EnergyShield® Continuous Wall Insulation Boards

ATLAS ROOFING CORPORATION

ENVIRONMENTAL PRODUCT DECLARATION

ISO 14025:2006 and ISO 21930:2017

Certified Environmental Product Declaration
www.nsf.org

Atlas Roofing Corporation is pleased to present this Environmental Product Declaration (EPD) for EnergyShield® Continuous Wall Insulation Boards. This EPD was developed in compliance with ISO 14025 and ISO 21930 and has been verified by NSF.

The LCA and the EPD were prepared by Vertima Inc. The EPD includes cradle-to-grave life cycle assessment (LCA) results.

For more information about Atlas Roofing Corporation, visit www.atlasrwi.com.

For any explanatory material regarding this EPD, please contact the program operator.

1. GENERAL INFORMATION

PCR GENERAL INFORMATION			
Reference PCR	PCR Part B: Building Envelope Thermal Insulation EPD Requirements (UL 10010-1), v.4.0 and its core PCR Part A: Life Cycle Assessment Calculation Rules and Report Requirements (UL 10010), v.4.0 UL Environment November 2025 to November 2030 (validity period of PCR Part B) March 28, 2022 to March 28, 2027 (validity period of PCR Part A)		
The PCR review was conducted by:	*Thomas Gloria, PhD (chair) Industrial Ecology Consultants t.gloria@ industrial-ecology.com*	*Cara Vought Sustainable Solutions cara@ sustainablesolutions. com*	*Andre Desjarlais Oak Ridge National Laboratory desjarlaisa@ornl.gov*

EPD GENERAL INFORMATION		
Program Operator	NSF 789 N. Dixboro Road, Ann Arbor, Michigan 48105 USA www.nsf.org	
General Program Instructions	NSF International, NSF Certification Policies for Environmental Product Declarations (EPD), 2022	
Declared Products	**EnergyShield®, EnergyShield® XR, EnergyShield® PRO, EnergyShield® CGF, EnergyShield® Panel Cast™, EnergyShield® CGF PRO, EnergyShield® PLY (Polyiso Portion), EnergyShield® PLY PRO (Polyiso portion)**	
EPD Registration Number EPD 11325	**EPD Date of Issue** July 28, 2026	**EPD Period of Validity** July 28, 2026 to July 28, 2031
EPD Recipient Organization	Atlas Roofing Corporation 2100 Riveredge Parkway, Suite 600 Atlanta, GA 30328 www.atlasrwi.com	

EPD Type/Scope and Functional Unit	**Year of Reported Manufacturer Primary Data**
Product-specific cradle-to-grave EPD with functional unit of 1 m² of insulation material with a thickness that gives an average thermal resistance of RSI = 1 m² K/W and with a building service life of 75 years.	2023

Geographical Scope	**LCA Software**	**LCI Databases**	**LCIA Methodology**
North America	OpenLCA v.2.03	Ecoinvent 3.9.1	TRACI 2.2, IPCC AR5, CML 4.8

This LCA and EPD were prepared by:	Vertima Inc. www.vertima.ca
This EPD and LCA were independently verified in accordance with ISO 14025:2006, ISO 14040:2006, ISO 14044:2006 and ISO 21930:2107, as well as the UL Environment PCR "Part B: Building Envelope Thermal Insulation EPD Requirements (UL 10010-1) v.4.0," and PCR "Part A: Life Cycle Assessment Calculation Rules and Report Requirements (UL 10010), v.4.0," which serves as the core PCR. ☐ Internal ☒ External	 Joseph Geibig Ecoform, LLC

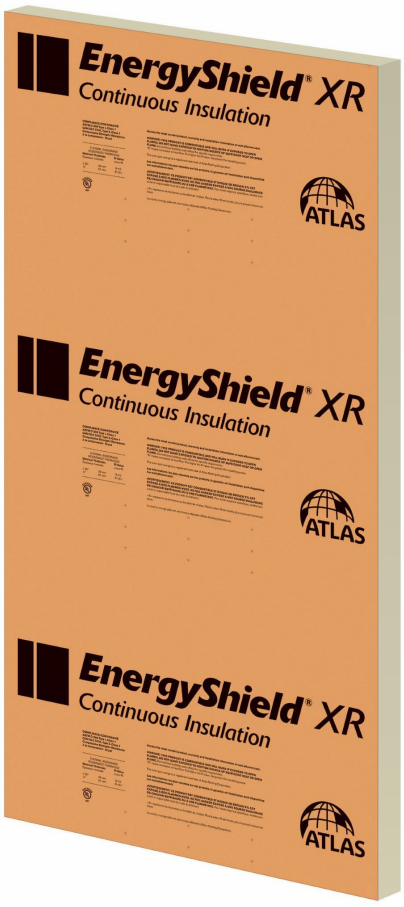
The owner of the declaration shall be liable for the underlying information and evidence; NSF or its affiliates, shall not be liable with respect to manufacturer information, life cycle assessment data, and evidence.

LIMITATIONS

Environmental declarations within the same product category but from different programs may not be comparable. [1]

Comparison of the environmental performance of products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building 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, variations and deviations are possible (e.g. Different LCA software and background LCI datasets that may lead to differences in calculated and reported results upstream or downstream of the life cycle stages declared).[2], [3]

The results of this study are representative of Atlas Roofing Corporation's 2023 production data on EnergyShield® continuous wall insulation boards with specific facer types.



[Photo courtesy of ATLAS]

2. PRODUCT SYSTEM DESCRIPTION

Atlas Roofing Corporation, hereinafter Atlas, has more than 40 years of experience manufacturing polyiso. The company has grown from a single manufacturing facility into an industry leader with 8 polyiso plants in North America and worldwide product distribution.

2.1. PRODUCT DESCRIPTION

Atlas EnergyShield® continuous wall insulation boards are cellular closed-cell rigid foam plastic insulation. Polyiso wall[1] insulation boards consist of a foam core between two facers (top and bottom). The foam core is comprised of a thermoset polymer that hardens by curing from a viscous liquid prepolymer. The rigid foam is produced through the reaction of methylene diphenyl diisocyanate (MDI) with polyester polyol. Other additives such as catalyst, surfactant, flame retardant, and blowing agent (pentane or pentane blends) are part of the formulation. Pentane is a hydrocarbon with negligible ozone depletion potential (ODP) [7] and low global warming potential (GWP).[8] For nearly 30 years, the polyiso industry has only utilized pentane or pentane blends in product formulations. Upon mixing of the components, the viscous pre-polymer is laid between the facers, and a chemical reaction cross-links polymer chains, creating a rigid, durable, and closed-cell structure.

For wall applications, this study considers two types of facers, an aluminum foil facer (AFF) and a coated glass facer (CGF) consisting of a fiberglass wet-process mat and an inorganic latex-based coating which play a critical role in accommodating a continuous manufacturing process. EnergyShield® (20 psi), EnergyShield® XR (25 psi) and EnergyShield® Pro (25 psi) all have an aluminum foil facer on both sides. EnergyShield CGF (20 psi), EnergyShield® CGF Pro (25 psi), EnergyShield® Panel Cast (25 psi), the polyiso portion of EnergyShield® Ply (20 psi) and EnergyShield® Ply Pro (25 psi) all have a coated glass facer on both sides.

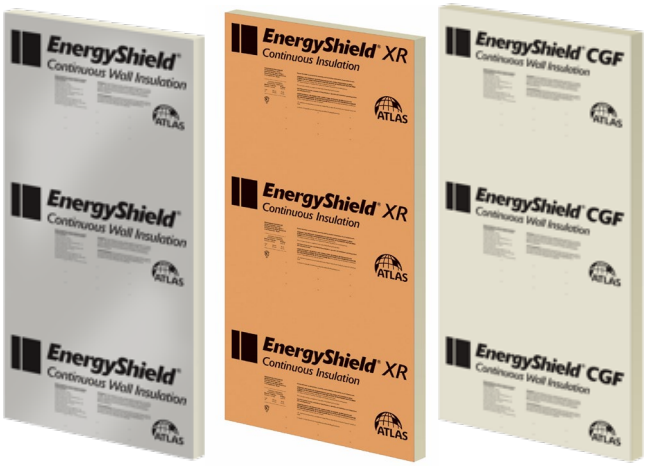


Figure 1: EnergyShield® [left], EnergyShield® XR [middle] and EnergyShield® CGF [right] polyiso wall insulation board.

[1] CSI and CSA MasterFormat® Reference: 07 21 13 Board insulation.

