Declaration Owner
Owens Corning
One Owens Corning Parkway, Toledo, OH, USA
1-800-GET-PINK (1-800-438-7465)
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Products
FOAMULAR® NGX® XPS Insulation

Functional Unit
1 m² of insulation with a thickness required for an average thermal resistance RSI = 1 m²K/W maintained for 75 years

EPD Number and Period of Validity
SCS-EPD-09753
EPD Valid January 10, 2024 through January 9, 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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Declaration Owner:	Owens Corning
Address:	One Owens Corning Parkway, Toledo, OH, USA
Declaration Number:	SCS-EPD-09753
Declaration Validity Period:	EPD Valid January 10, 2024 through January 9, 2029
Product:	FOAMULAR® NGX® XPS Insulation
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Rémi Bagard (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
EPD Scope	Cradle-to-Gate 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 locations listed below.

2. Product

2.1 Product Description and Application

FOAMULAR® NGX® XPS Insulation is a comprehensive line of extruded polystyrene rigid foam products that are easy to use, resist water absorption, deliver high compressive strength, and maintain a high R-value throughout the life of the building.* It has third-party certified recycled content - certified by SCS Global Services - and, in addition is GREENGUARD Gold certified, offers the industry's only lifetime limited warranty.* FOAMULAR® NGX® XPS Insulation is made with Owens Corning's patented Hydrovac® process technology under strict quality control measures, which makes it highly resistant to moisture and permits the product to retain its high R-value year after year even after prolonged exposure to moisture and freeze/thaw cycling. Another primary difference with FOAMULAR® NGX® XPS Insulation products is its compressive strength. FOAMULAR® NGX® XPS Insulation has compressive strengths of 15, 20, 25, 30, 35, 40, 60 and 100 psi. The variety of products provides different strengths for use in walls, where there is almost no compressive load, or intermediate strength product for use with modest loads such as around foundations, or in low slope roofs. It also is suitable for use under high load pavement, such as floor slabs or plaza decks. FOAMULAR® NGX® contains the additional benefit of being manufactured with a blowing agent formulation that delivers a 90% reduction to Global Warming Potential (100 year) compared to FOAMULAR® blowing agent, including the complete elimination of HFC 134a.

The following product names reflect differences in final product dimensions, application, and compressive strength only. All FOAMULAR® NGX® XPS Insulation products included in this study are made using consistent batch and blowing agent chemistry and manufacturing processes, making it appropriate to group them within a single EPD.

FOAMULAR® NGX® products
FOAMULAR® NGX® 150
FOAMULAR® NGX® 250
FOAMULAR® NGX® 350
FOAMULAR® NGX® 400/600/100
FOAMULAR® NGX® 404/604
FOAMULAR® NGX® 404RB/604RB
FOAMULAR® NGX® LT30/LT40
FOAMULAR® NGX® CW25
FOAMULAR® NGX® THERMAPINK® 25
FOAMULAR® NGX® INSUL-DRAIN
FOAMULAR® NGX® Fanfold
FOAMULAR® NGX® AgTek
FOAMULAR® NGX® PINKCORE®
FOAMULAR® NGX® EDGELOCK®
FOAMULAR® NGX® C-200
FOAMULAR® NGX® C-300
FOAMULAR® NGX® CodeBord
FOAMULAR® NGX® Insulating Sheathing
FOAMULAR® NGX® Half-inch

2.2 Methodological Framework

This declaration is a product-specific EPD and is cradle-to-installation with use stage and end-of-life. The underlying LCA upon which this EPD is based includes the following life cycle modules: *Raw Material supply* (A1); *Inbound Transportation* (A2); *Manufacturing* (A3); *Distribution* (A4); *Installation* (A5); *Use* (B1) *End-of-life, 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 in the US.

Table 1. *Technical specifications for FOAMULAR® NGX® commonly used in the US*

Properties	Test method	FOAMULAR® NGX® 150	FOAMULAR® NGX® 250	FOAMULAR® NGX® 400	FOAMULAR® NGX® 600	FOAMULAR® NGX® 1000
ASTM C578 Classification	ASTM C578	Type X	Type IV	Type VI	Type VII	Type V
Compressive resistance at yield or 10% deformation, whichever occurs first min, psi	ASTM D1621	15	25	40	60	100
Density, min, lb/ft³	ASTM D1622	1.3	1.55	1.8	2.2	3
Thermal resistance of 1.00-in. thickness, min, hr·ft2·°F/Btu Mean temperature: 75°F ± 2°F	ASTM C518	5.0	5.0	5.0	5.0	5.0
Flexural strength, min, psi	ASTM C203	40	50	90	120	150
Water vapor permeance of 1.00-in. thickness, max, perm	ASTM E96	1.5	1.5	1.1	1.1	1.1
Water absorption by total immersion, max, volume	ASTM C272	0.3	0.3	0.3	0.3	0.3

Note: *This chart reflects minimum and maximum physical properties required per ASTM C578 for classification purposes. Actual performance of specific products exceeds ASTM C578 requirements in some cases. Refer to product data sheets for more specific performance information.*

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

Table 2. *Technical specifications for FOAMULAR® NGX® commonly used in Canada*

Properties	Test method	FOAMULAR® NGX® C-200	FOAMULAR® NGX® C-300	FOAMULAR® NGX® 400	FOAMULAR® NGX® 600	FOAMULAR® NGX® 1000
Compliance	CAN/ULC S701	Type 3	Type 4	Type 4	Type 4	Type 4
Compressive resistance at yield or 10% deformation, whichever occurs first min, psi (kPa)	ASTM D1621	20 (140)	30 (210)	30 (210)	30 (210)	30 (210)
Long-Term Thermal Resistance, LTTR-Value,6 minimum hr•ft2•°F/Btu (RSI, °C•m2/W) @ 75°F (24°C) mean temperature	CAN/ULC S770-03	5.0	5.0	5.0	5.0	5.0
Flexural strength, min, psi (kPa)	ASTM C203	44 (300)	51 (350)	51 (350)	51 (350)	51 (350)
Water vapor permeance of 1.00-in. thickness, max, perm (ng/Pa•s•m2)	ASTM E96	2.62 (130)	1.57 (90)	1.57 (90)	1.57 (90)	1.57 (90)

Note: *This chart reflects minimum and maximum physical properties required per S701 for classification purposes. Actual performance of specific products exceeds S701 requirements in some cases. Refer to product data sheets for more specific performance information.*

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, FOAMULAR® NGX® XPS Insulation delivers its advertised R-value. For additional product property details, visit the specific product pages through www.owenscorning.com.

