Declaration Owner
Pittsburgh Corning, LLC
One Owens Corning Parkway, Toledo, OH, USA
1-800-GET-PINK (1-800-438-7465)
www.owenscorning.com

Products
FOAMGLAS® Insulation (Building Applications)

Functional Unit
1 m² of installed insulation with a thickness that gives an average thermal resistance RSI = 1 m²K/W and with a building service life of 75 years (packaging included)

EPD Number and Period of Validity
SCS-EPD-10047
EPD Valid March 26, 2024 through March 25, 2029

Product Category Rule
PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 4.0. Mar. 2022

PCR Guidance for Building-Related Products and Services Part B: Building Envelope Thermal Insulation EPD Requirements. Version 3.0. April 2023

Program Operator
SCS Global Services
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Address:	One Owens Corning Parkway, Toledo, OH, USA
Declaration Number:	SCS-EPD-10047
Declaration Validity Period:	EPD Valid March 26, 2024 through March 25, 2029
Product:	FOAMGLAS® Insulation (Building Applications)
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Katerina Softa (Owens Corning)
LCA Software:	SimaPro 9.5.0.0
LCI Database & Version Number	EcoInvent 3.9.1
LCIA Methodology & Version Number	TRACI 2.1 v1.08; CML I-A baseline v4.7; IPCC (2013, 2021)
Market(s) of Applicability	North America
EPD Type	Product-specific
Range of dataset variability	N/A
EPD Scope	Cradle-to-Installation with Options
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal X external
LCA Reviewer:	Beth Cassese, SCS Global Services
Part A Product Category Rule:	PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 4.0. UL Environment. Mar. 2022
PCR Review conducted by:	Lindita Bushi, PhD (Chair); Hugues Imbeault-Tétreault, ing., M.Sc.A.; Jack Geibig
Part B Product Category Rule:	PCR Guidance for Building-Related Products and Services Part B: Building Envelope Thermal Insulation EPD Requirements. Version 3.0. April 2023
Part B PCR Review conducted by:	Thomas Gloria (chair), Industrial Ecology Consultants; Christoph Koffler, thinkstep; Andre Desjarlais,Oak Ridge National Laboratory
Independent verification of the declaration and data, according to ISO 14025, ISO 21930, and the PCR	☐ internal X external
EPD Verifier:	Beth Cassese, SCS Global Services
Declaration Contents:	

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, and 21930.*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.*

In accordance with ISO 21930:2017, EPDs are comparable only if they comply with the core PCR, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

1. About Owens Corning

Founded in 1938, Owens Corning is a global building and construction materials leader committed to building a sustainable future through material innovation. Our three integrated businesses – Composites, Insulation, and Roofing – provide durable, sustainable, energy-efficient solutions that leverage our unique material science, manufacturing, and market knowledge to help our customers win and grow.

This Environmental Product Declaration is representative of products produced at the location listed below.

2. Product

2.1 Product Description and Application

FOAMGLAS® cellular glass insulation is a lightweight, rigid and durable material composed of glass cells. It is non-combustible, provides superior compressive strength, moisture resistance, dimensional stability and offers long-lasting thermal performance. This makes FOAMGLAS® insulation ideal for mission critical roofs.

FOAMGLAS® insulation is available in a wide range of products offerings, shapes and sizes for building and industrial specifications.

The following product names reflect differences in final product dimensions, application, thermal conductivity and compressive strength. All FOAMGLAS® Insulation products included in this study are made using consistent batch and additive materials and manufacturing processes, making it appropriate to group them within a single EPD.

FOAMGLAS® Insulation products	FOAMGLAS® S3
	FOAMGLAS® T4+

The Construction Specification Institute (CSI) codes covered by the subcategory PCR applicable to FOAMGLAS® Insulation are listed below:

- 07 21 00 - Thermal Insulation
  - 07 21 13 Board Insulation
- 07 22 00 - Roof and Deck Insulation
  - 07 22 16 Roof Board Insulation

FOAMGLAS® T4+ Insulation is suitable for various building applications such as low slope roofs, metal standing seam roofs, and perimeter masonry veneer thermal breaks. FOAMGLAS® T4+ offers a thermal conductivity of 0.041 W/(m·K) and a UDL compressive strength of 600 kPa. It provides a unique combination of properties that offer an alternative to other types of building insulation. FOAMGLAS® T4+ insulation is designed for use where mechanical attachment is required. Compressive strength requirements for any application should always be confirmed with a structural engineer to ensure the correct product specification.

FOAMGLAS® S3 Insulation: With a thermal conductivity (lambda value) of 0.045 W/(m·K) and a max compressive strength of 900 kPa, FOAMGLAS® S3 is typically selected for split slab vehicular traffic applications. It provides a unique combination of properties that offer an alternative to other types of building insulation. For use where high loads are present. Compressive strength and other requirements for any application should always be confirmed with the engineer or architect of record to ensure correct product use.

2.2 Methodological Framework

This declaration is a product-specific EPD and is cradle-to-installation with end-of-life. The underlying LCA upon which this EPD is based included the following life cycle modules: *Raw Material supply* (A1); *Inbound Transportation* (A2); *Manufacturing* (A3); *Distribution* (A4); *Installation* (A5); *Transport* (C2); and *End-of-life, Disposal* (C4). No known flows have been deliberately excluded. The product is expected to perform as claimed for the 75-year reference service life (RSL).

2.3 Technical Data

The following table provides technical specifications of the products commonly used.

Table 1. *Technical specifications for FOAMGLAS® Insulation*

Properties	Test method	FOAMGLAS® S3	FOAMGLAS® T4+
Density, minimum pcf (kg/m3)	ASTM C303	6.9 (110)	5.5 (88)
Water Absorption, maximum vol %	ASTM C240	0.1%	0.1%
Water Vapor Permeability, maximum perm-in (ng/Pa-s-m)	ASTM E96	0.005 (.007)	0.005 (.007)
Mold/Mildew Resistance	ASTM C1338	Pass	Pass
Corrosion Resistance	ASTM C1617	Pass (steel, less than DI water)	Pass (steel, less than DI water)
Hydrostatic Resistance, minimum equivalent water height in feet (meters)	ASTM D5385/C1306	34.5 (10.5)	34.5 (10.5)
Coefficient of Linear Thermal Expansion, maximum in/in/°F (mm/mm/°C)	ASTM E228	5.0 x 10-6 (9.0 x 10-6)	5.0 x 10-6 (9.0 x 10-6)
Dimensional Stability[1], %, maximum @ 158°F/97% R.H. @ -40°F/ambient R.H. @ 200°F/ambient R.H.	ASTM D2126	 1.0% 1.0% 1.0%	 1.0% 1.0% 1.0%
Compressive Strength (capped), minimum psi (kPa)	ASTM C165 Procedure A/ ASTM C240	130 (900)	87 (600)
Flexural Strength, psi (kPa), minimum	ASTM C203	72.5 (500)	65.3 (450)
Modulus of Elasticity, psi (MPa), Approximate (ν = 0.25) Perpendicular Parallel	ASTM C623	 168 (1158) 199 (1372)	 145 (1,000) 164 (1,131)
Combustibility[2]	ASTM E136	Non-combustible	Non-combustible
Surface Burning Characteristics [2,3], maximum Flame Spread Index Smoke Developed Index	ASTM E84	 0 0	 0 0
Thermal Resistance[4] per inch @ 75°F (24°C) mean temperature3, Hr-ft2-°F/BTU (m2-°C/W)	ASTM C518/ASTM C177	3.0 (0.54)	3.4 (0.59)