2.2. PRODUCT APPLICATION

EnergyShield® continuous wall insulation boards may be used in residential, light commercial, commercial, and industrial projects on new buildings and retrofit applications under various cladding types as continuous insulation (see Figure 2):

- Exterior or interior in wood and metal stud-framed wall systems including direct-to-steel stud applications
- Exterior or interior in masonry, masonry cavity systems, or concrete wall systems
- Attics and crawlspaces
- Knee wall, vaulted, and cathedral ceilings
- Below grade and under slab
- Building enclosure energy retrofits over existing cladding (for increased energy efficiency and level surface for installation of new cladding)

Polyiso wall insulation boards are typically mechanically fastened to the back-up wall or the supporting structure. Polyiso is a versatile insulation, and it may be approved for other applications and functions (see Figure 2):

- Insulated sheathing
- Water resistive barrier (WRB) (with all seams treated and installed in accordance the with manufacturer's installation instructions)
- Air barrier (for use as a component of the air barrier system, with all seams taped or sealed and installed in accordance with the manufacturer's installation instructions)
- Vapor retarder

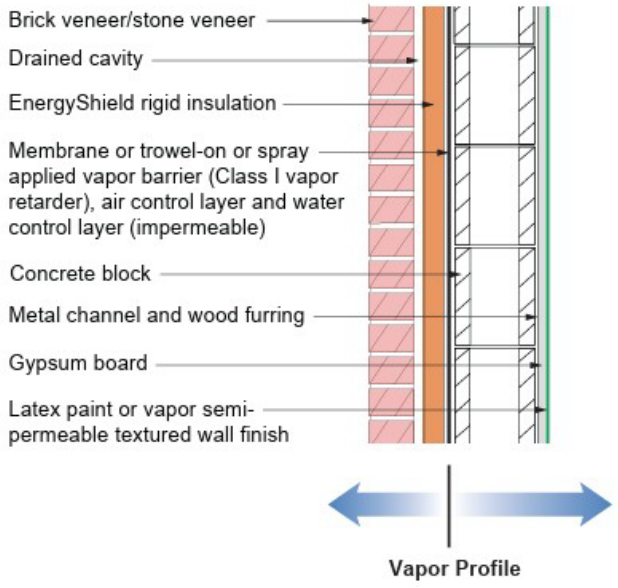


Figure 2: Typical control layers with a concrete block wall, masonry veneer and EnergyShield® wall insulation board.

2.3. MATERIAL COMPOSITION

EnergyShield® continuous wall insulation boards are comprised of a foam core and two facers on the top and bottom surfaces. The foam core consists of the average weighted formulation by mass listed in Table 1. More than half of the foam formulation consists of MDI which reacts with polyester polyol containing other chemicals including blowing agent, flame retardant, surfactant, catalyst, and water. The product contains no other additives, nor ancillary materials known to remain in the product. The chemical reaction forms a rigid cellular foam structure following a curing process.

The two types of facers on EnergyShield® continuous wall insulation boards are: (1) aluminum foil facer (AFF) and (2) coated polymer-bonded glass fiber (CGF). Atlas' EnergyShield® and EnergyShield® XR have a tri-laminate foil facer, composed of foil and kraft paper. The EnergyShield® Pro has an AFF comprised of an aluminum foil sheet reinforced with glass scrim. EnergyShield® CGF, EnergyShield® CGF Pro and EnergyShield® Panel Cast™ have a CGF facer composed of a fiberglass wet-process mat and an inorganic latex-based coating.

Table 1: Weighted average EnergyShield® continuous wall insulation board material composition and foam formulation ranges.

Component		Formulation Range (% by mass)			
		Facer: AFF		Facer: CGF	
		20 psi / 140 kPa	25 psi / 170 kPa	20 psi / 140 kPa	25 psi / 170 kPa
Facer		20.7%	18.0%	58.6%	53.3%
Foam		79.3%	82.0%	41.4%	46.7%
Foam composition	MDI	61.7% - 66.8%		60.4% - 65.6%	
	Polyester Polyol	22.4% - 24.6%		22.9% - 25.5%	
	Blowing Agent (Pentane)	3.7% - 6.2%		4.1% - 6.2%	
	Flame Retardant (TCPP)	4.3% - 4.7%		4.4% - 4.8%	
	Surfactant	1.0% - 1.2%		0.8% - 1.1%	
	Catalyst	1.4%		1.5% - 1.9%	
	Water	0.3% - 0.4%		0.3% - 0.4%	

2.4. TECHNICAL DATA

EnergyShield® continuous wall insulation boards are manufactured to meet the requirements of industry consensus product specifications and standards in the United States and Canada. Note: Compliance with model building codes does not always ensure compliance with state or local building codes, which may be amended versions of these model codes. Always check with local building code officials to confirm compliance. Typical physical properties for EnergyShield® continuous wall insulation boards are listed in Table 2.

- ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation.
- CAN/ULC-704.1 – Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.

Thermal Performance: The use of continuous insulation is required in model building codes as a prescriptive measure of increasing energy efficiency of building envelope components, including exterior walls. The thermal resistance (R-value) is a measure of insulation's resistance to heat transfer for a given material thickness. The R-value of polyiso insulation board is determined on full thickness boards using a test method described in ASTM C518 "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus."

Table 2: Typical physical properties of EnergyShield® continuous wall insulation boards and corresponding requirements listed in ASTM C1289 and CAN/ULC704.1 standards.

Physical Property	Standard Designation	ASTM C1289 (Type I, Class 1 and 2; Type II, Class 2)	CAN/ULC-704.1 (Type 1, 2 and 3)
Thermal Resistance per 25.4mm (1.0-inch) – RSI (R-Value)		EnergyShield® AFF products: 6.5 ft^2 °F h/Btu EnergyShield® CGF products: 6.0 ft^2 °F h/Btu Thermal resistance determined per ASTM C518 at 75°F mean temperature using materials conditioned in accordance with ASTM C1289	EnergyShield® AFF products: 1.14 m^2 K/W EnergyShield® CGF products: 1.06 m^2 K/W
Compressive Strength, Min	ASTM D1621	EnergyShield®, EnergyShield® CGF, EnergyShield® Ply – 20 psi EnergyShield® XR, EnergyShield® Pro, EnergyShield® CGF Pro, EnergyShield® Ply Pro, EnergyShied® PanelCast™ - 25 psi	EnergyShield®, EnergyShield® CGF, EnergyShield® Ply – 140 kPa EnergyShield® XR, EnergyShield® Pro, EnergyShield® CGF Pro, EnergyShield® Ply Pro, EnergyShied® PanelCast™ - 170 kPa
Flexural Strength, Min	ASTM C203	All - 40 psi	All - 275.0 kPa
Tensile Strength, Min		All - 500 psf (24 kPa) determined per ASTM C209	All - 35.0 kPa determined per ASTM D1623
Dimensional Stability, % Linear Change, Width and Length, Max	ASTM D2126	All - ± 2%	All - ± 2%
Water Absorption, % by Volume, Max		All - < 1% determined per ASTM C1763 – Procedure B	All - < 1% determined per ASTM D2842 – Procedure B
Water Vapor Permeance at 1 inch	ASTM E96/E96M Dessicant Method	EnergyShield® AFF products: ≤ 0.3 perm EnergyShield® CGF products: 1.2 perm	EnergyShield® AFF products: <15 ng/Pa·s·m^2 EnergyShield® CGF products: > 60 ng/Pa·s·m

2.5. MANUFACTURING

An overview of the manufacturing process for polyiso insulation is illustrated in Figure 4 *and is described below.*

Manufacturing Process Detail:

- ***Raw Material Unloading and Storage*** *- Raw materials are delivered to the manufacturing plant via bulk shipment methods including rail cars or large totes. After unloading, certain materials are transferred and stored on-site in large tanks or totes.*
- ***Facer Unwind*** *- Rolls of facer material are loaded on the front end of the lamination line. Two rolls of material are unwound and fed toward the laminator. The material will become the top and bottom of the finished product.*
- ***Compounding*** *- Raw materials are compounded and heated to form the polyol or B-side component of the product formulation. The isocyanate or A-side of the product formulation is heated and transferred through a separate line.*
- ***Mixing Head and Pour Table*** *- The A-side and B-side components are mixed with the blowing agent at the mixing head. At the pour table, the mixture is applied through the mixing head applicator and laid onto one layer of the facer material. The chemical reaction begins at this point in the process, and the second layer of the facer material is brought into contact with the foam mixture as it enters the laminator.*
- ***Laminator*** *- The chemical reaction transforms the liquid mixture into the rigid foam core as the product moves through the laminator. The laminator is used to control the thickness of the finished product as well as other characteristics such as cell formation, curing, and facer adhesion.*
- ***Trim and Cutting*** *- The product is manufactured in a continuous process and must be trimmed and cut after exiting the laminator. A cross-cut saw and gang saw are used to cut the material down to either 4' or 8' finished lengths.*
- ***Robot Stacker*** *- A conveyor system moves the polyiso boards through the trimming and cutting process to the robot stacker. An initial quality check is performed as the boards are stacked in bundles.*
- ***Packaging*** *- The stacked bundles are transferred to a hooding machine where each bundle is individually wrapped with a plastic film. The factory packaging secures the product for warehouse storage and transport.*
- ***Foot Station and Warehousing*** *- The product identification labels are applied to each bundle. A forklift transfers the bundles from the end of the line to warehouse storage. Polyiso boards complete the curing process while stored in the warehouse.*
- ***Quality Assurance and Control*** *- Product samples are selected and subjected to various quality assurance and quality control (QA/QC) testing. The QA/QC is performed against applicable standards and internal controls for physical properties including initial R-value, compressive strength, and dimensional stability.*
- ***Loading and Shipping*** *- After QA/QC testing and storage in the warehouse, the bundles are transferred to the loading dock. Bundles are loaded onto flatbed trucks and secured for transport to jobsites or distribution locations.*

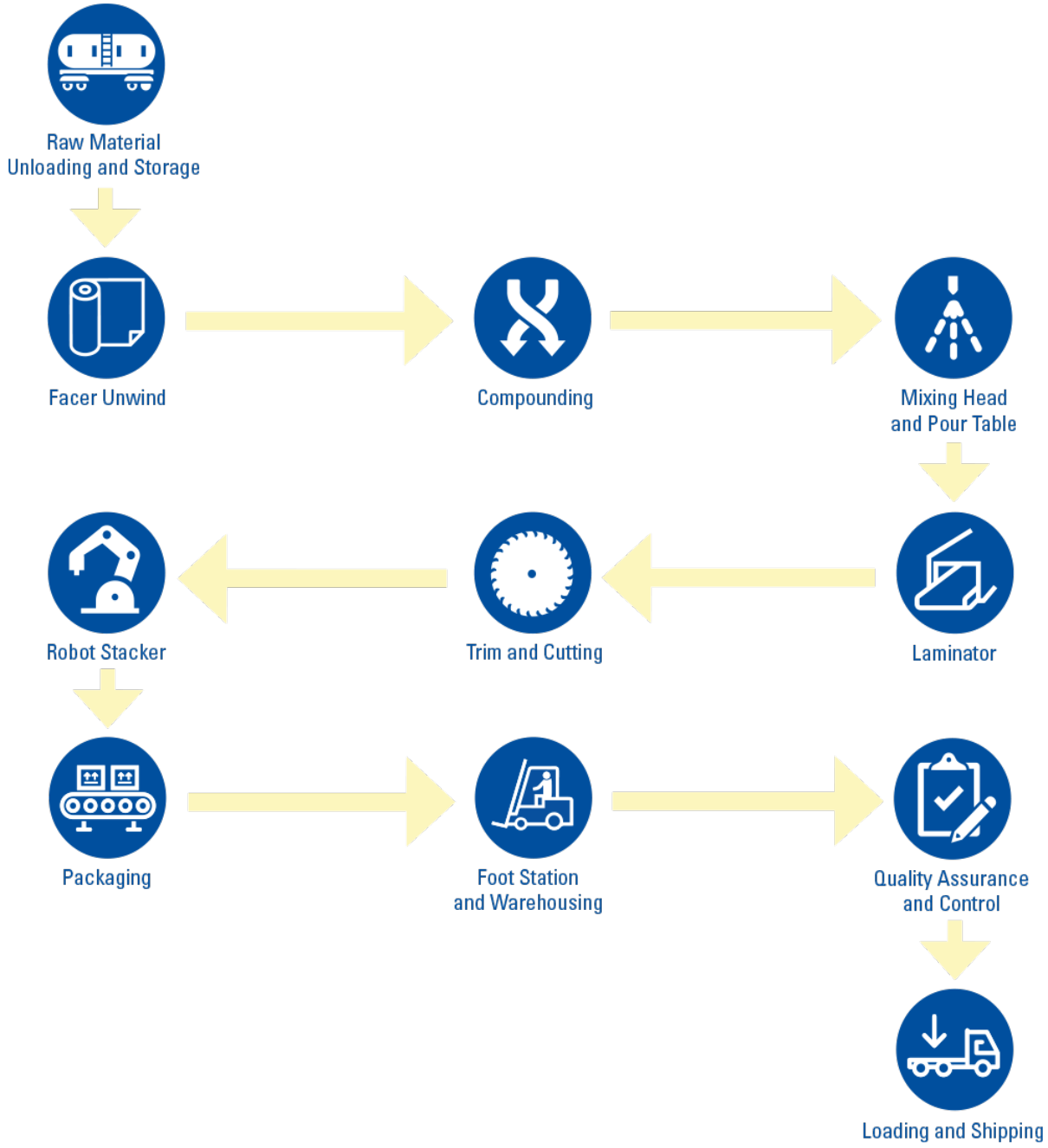


Figure 3: Illustration of the polyiso insulation manufacturing process.

2.6. PROPERTIES OF PRODUCT AS DELIVERED

The manufactured EnergyShield® continuous wall insulation boards are typically shipped and delivered to jobsites stacked in bundles protected by a plastic wrap, plastic bag, or both. The boards are typically 1.2 m by 2.4 m (4 feet by 8 feet) in size and stacked one on top of another to form a bundle. The number of polyiso boards in a bundle will vary depending on product thickness. Typically, the bundles are 1.2 m (48 inches) in height. For example, twice the number

of 2.54 cm (1.0-inch thick) boards can be stacked to make up the same height bundle compared to 2.0-inch-thick insulation boards. Typically, 48 boards at 2.54 cm (1.0-inch thick), 24 boards at 5.08 cm (2.0-inch thick) or 16 boards at 7.62 cm (3.0-inch thick) comprise a bundle of polyiso wall. Board thickness is typically 2.54 cm to 10.16 cm (1.0 to 4.0-inch thick), but may be as thin as 1.27 cm (0.5-inch thick).

2.7. PACKAGING

Bundles of EnergyShield® continuous wall insulation boards are bagged in plastic prior to shipment from the manufacturing facility. Packaging used to wrap/shroud bundles is made from extruded low-density polyethylene (LDPE) film. The bundles may be stacked on wood pallets.

Table 3: Amount of packaging materials for EnergyShield® continuous wall insulation boards per product reference service life (RSL)*.

	EnergyShield® foil-faced (AFF)		EnergyShield® coated glass facer (CGF)		
Material	20 psi	25 psi	20 psi	25 psi	Unit
Polyethylene	9.12E-03	1.14E-02	2.09E-02	2.17E-02	kg/m^2
Wood	4.90E-05	2.18E-04	2.38E-04	6.97E-04	kg/m^2

*: RSL is the lifetime of the product (RSL = 75 years for wall products.)

2.8. TRANSPORTATION

The EnergyShield® continuous wall insulation boards are transported in wrapped bundles from the manufacturing facilities to product distributor sites or directly to project jobsites by a diesel-powered truck with a flatbed trailer. The average transport distance from the production facility is 514 km (319 miles). Additional transportation details are reported in Table 9 in the life cycle assessment scenario section of the EPD.

2.9. PRODUCT INSTALLATION

Upon delivery to the jobsite, the bundles of EnergyShield® continuous wall insulation boards are unloaded from the truck using a crane or all-terrain forklift and are staged on the ground, all packaging is removed, assumed to be landfilled, and the individual wall insulation boards are installed by contracting crews. The polyiso wall insulation boards are attached to the structure using mechanical fasteners or adhesives. The waste scrap from installation is collected and transported to a local landfill for disposal. Disposal of installation waste scrap to a local landfill was modeled as 2% product loss as prescribed by the PCR.[2] Additional installation details are reported in Table 10 in the life cycle assessment scenario section of the EPD.

2.10. USE CONDITIONS

The use phase follows the installation of EnergyShield® continuous wall insulation boards. In a wall system, continuous insulation is located between the supporting structure and the cladding or the interior finish. The cladding, when installed properly and adequately maintained, protects the insulation from the environmental elements and weather during its use. Therefore, it is expected that EnergyShield® continuous wall insulation will not sustain damage that affects its performance and function and does not require maintenance.

