

ENVIRONMENTAL PRODUCT DECLARATION

FOAMULAR® XPS INSULATION

OWENS CORNING



Exceptional performance characteristics make FOAMULAR® XPS Insulation an excellent choice for a multitude of applications from foundations and below-grade systems to continuous wall applications and commercial roofing.



Owens Corning, and its family of companies, is a leading global producer of residential and commercial building materials, glass fiber reinforcements, and engineered materials for composite systems. It uses a decision framework for managing the company as a sustainable enterprise. It is the foundation of the company's strategy of building market-leading businesses, global in scope – human in scale, and reflects the company's purpose: our people and products make the world a better place.

Owens Corning is committed to balancing economic growth with social progress and sustainable solutions to its building materials and composite customers around the world.

This Environmental Product Declaration is a component of our stated goal to provide life cycle information on all core products.

sustainability.owenscorning.com





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According to ISO 14025,
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EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Environment 333 Pfingsten Road Northbrook, IL 60611 https://www.ul.com/ https://spot.ul.com/
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	General Program Instructions v.2.4 July 2018
MANUFACTURER NAME AND ADDRESS	Owens Corning, One Owens Corning Parkway, Toledo, OH, USA
DECLARATION NUMBER	4788721182.101.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	1 m ² insulation at R _{si} -1
REFERENCE PCR AND VERSION NUMBER	Part B: Building Envelope Thermal Insulation EPD Requirements, UL 10010-1
DESCRIPTION OF PRODUCT APPLICATION/USE	FOAMULAR® XPS is a type of rigid foam board insulation used in a variety of building applications, both residential and commercial, requiring the use of thermal
PRODUCT RSL DESCRIPTION (IF APPL.)	75 years
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	January 1, 2019
PERIOD OF VALIDITY	5 Years
EPD TYPE	Product-specific
RANGE OF DATASET VARIABILITY	Product-specific
EPD SCOPE	Cradle to gate with options (A4, A5, B1, C1-C4)
YEAR(S) OF REPORTED PRIMARY DATA	2017
LCA SOFTWARE & VERSION NUMBER	SimaPro 8.5.2.0
LCI DATABASE(S) & VERSION NUMBER	ecoinvent 3.4
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1 v1.04; Cumulative Energy Demand (CED) V1.10

This PCR Review was conducted by:	UL Environment
	PCR Review Panel
	epd@ulenvironment.com
This declaration was independently verified in accordance with ISO 14025: 2006. <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL	
	Grant R. Martin, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	
	Thomas P. Gloria, Industrial Ecology Consultants

LIMITATIONS

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

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1. Product Definition and Information

1.1. Description of Company/Organization

Founded in 1938, Owens Corning has been a leader in insulation, roofing and fiberglass composites. It has a global presence with 19,000 people in 37 countries. This Environmental Product Declaration is representative of product produced at the locations listed below.

Tallmadge Plant Tallmadge, OH 44278	Rockford Plant Rockford, IL 61109	Gresham Plant Gresham, OR 97080	Valleyfield Plant Valleyfield, QC, Canada J65 0A7	Monterrey Plant Santa Catarina, Nuevo Leon 66350, Mexico
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1.2. Product Description

Product Identification

FOAMULAR® XPS Insulation is a comprehensive line of 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 to the only XPS foam that is GREENGUARD Gold certified, offers the the industry's only lifetime limited warranty.* FOAMULAR® 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® XPS Insulation products is its compressive strength. FOAMULAR® XPS Insulation has compressive strengths of 15, 25, 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 floors or plaza decks. FOAMULAR® XPS Insulation is an integral component of our Owens Corning® ResidentialComplete® Wall Systems and the Owens Corning® CommercialComplete® Wall Systems portfolios.



**FOAMULAR® XPS Insulation limited lifetime warranty maintains 90% of its R-value for the lifetime of the building and covers all ASTM C578 properties. See actual warranty for complete details, limitations and requirements at www.owenscorningcommercial.com*



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Product Specification

	FOAMULAR® 150	FOAMULAR® 250	FOAMULAR® 400	FOAMULAR® 600	FOAMULAR® 1000
ASTM C578 Classification	Type X	Type IV	Type VI	Type VII	Type V
Compressive resistance at yield or 10 % deformation, whichever occurs first min, psi	15	25	40	60	100
Density, min, lb/ft ³	1.3	1.55	1.8	2.2	3
Thermal resistance of 1.00-in. thickness, min, hr-ft ² ·°F/Btu Mean temperature: 75°F ± 2°F	5	5	5	5	5
Flexural strength, min, psi	40	50	60	75	100
Water vapor permeance of 1.00-in. thickness, max, perm	1.5	1.5	1.1	1.1	1.1
Water absorption by total immersion, max, volume	0.3	0.3	0.3	0.3	0.3

Product Average

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

1.3. Application



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Available in a wide variety of sizes, thicknesses and compressive strengths, FOAMULAR® XPS Insulation can be used in residential and commercial buildings. It is available for a variety of applications including sheathing, residing, foundation, under slab, commercial walls, commercial roofing, plaza decks and under roads.

1.4. Declaration of 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); *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.

1.5. Technical Requirements

FOAMULAR® XPS Insulation boards are manufactured at minimum densities of 1.30, 1.45, 1.80, 2.20, and 3.00 lb/ft³ and have ASTM C578 designations of Type X, Type IV, Type VI, Type VII, and Type V respectively.

1.6. Properties of Declared Product as Delivered

FOAMULAR® XPS Insulation meets the performance requirements of ASTM C578 and CAN/ULC-S701. When installed in typical building and construction assemblies according to all applicable Owens Corning specifications, recommendations and guidelines, FOAMULAR® XPS Insulation retains at least 90% of its advertised R-value.*

1.7. Material Composition

FOAMULAR® XPS Insulation consists of two major components, polystyrene resin and a blend of HFC 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 performance additives, a brominated polymeric flame retardant, and colorant. Each of these minor components is less than 1% by mass of the total material composition.

Material Component	Material Component%
Additives	<1%
Blowing Agent	5% - 15%
Colorant	<1%
Flame retardant	<1%
Polystyrene (recycled)	<30%
Polystyrene (virgin)	65% - 75%

*FOAMULAR® XPS Insulation limited lifetime warranty maintains 90% of its R-value for the lifetime of the building and covers all ASTM C578 properties. See actual warranty for complete details, limitations and requirements at www.owenscorningcommercial.com



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1.8. Manufacturing

Manufacturing Locations

Owens Corning North American manufacturing locations can be found across the United States, Canada and Mexico. Primary data from these five manufacturing facilities were used for the underlying life cycle assessment. Results provided in this declaration are based on a BDFT-weighted average production of these five manufacturing facilities.