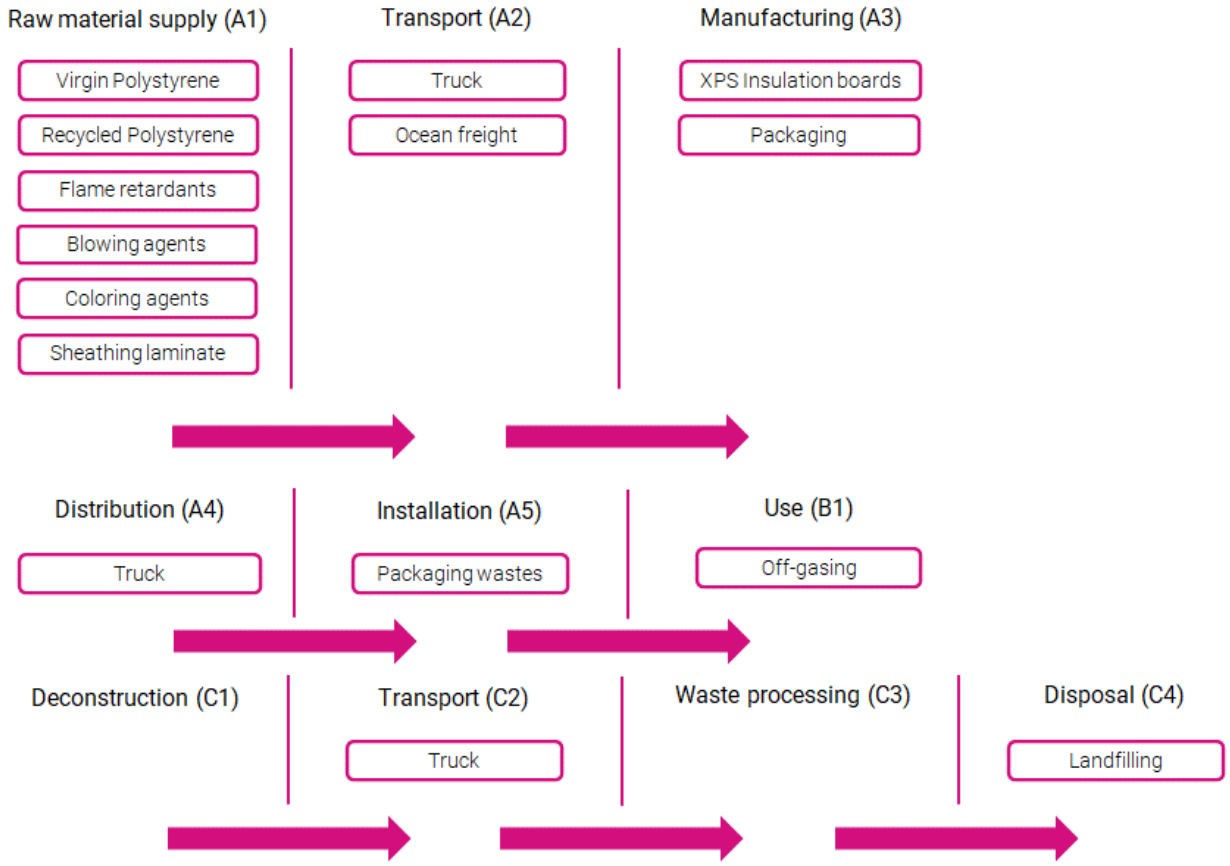
Table 3. *FOAMULAR® NGX® (US) Product Properties as Delivered*

Product	Width	Length	Thickness	R-Value
FOAMULAR® NGX® 150	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm), 108" (2,743 mm)	1" (25.4 mm)	5
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	1 ½" (38.1 mm)	7.5
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	2" (50.8 mm)	10
	48" (1,219 mm)	96" (2,438 mm)	2 ½" (63.5 mm)	12.5
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	3" (76.2 mm)	15
FOAMULAR® NGX® 250	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	¾" (19 mm)	4
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm), 108" (2,743 mm)	1" (25.4 mm)	5
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	1 ½" (38.1 mm)	7.5
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm), 108" (2,743 mm)	2" (50.8 mm)	10
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	2 ½" (63.5 mm)	12.5
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	3" (76.2 mm)	15
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	4" (101.6 mm)	20
FOAMULAR® NGX® 400	24" (610 mm)	96" (2,438 mm)	1" (25.4 mm)	5
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	2" (50.8 mm)	10
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	3" (76.2 mm)	15
	48" (1,219 mm)	96" (2,438 mm)	4" (101.6 mm)	20
FOAMULAR® NGX® 600	24" (610 mm)	96" (2,438 mm)	1" (25.4 mm)	5
	24" (610 mm)	96" (2,438 mm)	1 ½" (38.1 mm)	7.5
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	2" (50.8 mm)	10
	24" (610 mm), 48" (1,219 mm)	96" (2,438 mm)	3" (76.2 mm)	15
FOAMULAR® NGX® 1000	24" (610 mm)	96" (2,438 mm)	1 ½" (38.1 mm)	7.5
	24" (610 mm)	96" (2,438 mm)	2" (50.8 mm)	10
	24" (610 mm)	96" (2,438 mm)	3" (76.2 mm)	15

Table 4. *FOAMULAR® NGX® (Canada) Product Properties as Delivered*

Product	Width	Length	Thickness	R-Value
FOAMULAR® NGX® C-200	24″ (610 mm)	96″ (2,438 mm)	1″ (25.4 mm)	5
	24″ (610 mm)	96″ (2,438 mm)	1 ½″ (38.1 mm)	7.5
	24″ (610 mm)	96″ (2,438 mm)	2″ (50.8 mm)	10
	24″ (610 mm)	96″ (2,438 mm)	2 ½″ (63.5 mm)	12.5
	24″ (610 mm)	96″ (2,438 mm)	3″ (76.2 mm)	15
	24″ (610 mm)	96″ (2,438 mm)	3 ½″ (88.9 mm)	17.5
	24″ (610 mm)	96″ (2,438 mm)	4″ (101.6 mm)	20
FOAMULAR® NGX® C-300	24″ (610 mm)	96″ (2,438 mm)	1″ (25.4 mm)	5
	24″ (610 mm)	96″ (2,438 mm)	1 ½″ (38.1 mm)	7.5
	24″ (610 mm)	96″ (2,438 mm)	2″ (50.8 mm)	10
	24″ (610 mm)	96″ (2,438 mm)	2 ½″ (63.5 mm)	12.5
	24″ (610 mm)	96″ (2,438 mm)	3″ (76.2 mm)	15
	24″ (610 mm)	96″ (2,438 mm)	3 ½″ (88.9 mm)	17.5
	24″ (610 mm)	96″ (2,438 mm)	4″ (101.6 mm)	20
FOAMULAR® NGX® 400	24″ (610 mm)	96″ (2,438 mm)	1″ (25.4 mm)	5
	24″ (610 mm)	96″ (2,438 mm)	2″ (50.8 mm)	10
	24″ (610 mm)	96″ (2,438 mm)	3″ (76.2 mm)	15
	48″ (1,219 mm)	96″ (2,438 mm)	4″ (101.6 mm)	20
FOAMULAR® NGX® 600	24″ (610 mm)	96″ (2,438 mm)	1″ (25.4 mm)	5
	24″ (610 mm)	96″ (2,438 mm)	1 ½″ (38.1 mm)	7.5
	24″ (610 mm)	96″ (2,438 mm)	2″ (50.8 mm)	10
	24″ (610 mm)	96″ (2,438 mm)	3″ (76.2 mm)	15
FOAMULAR® NGX® 1000	24″ (610 mm)	96″ (2,438 mm)	1 ½″ (38.1 mm)	7.5
	24″ (610 mm)	96″ (2,438 mm)	2″ (50.8 mm)	10
	24″ (610 mm)	96″ (2,438 mm)	3″ (76.2 mm)	15

2.5 Flow Diagram



2.6 Material Composition

FOAMULAR® NGX® XPS Insulation consits of two major components, polystyrene resin and a blend of HFC and HFO blowing agents. Although the majority of the polystyrene is virgin material, there is an appreciable amount of pre-consumer recycled polystyrene content. The remainder of the material is composed of peformance additives, flame retardant, and colorant. Each of these minor components is less than 1% by mass of the total material composition.