2.11. PRODUCT REFERENCE SERVICE LIFE AND BUILDING ESTIMATED SERVICE LIFE

As defined in the governing PCR, the Building Estimated Service Life (ESL) is 75 years. Polyiso wall insulation boards should serve their functional purpose for the life of the building, and do not require replacement during the building's ESL. Therefore, the declared Product Reference Service Life (RSL) for wall products is established as equal to the PCR ESL for the building of 75 years, with no replacement required.

2.12. RE-USE PHASE

If the product is still in good condition and has not passed its reference service life, it may be reused. No re-use is considered in this EPD.

2.13. DISPOSAL

At the end of the building's service life, the EnergyShield® continuous wall insulation boards are assumed to be disposed in a landfill and no recycling is considered. The boards are transported 161 km (100 miles) to landfill sites by truck for disposal. Additional disposal details are reported in the Transport to waste disposal (module C2) and Disposal of waste (module C4) tables presented in the scenario section.

[EnergyShield® being re-used during siding replacement, photo courtesy of ATLAS]

3. LCA CALCULATION RULES

3.1. REFERENCE FLOW AND FUNCTIONAL UNIT

The selected functional unit (FU) for this study is: **1 m²** of installed insulation material with a thickness that gives an average thermal resistance **RSI = 1 m² K/W** and with a building service life of **75 years**.

Table 4 below (Table 5 for imperial units) summarizes the reference flows associated with the functional unit. EnergyShield® continuous wall insulation boards represent RSI value as per test method described in ASTM C518. Reference flows, which represent weighted average values, are shown per product reference service life (RSL) and per building estimated service life (ESL). The product weight per product RSL represents: 1 m^2 of product with RSI = 1m^2 K/W without installation loss or replacement. The product weight per building ESL, on the other hand, represents: 1 m^2 of product with RSI = 1m^2 K/W with installation loss and replacement

For EnergyShield® continuous wall insulation boards, there is a 2% loss; hence, to fulfill the functional unit, additional EnergyShield® continuous wall insulation boards must be produced. The reference mass per ESL is calculated as follows:

$$ESL\ product\ weight\ (kg) = \frac{RSL\ product\ weight\ (kg)}{(100\% - Installation\ loss\ (\%))}$$

For 20 psi AFF EnergyShield® wall insulation boards, this gives:

$$ESL\ product\ weight\ (kg)\ = \frac{0.832\ kg}{(100\% -\ 2\%)} = 0.849\ kg$$

Table 4: Reference flows of studied products per reference service life (RSL) and per building estimated service life (ESL) in metric units.

		EnergyShield® foil-faced (AFF)		EnergyShield® coated glass facer (CGF)		Unit
Reference flows		20 psi	25 psi	20 psi	25 psi	
RSL	**Product weight**	0.832	0.955	1.667	1.834	kg/m^2
	Facer weight	0.172		0.976		kg/m^2
	Foam weight	0.660	0.783	0.690	0.857	kg/m^2
	Thickness	22.3	22.3	24.0	24.0	mm
	RSI	1.0		1.0		m^2 K/W
ESL	**Product weight**	0.849	0.975	1.701	1.871	kg/m^2
	Installation loss	2.0%		2.0%		%
	Replacement (ESL/RSL-1)	0.000		0.000		

Table 5: Reference flows of studied products per reference service life (RSL) and per building estimated service life (ESL) in imperial units.

		EnergyShield® foil-faced (AFF)		EnergyShield® coated glass facer (CGF)		Unit
Reference flows		20 psi	25 psi	20 psi	25 psi	
RSL	**Product weight**	0.170	0.196	0.341	0.376	lb/ft^2
	Facer weight	0.035		0.200		kg/m^2
	Foam weight	0.135	0.160	0.141	0.176	lb/ft^2
	Thickness	0.877	0.877	0.943	0.943	inch
	R-value	5.68		5.68		ft^2 °F h/Btu
ESL	**Product weight**	0.174	0.200	0.348	0.383	lb/ft2
	Installation loss	2.0%		2.0%		%
	Replacement (ESL/RSL-1)	0.000		0.000		

3.2. PRODUCTION AVERAGE

All of Atlas polyiso manufacturing facilities, located in Toronto (ON), Vancouver (BC), Camp Hill (PA), Diboll (TX), East Moline (IL), LaGrange (GA), Northglenn (CO), and Phoenix (AZ), participated in the product-specific EPD. A vertical mass-weighted average was calculated based on the LCA results obtained from 8 facilities, regardless of their size, which provided their production data for the full 2023 calendar year. Products were classified based on their ASTM C1289 type, class, facer material, and compressive strength. Products within the same classification group are treated as equivalent because they share the same technical characteristics and are represented by the same underlying life cycle assessment model; hence, considered product-specific EPD.

3.3. ESTIMATES AND ASSUMPTIONS

The table below presents the datasets selected to represent the polyiso foam raw materials. It should be noted that the data used for AFF facer is based on a glass fiber reinforced aluminum foil facer, while Atlas uses, except for the EnergyShield® Pro, a tri-laminate reflective kraft foil facer on their insulation boards.

Table 6: Datasets selected to represent polyiso insulation raw materials.

Material	Data source	Data Reference Year
MDI	American Chemistry Council (ACC), 2022, cradle-to-gate LCI study: LCIA results (mass and elemental alloc.)	2015 - 2017
Polyester Polyol	Primary data	2023
Blowing agent	Ecoinvent dataset 3.9.1: pentane production | pentane | Cutoff, U - RoW	2001 - 2022
Flame retardant	TCPP GABi database: Tris(2-chloroisopropyl)phosphate (TCPP) - US	2018
Surfactant	Ecoinvent 3.9.1 datasets (for 1 kg of surfactant) 0.4 kg polydimethylsiloxane production | polydimethylsiloxane | Cutoff, U – GLO 0.6 kg polyol production | polyol | Cutoff, U - RoW	2015 - 2022
Catalyst	Ecoinvent 3.9.1 datasets (for 1 kg of catalyst) 0.5 kg ethanolamine production | triethanolamine | Cutoff, U - RoW 0.29 kg potassium hydroxide production | potassium hydroxide | Cutoff, U - RoW	2000 - 2022 1998 – 2022

Material	Data source	Data Reference Year
	USLCI dataset*: 0.31 kg Acetic acid, at plant/kg/RNA	2002
AFF Facer	Primary data	2023
CGF Facer	Primary data	2023

*Cut-off processes have been filled with ecoinvent data.

3.4. SYSTEM BOUNDARIES

The system boundaries are **cradle-to-grave**, i.e., cover all life cycle stages as shown in Table 7.[2] Impacts for modules B2 – B7 shall be reported as zero (0) impact for all environmental indicators and inventory metrics. Figure 9 presents the process flow diagram for polyiso wall insulation boards. Neither renewable energy credits nor carbon credits are used within the scope of this project.

Table 7: Description of the system boundary life cycle stages and related information modules.

PRODUCTION STAGE			CONSTRUC-TION PROCESS STAGE		USE STAGE							END-OF-LIFE STAGE			
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
Extraction and Upstream Production	Transport to Factory	Manufacturing	Transport to Site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction / Demolition	Transport to Waste Processing or Disposal	Waste Processing	Disposal of Waste
X	X	X	X	X	X	X	X	X*	X	X	X	X	X	X	X

Key: X = included; MND = module not declared (excluded).

*: EnergyShield® continuous wall insulation boards have a reference service life equal to the estimated service life of the building; hence, no replacement.

Production (modules A1 to A3)

Extraction and upstream production (module A1): This module includes the extraction and transformation of raw materials needed to produce polyiso products.

Transport to factory (module A2): This module includes the transportation of raw materials from suppliers to the manufacturing facilities.

Manufacturing (module A3): This module includes water and energy (electricity, natural gas, diesel) consumption for the manufacturing processes and building requirements (lighting, heating, cooling). Ancillary materials used in the polyiso manufacturing process and their transport from the suppliers to the manufacturing facilities have been considered here, as well as packaging materials to make the products ready for shipment. Blowing agent emissions from the production process and from the polyiso board cuttings are also included in this module, as well as the waste transport to the waste treatment center and the waste treatment itself. The majority of the manufacturing waste is sent to landfill.