Tallmadge Plant Tallmadge, OH 44278	Rockford Plant Rockford, IL 61109	Gresham Plant Gresham, OR 97080	Valleyfield Plant Valleyfield, QC, Canada J65 0A7	Monterrey Plant Santa Catarina, Nuevo Leon 66350, Mexico
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Manufacturing Process

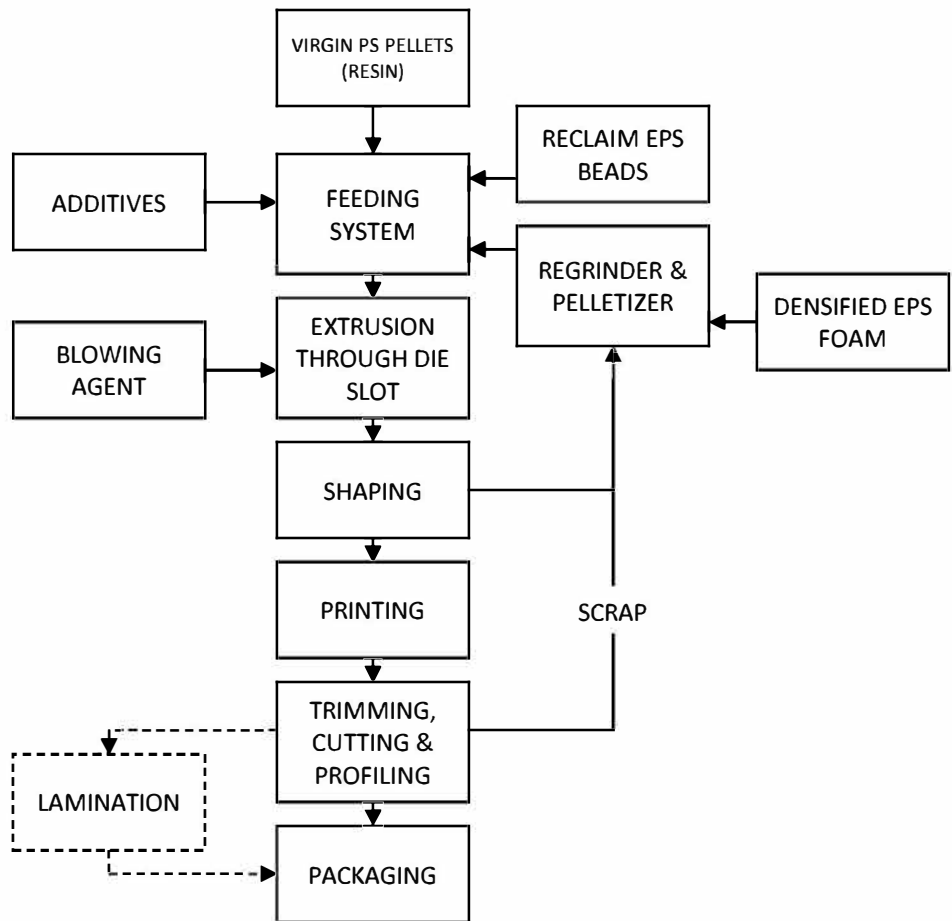


Figure 1. Process Flow Diagram for Manufacturing of XPS Insulation

The diagram above for FOAMULAR® XPS Insulation is representative of the processes 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.



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1.9. Packaging

FOAMULAR® 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 U.S. and Canada were used as a default assumption for the packaging waste generated during installation. Disposal rates used by material type and waste treatment method are shown in the table below.

Country/Region	Material Type	Recycling Rate	Landfill Rate	Incineration Rate
Canada	Plastics	78%	22%	0%
	Other materials	20%	80%	0%
United States	Plastics	15%	68%	17%
	Metals	57%	34%	9%
	Pulp (cardboard, paper)	75%	20%	5%

1.10. Transportation

The product outbound transportation from manufacturing facility is by diesel-truck. The average distance from manufacturing facility to construction site is 1,194 km.

1.11. Product Installation



General

Optimum performance of Owens Corning® FOAMULAR® 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 these 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 flat. FOAMULAR® 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



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insulation and framing members.

- ❖ FOAMULAR® XPS Insulation is not structural. Structural sheathing or bracing must be used when applying to wood or metal framing.

Wood Frame Walls

- ❖ Apply FOAMULAR® XPS Insulation to outside of braced framing or structural sheathing. Tongue and groove (T&G) edge panels install horizontally, square edge panels install vertically.
- ❖ Use cap-head (min. 1") nails or screws spaced 12" o.c. for the perimeter and 16" o.c. in the field to attach the panels.
- ❖ Choose fasteners of sufficient length to penetrate framing members a minimum 3/4" or through structural sheathing.
- ❖ Cover all framing with FOAMULAR® XPS Insulation and fit joints tightly. Joints and openings may be sealed with Owens Corning® JointSealR® Foam Joint Tape.

Metal Frame Walls

- ❖ Apply FOAMULAR® XPS Insulation directly to metal framing members. Tongue and groove edge panels install horizontally, square edge panels install vertically.
- ❖ Fasten panels to framing with cap-head (min. 1") screws spaced 12" o.c. at the perimeter and 16" o.c. in the field.
- ❖ Cover all framing with FOAMULAR® XPS Insulation and fit joints tightly. Joints and openings may be sealed with Owens Corning® JointSealR® Foam Joint Tape.

Foundation Wall-Exterior

- ❖ Prior to backfilling, install FOAMULAR® XPS Insulation to the exterior, from top of footing to the full height of the foundation wall, compliant with local building codes.
- ❖ Adhere FOAMULAR® XPS Insulation with long edges horizontal, edges tightly butted and vertical joints staggered. Joints and openings may be sealed with Owens Corning® JointSealR® Foam Joint Tape.
- ❖ Secure FOAMULAR® XPS Insulation with construction adhesive compatible with polystyrene or foamed plastics as noted by its manufacturer (follow adhesive manufacturers' application instructions).
- ❖ Apply FOAMULAR® XPS Insulation to wall within 15 minutes after adhesive is applied.
- ❖ Backfill carefully to avoid damage to FOAMULAR® XPS Insulation.

Basement Wall - Interior

- ❖ For installation on a framed wall built on the interior of the basement (foundation) wall see instructions for "Wood Frame Walls" and "Metal Frame Walls" above.
- ❖ For installation with furring, see instructions for FOAMULAR® InsulPink®.

Under Concrete Slab

- ❖ Install FOAMULAR® XPS Insulation after gravel fill has been built up to grade, thoroughly tamped and vapor retarder placed.
- ❖ Lay FOAMULAR® XPS Insulation in place with edges pressed together and butting the foundation wall or adjacent vertical insulation.
- ❖ Pour concrete slab to cover

Reference Documents

- ❖ Find specifications, case studies, reports, assemblies and other information at www.ocbuildingspec.com



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1.12. Use

Due to its nature, FOAMULAR® 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.

1.13. Reference Service Life and Estimated Building Service Life

The product is assumed to remain in service for the life of the building, 75 years.