Note: *Properties shown are representative values for 1-inch-thick material unless otherwise specified. Cellular glass may exhibit different physical properties based upon thickness. Certain physical properties are listed by minimum and maximum values per ASTM C1902. For details on specific test methods, please contact Owens Corning at 1-800-GET-PINK.*

[1] *Maximum change in any dimension*

[2] *Unfaced only.*

[3] *These laboratory tests are not intended to describe the hazards under actual fire conditions. Verify compliance with all required applicable fire assemblies.*

[4] *R means the resistance to heat flow; the higher the value, the greater the insulation power. This insulation must be installed properly to get the market R-value. Follow the manufacturer's instructions carefully. The U.S. FTC requires the R-value of home insulation to be measured at 75°F mean temperature. R-value claims should always be compared at the same mean temperature. Because rigid foam plastic insulation products are not all aged in accordance with the same standards, it is useful to publish comparison R-value data.*

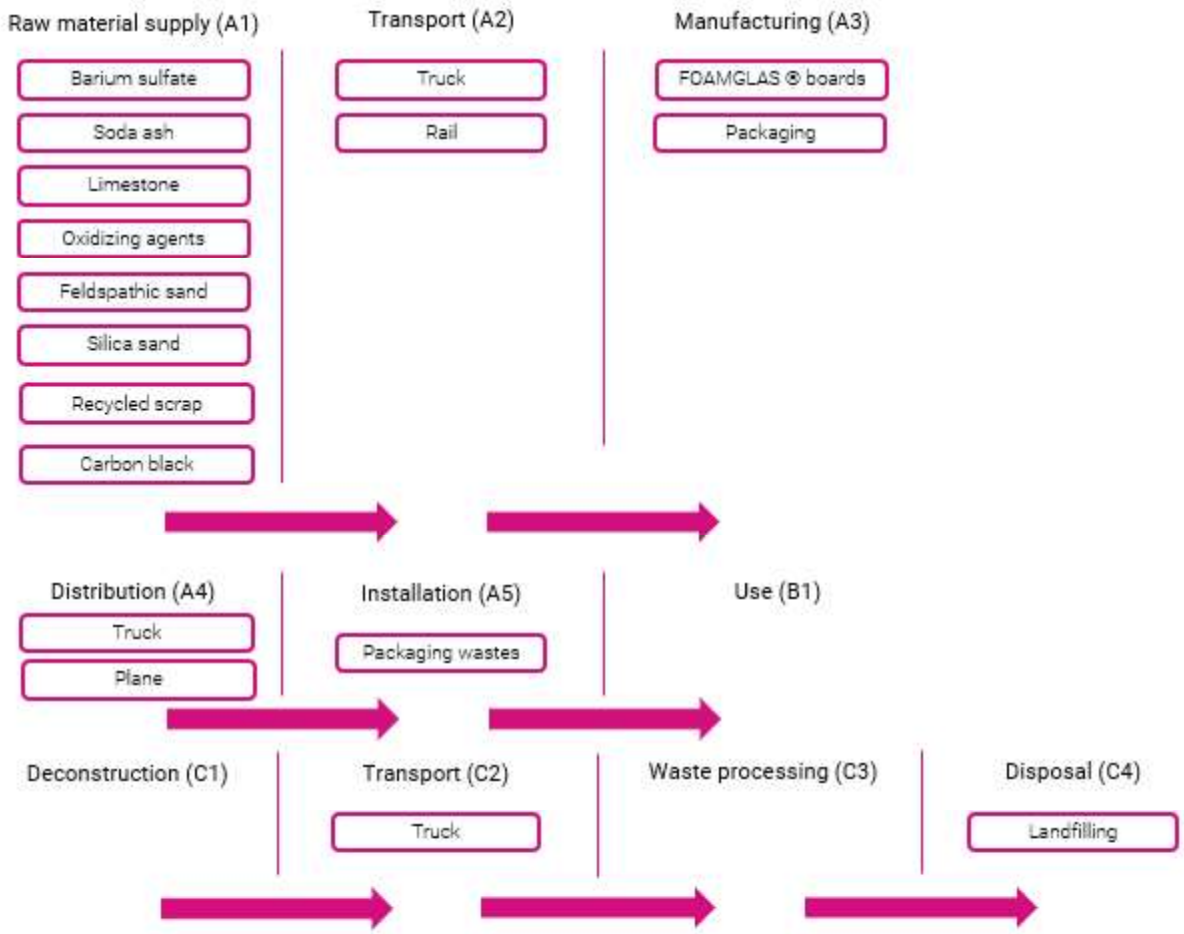
2.4 Properties of Declared Product as Delivered

When installed in typical building and construction assemblies according to all applicable Owens Corning® specifications, recommendations, and guidelines, FOAMGLAS® Insulation delivers its advertised R-value. For additional product property details, visit the specific product pages through www.owenscorning.com.

Table 2. *FOAMGLAS® Insulation Product Properties as Delivered*

Product	Width	Length	Thickness	R-Value
FOAMGLAS® S3 Insulation	24" (600 mm)	18" (450 mm)	2"-7" (0.5" increments)	6-21
FOAMGLAS® T4+ Insulation	24" (600 mm)	18" (450 mm)	2"-7" (0.5" increments)	5.0-23.8

2.5 Flow Diagram



2.6 Material Composition

FOAMGLAS® Insulation consits of two major components, the batch and additive materials. Although the majority of the batch is composed by sand, soda ash, limestone and an appreciable amount of pre-consumer recycled foamglas scrap, the remainder of the material is composed of peformance additives, oxidizing agents and colorant.

