ND	ND	ND	2.60E+00	2.20E+00	0.00E+00	4.58E+00	-6.22E+00
Secondary materials	kg	7.70E-02	2.50E-02	5.51E+00	5.61E+00	3.06E-02	2.15E-01	ND	1.56E-03	ND	ND	ND	ND	ND	2.89E-04	9.36E-04	0.00E+00	1.96E-03	-5.40E+00
Renew. secondary fuels	MJ	1.75E-02	3.14E-04	1.02E-01	1.19E-01	3.89E-04	1.40E-05	ND	4.45E-05	ND	ND	ND	ND	ND	8.45E-07	1.19E-05	0.00E+00	3.94E-05	-6.98E-04
Non-ren. secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	ND	0.00E+00	ND	ND	ND	ND	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	m3	1.85E-01	7.41E-03	8.39E-02	2.76E-01	9.02E-03	5.64E-03	ND	3.53E-02	ND	ND	ND	ND	ND	9.44E-04	3.25E-04	0.00E+00	-8.69E-02	-2.41E-03

8) PER = Primary energy resources.

Environmental Product Declaration

END OF LIFE - WASTE

Impact category	Unit	Product Stage				Construction - Installation		Use Stage							End of Life Stage				Reuse, Recover, Recycling
		A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste	kg	8.92E-01	9.78E-02	3.34E-01	1.32E+00	1.19E-01	2.39E-02	ND	3.13E-02	ND	ND	ND	ND	ND	9.61E-03	3.73E-03	0.00E+00	9.44E-03	-2.32E-02
Non-hazardous waste	kg	2.40E+01	1.85E+00	4.58E+00	3.04E+01	2.22E+00	5.51E+00	ND	1.19E+00	ND	ND	ND	ND	ND	4.25E-01	6.90E-02	0.00E+00	6.21E+01	-9.80E-01
Radioactive waste	kg	1.38E-04	1.14E-05	2.28E-05	1.72E-04	1.35E-05	1.42E-05	ND	5.62E-06	ND	ND	ND	ND	ND	1.25E-05	4.69E-07	0.00E+00	1.07E-06	-2.80E-05

END OF LIFE - OUTPUT FLOWS

Impact category	Unit	Product Stage				Construction - Installation		Use Stage							End of Life Stage				Reuse, Recover, Recycling
		A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	ND	0.00E+00	ND	ND	ND	ND	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	7.47E+01	7.47E+01	0.00E+00	2.70E-01	ND	0.00E+00	ND	ND	ND	ND	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy rec	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.35E-01	ND	0.00E+00	ND	ND	ND	ND	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.43E+00	ND	0.00E+00	ND	ND	ND	ND	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy – Electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.40E+00	ND	0.00E+00	ND	ND	ND	ND	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy – Heat	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E+00	ND	0.00E+00	ND	ND	ND	ND	ND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

ENVIRONMENTAL IMPACTS – EN 15804+A1, CML

Impact category	Unit	Product Stage				Construction - Installation		Use Stage							End of Life Stage				Reuse, Recover, Recycling
		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	3.21E+01	3.94E+00	2.70E+00	3.87E+01	4.83E+00	3.27E-01	ND	3.60E-01	ND	ND	ND	ND	ND	1.40E-01	1.51E-01	0.00E+00	2.52E-01	-3.45E-01
Ozone depletion Pot.	kg $CFC\text{-}_{11}e$	2.76E-07	4.44E-08	2.85E-08	3.49E-07	5.42E-08	5.23E-09	ND	7.42E-09	ND	ND	ND	ND	ND	7.67E-10	1.79E-09	0.00E+00	5.18E-09	-2.05E-09
Acidification	kg SO_2e	2.58E-01	1.03E-02	1.08E-02	2.79E-01	1.24E-02	9.06E-04	ND	1.82E-03	ND	ND	ND	ND	ND	3.29E-04	3.95E-04	0.00E+00	1.30E-03	-9.39E-04
Eutrophication	kg PO_4^3e	2.42E-02	2.53E-03	6.17E-03	3.29E-02	3.01E-03	4.12E-04	ND	2.25E-03	ND	ND	ND	ND	ND	5.77E-05	9.62E-05	0.00E+00	5.72E-04	-5.51E-04
POCP ("smog")	kg C_2H_4e	1.27E-02	9.41E-04	1.13E-03	1.48E-02	1.11E-03	9.72E-05	ND	1.50E-04	ND	ND	ND	ND	ND	1.99E-05	3.52E-05	0.00E+00	1.10E-04	-6.58E-05
ADP-elements	kg Sbe	3.65E-04	1.33E-05	4.17E-05	4.20E-04	1.56E-05	1.63E-06	ND	3.84E-06	ND	ND	ND	ND	ND	1.90E-07	4.12E-07	0.00E+00	4.68E-07	-5.41E-07
ADP-fossil	MJ	3.27E+02	5.48E+01	3.43E+01	4.16E+02	6.72E+01	3.19E+00	ND	5.07E+00	ND	ND	ND	ND	ND	1.76E+00	2.17E+00	0.00E+00	5.61E+00	-4.32E+00