1.14. Reuse, Recycling, and Energy Recovery

FOAMULAR® XPS insulation may be reused. Although recycling programs do not currently exist for XPS insulation, energy content from the material may be recovered.

1.15. Disposal

The End of Life stage modeled for XPS insulation consisted of the transportation by tractor-trailer truck of the foam for an assumed distance of 100 miles 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.

2. Life Cycle Assessment Background Information

2.1. Function and Functional Unit

The functional unit is 1 m² of insulation material with a thickness that gives an average thermal resistance $R_{Si} = 1 \text{ m}^2\text{K/W}$ and with a building service life of 75 years. FOAMULAR® Insulating Sheathing and FOAMULAR® PROPink® additionally have 1 m² of a laminate material on each side of the XPS insulation material. For laminate materials, the declared unit amount is 1 m², and the amount of the declared unit required for the functional unit is 2 m².

Table 1. Functional Unit Properties of FOAMULAR® XPS insulation

FOAMULAR® XPS Insulation	
Functional unit	1 m ² of insulation material with a thickness that gives an average thermal resistance $R_{Si} = 1 \text{ m}^2\text{K/W}$
Mass of Functional unit	7.77E-01 kg
Thickness to achieve Functional unit	2.88E-02 m

Table 2. Declared Unit Properties of Laminate Addons for FOAMULAR® INSULATING SHEATHING and FOAMULAR® PROPINK®

Laminate Addon for FOAMULAR® Insulating Sheathing	
Declared unit	1 m ² of Laminate Addon
Mass of Declared unit	3.51E-02 kg
Amount of Declared unit to achieve Functional unit	2 m ²
Laminate Addon for FOAMULAR® PROPINK®	
Declared unit	1 m ² of Laminate Addon
Mass of Declared unit	8.71E-02 kg
Amount of Declared unit to achieve Functional unit	2 m ²



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2.2. System Boundary

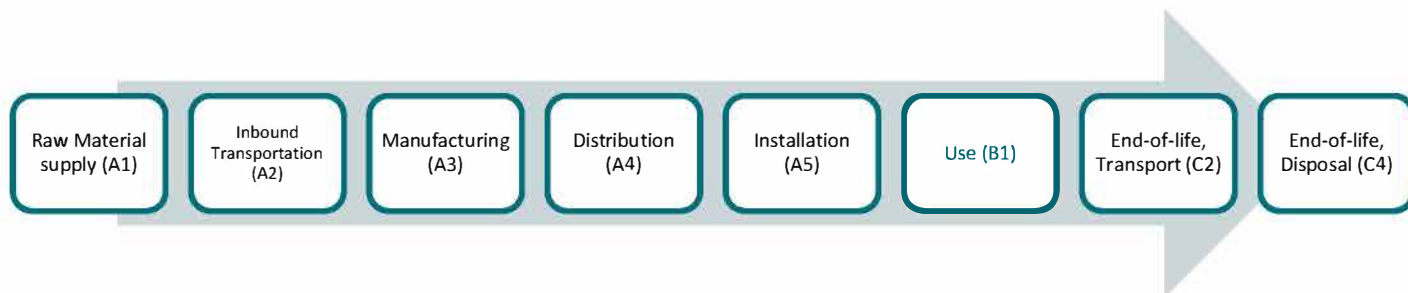


Figure 2. System Boundary of FOAMULAR® XPS Insulation

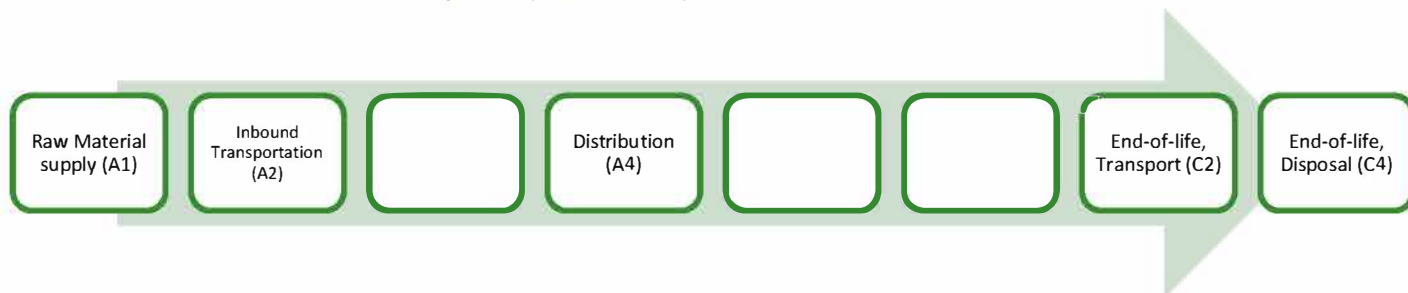


Figure 3. System Boundary of Laminate Addons for FOAMULAR® Insulating Sheathing FOAMULAR® PROPink®

The system boundaries for this study include inputs and outputs for the following life cycle stages for XPS foam insulation:

- Raw Material supply (A1) – *applicable to* FOAMULAR® XPS Insulation and Laminate Addons
 - extraction of resources and production of raw materials
 - collection and processing of recycled materials
 - extraction of resources and production of packaging materials for finished goods
- Inbound Transportation (A2) – *applicable to* FOAMULAR® XPS Insulation and Laminate Addons
 - transportation of all input materials to manufacturing facilities
- Manufacturing (A3) – *applicable to* FOAMULAR® XPS Insulation
 - electricity, natural gas combustion and LPG combustion (consumption and associated emissions)
 - water usage
 - blowing agent emissions from the trimming, cutting and profiling of the XPS boards as well as from the regrinding process and curing process and other releases to environmental media¹
- Distribution (A4) – *applicable to* FOAMULAR® XPS Insulation and Laminate Addons
 - transportation from manufacturing facilities to distribution centers
 - transportation from distribution centers to construction site
- Installation (A5) – *applicable to* FOAMULAR® XPS Insulation
 - transportation and disposal of packaging waste
- Use (B1) – *applicable to* FOAMULAR® XPS Insulation
 - blowing agent emissions during distribution and installation of XPS insulation and its diffusion from the XPS insulation board over 75-year reference service life
- End-of-life, Transport (C2) – *applicable to* FOAMULAR® XPS Insulation and Laminate Addons

¹ All manufacturing waste (i.e., scrap and trim) is recycled internally; there is no manufacturing waste to landfill from the manufacturing process.