Table 3. *FOAMGLAS® Insulation composition*

Component	Composition % (by Mass)
Barium sulfate	<1%
Soda ash	10-15%
Oxidizing agents	1-5%
Limestone	10-15%
Feldspathic sand	40-45%
Silica sand	4-10 %
Onsite Recycled scrap	20-25%
Carbon black	< 1%

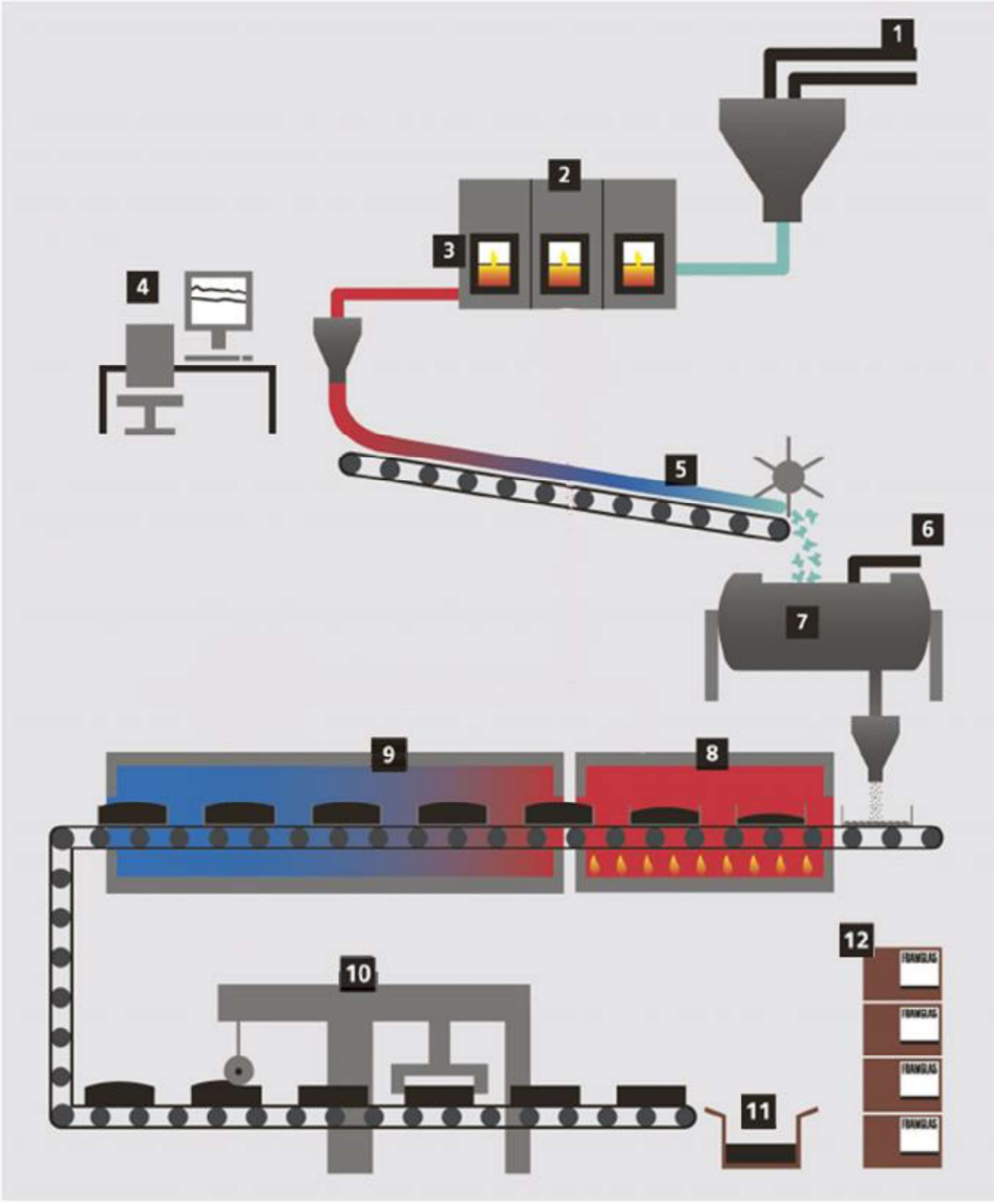
There are no hazardous substances contained in the product per the North American regional definition of hazardous wastes.

The product does not release any dangerous, regulated substances.

2.7 Manufacture

Owens Corning® FOAMGLAS® Insulation is manufactured in Sedalia, Missouri, USA. The manufacturing steps are listed below:

1. Mixing and batching of the raw materials: barium sulfate, soda ash, oxidizing agents, limestone, feldspathic sand, silica sand and recycled scrap.
2. The melting furnace has a constant temperature of 1300°C.
3. Molten glass is drawn out of the furnace.
4. Control room for monitoring the production.
5. The glass is drawn off and falls onto the conveyor band where it cools down before entering the ball mill.
6. Addition of "carbon black".
7. Ball mill grinds all ingredients into a fine powder before putting them into stainless steel molds.
8. The filled molds pass through a cellulating oven (foaming furnace) with a temperature of 850°C. This is where the material gains its unique cell structure.
9. The FOAMGLAS® blocks pass through an annealing oven to allow carefully controlled cooling without thermal stress.
10. The blocks are cut to size and sorted by batch. Production waste is recycled.
11. FOAMGLAS® slabs are then packaged, labelled and palletized.
12. Finished FOAMGLAS® insulation products are stored and prepared for transport.



The diagram above represents the manufacturing process for FOAMGLAS® Insulation used in the manufacturing facility.

2.8 Packaging

FOAMGLAS® Insulation is packaged and shipped in cardboard boxes which are shrink wrapped in two directions before they are put on a wooden pallet. Then the entire pallet is stretch wrapped to keep the boxes from shifting in transit. Regional disposal scenario for the US was used as a default assumption for the packaging waste generated during installation. Disposal rates used by raw material type and waste treatment method are shown in the tables below.

Table 4. *Packaging for 1 m² of FOAMGLAS® Insulation*

Packaging Material
Corrugated carton (cardboard)
Film (LDPE)
Labels (paper)
Corrugated pad (cardboard)
Pallet pad (wood)
Pallets (wood)

Per the PCR regional packaging scenarios, the following dispositions are assumed:

Table 5. *Waste Treatment of Packaging*

Country/Region	Material Type	Recycling Rate	Landfill Rate	Incineration Rate
United States	Plastics	15%[1]	68%	17%
	Pulp (cardboard, paper)	75%[2]	20%	5%

1 *The percentage was corrected from 9% to 15% in order to have a total of 100%.*

2 *The percentage was corrected to 75% in order to have a total of 100%.*

The wooden packaging items were assumed to get landfilled.

2.9 Transportation

The outbound transportation or distribution includes the transportation of the finished product to customers by diesel semi-truck. The weighted average outbound transportation distance from the specified location to the building site is 1165 km.

2.10 Product Installation

General

In general, FOAMGLAS® insulation products can be integrated into various building applications such as low slope roofs, metal standing seam roofs, and perimeter masonry veneer thermal breaks. Each application can require unique ancillaries and tools depending on the case. Compressive strength and other requirements for any application should always be confirmed with the engineer or architect of record to ensure correct product use.