Table 5. *FOAMULAR® NGX® composition*

Component	Composition % (by Mass)
Polystyrene (virgin)	65-85%
Polystyrene (recycled)	5-25%
Blowing agent	5-15%
Flame retardant	< 1%
Coloring agent	< 1%
Additives	< 1 %

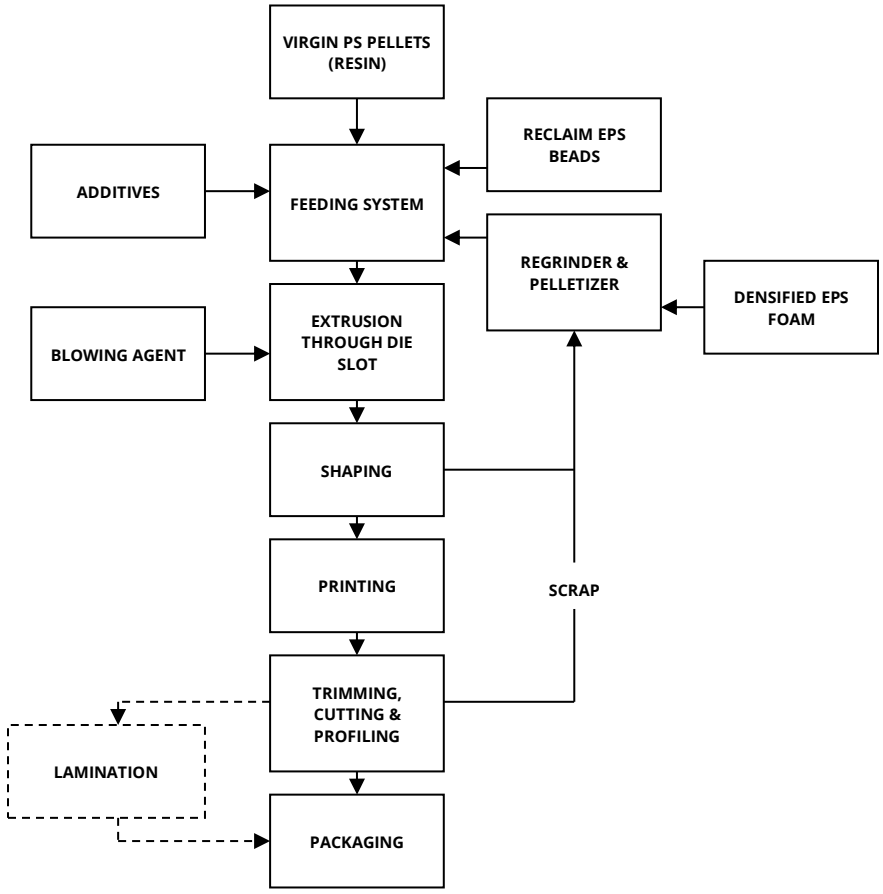
There are no hazardous substances contained in the product per the North American regional definition of hazardous wastes.

The product does not release any dangerous, regulated substances.

2.7 Manufacture

Owens Corning® FOAMULAR® NGX® XPS Insulation manufacturing locations can be found across the United States and Canada. Product covered by this Environmental Product Declaration was produced in the following locations:

Gresham Plant Portland, OR, USA	**Rockford Plant** Rockford, IL, USA
Tallmadge Plant Tallmadge, OH, USA	**Valleyfield Plant** Grande-Île, QC, Canada



The diagram above represents the manufacturing process for FOAMULAR® NGX® XPS Insulation used among the manufacturing facilities. Although minor differences exist due to the availability of specific suppliers for materials, there are no significant process differences among manufacturing locations.

2.8 Packaging

FOAMULAR® NGX® XPS Insulation is packaged and shipped in units (typically 3,072 board-feet per unit) with two stretch-wrap bands per bundle. Regional disposal scenarios for the US and Canada were 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 6. *Packaging for 1 m² of FOAMULAR® NGX® XPS Insulation*

Packaging Material
Stretch-wrap bands (LDPE)
Edge protector (cardboard)
Pallets (wood)

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

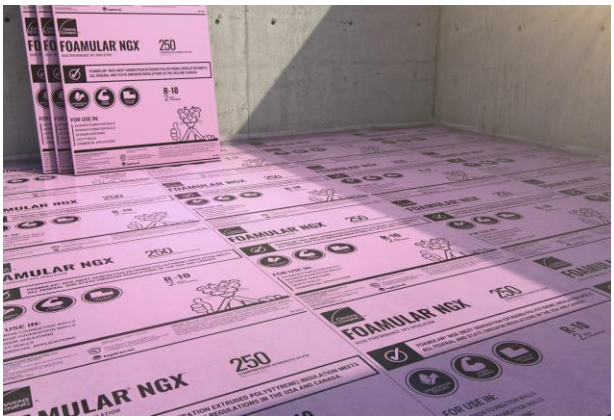
Table 7. *Waste Treatment of Packaging*

Country/Region	Material Type	Recycling Rate	Landfill Rate	Incineration Rate
Canada	Plastics	78%	22%	0%
	Other	20%	80%	0%
United States	Plastics	15%	68%	17%
	Pulp (cardboard, paper)	75%	20%	5%

2.9 Transportation

The outbound transportation or distribution includes the transportation of the finished product to customers primarily by diesel semi-truck. The weighted average outbound transportation distance from the specified location to the building site is 629 km.

2.10 Product Installation



General

Optimum performance of FOAMULAR® NGX® XPS Insulation products is dependent on the selection of the correct product for the assembly or application into/on which it is to be placed and following the associated installation instructions. General rules which apply to both selection and installation include:

- The framed assembly or masonry surface onto which the Insulation is to be applied must be even. FOAMULAR® NGX® XPS Insulation is a rigid product and not intended for uneven surfaces. Any deformation of the application surface can result in a weakening of the attachment points and / or cracking of the insulation.
- There should be no voids or gaps in the insulation itself, around any objects that penetrate the insulation or at the interface of the insulation and framing members.
- FOAMULAR® NGX® XPS Insulation with no sheathing is not structural. When applying to wood or metal framing, either FOAMULAR® NGX® Insulating Sheathing or a structural sheathing or bracing must be used in association with other FOAMULAR® NGX® XPS Insulation.