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- transportation from building deconstruction site to landfill
- End-of-life, Disposal (C4) – *applicable* to FOAMULAR® XPS Insulation and Laminate Addons
 - disposal in landfill
 - blowing agent emissions released from XPS insulation during disposal

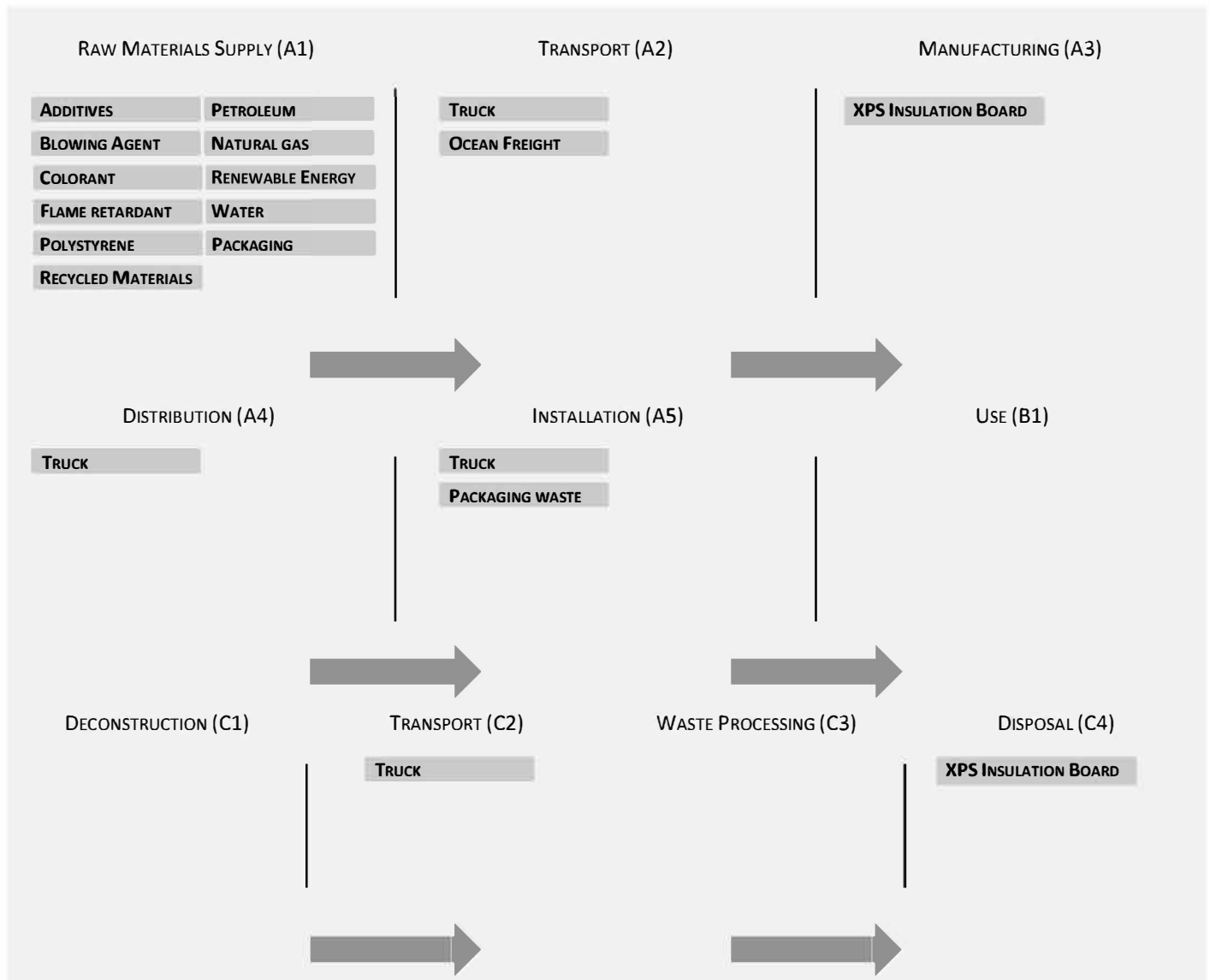


Figure 4. Flow Diagram of FOAMULAR® XPS Insulation

2.3. Estimates and Assumptions

FOAMULAR® XPS Insulation is a passive device requiring no utilities or maintenance over its useful life; it is assumed that the product remains in service for the 75-year reference service.

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2.4. Cut-off Criteria

Per section 2.9 of the governing PCR, the procedure detailed in ISO 21930, section 7.1.8 was followed regarding the exclusion of inputs and outputs. For energy, mass and environmental impacts, the cut-off criteria were 1% per the standard. Per the standard “the total of neglected input flows per module shall be a maximum of 5% of energy usage, mass and environmental impacts.” Flows excluded for this study include infrastructure, capital goods and workforce burdens. Inputs and outputs associated with infrastructure (construction, maintenance and demolition of buildings/plants, road surfaces, transport equipment, etc.) are not included. This choice is based on experience from previous LCAs where the contribution from these items was negligible due to the long lifetime of the equipment compared to the high production volume of material during that lifetime. Although pallets are used in the transportation of packaged, finished XPS insulation boards, pallets have been excluded due to their high reuse rates since they would have a negligible impact if otherwise included.

2.5. Data Sources

Primary data was collected from the locations listed in the Manufacturing section. Life-cycle modeling and calculation of potential environmental impacts were conducted using the LCA software SimaPro 8, version 8.5.2.0, developed by PRé Consultants bv. The LCI database used for secondary data was the ecoinvent 3.4 database, provided with the Developer version of the software. In situations where LCI databases did not contain life-cycle inventory data for certain specific materials or processes used in either the manufacturing of precursor, input raw materials or the manufacturing of the XPS insulation itself, LCI data for a similar material or process was used as a substitute. In order to determine the most representative substitute, preliminary analyses were conducted.

2.6. Data Quality

To determine how representative the data used to model the life-cycle of Owens Corning® FOAMULAR® XPS Insulation manufactured in 2017 is, the temporal, geographical and technological aspects of the data were assessed. For the five Owens Corning facilities analyzed in the underlying LCA study, the data used adequately represents the technology used in 2017 in the United States, Canada and Mexico.

2.7. Period under Review

For the manufacturing facilities considered in the LCA, Owens Corning primary data was collected for the 2017 calendar year.

2.8. Allocation

The products studied in this analysis are all members of the FOAMULAR® XPS insulation product family. Plants reported the total board-foot amount of FOAMULAR® XPS insulation produced as well as the board-foot amount produced of each individual product. In general, the characteristics that differentiate one product from another within the family are its compressive strength, density and thickness. Particular product application can be considered another differentiating characteristic; however, these three attributes are the main physical properties that distinguish one product from another. Aside from having the same composition and method of production, all products within the FOAMULAR® XPS insulation product family have a thermal resistance of R-5 per inch thickness; this is a unifying characteristic. Exceptions to this are FOAMULAR® High-R CW Plus and FOAMULAR® CC High-R, which have a slightly higher R-value per unit thickness, and two sheathing (i.e., laminated) products, FOAMULAR® Insulating Sheathing and PROPINK®. For each of these four products, it was possible to avoid allocation.