Reference Documents

Find specifications, case studies, reports, assemblies and other information at https://owenscorning.com/foamglas

2.11 Use

Insulation is a passive device that requires no extra utilities or maintenance to operate over its useful life.

2.12 Reference Service Life and Estimated Building Service Life

As prescribed in the applicable PCR, the Reference Service Life (RSL) of the insulation product is 75 years, which aligns with an assumed building Estimated Service Life (ESL) of 75 years, for the purposes of this study.

2.13 Re-use Phase

Although reuse of FOAMGLAS® insulation boards at its end of life is possible, there are no formal programs for collection and transport. It is assumed that all product is sent to landfill at end of life.

2.14 Disposal

It was assumed that all materials removed from the decommissioning of a building were taken to a local construction waste landfill, using 100 miles (or 161 km) as the average distance to landfill.

3. LCA: Calculation Rules

3.1 Functional Unit

1 m^2 of installed insulation material with a thickness that gives an average thermal resistance R_{SI} = 1 m^2K/W and with a building service life of 75 years, including packaging.

Table 6. *Functional unit and reference flows*

Functional Unit	Product	Thickness to Achieve FU (m)	Reference flow (kg/m²)
1 m² of insulation with a thickness required for an average thermal resistance R_{SI} = 1 m²K/W	FOAMGLAS® S3	4.50E-02	5.85E+00
	FOAMGLAS® T4+	4.10E-02	4.72E+00

3.2 System Boundary

This declaration is a product-specific EPD and is cradle-to-installation with end-of-life. Details of the system boundaries may be found in the diagrams below.

Table 7. *System boundary*

Product			Construction Process		Use							End-of-life				Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material extraction and processing	Transport to manufacturer	Manufacturing	Transport	Construction - installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery and/or recycling potential
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	X	MND	X	MND

x = Included in system boundary | MND = Module not declared

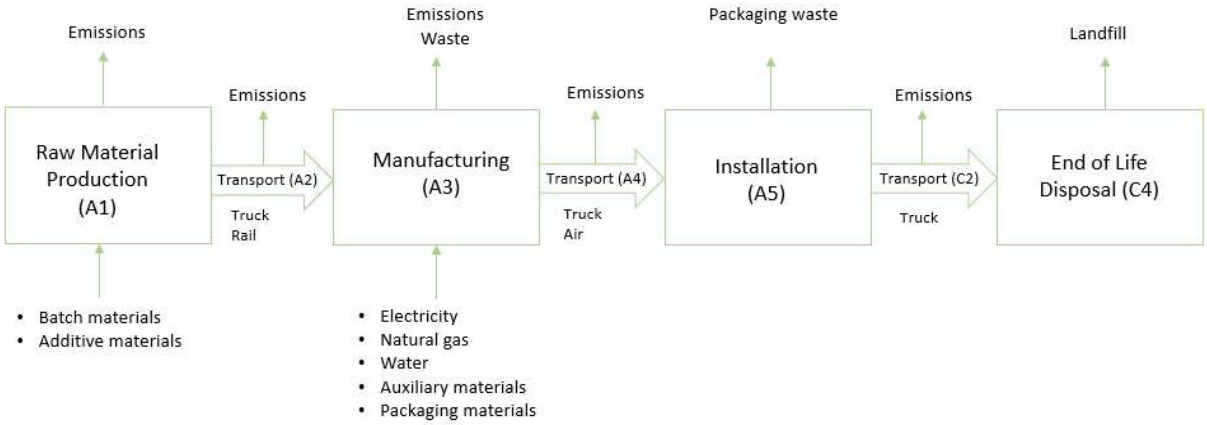


Figure 1. *Flow diagram/System Boundary for FOAMGLAS® Insulation*

3.3 Estimates and Assumptions

Since insulation is a passive device, it is assumed that no utility source or maintenance is needed during the use stage.

3.4 Cut-off criteria

The underlying LCA study is in compliance with the cut-off criteria specified in the PCR. Due to the long lifetime of equipment, capital goods and infrastructure flows were excluded as having a negligible impact on the conclusions of the LCA.

3.5 Background Data

Primary manufacturing data was collected from the included manufacturing locations listed in the Manufacturing section. Secondary data primarily reference the EcoInvent 3.9.1 database.

Table 8. *Data Sources*

Flow		Dataset	Database Source(s)
Product Materials			
Barium sulfate	Batch	Barium sulfide {GLO}| barium sulfide production | Cut-off, U	Ecoinvent 3.9.1
Natural Soda ash, dense	Batch	Natural Soda ash (based on USLCI)	Ecoinvent 3.9.1
Oxidizing agents	Batch & Additives	Various	Ecoinvent 3.9.1
Limestone	Batch	Limestone, crushed, for mill {RoW}| limestone production, crushed, for mill | Cut-off, U	Ecoinvent 3.9.1
Feldspathic sand	Batch	Feldspar {RoW}| feldspar production | Cut-off, U	Ecoinvent 3.9.1
Silica sand	Batch	Silica sand {RoW}| silica sand production | Cut-off, U	Ecoinvent 3.9.1
Carbon black	Additives	Carbon black {GLO}| carbon black production | Cut-off, U	Ecoinvent 3.9.1
LDPE film	Packaging	Packaging film, low density polyethylene {RoW}| packaging film production, low density polyethylene | Cut-off, U	Ecoinvent 3.9.1
Corrugated Carton	Packaging	Corrugated board box {RoW}| corrugated board box production | Cut-off, U	Ecoinvent 3.9.1
Labels	Packaging	Printed paper {GLO}| market for printed paper | Cut-off, U	Ecoinvent 3.9.1
Corrugated pad	Packaging	Corrugated board box {RoW}| corrugated board box production | Cut-off, U	Ecoinvent 3.9.1
Pallet pad	Packaging	EUR-flat pallet {RoW}| EUR-flat pallet production | Cut-off, U	Ecoinvent 3.9.1
Pallet	Packaging	EUR-flat pallet {RoW}| EUR-flat pallet production | Cut-off, U	Ecoinvent 3.9.1
Electricity/Heat/Resources for Manufacturing			