Construction (modules A4 to A5)

Delivery and installation: These modules included the delivery of the product to the client and their installation. Product loss during the installation of wall insulation boards is 2%.[2] Waste generated during installation, such as product loss and packaging, are considered landfilled. Transport and treatment of waste are included. It should be noted that the production (modules A1 to A3) and delivery (A4) of lost products are included in module A5.

Use (modules B1 to B7)

Use: Module B1 includes pentane emissions during the use phase. For wall applications, modules B2, B3, B4, B5, B6, and B7 are "null" for the purpose of the EPDs.

End-of-Life (modules C1 to C4)

End-of-life: This stage includes modules C2 and C4, transport to and treatment of waste at inert material landfill, respectively. Modules C1 and C3 modules are "null."

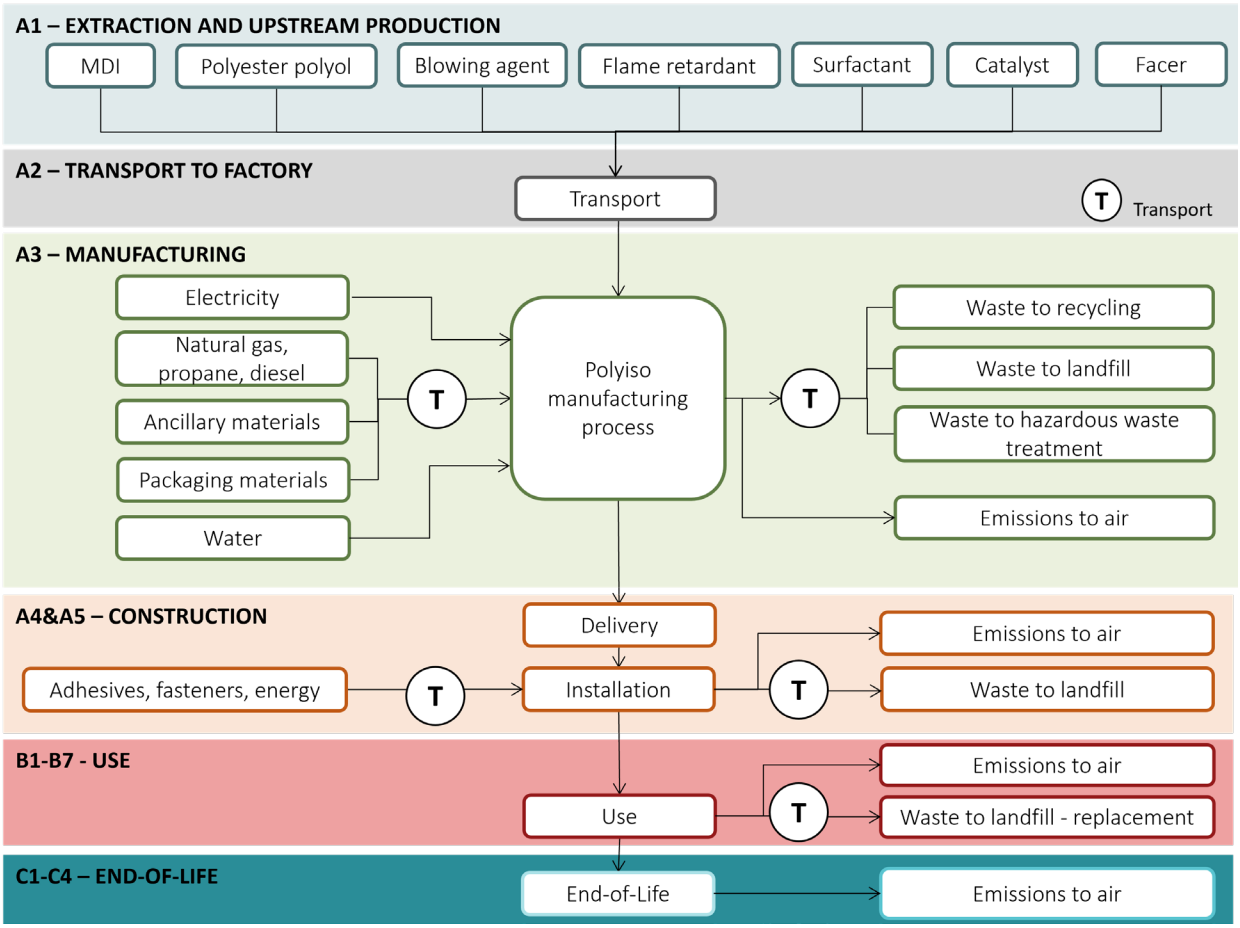


Figure 4: Cradle-to-grave system boundaries of polyiso product LCA.

3.5. CUT-OFF CRITERIA

According to ISO 21930:2017, cut-off rules shall not be applied in order to hide data. All data shall be included. In the case of insufficient data, the cut-off criteria shall be 1% of energy or 1% of total mass input and 1% of environmental impacts of the unit process. The total cut-off input flows per module shall be a maximum of 5% energy, mass, and environmental impacts.

No known flows are deliberately excluded from this study.

For this study, no data on the construction, maintenance, or dismantling of the capital assets, daily transport of employees, office work, business trips, or other employee activities were included in the model. The model only takes into account the processes associated with infrastructures that are already included in the ecoinvent unit processes.

3.6. ALLOCATION

Whenever possible, allocation should be avoided by collecting data related to the process under study or by expanding the product system. When allocation cannot be avoided, according to UL Solutions Part B PCR, mass allocation should be used.[2]

Energy consumption, ancillary materials, and packaging materials were provided for the entire manufacturing facilities; thus, mass allocation was used. Otherwise, no co-product allocation was required.

Waste processing of the material flows undergoing recycling processes are included up to the system boundary of the end-of-waste.[6] In other words, a cut-off approach was used as further processing of the recycled material is part of the raw material preparation of another product system (open-loop recycling).

Blowing agent (pentane) emissions during the life cycle of the product were calculated from primary data and PCR blowing agent emission allocation factors to preserve mass balance. Thus, the calculated blowing agent emission allocation factors differ slightly from the ones presented in the UL Solutions Part B PCR for Building Envelope Thermal Insulation products,[2] and are shown in the table below.

Table 8: Calculated pentane emission allocation factors per information module.

	A3	A5	B1	C4	Remains in material
Polyiso Wall Insulation Boards	6.6% - 7.7%	2.0%	19.4% - 19.7%	70.9% - 71.8%	0%

3.7. CALCULATION METHOD

The openLCA software v2.03 [12], an open-source software, was used to calculate the inventory and to assess potential environmental impacts associated with the inventoried emissions.

3.8. DATA SOURCES AND QUALITY REQUIREMENTS

Data Source/Quality Parameter	Data Source/Quality Discussion
Source of manufacturing data (primary data)	Manufacturing data was collected from 8 manufacturing plants located in North America for the 2023 production year. This data included: total annual mass of products produced at the manufacturing plants; specific product composition; raw materials and fuels entering the product production process; transport distance of materials and fuels; electricity consumption; water consumption; emissions to the environment at the manufacturing plant; and packaging.
Source of secondary data (background data)	MDI: American Chemistry Council (ACC), 2022, cradle-to-gate LCI study: LCIA results (mass and elemental allocation) Polyester Polyol and facer: primary data Flame retardant: GaBi Catalyst: ecoinvent 3.9.1 and US LCI Pentane, surfactant, energy use, transport, waste treatment and packaging: ecoinvent 3.9.1
Geographical representativeness	Manufacturing facilities are based in North America; hence electricity consumption is based on each facility's regional grid mix and natural gas consumption from the Canadian or US high-pressure natural gas market as appropriate. Geographical correlation of the material supply and the selected datasets are largely representative of the same area. When this was not possible, datasets representing a larger geographical area were used.
Temporal representativeness	Primary data was collected from the polyiso manufacturers and their specific facilities for the full 2023 calendar year. Datasets selected were almost all from a time period ending within the last ten years.
Technological representativeness	Primary data, obtained from the polyiso manufacturer, is representative of the current technologies and materials used by their company.
Completeness	All relevant process steps were considered and modeled to satisfy the goal and scope. No known flows were cut off.
Consistency	The same data was collected from all facilities, the same data treatment was applied to all facilities and, as a vertical mass-weighted average was calculated based on the LCA results obtained from facilities, the same model was used for all facilities; hence, the consistency of this study is high.
Reproducibility	Given access to the LCA report and the quality-checked primary data of all facilities, an independent practitioner would be able to reproduce the results as calculation rules and model details are reported in detail in the LCA report.