The incremental amount of thermal resistance per inch provided by FOAMULAR® High-R CW Plus and FOAMULAR® CC High-R is approximately $R = 0.129 \text{ hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{BTU}$, and the amount of FOAMULAR® High-R CW Plus and FOAMULAR® CC High-R produced was less than 0.5% of total production. It is on these bases, allocation was avoided for these particular products. In the case of the two sheathing products, allocation was avoided by treating the laminating film materials as separate modular processes, the LCIs of which are analyzed separately.

With regard to the other products, which constitute the remaining 96% of the FOAMULAR® XPS insulation board-feet produced, it had been decided initially that mass allocation would be used to attribute quantities of process inputs and outputs among these various products based on the relative output of board-feet and the average density of the products. This would have been ideal; however, since these remaining products have essentially the same composition and differ only in compressive strength and density, the total mass of inputs and outputs were modeled without any allocation. Aside from those mentioned, no other allocation modeling considerations were necessary for the study.



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3. Life Cycle Assessment Scenarios

Table 3. Transport to the building site (A4)

	FOAMULAR® XPS Insulation (1 m ² , R _{SI} =1)	Laminate Addon for FOAMULAR® Insulating Sheathing (1 m ²)	Laminate Addon for FOAMULAR® PROPink® (1 m ²)	
Name	Value	Value	Value	Unit
Fuel type	diesel, low-sulfur	diesel, low-sulfur	diesel, low-sulfur	
Liters of fuel	3.53E-03	1.59E-04	3.96E-04	l/100km
Vehicle type	Transport, freight, lorry 16-32 metric ton, EURO3	Transport, freight, lorry 16-32 metric ton, EURO3	Transport, freight, lorry 16-32 metric ton, EURO3	
Transport distance	1.19E+03	1.08E+03	1.14E+03	km
Capacity utilization (including empty runs, mass based)*	63%	63%	63%	%
Gross density of products transported	2.69E+01	9.20E+02	1.03E+03	kg/m ³
Weight of products transported (if gross density not reported)	7.77E-01	3.51E-02	8.71E-02	kg
Volume of products transported (if gross density not reported)	2.88E-02	3.81E-05	8.46E-05	m ³
Capacity utilization volume factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaging products)	1	1	1	-

* EcoTransIT. World. Ecological Transport Information Tool for Worldwide Transports Methodology and Data - Update 4th December 2014.
(https://www.ecotransit.org/download/EcoTransIT_World_Methodology_Report_2014-12-04.pdf)

Table 4. Installation into the building (A5)

Name	Value	Unit
Ancillary materials	0.00E+00	kg
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	0.00E+00	m ³
Other resources	0.00E+00	kg
Electricity consumption	0.00E+00	kWh
Other energy carriers	0.00E+00	MJ
Product loss per functional unit	0.00E+00	kg
Waste materials at the construction site before waste processing, generated by product installation	1.93E-02	kg
Output materials resulting from on-site waste processing (specified by route; e.g. for recycling, energy recovery and/or disposal)	0.00E+00	kg
Biogenic carbon contained in packaging	0.00E+00	kg CO ₂
Direct emissions to ambient air, soil and water	0.00E+00	kg
VOC content*	0.00E+00	µg/m ³

* VOC content determined in accordance to "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources
using Environmental Chambers - version 1.2." CA Specification 01350.



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Table 5. Reference Service Life

Name	Value
RSL	75 years
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
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® XPS Insulation 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. Once covered, the deterioration stops, and damage is limited to the thin top surface layers of cells. Cells below are generally unharmed and still useful insulation.
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-minute thermal barrier. Gypsum board, ½" thick is a common covering.
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)

Table 6. End-of-life, Transport (C2)

		FOAMULAR® XPS Insulation (1 m ² , R _{SI} -1)	Laminate Addon for FOAMULAR® Insulating Sheathing (1 m ²)	Laminate Addon for FOAMULAR® PROPink® (1 m ²)	
Name		Value	Value	Value	Unit
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation)	Although reuse and recycling of XPS insulation 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 (specified by type)	Collected separately	0.00E+00	0.00E+00	0.00E+00	kg
	Collected with mixed construction waste	7.77E-01	3.51E-02	8.71E-02	kg
Recovery (specified by type)	Reuse	0.00E+00	0.00E+00	0.00E+00	kg
	Recycling	0.00E+00	0.00E+00	0.00E+00	kg
	Landfill	0.00E+00	0.00E+00	0.00E+00	kg
	Incineration	0.00E+00	0.00E+00	0.00E+00	kg
	Incineration with energy recovery	0.00E+00	0.00E+00	0.00E+00	kg
Disposal (specified by type)	Energy conversion efficiency rate	0.00E+00	0.00E+00	0.00E+00	
	Product or material for final deposition	0.00E+00	0.00E+00	0.00E+00	kg
Removals of biogenic carbon (excluding packaging)		0.00E+00	0.00E+00	0.00E+00	kg CO2



ENVIRONMENTAL PRODUCT DECLARATION



FOAMULAR® XPS Insulation

According to ISO 14025,
EN 15804 and ISO 21930:2017

Table 7. End-of-life, Disposal (C4)

		FOAMULAR® XPS Insulation (1 m ² , R _{SI} -1)	Laminate Addon for FOAMULAR® Insulating Sheathing (1 m ²)	Laminate Addon for FOAMULAR® PROPink® (1 m ²)	
Name		Value	Value	Value	Unit
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation)	Although reuse and recycling of XPS insulation 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 (specified by type)	Collected separately	0.00E+00	0.00E+00	0.00E+00	kg
	Collected with mixed construction waste	0.00E+00	0.00E+00	0.00E+00	kg
Recovery (specified by type)	Reuse	0.00E+00	0.00E+00	0.00E+00	kg
	Recycling	0.00E+00	0.00E+00	0.00E+00	kg
	Landfill	0.00E+00	0.00E+00	0.00E+00	kg
	Incineration	0.00E+00	0.00E+00	0.00E+00	kg
	Incineration with energy recovery	0.00E+00	0.00E+00	0.00E+00	kg
	Energy conversion efficiency rate	0.00E+00	0.00E+00	0.00E+00	
Disposal (specified by type)	Product or material for final deposition	7.77E-01	3.51E-02	8.71E-02	kg
Removals of biogenic carbon (excluding packaging)		0.00E+00	0.00E+00	0.00E+00	kg CO2



ENVIRONMENTAL PRODUCT DECLARATION



FOAMULAR® XPS Insulation

According to ISO 14025,
EN 15804 and ISO 21930:2017

4. Life Cycle Assessment Results

Table 8. Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				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 supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential	Reference Service Life
FOAMULAR® XPS Insulation (1 m ² , R _{SI} -1)	x	x	x	x	x	x	MND	MND	MND	MND	MND	MND	MND	x	MND	x	MND	75 years
Laminate Addon for FOAMULAR® Insulating Sheathing (1 m ²)	x	x	MND	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	x	MND	x	MND	75 years
Laminate Addon for FOAMULAR® PROPink® (1 m ²)	x	x	MND	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	x	MND	x	MND	75 years
EPD Type: Cradle to installation with end of life	Required					Optional (Based on scenarios)							Required					Required