Flow	Dataset	Database Source(s)
Electricity	Electricity, medium voltage {MRO, US only}| market for electricity, medium voltage	Cut-off, U	Ecoinvent 3.9.1
Natural Gas	Natural gas, high pressure {US}| market for natural gas, high pressure	Cut-off, U	Ecoinvent 3.9.1
Water	Tap water {RoW}| market for tap water	Cut-off, U	Ecoinvent 3.9.1
Direct emissions		
Air emissions	Direct air emissions reported from the plant	Plant specific data
Production waste treatment		
Non-hazardous wastes to landfill	Waste glass {CH}| treatment of waste glass, inert material landfill	Cut-off, U	Ecoinvent 3.9.1
Wastewater treatment	Wastewater, average {RoW}| market for wastewater, average	Cut-off, U	Ecoinvent 3.9.1
Transportation		
Truck	Transport, freight, lorry >32 metric ton, EURO6 {RoW}| market for transport, freight, lorry >32 metric ton, EURO6	Cut-off, U	Ecoinvent 3.9.1
Rail	Transport, freight train {US}| transport, freight train, diesel	Cut-off, U	Ecoinvent 3.9.1
Packaging end of life treatment		
Cardboard wastes recycling	Waste paperboard (dummy flow) for recycling	Ecoinvent 3.9.1
LDPE film recycling	Waste plastic (dummy flow) for recycling	Ecoinvent 3.9.1
Pallet recycling	Waste wood (dummy flow) for recycling	Ecoinvent 3.9.1
Cardboard wastes incineration	Waste paperboard {RoW}| treatment of waste paperboard, municipal incineration	Cut-off, U	Ecoinvent 3.9.1
LDPE film incineration	Waste polyethylene {RoW}| treatment of waste polyethylene, municipal incineration	Cut-off, U	Ecoinvent 3.9.1
Pallet incineration	Waste wood, untreated {RoW}| treatment of waste wood, untreated, municipal incineration	Cut-off, U	Ecoinvent 3.9.1
Cardboard wastes landfilling	Waste paperboard {RoW}| treatment of waste paperboard, inert material landfill	Cut-off, U	Ecoinvent 3.9.1
LDPE film landfilling	Waste polyethylene {RoW}| treatment of waste polyethylene, sanitary landfill	Cut-off, U	Ecoinvent 3.9.1
Pallet landfilling	Waste wood, untreated {RoW}| treatment of waste wood, untreated, sanitary landfill	Cut-off, U	Ecoinvent 3.9.1
Product end of life		
Product landfilling	Waste glass {GLO}| treatment of waste glass, sanitary landfill	Cut-off, U	Ecoinvent 3.9.1

3.6 Data Quality

Primary data was based on measured and calculated data from the Sedalia manufacturing plant, that was producing 100% of FOAMGLAS® Insulation boards in 2023 in US. It meets requirements for completeness along with temporal, geographical and technological representativeness. Background data was taken from the EcoInvent database, which is on the approved database list in the PCR.

Table 9. *Data quality assessment*

Data Quality Parameter	Data Quality Discussion
Time-related Coverage: Age of data and the minimum length of time over which data is collected	Primary data were based on Owens Corning's annual operations during calendar year 2022 (2023 for ancillary materials), consistent with the goal and scope of this analysis. The time coverage of secondary data used from the LCI databases is discussed in the Background Data section.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The geographical coverage for this study is Sedalia, Missouri, USA. As such, data was sourced from the Sedalia plant that produce FOAMGLAS® insulation products for US. The geographical coverage of the secondary data used from the LCI databases is discussed in the Background Data section.
Technology Coverage: Specific technology or technology mix	Technological representativeness was based on primary manufacturing data from the Owens Corning facility included in the study.
Precision: Measure of the variability of the data values for each data expressed	Primary data were based on measured and calculated data from the Owens Corning plant which manufactures products covered by this study. The facility data was collected for the reference year 2022 (2023 for ancillary materials), and several sources were used to compare collected values and ensure precision. The data precision is therefore deemed to be of high quality for all measured and calculated data.
Completeness: Percentage of flow that is measured or estimated	All relevant process steps within the system boundary were considered. The primary data provided for FOAMGLAS® insulation manufacturing were benchmarked with data collected for previous models which have undergone third party review.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data sets used in the underlying LCA study were selected based on the most appropriate temporal, geographical, and technological representation of the actual processes and technology. These data sets reflect average processes from multiple sources, and thus generally represent the actual technology utilized to produce the materials. Still, it is often unknown the extent to which secondary data sets deviate from the specific system being studied.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	To ensure consistency, only primary data of the same level of detail and equivalent time interval (i.e., one calendar year) were used, and allocation was conducted similarly for all data categories and life cycle stages. All background data were sourced from the EcoInvent 3.9.1 database selecting the most appropriate geography.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	The reproducibility of the study results is merited by the scope information provided in the underlying LCA report. Due to confidentiality of the data values, however, certain details were omitted from this public facing EPD, which may limit reproducibility by the public.
Sources of the Data: Description of all primary and secondary data sources	Primary data for raw material consumption, inbound transportation, annual production, energy consumption, water consumption, emissions to air, waste generation, packaging usage, distribution of finished goods, waste generation during installation, and installation practices were used in this study. Secondary data sets were selected from the EcoInvent 3.9.1 database.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Because the quality of secondary data is not as good as primary data, the use of secondary data becomes an inherent limitation of the study. Secondary data may cover a broad range of technologies, time periods, and geographical locations. Because hundreds of data sets are linked together and because it is often unknown how much the secondary data used deviate from the specific system being studied, quantifying data uncertainty for the complete system becomes very challenging. As a result, it is not possible to provide a reliable quantified assessment of overall data uncertainty for this study.

3.7 Period under review

The period of review is calendar year 2022.

3.8 Allocation

Allocation of primary data was used in this study. In some cases, primary data collected from the manufacturing site were provided on a facility-wide basis and then allocated to the specific insulation product based on production volume (by mass). The types of production activities for the products manufactured at the given manufacturing facility are similar, so mass allocation is considered an acceptable allocation strategy.

3.9 Comparability

The PCR that this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled. In addition, comparability of EPDs is limited to those applying a functional unit.

Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of Building Envelope Thermal Insulation products using EPD information shall be based on the product's use and impacts at the construction works level, and therefore EPDs may not be used for comparability purposes when not considering the construction works energy use phase as instructed under this PCR. Full conformance with the PCR for Building Envelope Thermal Insulation products allows EPD comparability only when all stages of a life cycle have been considered, when they comply with all referenced standards, use the same sub-category Part B PCR, and use equivalent scenarios with respect to construction works. However, variation and deviations are possible.