Frame Walls

When installed on frame walls, FOAMULAR® NGX® XPS Insulation products must be mechanically fastened using nails or screws with washers to prevent pull-through and adequately secure foam. Cover all framing with FOAMULAR® NGX® XPS Insulation and fit joints tightly. Sealing of joints is not required, but joints and openings may be sealed with Owens Corning® JointSealR® Foam Joint Tape.

Masonry Walls

When installed on masonry walls, FOAMULAR® NGX® XPS Insulation products must be secured using construction adhesive compatible with polystyrene, compression fit, or mechanical fasteners. Cover all framing with FOAMULAR® NGX® XPS Insulation and fit joints tightly. Sealing of joints is not required, but joints and openings may be sealed with Owens Corning® JointSealR® Foam Joint Tape.

Under Concrete Slab

When installed under concrete slab, FOAMULAR® NGX® XPS Insulation products must be installed on a gravel fill built up to grade, thoroughly tamped and on prepared and secured drainage aggregate, vapor retarders as required, and gas barriers as required. The FOAMULAR® NGX® XPS Insulation layer is then covered by a concrete slab poured on it.

Reference Documents

Find specifications, case studies, reports, assemblies and other information at www.owenscorning.com/foamular.

2.11 Use

Due to its nature, FOAMULAR® NGX® XPS Insulation is a passive device requiring no utilities or maintenance over its useful life. Nevertheless, provided the XPS foam is used as intended, during the use phase, reductions in a building's energy consumption and releases of blowing agents do occur. Although both of these can be attributed to the use of XPS foam insulation, only the environmental impacts due to the blowing agent emissions have been included within the system boundaries since diffusion of the blowing agent occurs whether or not the XPS foam is used for thermal insulation to affect these subsequent energy savings.

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 and recycling of XPS 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

The End of Life stage modeled for XPS insulation consists of the transportation by tractor-trailer truck of the foam for an assumed distance of 100 miles (161 km) to a landfill and the subsequent disposal of the used XPS insulation in the landfill including releases to air of all remaining, residual blowing agents.

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.

Product Average

The results of this declaration represent an average performance for the listed products. Reported area weights for included products and production locations were taken from quality control data to create a weighted average which was used to determine the functional unit mass for the LCA.

Table 8. *Functional unit and reference flows*

Functional Unit	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	2.88E-02	8.06E-01

Table 9. *Declared Unit Properties of Laminate add-on*

Product	Mass of Declared Unit (1 m² on both sides) (kg/m²)
Sheathing laminate add-on	2.91E-02

3.2 System Boundary

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

Table 10. *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	X	MND	MND	MND	MND	MND	MND	MND	X	MND	X	MND

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

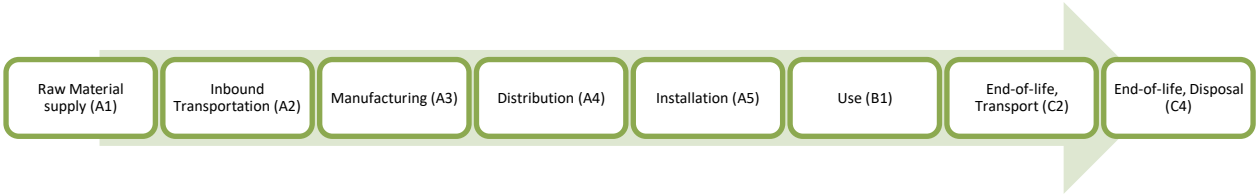


Figure 1. *Flow diagram/System Boundary for FOAMULAR® NGX® XPS Insulation*

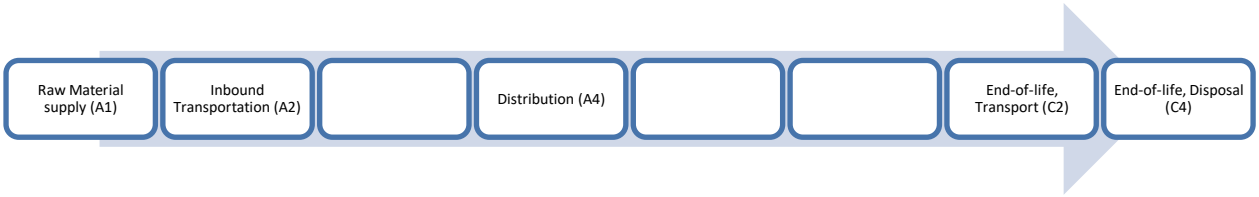


Figure 2. *Flow diagram/System Boundary for Sheathing laminate add-on*

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 11. *Data Sources*

Flow		Dataset	Database Source(s)
Product Materials			
Virgin Polystyrene (1kg)	Batch	Polystyrene, general purpose {GLO}| market for polystyrene, general purpose | Cut-off, U	Ecoinvent 3.9.1
Recycled polystyrene (1kg)	Batch	Extrusion, plastic film {GLO}| market for extrusion, plastic film | Cut-off, U	Ecoinvent 3.9.1
		Transport, freight, lorry >32 metric ton, EURO6 {RoW}| market for transport, freight, lorry >32 metric ton, EURO6 | Cut-off, U	Ecoinvent 3.9.1
Flame retardant	Batch	Market for acrylonitrile-butadiene-styrene copolymer GLO	Ecoinvent 3.9.1
		Polystyrene, general purpose {GLO}| market for polystyrene, general purpose | Cut-off, U	Ecoinvent 3.9.1
Coloring agent	Batch	Polystyrene, general purpose {GLO}| market for polystyrene, general purpose | Cut-off, U	Ecoinvent 3.9.1
		Market for chemical, organic GLO	Ecoinvent 3.9.1
PS-Graphite	Batch	Polystyrene, general purpose {GLO}| market for polystyrene, general purpose | Cut-off, U	Ecoinvent 3.9.1
		Market for graphite GLO	Ecoinvent 3.9.1
Blowing agent blend	Blowing agent	1,1-difluoroethane, HFC-152a {GLO}| market for 1,1-difluoroethane, HFC-152a | Cut-off, U	Ecoinvent 3.9.1
		HFO 1336mzz-Z, Rolled Up Model S	Supplier specific data
		Carbon dioxide production, liquid RoW	Ecoinvent 3.9.1