Environmental Product Declaration

ADDITIONAL INDICATOR – GWP-GHG FROM EN 15804

Impact category	Unit	Product Stage				Construction - Installation		Use Stage							End of Life Stage				Reuse, Recover, Recycling
		A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-GHG[9])	kg CO_2e	3.20E+01	3.97E+00	2.71E+00	3.86E+01	4.85E+00	2.61E-01	ND	3.62E-01	ND	ND	ND	ND	ND	1.41E-01	1.52E-01	0.00E+00	2.53E-01	-3.47E-01

9) This indicator includes all greenhouse gases excluding biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. In addition, the characterization factors for the flows – CH4 fossil, CH4 biogenic and Dinitrogen monoxide – were updated. This indicator is identical to the GWP-total of EN 15804:2012+A2:2019 except that the characterization factor for biogenic CO2 is set to zero.

ENVIRONMENTAL IMPACTS – TRACI 2.1

Impact category	Unit	Product Stage				Construction - Installation		Use Stage							End of Life Stage				Reuse, Recover, Recycling
		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	3.18E+01	3.91E+00	2.67E+00	3.84E+01	4.79E+00	3.18E-01	ND	3.57E-01	ND	ND	ND	ND	ND	1.40E-01	1.50E-01	0.00E+00	2.48E-01	-3.43E-01
Ozone Depletion	kg $CFC\text{-}_{11}e$	3.63E-07	5.87E-08	3.67E-08	4.58E-07	7.16E-08	6.84E-09	ND	8.62E-09	ND	ND	ND	ND	ND	9.66E-10	2.36E-09	0.00E+00	6.82E-09	-2.59E-09
Acidification	kg SO_2e	2.59E-01	1.19E-02	1.17E-02	2.83E-01	1.44E-02	9.42E-04	ND	1.89E-03	ND	ND	ND	ND	ND	3.33E-04	4.59E-04	0.00E+00	1.60E-03	-9.99E-04
Eutrophication	kg Ne	1.33E-02	1.27E-03	2.96E-03	1.76E-02	1.53E-03	5.33E-04	ND	1.38E-03	ND	ND	ND	ND	ND	7.99E-05	4.84E-05	0.00E+00	2.38E-04	-3.35E-04
POCP ("smog")	kg O_3e	3.24E+00	2.98E-01	2.28E-01	3.76E+00	3.57E-01	1.21E-02	ND	2.15E-02	ND	ND	ND	ND	ND	4.13E-03	1.17E-02	0.00E+00	4.56E-02	-1.61E-02
ADP-fossil	MJ	3.37E+02	5.56E+01	3.48E+01	4.28E+02	6.81E+01	3.94E+00	ND	4.91E+00	ND	ND	ND	ND	ND	2.60E+00	2.20E+00	0.00E+00	0.00E+00	-6.22E+00

LCA Software

This EPD has been created using One Click LCA EPD Generator for EPD Hub V3 and EPD Process Certification v3.2.3. The LCA and EPD have been prepared according to the reference standards and ISO 14040/14044. The EPD Generator uses Ecoinvent v3.10.1/3.11 and One Click LCA databases as sources of environmental data. Allocation used in Ecoinvent 3.10.1/3.11 environmental data sources follow the methodology 'allocation, Cut-off, EN 15804+A2'.

LIFE-CYCLE ASSESSMENT

EPD Hub declares that this EPD is verified in accordance with ISO 14025 by an independent, third-party verifier. The project report on the Life Cycle Assessment and the report(s) on features of environmental relevance is filed at EPD Hub. EPD Hub PCR and ECO Platform verification checklist are used. EPD Hub cannot identify any unjustified deviations from the PCR and EN 15804+A2 in the Environmental Product Declaration and its project report.

EPD Hub maintains its independence as a third-party body; it was not involved in the execution of the LCA or in the development of the declaration and has no conflicts of interest regarding this verification.

The company-specific data and upstream and downstream data have been examined as regards plausibility and consistency. The publisher is responsible for ensuring the factual integrity and legal compliance of this declaration.

The software used in creation of this LCA and EPD is verified by EPD Hub to conform to the procedural and methodological requirements outlined in ISO 14025:2010, ISO 14040/14044, EN 15804+A2, and EPD Hub Core Product Category Rules and General Program Instructions.

Verified tools

Tool verifier: Magaly Gonzalez Vazquez
Tool verification validity: 27 March 2025 - 26 March 2028
Sarah Curpen, as authorized verifier acting for EPD HUB Limited 20.03.2026

EPD Hub
VERIFIED ISO 14025

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