4. LCA: Scenarios and Additional Technical Information

4.1 Transport to the Building Site (A4)

Table 10. *Product distribution parameters, per functional unit, for FOAMGLAS® Insulation*

Name	Unit	FOAMGLAS® S3	FOAMGLAS® T4
Vehicle type	-	EURO6, lorry >32 metric ton	
Fuel type	-	low-sulfur diesel	
Liters of fuel	l/100km	1.53E-02	1.23E-02
Transport distance	km	1.165E+03	
Capacity utilization	%	50%	
Gross density of products transported	kg/m^3	1.30E+02	1.15E+02
Capacity utilization volume factor	-	= 1	

4.2 Installation into the Building (A5)

Table 11. *Installation summary, per functional unit, for FOAMGLAS® Insulation*

Name	Unit	FOAMGLAS® S3	FOAMGLAS® T4
Ancillary materials (per m^2)	kg	0.00E+00	0.00E+00
Water consumption specified by water source and fate	m^3	0.00E+00	0.00E+00
Other resources	kg	0.00E+00	0.00E+00
Electricity consumption	kwh	0.00E+00	0.00E+00
Other energy carriers	MJ	0.00E+00	0.00E+00
Product loss per functional unit	kg	0.00E+00	0.00E+00
Waste materials at the construction site before waste processing, generated by product installation	kg	8.85E-01	7.13E-01
Output materials resulting from on-site waste processing	kg	0.00E+00	0.00E+00
Mass of packaging waste specified by type	kg	8.85E-01	7.13E-01
Recycle	kg	2.43E-01	1.96E-01
Landfill	kg	6.17E-01	4.97E-01
Incineration	kg	2.50E-02	2.01E-02
Biogenic carbon contained in packaging	kg CO_2	1.43E+00	1.15E+00
Direct emissions to ambient air, soil, and water	kg	0.00E+00	0.00E+00
VOC content	µg/m^3	None detected	

4.3 Reference Service Life

Table 12. *Reference Service Life, per functional unit, for FOAMGLAS® Insulation*

Name	FOAMGLAS® S3	FOAMGLAS® T4+	Comment
RSL	75 years		N/A
Declared product properties (at the gate) and finishes, etc	Not applicable		Insulation properties require installation into a building
Design application parameters (if instructed by the manufacturer), including references to the appropriate practices and application codes	Install per instructions		N/A
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Will meet the product properties		Installer should install per manufacturer instructions
Outdoor environment, (if relevant for outdoor applications), e.g. weathering, pollutants, UV and wind exposure, building orientation, shading, temperature	Not specific instructions		Slabs are used throughout the entire internal and external building envelope.
Indoor environment, (if relevant for indoor applications), e.g. temperature, moisture, chemical exposure	Not specific instructions		Slabs are used throughout the entire internal and external building envelope.
Use conditions, e.g. frequency of use, mechanical exposure	Not applicable		Insulation is a passive product which is not used directly during life
Maintenance, e.g. required frequency, type and quality of replacement components	None needed		Insulation does not need maintenance during its use

4.4 End-of-Life (C1-C4)

Table 13. *End-of-Life summary, per functional unit, for FOAMGLAS® Insulation*

End-of-life		Unit	FOAMGLAS® S3	FOAMGLAS® T4+
Assumptions for scenario development		N/A	Although reuse and recycling of FOAMGLAS® insulation boards at its end of life is possible, there are no formal programs for collection and transport. It is assumed that all product is sent to landfill at end of life.	
Collection process	Collected separately	kg	0.00E+00	0.00E+00
	Collected with mixed construction waste	kg	5.85E+00	4.72E+00
Disposition	Reuse	kg	0.00E+00	0.00E+00
	Recycling	kg	0.00E+00	0.00E+00
	Energy recovery	kg	0.00E+00	0.00E+00
	Landfill	kg	5.85E+00	4.72E+00
Removals of biogenic carbon (excluding packaging)		kg CO_2	0.00E+00	0.00E+00

5. LCA: Results

Results of the Life Cycle Assessment are presented below. It is noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. All values in the tables below are rounded to three significant digits. The following impact indicators, specified by the PCR, are reported below.

Table 14. *Life Cycle Impact Assessment Indicators and characterization methods used*

Abbreviation	Impact Category	Unit	Characterization Method
GWP 100a	Global Warming Potential, IPCC 2013	[kg CO_2]	IPCC 2013 (AR5)
ODP	Ozone Depletion Potential	kg CFC-11 eq	TRACI 2.1
AP	Acidification Potential	kg SO2 eq	TRACI 2.1
EP	Eutrophication Potential	Kg N eq	TRACI 2.1
SFP	Smog Formation Potential	kg O3 eq	TRACI 2.1
ADP_{fossil}	Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	MJ, LHV	CML-baseline v4.7
GWP 100a	Global Warming Potential, IPCC 2021	kg CO_2 eq	IPCC 2021 (AR6)

These impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development, however the EPD users shall not use additional measures for comparative purposes.

Table 15. *Additional transparency indicators used*

Resources	Unit	Waste and Outflows	Unit
RPR_E: Renewable primary energy used as energy carrier (fuel)	[MJ, LHV]	**HWD**: Hazardous waste disposed	[kg]
RPR_M: Renewable primary resources with energy content used as material	[MJ, LHV]	**NHWD**: Non-hazardous waste disposed	[kg]
$NRPR_E$: Non-renewable primary resources used as an energy carrier (fuel)	[MJ, LHV]	**HLRW**: High-level radioactive waste, conditioned, to final repository	[kg] or [m^3]
$NRPR_M$: Non-renewable primary resources with energy content used as material	[MJ, LHV]	**ILLRW**: Intermediate- and low-level radioactive waste, conditioned, to final repository	[kg] or [m^3]
SM: Secondary materials	[kg]	**CRU**: Components for re-use	[kg]
RSF: Renewable secondary fuels	[MJ, LHV]	**MR**: Materials for recycling	[kg]
NRSF: Non-renewable secondary fuels	[MJ, LHV]	**MER**: Materials for energy recovery	[kg]
RE: Recovered energy	[MJ, LHV]	**EE**: Recovered energy exported from the product system	MJ, heating value ([Hi] lower heating value) per energy carrier
FW: Use of net fresh water resources	[m^3]		

Table 16. *Carbon Emissions and Removals*

Parameter	Unit
BCRP: Biogenic Carbon Removal from Product	[kg CO2]
BCEP: Biogenic Carbon Emission from Product	[kg CO2]
BCRK: Biogenic Carbon Removal from Packaging	[kg CO2]
BCEK: Biogenic Carbon Emission from Packaging	[kg CO2]
BCEW: Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	[kg CO2]
CCE: Calcination Carbon Emissions	[kg CO2]
CCR: Carbonation Carbon Removals	[kg CO2]
CWNR: Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes	[kg CO2]

Table 17. *North American Life Cycle Impact Assessment (LCIA) results for 1 m² FOAMGLAS®S3 Insulation*

Impact Category	Unit	A1 – A3	A4	A5	C2	C4
GWP 100[1]	[kg CO_2 eq]	2.80E+01	7.97E-01	8.64E-02	9.57E-02	6.18E-02
ODP	[kg CFC-11 eq]	2.21E-07	1.48E-08	4.55E-10	1.78E-09	1.69E-09
AP	[kg SO_2 eq]	1.56E-01	1.88E-03	8.33E-05	2.25E-04	4.10E-04
EP	[kg N eq]	8.15E-02	6.77E-04	4.30E-03	8.13E-05	8.57E-05
SFP	[kg O_3 eq]	2.76E+00	3.37E-02	1.92E-03	4.04E-03	1.09E-02
ADP_{fossil}	[MJ, LHV]	3.71E+02	1.18E+01	3.49E-01	1.42E+00	1.37E+00
IPCC GWP 100a (2021)[2]	[kg CO_2 eq]	2.79E+01	7.96E-01	8.56E-02	9.55E-02	6.16E-02

[1]The GWP 100 impacts are based on 100-year time horizon GWP factors provided by the IPCC 2013 Fifth Assessment Report (AR5).
[2]100-year time horizon GWP factors as provided by the Sixth Assessment Report (AR6) shall be used for conformance with ISO 21930, Section 7.3.