Flow		Dataset	Database Source(s)
Sheathing LDPE film	Sheathing	Packaging film production, low density polyethylene RoW	Ecoinvent 3.9.1
LDPE film	Packaging	Market for packaging film, low density polyethylene GLO	Ecoinvent 3.9.1
Cardboard protection	Packaging	Market for corrugated board box RoW	Ecoinvent 3.9.1
Pallets	Packaging	Market for EUR-flat pallet RoW	Ecoinvent 3.9.1
Electricity/Heat/Resources for Manufacturing			
Electricity - Gresham		Electricity, medium voltage {WECC, US only}| market for electricity, medium voltage | Cut-off, U	Ecoinvent 3.9.1
Electricity - Rockford		Electricity, medium voltage {RFC}| market for electricity, medium voltage | Cut-off, U	Ecoinvent 3.9.1
Electricity - Tallmadge		Electricity, medium voltage {RFC}| market for electricity, medium voltage | Cut-off, U	Ecoinvent 3.9.1
Electricity – Valleyfield		Electricity, medium voltage {CA-QC}| market for electricity, medium voltage | Cut-off, U	Ecoinvent 3.9.1
Natural gas		Heat, district or industrial, natural gas {RoW}| heat production, natural gas, at industrial furnace >100kW | Cut-off, U	Ecoinvent 3.9.1
Diesel		Diesel, burned in building machine {GLO}| diesel, burned in building machine | Cut-off, U	Ecoinvent 3.9.1
Liquified Petroleum Gas		Propane, burned in building machine {GLO}| market for propane, burned in building machine | Cut-off, U Proxy	Ecoinvent 3.9.1
Propane		Propane, burned in building machine {GLO}| market for propane, burned in building machine | Cut-off, U	Ecoinvent 3.9.1
Water		Tap water {GLO}| market group for tap water | Cut-off, U	Ecoinvent 3.9.1
Direct emissions			
Air emissions		Direct air emissions reported from the plants: HFC152a, HFO1336mzz(Z) HFO1234ze(E), CO_2, PM<2.5µm, PM > 2.5µm and <10µm	Plant specific data
Production waste treatment			
Cardboard wastes recycling		Core board (waste treatment) {GLO}| recycling of core board | Cut-off, U	Ecoinvent 3.9.1
Metal wastes recycling		Steel and iron (waste treatment) {GLO}| recycling of steel and iron | Cut-off, U	Ecoinvent 3.9.1
Pallet wastes recycling		Waste wood, untreated {RoW}| market for waste wood, untreated | Cut-off, U	Ecoinvent 3.9.1
Polystyrene wastes recycling		PE (waste treatment) {GLO}| recycling of PE | Cut-off, U	Ecoinvent 3.9.1
Oil wastes recycling		market for waste textile, soiled RoW	Ecoinvent 3.9.1
Non-hazardous wastes to recycling		Inert waste, for final disposal {RoW}| market for inert waste, for final disposal | Cut-off, U	Ecoinvent 3.9.1
Non-hazardous wastes to landfill		Inert waste, for final disposal {RoW}| treatment of inert waste, inert material landfill | Cut-off, U	Ecoinvent 3.9.1
Non-hazardous wastes to incineration		treatment of municipal solid waste, incineration RoW	Ecoinvent 3.9.1
Liquid hazardous wastes incineration		treatment of hazardous waste, hazardous waste incineration RoW	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}| transport, freight, lorry >32 metric ton, EURO6 | Cut-off, U	Ecoinvent 3.9.1
Oceanic vessel (ship)		Transport, freight, sea, container ship {GLO}| market for transport, freight, sea, container ship | Cut-off, U	Ecoinvent 3.9.1
Packaging end of life treatment			
Cardboard wastes recycling		Core board (waste treatment) {GLO}| recycling of core board | Cut-off, U	Ecoinvent 3.9.1
LDPE film recycling		PE (waste treatment) {GLO}| recycling of PE | Cut-off, U	Ecoinvent 3.9.1
Pallet recycling		Core board (waste treatment) {GLO}| recycling of core board | Cut-off, U Proxy	Ecoinvent 3.9.1
Cardboard wastes incineration		Waste paperboard {RoW}| treatment of waste paperboard, municipal incineration | Cut-off, U	Ecoinvent 3.9.1

Flow	Dataset	Database Source(s)
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	Inert waste, for final disposal {RoW}| treatment of inert waste, inert material landfill	Cut-off, U	Ecoinvent 3.9.1
Pallet landfilling	Waste wood, untreated {CH}| treatment of waste wood, untreated, sanitary landfill	Cut-off, U	Ecoinvent 3.9.1
Product end of life		
Product landfilling	Inert waste, for final disposal {RoW}| treatment of inert waste, inert material landfill	Cut-off, U	Ecoinvent 3.9.1

3.6 Data Quality

Primary data was based on measured and calculated data from all current North American Owens Corning plants which will be producing FOAMULAR® NGX® in 2024. These sites were producing a mix of FOAMULAR® and FOAMULAR® NGX® products in 2022. Only the blowing agent blend and associated emissions are expected to change following the full conversion to FOAMULAR® NGX® production. 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 12. *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, 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 the USA and Canada. As such, data were sourced from one facility in Canada and three facilities in the USA. 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 four Owens Corning facilities 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 all the Owens Corning plants which manufacture products covered by this study. The facility data were collected for the reference year 2022, 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 FOMAULAR® NGX® XPS 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 manufacturing sites 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 a 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 13. *Product distribution parameters, per functional unit, for FOAMULAR® NGX®*

Name	Unit	Value
Vehicle type	-	EURO6, lorry >32 metric ton
Fuel type	-	low-sulfur diesel
Liters of fuel	l/100km	1.82E-03
Transport distance	km	629
Capacity utilization	%	50
Gross density of products transported	kg/m^3	28.0
Capacity utilization volume factor	-	= 1

4.2 Installation into the Building (A5)

Table 14. *Installation summary, per functional unit, for FOAMULAR® NGX®*

Name	Unit	Value
Ancillary materials (per m^2)	kg	0.00E+00
Water consumption specified by water source and fate	m^3	0.00E+00
Other resources	kg	0.00E+00
Electricity consumption	kwh	0.00E+00
Other energy carriers	MJ	0.00E+00
Product loss per functional unit	kg	0.00E+00
Waste materials at the construction site before waste processing, generated by product installation	kg	3.70E-01
Output materials resulting from on-site waste processing	kg	0.00E+00
Mass of packaging waste specified by type	kg	3.70E-01
Recycle (US / Canada)	kg	*2.72E-01 / 7.94E-02*
Landfill (US / Canada)	kg	*7.84E-02 / 2.90E-01*
Incineration (US / Canada)	kg	*1.96E-02 / 0.00E+00*
Biogenic carbon contained in packaging	kg CO_2	4.39E-01
Direct emissions to ambient air, soil, and water	kg	0.00E+00
VOC content	µg/m^3	None detected

4.3 Reference Service Life

Table 15. *Reference Service Life, per functional unit, for FOAMULAR® NGX®*

Name		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 R-value	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	FOAMULAR® NGX® can be exposed to the exterior during normal construction cycles. During that time some fading of color may begin due to UV exposure, and, if exposed for extended periods of time, some degradation or "dusting" of the polystyrene surface may begin. It is best if the product is covered within 60 days to minimize degradation and as soon as possible for the horizontal facing products. Once covered, the deterioration stops, and damage is limited to the thin top surface layers of cells.	N/A
Indoor environment, (if relevant for indoor applications), e.g. temperature, moisture, chemical exposure	To comply with building codes, all foam plastics must be covered with a 15 minutes thermal barrier unless exception criteria as outlined in building code are met. Gypsum board, ½" thick is a common covering.	N/A
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 16. *End-of-Life summary, per functional unit, for FOAMULAR® NGX®*

End-of-life		Unit	Value
Assumptions for scenario development			Although reuse and recycling of XPS 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
	Collected with mixed construction waste	kg	8.06E-01
Disposition	Reuse	kg	0.00E+00
	Recycling	kg	0.00E+00
	Energy recovery	kg	0.00E+00
	Landfill	kg	8.06E-01
Removals of biogenic carbon (excluding packaging)[1]		kg CO_2	0.00E+00

[1]Biogenic carbon removals resulting from the use of bio-based binder.