4. LIFE CYCLE ASSESSMENT SCENARIO

4.1. TRANSPORT TO INSTALLATION SITE (MODULE A4)

Primary data was collected from each participating manufacturer regarding product transport to installation sites or distributors (transport distance and transport mode).

Table 9: Transport to building site assumptions (module A4).

Name	Manufactured boards	Unit
Fuel type	Diesel	
Vehicle type*	53' Tractor-trailer	
Transport distance**	514	km
Capacity utilization (including empty runs, mass-based)	50	%
Gross density of products transported	37.4 – 76.5	kg/m^3
Capacity utilization volume factor	1	

* Modelled using ecoinvent 3.9.1 dataset "transport, freight, lorry >32 metric ton, EURO6 | transport, freight, lorry >32 metric ton, EURO6 | Cutoff, U – RoW."

** From primary data, represents the mass weighted average.

4.2. INSTALLATION (MODULE A5)

UL Solutions Part B PCR is prescriptive on the installation assumptions (ancillary materials, electricity consumption, diesel fuel consumption) and product losses during installation.[2] All studied products have the same installation assumptions and transport distance from the building site to waste processing. Details are presented in Table 10. Waste product and packaging are considered non-hazardous waste sent to inert landfill by refuse truck over 161 km. The packaging waste, a low fraction of the Construction & Demolition (C&D) waste, is difficult to separate and recover; thus, packaging waste is considered all sent to landfill.[9] Biogenic carbon is considered emitted from wood pallets and, apart from pentane emissions, no other VOC emissions are considered emitted in A5, nor were any VOC emissions tests performed.

Table 10: Installation into the building site assumption (module A5).

Name	Manufactured boards	Unit
Ancillary materials	0.0012 Fasteners 0.0012 Adhesive	kg
Electricity consumption	0.012	kWh
Diesel fuel for onboard generators	0.37	MJ
Product loss	2%	%
Pentane emissions	0.0008-0.0009	kg
Product waste at the construction site before waste processing, generated by product installation	0.017 – 0.037	kg
LDPE packaging waste	0009 – 0.022	kg
Wood packaging waste	0.00005-0.00071	kg
Biogenic carbon content in packaging*	0.00009 – 0.0013	kg CO_2

* Wood pallets are considered to contain 50% carbon.

4.3. USE (MODULE B1)

The use phase only includes pentane emissions. According to the UL Solutions Part B PCR: Building Insulation,[2] 21.5% of the pentane in the installed product is emitted during the use phase and the balance at disposal (module C4).

4.4. REPLACEMENT (MODULE B4)

Wall products are not replaced during the estimated service life (ESL) of the building as their RSF is estimated to be equal to the building's ESL.

4.5. END-OF-LIFE (MODULES C1-C4)

At their end-of-life, EnergyShield® continuous wall insulation boards are removed when the building is decommissioned and transported to a landfill.

EnergyShield® continuous wall insulation boards do not require waste processing. In addition, potential environmental impacts associated with the deconstruction of polyiso boards are considered negligible compared to the potential environmental impacts of the deconstruction of the whole building; hence, module C1 is considered null.

Table 11: End-of-life (modules C1-C4).

Name		Manufactured boards	Unit
Transport		161	km
Collection process *	Collected with mixed construction waste	0.824 – 1.826	kg
Disposal **	Product for final disposal (100% landfill)	0.792 – 1.799	kg
Blowing agent emissions		0.037 – 0.034	kg

* Mass adjusted to account for mass loss due to off-gassing in module B1. Values per product reference service life (RSL).

**Mass adjusted to account for mass of pentane loss in module B1 and module C4, which is 100% of the pentane in product. Values per product reference service life (RSL).

5. LIFE CYCLE ASSESSMENT RESULTS

5.1. RESULTS TABLES

It should be noted that Life Cycle Impact Assessment (LCIA) results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins, or risks.

The reported six 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.

The tables below present the LCIA results according to the product functional unit using the TRACI 2.2 methodology (GWP from IPCC AR5, ADF-ff from CML 4.8), as well as primary energy consumption, consumption of renewable and non-renewable materials, water consumption, and waste generation. EPA updated TRACI in 2021 to include spatially-specific eutrophication factors. All other indicators remain the same from version 2.1; hence, as an optional additional indicator, Eutrophication Potential from TRACI 2.1 is shown for information purposes. It should be noted that modules B2 – B7 are reported as zero, as are modules C1 and C3 as they have no associated impacts.

TRACI 2.2 potential impact indicators
GWP: Global Warming Potential; **ADP-ff**: Abiotic Resource Depletion Potential of Non-Renewable (Fossil) Energy Resources; **AP**: Acidification Potential; **EP_f**: Eutrophication Potential – Freshwater; **EP_m**: Eutrophication Potential – Marine; **ODP**: Ozone Layer Depletion Potential; **SFP**: Smog Formation Potential.
Resource use
RPR_E: Renewable Primary Resources Used as Energy Carrier (Fuel); **RPR_M**: Renewable Primary Resources with Energy Content Used as Material; **RPR_T**: Renewable Primary Resources Total; **$NRPR_E$**: Non-Renewable Primary Resources Used as Energy Carrier (Fuel); **$NRPR_M$**: Non-Renewable Primary Resources with Energy Content Used as Material; **$NRPR_T$**: Non-Renewable Primary Resources Total; **SM**: Secondary Materials; **RSF**: Renewable Secondary Fuels; **NRSF**: Non-Renewable Secondary Fuels; **RE**: Recovered Energy; **FW**: Use of Net Fresh Water Resources.
Output flows and waste categories
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; **MFR**: Materials for Recycling; **MER**: Materials for Energy Recovery; **EE**: Exported Energy.
Additional indicator – TRACI 2.1
EP: Eutrophication Potential

Table 12: Cradle-to-grave LCA results for 1 m² of installed EnergyShield® wall insulation boards, AFF, 20 psi, with a thickness that gives an average thermal resistance RSI = 1 m² K/W and with a building service life of 75 years.

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	GWP[1]	kg CO_2 eq.	3.73E+00	8.92E-02	1.54E-01	4.28E-02	1.39E-01	0.00E+00	0.00E+00	1.84E-01	5.08E-03
	GWP_{fossil}[1]	kg CO_2 eq.	3.71E+00	8.92E-02	1.54E-01	4.28E-02	1.38E-01	0.00E+00	0.00E+00	1.84E-01	5.08E-03
	$GWP_{biogenic}$[1]	kg CO_2 eq.	6.26E-03	2.73E-05	1.41E-04	1.27E-05	1.77E-04	0.00E+00	0.00E+00	1.87E-05	2.06E-06
	$GWP_{LU\&LUT}$[1]	kg CO_2 eq.	2.03E-02	5.42E-05	3.75E-04	2.22E-05	4.51E-04	0.00E+00	0.00E+00	2.31E-05	3.01E-06
	ADP-ff[2]	MJ, LHV	6.56E+01	1.23E+00	2.44E+00	6.50E-01	2.19E+00	0.00E+00	0.00E+00	2.39E+00	1.25E-01
	AP	kg SO_2 eq.	1.58E-02	7.00E-04	3.54E-04	1.03E-04	7.41E-04	0.00E+00	0.00E+00	9.16E-04	3.42E-05
	EP_f	kg P eq.	8.39E-04	7.24E-06	2.29E-05	3.44E-06	2.48E-05	0.00E+00	0.00E+00	3.24E-06	3.97E-07
	EP_m	kg N eq.	9.09E-03	6.41E-04	3.08E-04	7.65E-05	6.79E-04	0.00E+00	0.00E+00	1.12E-03	3.72E-05
	ODP	kg CFC-11 eq.	4.92E-06	1.51E-09	1.74E-09	7.90E-10	1.02E-07	0.00E+00	0.00E+00	3.04E-09	1.55E-10
	SFP	kg O_3 eq.	2.28E-01	1.63E-02	1.33E-02	2.16E-03	1.85E-02	1.15E-02	0.00E+00	3.05E-02	4.30E-02
Resource use	RPR_E[3]	MJ, LHV	3.02E+00	2.21E-02	1.84E-01	9.29E-03	9.26E-02	0.00E+00	0.00E+00	1.05E-02	1.22E-03
	RPR_M[4]	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	3.02E+00	2.21E-02	1.84E-01	9.29E-03	9.26E-02	0.00E+00	0.00E+00	1.05E-02	1.22E-03
	$NRPR_E$[5]	MJ, LHV	3.77E+01	1.25E+00	2.90E+00	6.55E-01	1.64E+00	0.00E+00	0.00E+00	2.38E+00	1.26E-01
	$NRPR_M$[6]	MJ, LHV	3.04E+01	0.00E+00	0.00E+00	0.00E+00	6.49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	6.81E+01	1.25E+00	2.90E+00	6.55E-01	2.29E+00	0.00E+00	0.00E+00	2.38E+00	1.26E-01
	SM	kg	1.22E-02	0.00E+00	0.00E+00	0.00E+00	2.49E-04	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	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	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	0.00E+00	0.00E+00	0.00E+00
	FW[7]	m^3	2.54E-02	1.72E-04	1.60E-03	9.39E-05	7.93E-04	0.00E+00	0.00E+00	1.16E-04	1.33E-04
Output flows and waste categories	HWD[8]	kg	3.50E+00	3.91E-02	1.21E-01	1.87E-02	1.11E-01	0.00E+00	0.00E+00	1.72E-02	2.11E-03
	NHWD[9]	kg	2.20E-01	6.80E-02	1.58E-02	5.56E-02	3.52E-02	0.00E+00	0.00E+00	1.16E-02	8.33E-01
	HLRW[10]	m^3	3.27E-09	1.64E-11	1.17E-09	7.72E-12	1.31E-10	0.00E+00	0.00E+00	9.56E-12	9.87E-13
	ILLRW[11]	m^3	2.45E-08	8.72E-11	1.57E-09	4.06E-11	7.27E-10	0.00E+00	0.00E+00	4.88E-11	5.31E-12
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	0.00E+00	0.00E+00	8.90E-04	0.00E+00	1.82E-05	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	EP	kg N eq.	8.88E-03	9.84E-05	2.13E-04	3.73E-05	2.82E-04	0.00E+00	0.00E+00	9.61E-05	5.86E-06