Table 18. *North American Life Cycle Impact Assessment (LCIA) results for 1 m² FOAMGLAS® T4+ Insulation*

Impact Category	Unit	A1 – A3	A4	A5	C2	C4
GWP 100[1]	[kg CO_2 eq]	2.27E+01	6.46E-01	7.00E-02	7.75E-02	5.01E-02
ODP	[kg CFC-11 eq]	1.79E-07	1.20E-08	3.69E-10	1.44E-09	1.37E-09
AP	[kg SO_2 eq]	1.26E-01	1.52E-03	6.75E-05	1.83E-04	3.32E-04
EP	[kg N eq]	6.61E-02	5.49E-04	3.48E-03	6.59E-05	6.94E-05
SFP	[kg O_3 eq]	2.24E+00	2.73E-02	1.56E-03	3.28E-03	8.83E-03
ADP_{fossil}	[MJ, LHV]	3.01E+02	9.59E+00	2.83E-01	1.15E+00	1.11E+00
IPCC GWP 100a (2021)[2]	[kg CO_2 eq]	2.26E+01	6.45E-01	6.94E-02	7.74E-02	4.99E-02

Table 19. *Resource Use Indicator Results for 1 m² FOAMGLAS® S3 Insulation*

Resource Use	Unit	A1 – A3	A4	A5	C2	C4
RPR_E	[MJ, LHV]	5.66E+01	1.52E-01	5.40E-03	1.82E-02	1.58E-02
RPR_M	[MJ, LHV]	1.29E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	[MJ, LHV]	3.88E+02	1.20E+01	3.55E-01	1.44E+00	1.39E+00
$NRPR_M$	[MJ, LHV]	2.24E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	[MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	[MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	[MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	[m^3]	8.72E-02	1.92E-03	2.08E-04	2.30E-04	1.48E-03

Table 20. *Resource Use Indicator Results for 1 m² FOAMGLAS® T4+ Insulation*

Resource Use	Unit	A1 – A3	A4	A5	C2	C4
RPR_E	[MJ, LHV]	4.58E+01	1.23E-01	4.37E-03	1.48E-02	1.28E-02
RPR_M	[MJ, LHV]	1.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	[MJ, LHV]	3.14E+02	9.73E+00	2.88E-01	1.17E+00	1.12E+00
$NRPR_M$	[MJ, LHV]	1.82E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	[MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	[MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	[MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	[m^3]	7.07E-02	1.55E-03	1.69E-04	1.86E-04	1.20E-03

Table 21. *Waste and Output Flow Indicator Results for 1 m² FOAMGLAS® S3 Insulation*

Resource Use	Unit	A1 – A3	A4	A5	C2	C4
HWD	[kg]	1.52E-03	7.58E-05	2.05E-06	9.09E-06	7.20E-06
NHWD	[kg]	3.88E+00	1.04E+00	6.35E-01	1.25E-01	5.85E+00
HLRW	[kg]	5.21E-05	7.63E-07	2.72E-08	9.15E-08	7.12E-08
ILLRW	[kg]	1.90E-04	1.86E-06	6.75E-08	2.23E-07	1.78E-07
CRU	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 22. *Waste and Output Flow Indicator Results for 1 m² FOAMGLAS® T4+ Insulation*

Resource Use	Unit	A1 – A3	A4	A5	C2	C4
HWD	[kg]	1.23E-03	6.14E-05	1.66E-06	7.37E-06	5.83E-06
NHWD	[kg]	3.14E+00	8.46E-01	5.14E-01	1.02E-01	4.74E+00
HLRW	[kg]	4.22E-05	6.18E-07	2.20E-08	7.42E-08	5.77E-08
ILLRW	[kg]	1.54E-04	1.50E-06	5.47E-08	1.80E-07	1.44E-07
CRU	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 23. *Carbon Emissions and Removals Indicator Results for 1 m² FOAMGLAS®S3 Insulation*

Resource Use	Unit	A1 – A3	A4	A5	C2	C4
BCRP	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	[kg CO_2]	1.43E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	[kg CO_2]	0.00E+00	0.00E+00	1.43E+00	0.00E+00	0.00E+00
BCEW	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	[kg CO_2]	5.54E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 24. *Carbon Emissions and Removals Indicator Results for 1 m² FOAMGLAS® T4+ Insulation*

Resource Use	Unit	A1 – A3	A4	A5	C2	C4
BCRP	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	[kg CO_2]	1.16E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	[kg CO_2]	0.00E+00	0.00E+00	1.16E+00	0.00E+00	0.00E+00
BCEW	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	[kg CO_2]	4.49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

6. LCA: Interpretation

The manufacturing stage (A3) is clearly the key contribution to all the impact categories. The raw material supply (A1) is the second higher contributor to all the required impact categories, following the manufacturing stage (A3).

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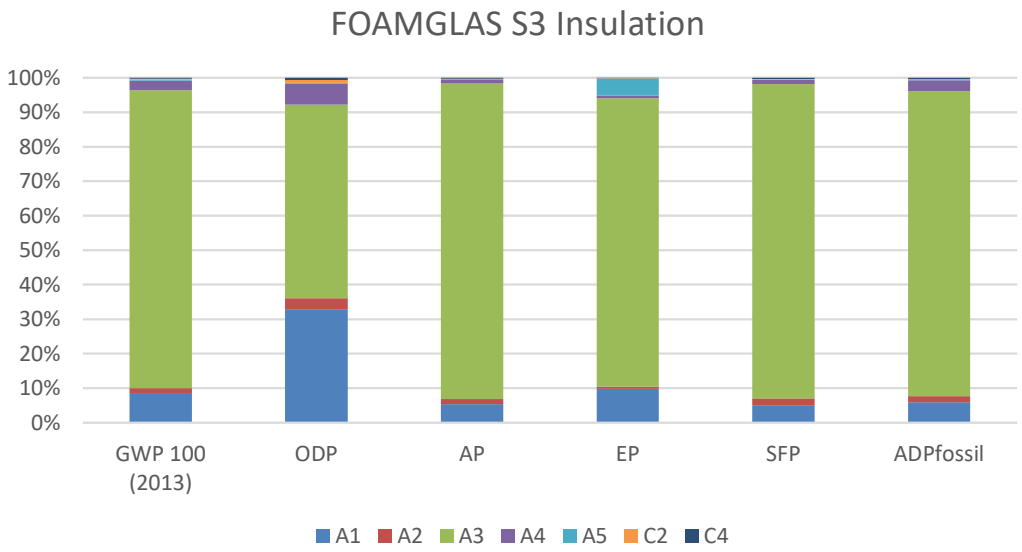