ENVIRONMENTAL PRODUCT DECLARATION



FOAMULAR® XPS Insulation

According to ISO 14025,
EN 15804 and ISO 21930:2017

4.1. Life Cycle Impact Assessment Results

Table 9. LCIA Results for North America (TRACI) for FOAMULAR® XPS Insulation (1 m², R_{SI}-1)

FOAMULAR® XPS Insulation (1 m ² , R _{SI} -1)									
TRACI v2.1	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
GWP 100 [kg CO ₂ eq]	2.19E+01	1.54E-01	2.10E-03	2.86E+01	MND	MND	2.07E-02	MND	7.39E+00
ODP [kg CFC-11 eq]	3.35E-05	3.75E-08	1.46E-10	0.00E+00	MND	MND	5.05E-09	MND	1.83E-09
AP [kg SO ₂ eq]	1.37E-02	9.55E-04	3.82E-06	0.00E+00	MND	MND	1.28E-04	MND	3.54E-05
EP [kg N eq]	6.45E-03	1.85E-04	1.12E-06	0.00E+00	MND	MND	2.50E-05	MND	7.58E-06
POCP [kg O ₃ eq]	1.79E-01	2.57E-02	1.03E-04	3.39E-04	MND	MND	3.46E-03	MND	8.50E-04
ADP _{fossil} [MJ, LHV]	9.41E+00	3.37E-01	1.32E-03	0.00E+00	MND	MND	4.53E-02	MND	1.71E-02

[GWP 100 - Global Warming Potential]; [ODP - Ozone Depletion Potential]; [AP - Acidification Potential]; [EP - Eutrophication Potential];
[POCP - Smog Formation Potential]; [ADP_{fossil} - Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources]

Table 10. LCIA Results for North America (TRACI) for Laminate Addon for FOAMULAR® Insulating Sheathing (1 m²)

Laminate Addon for FOAMULAR® Insulating Sheathing (1 m ²)									
TRACI v2.1	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
GWP 100 [kg CO ₂ eq]	1.05E-01	6.29E-03	MND	MND	MND	MND	9.33E-04	MND	1.86E-04
ODP [kg CFC-11 eq]	3.40E-09	1.54E-09	MND	MND	MND	MND	2.28E-10	MND	8.25E-11
AP [kg SO ₂ eq]	4.27E-04	3.91E-05	MND	MND	MND	MND	5.79E-06	MND	1.60E-06
EP [kg N eq]	1.17E-04	7.59E-06	MND	MND	MND	MND	1.13E-06	MND	3.42E-07
POCP [kg O ₃ eq]	5.66E-03	1.05E-03	MND	MND	MND	MND	1.56E-04	MND	3.80E-05
ADP _{fossil} [MJ, LHV]	3.93E-01	1.38E-02	MND	MND	MND	MND	2.04E-03	MND	7.70E-04

[GWP 100 - Global Warming Potential]; [ODP - Ozone Depletion Potential]; [AP - Acidification Potential]; [EP - Eutrophication Potential];
[POCP - Smog Formation Potential]; [ADP_{fossil} - Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources]

Table 11. LCIA Results for North America (TRACI) for Laminate Addon for FOAMULAR® PROPink® (1 m²)

Laminate Addon for FOAMULAR® PROPink® (1 m ²)									
TRACI v2.1	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
GWP 100 [kg CO ₂ eq]	2.89E-01	1.64E-02	MND	MND	MND	MND	2.32E-03	MND	4.62E-04
ODP [kg CFC-11 eq]	1.53E-08	4.01E-09	MND	MND	MND	MND	5.66E-10	MND	2.05E-10
AP [kg SO ₂ eq]	1.20E-03	1.02E-04	MND	MND	MND	MND	1.44E-05	MND	3.97E-06
EP [kg N eq]	4.75E-04	1.98E-05	MND	MND	MND	MND	2.80E-06	MND	8.49E-07
POCP [kg O ₃ eq]	1.66E-02	2.75E-03	MND	MND	MND	MND	3.88E-04	MND	9.46E-05
ADP _{fossil} [MJ, LHV]	9.79E-01	3.60E-02	MND	MND	MND	MND	5.08E-03	MND	1.91E-03

[GWP 100 - Global Warming Potential]; [ODP - Ozone Depletion Potential]; [AP - Acidification Potential]; [EP - Eutrophication Potential];
[POCP - Smog Formation Potential]; [ADP_{fossil} - Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources]



ENVIRONMENTAL PRODUCT DECLARATION



FOAMULAR® XPS Insulation

According to ISO 14025,
EN 15804 and ISO 21930:2017

4.2. Life Cycle Inventory Results

Table 12. Resource Use for FOAMULAR® XPS Insulation (1 m², R_S-1)

Parameter	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	1.88E+00	2.98E-02	1.35E-04	0.00E+00	MND	MND	4.01E-03	MND	3.03E-03
RPRM [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	3.87E+01	2.51E+00	9.84E-03	0.00E+00	MND	MND	3.37E-01	MND	1.26E-01
NRPRM [MJ, LHV]	3.84E+01	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	9.51E-02	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
FW [m ³]	5.13E-02	4.26E-04	3.29E-06	0.00E+00	MND	MND	5.73E-05	MND	1.31E-04

[RPRE - Renewable primary energy used as energy carrier (fuel)]; [RPRM - Renewable primary resources with energy content used as material]; [RPRT - Total use of renewable primary resources with energy content]; [NRPRE - Non-renewable primary resources used as an energy carrier (fuel)]; [NRPRM - Non-renewable primary resources with energy content used as material]; [NRPRT - Total use of non-renewable primary resources with energy content]; [SM - Secondary materials]; [RSF - Renewable secondary fuels]; [NRSF - Non-renewable secondary fuels]; [RE - Recovered energy]; [FW - Use of net fresh water resources]

Table 13. Resource Use for Laminate Addon for FOAMULAR® Insulating Sheathing (1 m²)

Parameter	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	1.19E-01	1.22E-03	MND	MND	MND	MND	1.81E-04	MND	1.37E-04
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	1.67E+00	1.03E-01	MND	MND	MND	MND	1.52E-02	MND	5.67E-03
NRPRM [MJ, LHV]	1.56E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m ³]	1.41E-03	1.74E-05	MND	MND	MND	MND	2.58E-06	MND	5.91E-06

Table 14. Resource Use for Laminate Addon for FOAMULAR® PROPink® (1 m²)

Parameter	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	3.01E-01	3.18E-03	MND	MND	MND	MND	4.49E-04	MND	3.40E-04
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	4.87E+00	2.68E-01	MND	MND	MND	MND	3.78E-02	MND	1.41E-02
NRPRM [MJ, LHV]	3.24E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m ³]	3.93E-03	4.55E-05	MND	MND	MND	MND	6.42E-06	MND	1.47E-05