Table 13: Cradle-to-grave LCA results for 1 m² of installed EnergyShield® XR and EnergyShield® Pro wall insulation boards, AFF, 25 psi, with a thickness that gives an average thermal resistance RSI = 1 m² K/W and with a building service life of 75 years.

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	GWP[1]	kg CO_2 eq.	4.10E+00	7.20E-02	1.70E-01	4.91E-02	1.48E-01	0.00E+00	0.00E+00	2.12E-01	5.83E-03
	GWP_{fossil}[1]	kg CO_2 eq.	4.07E+00	7.20E-02	1.69E-01	4.91E-02	1.47E-01	0.00E+00	0.00E+00	2.12E-01	5.83E-03
	$GWP_{biogenic}$[1]	kg CO_2 eq.	6.49E-03	2.36E-05	1.31E-04	1.46E-05	1.82E-04	0.00E+00	0.00E+00	2.16E-05	2.36E-06
	$GWP_{LU\&LUT}$[1]	kg CO_2 eq.	2.16E-02	4.23E-05	1.57E-04	2.54E-05	4.73E-04	0.00E+00	0.00E+00	2.67E-05	3.45E-06
	ADP-ff[2]	MJ, LHV	7.40E+01	1.01E+00	2.71E+00	7.46E-01	2.37E+00	0.00E+00	0.00E+00	2.75E+00	1.44E-01
	AP	kg SO_2 eq.	1.69E-02	3.80E-04	3.83E-04	1.18E-04	7.64E-04	0.00E+00	0.00E+00	1.06E-03	3.92E-05
	EP_f	kg P eq.	8.66E-04	6.47E-06	5.06E-05	3.94E-06	2.59E-05	0.00E+00	0.00E+00	3.73E-06	4.56E-07
	EP_m	kg N eq.	9.98E-03	3.97E-04	2.87E-04	8.79E-05	6.98E-04	0.00E+00	0.00E+00	1.29E-03	4.27E-05
	ODP	kg CFC-11 eq.	4.79E-06	1.22E-09	1.87E-09	9.07E-10	9.90E-08	0.00E+00	0.00E+00	3.50E-09	1.78E-10
	SFP	kg O_3 eq.	2.49E-01	1.02E-02	1.11E-02	2.48E-03	1.86E-02	8.25E-03	0.00E+00	3.51E-02	3.12E-02
Resource use	RPR_E[3]	MJ, LHV	3.12E+00	1.99E-02	2.22E-01	1.07E-02	9.56E-02	0.00E+00	0.00E+00	1.21E-02	1.39E-03
	RPR_M[4]	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	3.12E+00	1.99E-02	2.22E-01	1.07E-02	9.56E-02	0.00E+00	0.00E+00	1.21E-02	1.39E-03
	$NRPR_E$[5]	MJ, LHV	4.04E+01	1.03E+00	2.97E+00	7.51E-01	1.71E+00	0.00E+00	0.00E+00	2.74E+00	1.45E-01
	$NRPR_M$[6]	MJ, LHV	3.62E+01	0.00E+00	0.00E+00	0.00E+00	7.67E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	7.66E+01	1.03E+00	2.97E+00	7.51E-01	2.48E+00	0.00E+00	0.00E+00	2.74E+00	1.45E-01
	SM	kg	1.23E-02	0.00E+00	0.00E+00	0.00E+00	2.50E-04	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	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	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	0.00E+00	0.00E+00	0.00E+00
	FW[7]	m^3	2.74E-02	1.52E-04	7.35E-04	1.08E-04	8.17E-04	0.00E+00	0.00E+00	1.34E-04	1.53E-04
Output flows and waste categories	HWD[8]	kg	3.57E+00	3.49E-02	2.65E-01	2.15E-02	1.15E-01	0.00E+00	0.00E+00	1.99E-02	2.43E-03
	NHWD[9]	kg	2.37E-01	6.09E-02	2.01E-02	6.38E-02	4.05E-02	0.00E+00	0.00E+00	1.34E-02	9.56E-01
	HLRW[10]	m^3	3.87E-09	1.47E-11	1.44E-10	8.86E-12	1.22E-10	0.00E+00	0.00E+00	1.10E-11	1.13E-12
	ILLRW[11]	m^3	2.92E-08	7.80E-11	1.17E-09	4.66E-11	8.14E-10	0.00E+00	0.00E+00	5.62E-11	6.10E-12
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	0.00E+00	0.00E+00	6.42E-04	0.00E+00	1.31E-05	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	EP	kg N eq.	9.28E-03	7.93E-05	4.32E-04	4.28E-05	2.95E-04	0.00E+00	0.00E+00	1.11E-04	6.73E-06

Table 14: Cradle-to-grave LCA results for 1 m² of installed EnergyShield® CGF wall insulation boards, CGF, 20 psi, with a thickness that gives an average thermal resistance RSI = 1 m² K/W and with a building service life of 75 years.