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 17. *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 18. *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]
RPR_T: Total use of renewable primary resources with energy content	[MJ, LHV]	**HLRW**: High-level radioactive waste, conditioned, to final repository	[kg] or [m^3]
$NRPR_E$: Non-renewable primary resources used as an energy carrier (fuel)	[MJ, LHV]	**ILLRW**: Intermediate- and low-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]	**CRU**: Components for re-use	[kg]
$NRPR_T$: Total use of non-renewable primary resources with energy content	[MJ, LHV]	**MR**: Materials for recycling	[kg]
SM: Secondary materials	[kg]	**MER**: Materials for energy recovery	[kg]
RSF: Renewable secondary fuels	[MJ, LHV]	**EE**: Recovered energy exported from the product system	MJ, heating value ([Hi] lower heating value) per energy carrier
NRSF: Non-renewable secondary fuels	[MJ, LHV]		
RE: Recovered energy	[MJ, LHV]		
FW: Use of net fresh water resources	[m^3]		

Table 19. *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 20. *North American Life Cycle Impact Assessment (LCIA) results for 1 m² FOAMULAR® NGX® at R_{SI} = 1*

Impact Category	Unit	A1 – A3	A4	A5	B1	C2	C4
GWP 100[1]	[kg CO_2 eq]	6.58E+00	7.47E-02	1.82E-02	2.78E+00	1.30E-02	3.85E-01
ODP	[kg CFC-11 eq]	2.00E-05	1.39E-09	1.53E-10	0.00E+00	2.41E-10	1.50E-10
AP	[kg SO_2 eq]	1.38E-02	1.76E-04	2.57E-05	0.00E+00	3.06E-05	3.25E-05
EP	[kg N eq]	8.28E-04	1.98E-05	7.48E-06	0.00E+00	3.44E-06	2.78E-06
SFP	[kg O_3 eq]	1.61E-01	3.16E-03	5.63E-04	3.52E-04	5.49E-04	9.06E-04
ADP_{fossil}	[MJ, LHV]	6.52E+01	1.11E+00	1.21E-01	0.00E+00	1.93E-01	1.19E-01
IPCC GWP 100a (2021)[2]	[kg CO_2 eq]	7.08E+00	7.46E-02	1.81E-02	3.30E+00	1.29E-02	4.52E-01

[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 21. *North American Life Cycle Impact Assessment (LCIA) results for 1 m² Sheathing laminate add-on on both sides*

Sheathing laminate add-on							
Impact Category	**Unit**	**A1 – A3**	**A4**	**A5**	**B1**	**C2**	**C4**
GWP 100[1]	[kg CO_2 eq]	1.87E-01	3.73E-03	0.00E+00	0.00E+00	9.54E-04	3.55E-04
ODP	[kg CFC-11 eq]	1.52E-09	6.92E-11	0.00E+00	0.00E+00	1.77E-11	1.10E-11
AP	[kg SO_2 eq]	6.93E-04	8.78E-06	0.00E+00	0.00E+00	2.25E-06	2.39E-06
EP	[kg N eq]	6.72E-05	9.89E-07	0.00E+00	0.00E+00	2.53E-07	2.05E-07
SFP	[kg O_3 eq]	1.00E-02	1.58E-04	0.00E+00	0.00E+00	4.04E-05	6.34E-05
ADP_{fossil}	[MJ, LHV]	4.75E+00	5.53E-02	0.00E+00	0.00E+00	1.42E-02	8.72E-03
IPCC GWP 100a (2021)[2]	[kg CO_2 eq]	1.86E-01	3.72E-03	0.00E+00	0.00E+00	9.52E-04	3.54E-04

[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 22. *Resource Use Indicator Results for 1 m² FOAMULAR® NGX® at R_{SI} = 1*

Resource Use	Unit	A1 – A3	A4	A5	B1	C2	C4
RPR_E	[MJ, LHV]	6.89E+00	1.42E-02	1.74E-03	0.00E+00	2.47E-03	1.01E-03
RPR_M	[MJ, LHV]	5.05E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	[MJ, LHV]	4.06E+01	1.13E+00	1.23E-01	0.00E+00	1.95E-01	1.20E-01
$NRPR_M$	[MJ, LHV]	2.95E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	[kg]	9.11E-02	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	0.00E+00
NRSF	[MJ, LHV]	0.00E+00	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	0.00E+00
FW	[m^3]	3.73E-01	1.80E-04	4.20E-05	0.00E+00	3.12E-05	1.27E-04

Table 23. *Resource Use Indicator Results for 1 m² Sheathing laminate add-on on both sides*

Sheathing laminate add-on							
Resource Use	**Unit**	**A1 – A3**	**A4**	**A5**	**B1**	**C2**	**C4**
RPR_E	[MJ, LHV]	2.14E-01	7.10E-04	0.00E+00	0.00E+00	1.82E-04	7.46E-05
RPR_M	[MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	[MJ, LHV]	2.67E+00	5.61E-02	0.00E+00	0.00E+00	1.44E-02	8.81E-03
$NRPR_M$	[MJ, LHV]	2.37E+00	0.00E+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	0.00E+00
RSF	[MJ, LHV]	0.00E+00	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	0.00E+00
RE	[MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	[m^3]	1.54E-03	8.95E-06	0.00E+00	0.00E+00	2.29E-06	9.36E-06

Table 24. *Waste and Output Flow Indicator Results for 1 m² FOAMULAR® NGX® at R_{SI} = 1*

Resource Use	Unit	A1 – A3	A4	A5	B1	C2	C4
HWD	[kg]	9.34E-05	7.10E-06	7.36E-07	0.00E+00	1.23E-06	6.35E-07
NHWD	[kg]	3.58E-01	9.79E-02	4.95E-01	0.00E+00	1.70E-02	1.58E+00
HLRW	[kg]	9.82E-06	7.15E-08	8.73E-09	0.00E+00	1.24E-08	5.07E-09
ILLRW	[kg]	3.54E-05	1.74E-07	2.15E-08	0.00E+00	3.02E-08	1.26E-08
CRU	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	[kg]	3.26E-03	0.00E+00	2.19E-01	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	0.00E+00
EE	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 25. *Waste and Output Flow Indicator Results for 1 m² Sheathing laminate add-on on both sides*