ENVIRONMENTAL PRODUCT DECLARATION



FOAMULAR® XPS Insulation

According to ISO 14025,
EN 15804 and ISO 21930:2017

Table 15. Output Flows and Waste Categories for FOAMULAR® XPS Insulation (1 m², R_{SI}-1)

Parameter	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
HWD [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
NHWD [kg]	0.00E+00	0.00E+00	1.93E-02	0.00E+00	MND	MND	0.00E+00	MND	7.77E-01
HLRW [kg] or [m ³]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
ILLRW [kg] or [m ³]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00

[HWD - Hazardous waste disposed]; [NHWD - Non-hazardous waste disposed]; [HLRW - High-level radioactive waste, conditioned, to final repository]; [ILLRW - Intermediate- and low-level radioactive waste, conditioned, to final repository]; [CRU - Components for re-use]; [MR - Materials for recycling]; [MER - Materials for energy recovery]; [EE - Exported energy];

Table 16. Output Flows and Waste Categories for Laminate Addon for FOAMULAR® Insulating Sheathing (1 m²)

Parameter	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
HWD [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NHWD [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	3.51E-02
HLRW [kg] or [m ³]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
ILLRW [kg] or [m ³]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00

[HWD - Hazardous waste disposed]; [NHWD - Non-hazardous waste disposed]; [HLRW - High-level radioactive waste, conditioned, to final repository]; [ILLRW - Intermediate- and low-level radioactive waste, conditioned, to final repository]; [CRU - Components for re-use]; [MR - Materials for recycling]; [MER - Materials for energy recovery]; [EE - Exported energy];

Table 17. Output Flows and Waste Categories for Laminate Addon for FOAMULAR® PROPink® (1 m²)

Parameter	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
HWD [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NHWD [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	8.71E-02
HLRW [kg] or [m ³]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
ILLRW [kg] or [m ³]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00

[HWD - Hazardous waste disposed]; [NHWD - Non-hazardous waste disposed]; [HLRW - High-level radioactive waste, conditioned, to final repository]; [ILLRW - Intermediate- and low-level radioactive waste, conditioned, to final repository]; [CRU - Components for re-use]; [MR - Materials for recycling]; [MER - Materials for energy recovery]; [EE - Exported energy];



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FOAMULAR® XPS Insulation

According to ISO 14025,
EN 15804 and ISO 21930:2017

Table 18. Carbon Emissions and Removals for FOAMULAR® XPS Insulation (1 m², R_{SI}-1)

Parameter	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
BCRP [kg CO ₂]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO ₂]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO ₂]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO ₂]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO ₂]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO ₂]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO ₂]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO ₂]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00

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

Table 19. Carbon Emissions and Removals for Laminate Addon for FOAMULAR® Insulating Sheathing (1 m²)

Parameter	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
BCRP [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00

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

Table 20. Carbon Emissions and Removals for Laminate Addon for FOAMULAR® PROPink® (1 m²)

Parameter	A1 - A3	A4	A5	B1	B2 - B7	C1	C2	C3	C4
BCRP [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO ₂]	0.00E+00	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00

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



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4.3. Calculating Impact Category Results for Products with Specific Performance Properties

The impact category values found in Table 9 are for the functional unit amount of XPS insulation. This corresponds to XPS insulation with a surface area of 1 m² and having a thermal resistance of R_{SI} = 1. In Imperial units, this thermal resistance, or R-value, is equivalent to 5.68 hr·ft²·°F/BTU (i.e., R_{IP} = 5.68 or R - 5.68). However, FOAMULAR® 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:

$$\text{Impact}_{AD} = \text{Impact}_{FU} \times \text{CS}_{\text{factor}} \times \text{R}_{\text{factor}}$$

where Impact_{AD} is the adapted impact category value, Impact_{FU} is the impact category value of the functional unit found in Table 9, CS_{factor} is the multiplier for a specific compressive strength, and R_{factor} is the multiplier for a specific thermal resistance.

Compressive Strength (psi)	CS _{factor}	Thermal Resistance, hr·ft ² ·°F/Btu (R _{IP})	R _{factor}
15	0.773	R - 5	0.881
25	0.921	R - 10	1.761
40	1.070	R - 15	2.642
60	1.308	R - 20	3.522
100	1.783		

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

$$\text{Impact}_{AD} = 58.1 \text{ CO}_2 \text{ eq} \times 0.921 \times 1.761 = 94.3 \text{ CO}_2 \text{ eq}$$

This procedure can be repeated for the remaining impact categories to generate the following table:

FOAMULAR® 250 XPS Insulation (1 m ² , R-10)	
TRACI v2.1	A1 - C4
GWP 100 [kg CO ₂ eq]	9.43E+01
ODP [kg CFC-11 eq]	5.44E-05
AP [kg SO ₂ eq]	2.41E-02
EP [kg N eq]	1.08E-02
POCP [kg O ₃ eq]	3.39E-01
ADP _{fossil} [MJ, LHV]	1.59E+01

The FOAMULAR® XPS Insulation product family has two sheathing products, FOAMULAR® PROPINK and FOAMULAR® Insulating Sheathing XPS Insulation. The impacts for these products are based on thickness and the impacts due to the lamination must be added. The impacts for the sheathing products can be calculated using the equation below.

$$\text{Impact}_{AD} = \text{Impact}_{FU} \times d_{\text{factor}} + \text{Impact}_{\text{lamination}}$$

Thickness (in)	d _{factor}
½	0.440
¾	0.660
1	0.881



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FOAMULAR® Insulating Sheathing					
Impact _{FU}		d _{factor}		Impact _{Lamination}	
Impact _{AD}	GWP 100	5.81E+01	X	0.440 (½ in)	2.25E-01 kg CO2 eq
	ODP	3.35E-05			1.05E-08 kg CFC-11 eq
	AP	1.48E-02		0.660 (¾ in)	9.48E-04 kg SO2 eq
	EP	6.67E-03			2.52E-04 kg N eq
	POCP	2.09E-01		0.881 (1 in)	1.38E-02 kg O3 eq
	ADP _{fossil}	9.81E+00			8.20E-01 MJ, LHV

PROPINK®					
Impact _{FU}		d _{factor}		Impact _{Lamination}	
Impact _{AD}	GWP 100	5.81E+01	X	0.440 (½ in)	1.16E+02 kg CO2 eq
	ODP	3.35E-05			6.71E-05 kg CFC-11 eq
	AP	1.48E-02		0.660 (¾ in)	3.06E-02 kg SO2 eq
	EP	6.67E-03			1.36E-02 kg N eq
	POCP	2.09E-01		0.881 (1 in)	4.32E-01 kg O3 eq
	ADP _{fossil}	9.81E+00			2.04E+01 MJ, LHV

5. LCA Interpretation

The underlying LCA upon which this EPD is based considered the following six environmental impact categories: Global Warming Potential (GWP 100); Ozone Depletion Potential (ODP); Acidification Potential (AP); Eutrophication Potential (EP); Smog Formation Potential (POCP); and Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADP_{fossil}). The impact assessment results indicate that among the life cycle modules declared for FOAMULAR® XPS Insulation, the *Raw Materials supply* (A1) life cycle module, which represents both batch materials and packaging materials, accounted for the majority of the potential environmental impact in four of these six impact categories.