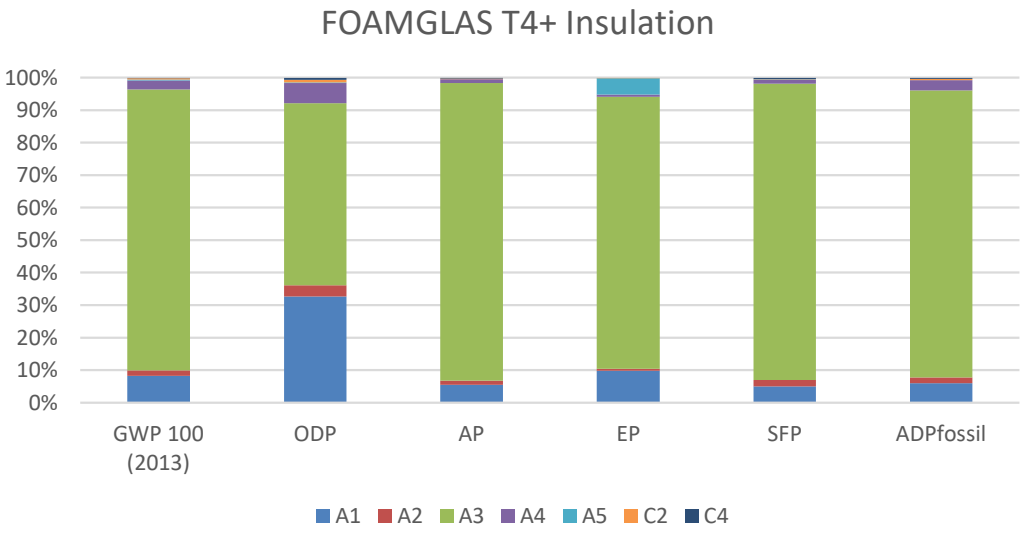

6.1 Sensitivity Analysis

Since all the products covered in this EPD are coming from the same manufacturing site, variations mostly come from differences between products, mainly product density. Despite these variations it is still appropriate to group the FOAMGLAS® Insulation products into a single average because the data reflect a consistent time window and there is no significant variation in methods or materials used to manufacture the products.

6.2 Assumptions and Limitations

The ability of LCA to consider the entire life cycle of products makes it an attractive tool for the assessment of potential environmental impacts. Nevertheless, similar to other environmental management analysis tools, LCA has several limitations

related to data quality and unavailability of potentially relevant data. It should be kept in mind that the impact assessment results are relative expressions and do not predict impacts on category endpoints, exceeding thresholds, or risks.

The study was conducted by including the relevant system boundaries and best available data for FOAMGLAS® Insulation products, using a consistent data collection method and timeframe. In cases where data were reported for the entire facility rather than for the specific insulation materials product, mass allocation was used to allocate the facility-wide impacts to the specific product. This assumes that all products equally consume facility inputs and contribute to facility outputs.

7. Additional Environmental Information

7.1 Environment and Health during Manufacture

Owens Corning manufacturing facility of FOAMGLAS® Insulation in Sedalia, Missouri, USA has the third part certifications of declare label for FOAMGLAS® T4+, S3, FG ONE Cellular Glass Insulation.

7.2 Energy Savings During Use

Insulation is a passive product that requires no extra utilities to operate over its useful life. Insulation of a building is responsible for reducing the energy burden associated with heating and cooling of a building. Due to the variety of use applications of the product, the energy savings of the product may vary. The product is capable of maintaining thermal performance for the life of the building; however, if it becomes damaged during use or servicing of other building components, it will need to be replaced. Since these circumstances may vary widely, no attempt has been made in this study to estimate a reference service life and energy savings during use.

7.3 Environment and Health during Installation

This product is considered an article. 29 CFR 1910.1200(c) definition of an article is as follows: "Article" means a manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical (as determined under paragraph (d) of this section), and does not pose a physical hazard or health risk to employees.

7.4 Extraordinary Effects

No extraordinary effects or environmental impacts are expected due to destruction of the product by fire, water, or mechanical means.

7.5 Delayed Emissions

No delayed emissions are expected from this product.

7.6 Environmental Activities and Certifications

FOAMGLAS® Insulation products have the following certifications and sustainable features:

- Declare label for FOAMGLAS® T4+, S3, FG ONE Cellular Glass Insulation

7.7 Further Information

Further information on the product can be found on the manufacturers' website at www.owenscorning.com.

8. References

- Life Cycle Assessment of Owens Corning Cellular glass insulation products: FOAMGLAS®
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
- ISO 14040: 2006 Environmental Management – Life cycle assessment – Principles and Framework
- ISO 14044: 2006/AMD 1:2017/ AMD 2:2020 Environmental Management – Life cycle assessment – Requirements and Guidelines.
- PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 4.0. UL Environment. Mar. 2022
- PCR Guidance for Building-Related Products and Services Part B: Building Envelope Thermal Insulation EPD Requirements. Version 3.0. April 2023.
- ISO 21930: 2017 Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services.
- SCS Type III Environmental Declaration Program: Program Operator Manual. V12.0 November 2023. SCS Global Services.
- ASTM C203 Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
- ASTM C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- ASTM C303-21 Standard Test Method for Dimensions and Density of Preformed Block and Board–Type Thermal Insulation
- ASTM C240-21 Standard Test Methods for Testing Cellular Glass Insulation Block
- ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials
- ASTM C1338 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
- ASTM C1617 Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals
- ASTM D5385 Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
- ASTM C1306 Standard Test Method for Hydrostatic Pressure Resistance of a Liquid-Applied Waterproofing Membrane
- ASTM E228 Standard Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer
- ASTM D2126 Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
- ASTM C165 Standard Test Method for Measuring Compressive Properties of Thermal Insulations
- ASTM C240 Standard Test Methods for Testing Cellular Glass Insulation Block
- ASTM C623 Standard Test Method for Young's Modulus, Shear Modulus, and Poisson's Ratio for Glass and Glass-Ceramics by Resonance
- ASTM E136 Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C
- ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
- US EPA Greenhouse Gas Equivalencies Calculator (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator)

For more information, contact:

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