Sheathing laminate add-on							
Resource Use	**Unit**	**A1 – A3**	**A4**	**A5**	**B1**	**C2**	**C4**
HWD	[kg]	3.21E-06	3.54E-07	0.00E+00	0.00E+00	9.07E-08	4.67E-08
NHWD	[kg]	2.20E-02	4.88E-03	0.00E+00	0.00E+00	1.25E-03	1.16E-01
HLRW	[kg]	8.06E-07	3.57E-09	0.00E+00	0.00E+00	9.12E-10	3.73E-10
ILLRW	[kg]	2.17E-06	8.67E-09	0.00E+00	0.00E+00	2.22E-09	9.29E-10
CRU	[kg]	0.00E+00	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	0.00E+00
MER	[kg]	0.00E+00	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	0.00E+00

Table 26. *Carbon Emissions and Removals Indicator Results for 1 m² FOAMULAR® NGX® at R_{SI} = 1*

Resource Use	Unit	A1 – A3	A4	A5	B1	C2	C4
BCRP	[kg CO_2]	0.00E+00	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	0.00E+00
BCRK	[kg CO_2]	4.39E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	[kg CO_2]	0.00E+00	0.00E+00	4.39E-01	0.00E+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	0.00E+00
CCE	[kg CO_2]	0.00E+00	0.00E+00	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	0.00E+00
CWNR	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 27. *Carbon Emissions and Removals Indicator Results for 1 m² Sheathing laminate add-on on both sides*

Sheathing laminate add-on							
Resource Use	Unit	A1 – A3	A4	A5	B1	C2	C4
BCRP	[kg CO_2]	0.00E+00	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	0.00E+00
BCRK	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+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	0.00E+00
CCE	[kg CO_2]	0.00E+00	0.00E+00	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	0.00E+00
CWNR	[kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Calculating Environmental Impact Values for products with specific performance properties

Results presented above are representative of an average product corresponding to the functional unit of RSI = 1 m^2K/W, expressed in metric units. That is equivalent to R = 5.68 in US Customary Units, which is the value one would find stated on the label of an insulation package as sold in North America.

However, FOAMULAR® NGX® XPS insulation is available in a variety of R-values and compressive strengths. In order to calculate adapted impact category values for XPS insulation, which has a specific R-value and compressive strength, the following equation and chart can be used.

$$Impacts_{Adapted} = Impacts_{Functional\ Unit} \times R_{factor} \times CS_{factor}$$

With

- $Impacts_{Adapted}$: the adapted impact category value
- $Impacts_{Functional\ Unit}$: the impact category value of the functional unit
- CS_{factor} : the multiplier for a specific compressive strength
- R_{factor} : the multiplier for a specific thermal resistance

R_{factor} table	
R-values (hr·ft2·°F/Btu)	R_{factor}
R-5	0.881
R-10	1.761
R-15	2.642
R-20	3.522

CS_{factor} table	
Compressive strength (psi)	CS_{factor}
15	0.915
25	0.904
40	1.121
60	1.442
100	2.060

For example, in order to calculate the GWP of 1 m² of FOAMULAR® NGX® 250, a product which has a compressive strength of 25 psi, and provides a thermal resistance of R - 10, the calculation is as follows.

$$Impacts = 9.85\ kg\ CO_2\ eq. \times 1.761 \times 0.904 = 15.7\ kg\ CO_2\ eq.$$

This can be further applied to the other indicators to generate the following table.

Table 28. *Example of adapted results for a FOAMULAR® NGX® product with R=10 and CS = 25 psi*

Impact Category	Unit	A1 – C4
GWP 100	[kg CO_2 eq]	1.57E+01
ODP	[kg CFC-11 eq]	3.19E-05
AP	[kg SO_2 eq]	2.23E-02
EP	[kg N eq]	1.37E-03
SFP	[kg O_3 eq]	2.64E-01
ADP_{fossil}	[MJ, LHV]	1.06E+02
IPCC GWP 100a (2021)	[kg CO_2 eq]	1.74E+01

Calculating Environmental Impact Values for products with a specific thickness and laminate add-on

The FOAMULAR® NGX® XPS Insulation product family also proposes a sheathing version of FOAMULAR® NGX® Insulating Sheathing XPS Insulation. The impacts for this product range are based on thickness and the impacts due to the laminate add-on. The impacts for the sheathed products can be calculated using the equation below.

$$Impacts_{Adapted} = Impacts_{Functional\ Unit} \times d_{factor} + Impacts_{Laminate}$$

With

- $Impacts_{Adapted}$: the adapted impact category value
- $Impacts_{Functional\ Unit}$: the impact category value of the functional unit
- d_{factor} : the multiplier for a specific thickness
- $Impacts_{Laminate}$: the impact category value for the laminate

Impacts for the laminate add-on are provide in Table 21, Table 23, Table 25 and Table 27.

Table 29. *Multiplier factor to adjust results to a given thickness*

Thickness	d_{factor}
½ inch	0.441
¾ inch	0.661
1 inch	0.882

The total impacts for a given product can be thus calculated using the following data.

Impacts =

$Impacts_{Functional\ Unit}$	
GWP 100 [kg CO2 eq]	9.85E+00
ODP [kg CFC-11 eq]	2.00E-05
AP [kg SO2 eq]	1.40E-02
EP [kg N eq]	8.61E-04
SFP [kg O3 eq]	1.66E-01
ADP_{fossil} [MJ, LHV]	6.67E+01

X

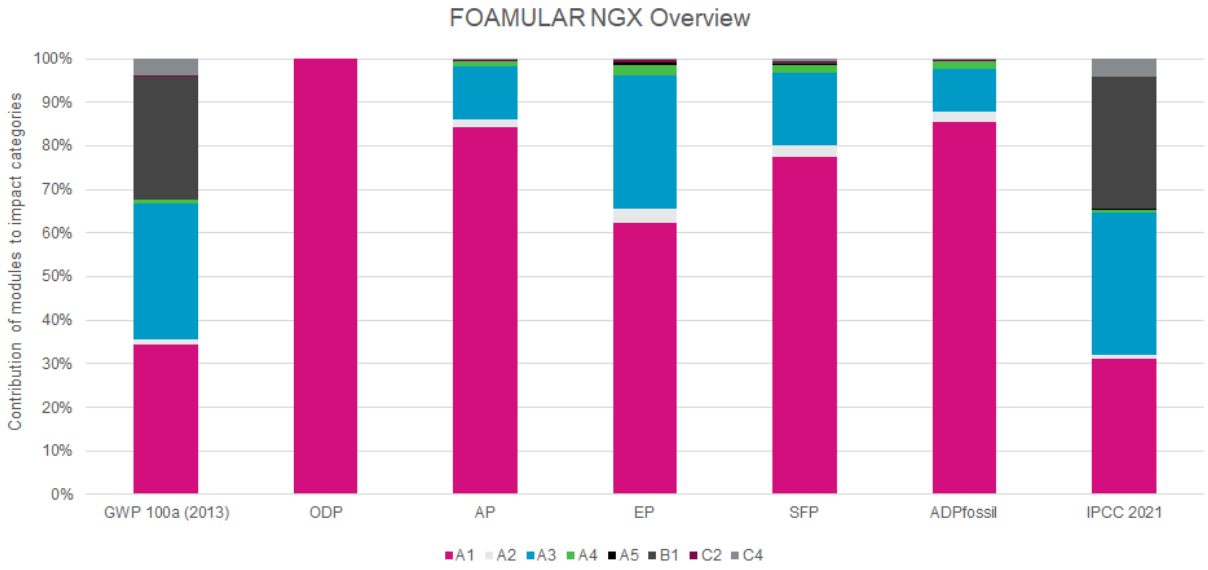
d_{factor}
0.441 (½ in)
0.661 (¾ in)
0.882 (1 in)