The only impact categories for which the *Raw Materials supply* (A1) life cycle module was not the greatest contributor were the GWP and EP impact categories. For the global warming potential impact category, the *Use* (B1) life cycle module was the major contributor. Diffusion of the blowing agent from installed XPS insulation during the 75-year use phase is the cause for this life cycle module's being the greatest contributor to the GWP. Although the intended application of XPS foam is for building envelope thermal insulation, the affected reductions in a building's energy consumption when the XPS foam is used for this purpose were not included in the *Use* life cycle stage. The reason that blowing agent emissions were included within the *Use* (B1) life cycle module is because these emissions occur regardless of the end use application. For the eutrophication potential impact category, the *Manufacturing* (A3) life cycle module was the greatest source of impact. Electricity is the predominate energy carrier used for extrusion in the manufacture XPS insulation; upstream processes used to generate electricity indicate their significant impact on eutrophication.



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6. Additional Environmental Information

6.1. Environment and Health During Manufacturing

Owens Corning manufacturing facilities of FOAMULAR® XPS Insulation maintain quality management systems.

6.2. Building Use Stage Benefits

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 for rigid polystyrene insulation) and the global warming gas avoidance associated with the energy that is saved.

Example Basis: A three-story 55,628 square foot office building insulated with only extruded polystyrene for the walls and roof. The roof insulated area is 17,876 square feet. The wall insulating area is 14,263 square feet. The example includes two types of building structure for two locations. A cinder block wall structure and a steel wall frame structure building were used in the analysis. Chicago, Illinois and Phoenix, Arizona locations were used for the building locations. Buildings were insulated in compliance with ASHRAE Standard 90.1-2007 code. The energy analysis was performed using EnergyPlus, hourly energy analysis simulation program.

Energy Savings

Chicago - Illinois Energy Savings	Life cycle MJ for Insulation Used in Building	MJ saved/year for Insulated Building	Net MJ Saved (first year)	Payback Time (years)	MJ Saved Over 75-year use phase
Cinder Block	692,777	872,779	180,002	0.8	6.48E+07
Steel Stud	738,880	1,049,086	310,206	0.7	7.79E+07
Phoenix - Arizona Energy Savings					
Cinder Block	600,569	519,848	-80,722	1.2	3.84E+07
Steel Stud	604,258	668,195	63,937	0.9	4.95E+07

When properly installed, due to the savings it affords in an otherwise non-insulated building, the energy resource impact from the life cycle of insulation has a payback period of 0.7 to 1.2 years. Based on the US EPA's Greenhouse Gas Equivalencies Calculator, the annual avoided GHGs from the energy saved by the insulation in the Chicago steel-stud structure is equivalent to the GHGs emitted annually by 42 automobiles over 75 years. For the Phoenix steel-stud structure, the annual avoided GHGs from the energy saved by the insulation is equivalent to the GHGs emitted annually by 27 automobiles over 75 years.

Greenhouse Gas Avoidance

Chicago - Illinois CO ₂ eq Savings	Life cycle kg CO ₂ eq for Insulation Used in Building	kg CO ₂ eq saved/year for Insulated Building	Net kg CO ₂ eq Saved (first year)	Payback Time (years)	Net kg CO ₂ eq Saved Over 75-year use phase
Cinder Block	192,305	148,962	-43,342	1.3	1.10E+07
Steel Stud	205,102	182,841	-22,262	1.1	1.35E+07
Phoenix - Arizona CO ₂ eq Savings					
Cinder Block	166,709	67,180	-99,529	2.5	4.87E+06
Steel Stud	167,733	86,325	-81,408	1.9	6.31E+06

Note: CO₂ equivalents due to electricity generation were calculated using the U.S. EPA's eGRID2012 Version 1.0, Year 2009 GHG annual Output Emission Rates. The CO₂ equivalent factor of 117.08 lb CO₂ eq/MMBTU as used for natural gas energy is from the EPA study on fuel sources and their impacts.



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Based on the steel-stud Chicago building, the greenhouse gas avoidance for the energy savings on an insulated building would be equal to 13,508 metric tonnes of CO₂. This represents an annual greenhouse gas avoidance of 180 metric tonnes per year for the 75-year life of the building. The greenhouse gas avoidance for the steel-stud Phoenix building is equal to 6,307 metric tonnes over the 75-year life of the structure. This represents an annual greenhouse gas avoidance of 84.1 metric tonnes over the 75-year life of the building.

6.3. 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.

6.4. Extraordinary Effects

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

6.5. Delayed Emissions

No delayed emissions are expected from this product.

6.6. Environmental Activities and Certifications

- FOAMULAR® XPS Insulation is third party certified for recycled content by Scientific Certification Systems (SCS) to contain a minimum of 20% recycled content.
- Qualified as an ENERGY STAR® product, under the U.S. Environmental Protection Agency and the U.S. Department of Energy.
- Utilizing FOAMULAR® XPS Insulation can help builders achieve green building program certifications including the Environmental Protection Agency's ENERGY STAR®, the National Association of Home Builders' National Green Building Standard ICC 700-2008, and the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) Rating Systems.
- FOAMULAR® XPS Insulation is reusable.



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6.7. Further Information

Additional information may be found at www.owenscorning.com

6.8. Indoor Environmental

FOAMULAR® XPS Insulation has achieved GREENGUARD Gold Certification.

7. References

Product Category Rules (PCR) Guidance for Building-Related Products and Services - Part B: Building Envelope Thermal Insulation EPD Requirements, UL 10010-1 Version 2.0, Second Edition, UL Environment, April 10, 2018.

Product Category Rules for Building Related Products and Services - Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010 Version 3.2, Fifth Edition, UL Environment, December 12, 2018.

ISO 14025:2006(E), Environmental labels and declarations -Type III environmental declarations -Principles and procedures

ISO 14040:2006(E), Environmental management - Life cycle assessment - Principles and framework

ISO 14044:2006(E), Environmental management - Life cycle assessment - Requirements and guidelines

BS EN 15804:2012, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

ISO 21930:2017(E), Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services

PRé Consultants: SimaPro 8.5.2.0 LCA Software. 2018. The Netherlands.

ASHRAE Standard 90.1-2007 Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM C578-18: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

ASTM C518-17: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers - version 1.2, CA Specification 01350, January 2017.