+

$Impacts_{Lamniate}$
1.92E-01
2.99E-09
7.07E-04
6.86E-05
1.03E-02
4.83E+00

6. LCA: Interpretation

The production of raw materials, especially virgin polystyrene is the key contribution for most of the impact category, except for Global Warming Potential, for which the emissions of blowing agent during the manufacture, use and end of life are the key driver of the impact.



6.1 Sensitivity Analysis

Comparison between the individual plants and overall average indicator result totals shows limited variations. Despite these variations, it is still appropriate to group the FOAMULAR® NGX® products made at these facilities into a single network 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 FOAMULAR® NGX® products, using a consistent data collection method and timeframe for each facility. 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 facilities of FOAMULAR® NGX® XPS Insulation maintain quality management systems.

7.2 Energy Savings During Use

Insulation is a passive device 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. The example below provides the net energy savings (energy saved minus life cycle energy of FOAMULAR® NGX®), as well as the carbon dioxide equivalent savings computed using the US EPA Greenhouse Gas Equivalencies Calculator.

Example Basis

A three-story 54,000 square foot office building insulated with only extruded polystyrene for the walls and roof, considering a typical 25 psi product. The roof insulated area is 18,000 square feet. The wall insulating area is 11,518 square feet. The example includes a steel stud building structure for two locations. Chicago, Illinois and Phoenix, Arizona locations were used for the building locations. Buildings were insulated in compliance with ASHRAE Standard 90.1-2016 code.

Table 30. *Energy and Carbon Savings for FOAMULAR® NGX® Insulation used in different US locations*

	Chicago, Illinois	Phoenix, Arizona
Heating and Cooling Energy Savings		
Total life cycle MJ for FOAMULAR® NGX® products used in building	761,520	660,296
Total annual MJ energy saved for an insulated vs. non-insulated building	595,017	143,634
Payback time (years)	1.28	4.60
Net MJ saved over the 75 years use phase of building	43,864,738	10,112,274
Carbon Equivalent Savings		
Total kg CO_2 eq for FOAMULAR® NGX® products used in building (Embodied Carbon)	124,401	107,865
Annual savings kg CO_2 eq from heating and cooling (Operational Carbon)	117,000	28,300
Payback time (years) for CO_2 eq. saved	1.06	3.81
Annual Number of Passenger Vehicles Driven	26	6

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 WHMIS Regulatory Status This product is considered an article per the Canadian Hazardous Products Regulation SOR/2015-17.

Manufactured articles which meet the definition of the Canadian Hazardous Products Act (any article that is formed to a specific shape or design during manufacture, the intended use of which when in that form is dependent in whole or in part on its shape or design, and that, when being installed, if the intended use of the article requires it to be installed, and under normal conditions of use, will not release or otherwise cause an individual to be exposed to a hazardous product) are not regulated by the Canadian Hazardous Products Regulation SOR/2015-17. The product's Safe Use Instruction Sheet includes exposure guidelines, engineering controls and individual protection measures.

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

FOAMULAR® NGX® Insulation products have the following certifications and sustainable features:

- FOAMULAR® NGX® XPS Insulation is third party certified for recycled content by SCS Global Services to contain an average of 20% recycled content
- GREENGUARD Gold: Certified products are certified to GREENGUARD standards for low chemical emissions into indoor air during product usage.
- Seal and Insulate with ENERGY STAR.
- FOAMULAR® NGX™ XPS Insulation has been optimized to demonstrate a greater than 20% reduction in embodied carbon, as well as greater than 5% reduction of two additional impact categories which qualifies for 2 products for the Option 2 Embodied Carbon / LCA Optimization credit under MR: Environmental Product Declarations for LEED v4.1.

Made with Renewable Energy and Reduced Carbon Footprint

FOAMULAR® NGX® XPS insulation is available with SCS Global Services certification for "Made with Renewable Electricity" and "Reduced Carbon Footprint". The updated environmental impacts for the products by matching the amount of electricity used in manufacturing with wind energy produced as part of Owens Corning's Power Purchase Agreement were calculated and can be found in the tables below. The values for life cycle stages A1-A3 below reflect calculations based on the 2022 plant dataset and the electricity impacts per the SimaPro implementation of the EcoInvent versions of the NERC power grids. Certificates published on the SCS Global Services website are based on calculations using updated NERC and eGrid power grid data and updated manufacturing production data per the certifcation guideline, so variation between the values is expected.

Table 31. *Changes in Environmental Impact Category Results Due to the use of Renewable Energy*

Impact category	Unit	2022 Dataset – Grid Electricity	2022 Dataset – REC Electricity	Change with REC	% Change
GWP 100	kg CO2 eq	9.85E+00	9.60E+00	-2.53E-01	-3%
ODP	kg CFC-11 eq	2.00E-05	2.00E-05	-3.02E-09	0%
AP	kg SO2 eq	1.40E-02	1.34E-02	-6.48E-04	-5%
EP	kg N eq	8.61E-04	7.47E-04	-1.15E-04	-13%
SFP	kg O3 eq	1.66E-01	1.59E-01	-6.79E-03	-4%
ADP_{fossil}	MJ	6.67E+01	6.38E+01	-2.86E+00	-4%
IPCC GWP 100a (2021)	kg CO2 eq	1.09E+01	1.07E+01	-2.52E-01	-2%

7.7 Further Information

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

8. References

- Life Cycle Assessment of Owens Corning FOAMULAR® and FOAMULAR® NGX® extruded polystyrene insulation
- 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 December 2023. SCS Global Services.
- IECC-2015, International Energy Conservation Code
- ASTM C203 Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
- ASTM C272 Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions
- ASTM C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
- ASTM D1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics
- ASTM D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics
- ASTM E96, Standard Test Method for Water Vapor Transmission of Materials
- US EPA Greenhouse Gas Equivalencies Calculator (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator)
- SCS Global Services Guideline for Claims of "Made with Renewable Energy" or "Reduced Carbon Footprint" Based on Power Purchase Agreement, February 2018

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