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	GWP[1]	kg CO_2 eq.	3.64E+00	1.33E-01	3.98E-01	8.57E-02	1.50E-01	0.00E+00	0.00E+00	3.71E-01	9.91E-03
	GWP_{fossil}[1]	kg CO_2 eq.	3.61E+00	1.33E-01	3.98E-01	8.57E-02	1.50E-01	0.00E+00	0.00E+00	3.71E-01	9.91E-03
	$GWP_{biogenic}$[1]	kg CO_2 eq.	6.34E-03	4.34E-05	2.35E-04	2.54E-05	1.82E-04	0.00E+00	0.00E+00	3.77E-05	4.01E-06
	$GWP_{LU\&LUT}$[1]	kg CO_2 eq.	1.83E-02	7.87E-05	2.97E-04	4.44E-05	4.11E-04	0.00E+00	0.00E+00	4.66E-05	5.87E-06
	ADP-ff[2]	MJ, LHV	7.31E+01	1.87E+00	6.03E+00	1.30E+00	2.53E+00	0.00E+00	0.00E+00	4.80E+00	2.45E-01
	AP	kg SO_2 eq.	1.21E-02	7.47E-04	1.29E-03	2.06E-04	7.22E-04	0.00E+00	0.00E+00	1.84E-03	6.67E-05
	EP_f	kg P eq.	6.32E-04	1.19E-05	7.98E-05	6.88E-06	2.20E-05	0.00E+00	0.00E+00	6.51E-06	7.74E-07
	EP_m	kg N eq.	8.24E-03	7.67E-04	1.24E-03	1.53E-04	7.25E-04	0.00E+00	0.00E+00	2.25E-03	7.26E-05
	ODP	kg CFC-11 eq.	3.59E-06	2.25E-09	4.43E-09	1.58E-09	7.47E-08	0.00E+00	0.00E+00	6.11E-09	3.03E-10
	SFP	kg O_3 eq.	2.12E-01	1.97E-02	3.77E-02	4.32E-03	1.99E-02	1.22E-02	0.00E+00	6.14E-02	4.63E-02
Resource use	RPR_E[3]	MJ, LHV	2.33E+00	3.65E-02	3.01E-01	1.86E-02	8.19E-02	0.00E+00	0.00E+00	2.12E-02	2.37E-03
	RPR_M[4]	MJ, LHV	1.03E-02	0.00E+00	0.00E+00	0.00E+00	2.10E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	2.34E+00	3.65E-02	3.01E-01	1.86E-02	8.21E-02	0.00E+00	0.00E+00	2.12E-02	2.37E-03
	$NRPR_E$[5]	MJ, LHV	4.54E+01	1.89E+00	6.59E+00	1.31E+00	1.99E+00	0.00E+00	0.00E+00	4.79E+00	2.46E-01
	$NRPR_M$[6]	MJ, LHV	3.22E+01	0.00E+00	0.00E+00	0.00E+00	6.85E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	7.77E+01	1.89E+00	6.59E+00	1.31E+00	2.68E+00	0.00E+00	0.00E+00	4.79E+00	2.46E-01
	SM	kg	3.21E-02	0.00E+00	0.00E+00	0.00E+00	6.56E-04	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	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	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	0.00E+00	0.00E+00	0.00E+00
	FW[7]	m^3	2.57E-02	2.79E-04	1.48E-03	1.88E-04	8.09E-04	0.00E+00	0.00E+00	2.33E-04	2.60E-04
Output flows and waste categories	HWD[8]	kg	2.46E+00	6.40E-02	4.17E-01	3.75E-02	9.69E-02	0.00E+00	0.00E+00	3.47E-02	4.12E-03
	NHWD[9]	kg	4.93E-01	1.11E-01	5.27E-02	1.11E-01	7.28E-02	0.00E+00	0.00E+00	2.33E-02	1.62E+00
	HLRW[10]	m^3	5.27E-09	2.69E-11	5.62E-10	1.55E-11	1.60E-10	0.00E+00	0.00E+00	1.92E-11	1.93E-12
	ILLRW[11]	m^3	4.11E-08	1.43E-10	2.49E-09	8.12E-11	1.09E-09	0.00E+00	0.00E+00	9.82E-11	1.04E-11
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	4.73E-02	0.00E+00	1.50E-03	0.00E+00	9.96E-04	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	EP	kg N eq.	9.05E-03	1.47E-04	7.28E-04	7.46E-05	3.01E-04	0.00E+00	0.00E+00	1.93E-04	1.14E-05

Table 15: Cradle-to-grave LCA results for 1 m² of installed EnergyShield® CGF Pro and EnergyShield® PanelCast™ wall insulation boards, CGF, 25 psi, with a thickness that gives an average thermal resistance RSI = 1 m² K/W and with a building service life of 75 years.

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	$GWP^{(1)}$	kg CO_2 eq.	4.12E+00	1.31E-01	3.33E-01	9.43E-02	1.60E-01	0.00E+00	0.00E+00	4.09E-01	1.10E-02
	$GWP_{fossil}^{(1)}$	kg CO_2 eq.	4.09E+00	1.31E-01	3.33E-01	9.43E-02	1.59E-01	0.00E+00	0.00E+00	4.09E-01	1.10E-02
	$GWP_{biogenic}^{(1)}$	kg CO_2 eq.	6.94E-03	4.23E-05	2.39E-04	2.80E-05	1.94E-04	0.00E+00	0.00E+00	4.15E-05	4.45E-06
	$GWP_{LU\&LUT}^{(1)}$	kg CO_2 eq.	2.03E-02	7.68E-05	3.20E-04	4.88E-05	4.51E-04	0.00E+00	0.00E+00	5.13E-05	6.50E-06
	$ADP\text{-}ff^{(2)}$	MJ, LHV	8.45E+01	1.85E+00	5.30E+00	1.43E+00	2.76E+00	0.00E+00	0.00E+00	5.29E+00	2.71E-01
	AP	kg SO_2 eq.	1.36E-02	7.15E-04	7.90E-04	2.26E-04	7.47E-04	0.00E+00	0.00E+00	2.03E-03	7.39E-05
	EP_f	kg P eq.	6.73E-04	1.15E-05	1.02E-04	7.57E-06	2.33E-05	0.00E+00	0.00E+00	7.17E-06	8.58E-07
	EP_m	kg N eq.	9.43E-03	7.24E-04	6.10E-04	1.69E-04	7.41E-04	0.00E+00	0.00E+00	2.48E-03	8.04E-05
	ODP	kg CFC-11 eq.	5.98E-06	2.23E-09	3.58E-09	1.74E-09	1.23E-07	0.00E+00	0.00E+00	6.74E-09	3.36E-10
	SFP	kg O_3 eq.	2.41E-01	1.86E-02	2.07E-02	4.75E-03	2.01E-02	9.92E-03	0.00E+00	6.76E-02	3.83E-02
Resource use	$RPR_E^{(3)}$	MJ, LHV	2.52E+00	3.53E-02	4.25E-01	2.05E-02	8.85E-02	0.00E+00	0.00E+00	2.33E-02	2.63E-03
	$RPR_M^{(4)}$	MJ, LHV	1.03E-02	0.00E+00	0.00E+00	0.00E+00	2.10E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	2.54E+00	3.53E-02	4.25E-01	2.05E-02	8.87E-02	0.00E+00	0.00E+00	2.33E-02	2.63E-03
	$NRPR_E^{(5)}$	MJ, LHV	4.94E+01	1.87E+00	5.74E+00	1.44E+00	2.07E+00	0.00E+00	0.00E+00	5.28E+00	2.72E-01
	$NRPR_M^{(6)}$	MJ, LHV	3.98E+01	0.00E+00	0.00E+00	0.00E+00	8.39E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	8.91E+01	1.87E+00	5.74E+00	1.44E+00	2.91E+00	0.00E+00	0.00E+00	5.28E+00	2.72E-01
	SM	kg	3.20E-02	0.00E+00	0.00E+00	0.00E+00	6.53E-04	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	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	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	0.00E+00	0.00E+00	0.00E+00
	$FW^{(7)}$	m^3	2.86E-02	2.74E-04	1.36E-03	2.07E-04	8.68E-04	0.00E+00	0.00E+00	2.57E-04	2.88E-04
Output flows and waste categories	$HWD^{(8)}$	kg	2.56E+00	6.23E-02	5.35E-01	4.13E-02	1.02E-01	0.00E+00	0.00E+00	3.82E-02	4.57E-03
	$NHWD^{(9)}$	kg	5.15E-01	1.13E-01	4.35E-02	1.23E-01	7.75E-02	0.00E+00	0.00E+00	2.57E-02	1.80E+00
	$HLRW^{(10)}$	m^3	6.00E-09	2.62E-11	2.51E-10	1.70E-11	1.69E-10	0.00E+00	0.00E+00	2.12E-11	2.13E-12
	$ILLRW^{(11)}$	m^3	4.68E-08	1.39E-10	2.01E-09	8.94E-11	1.19E-09	0.00E+00	0.00E+00	1.08E-10	1.15E-11
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	4.71E-02	0.00E+00	2.23E-03	0.00E+00	1.01E-03	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	EP	kg N eq.	9.64E-03	1.43E-04	8.72E-04	8.21E-05	3.17E-04	0.00E+00	0.00E+00	2.13E-04	1.27E-05

Table notes

(1) GWP 100, excludes biogenic CO_2 removals and emissions associated with biobased products and packaging; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5). $GWP_{biogenic}$ includes biogenic methane emissions to air, while $GWP_{LU\&LUT}$ includes carbon dioxide emissions to air from land transformation and to soil or biomass stock, as well as methane emissions to air from soil or biomass stock.

(2) Abiotic Resource Depletion Potential of non-renewable (fossil) energy resources (ADP-ff, in MJ, LHV) is based on CML-baseline, v4. August 2016.

(3) $RPR_E = RPR_T - RPR_M$, where RPR_T is equal to the value for renewable energy obtained using the CED methodology (LHV).

(4) Calculated as per ACLCA ISO 21930 Guidance, 6.2 Renewable primary resources with energy content used as a material, RPR_M.

(5) $NRPR_E = NRPR_T - NRPR_M$, where $NRPR_T$ is equal to the value for non-renewable energy obtained using the CED methodology (LHV).

(6) Calculated as per ACLCA ISO 21930 Guidance, 6.4 Non-renewable primary resources with energy content used as a material, $NRPR_M$.

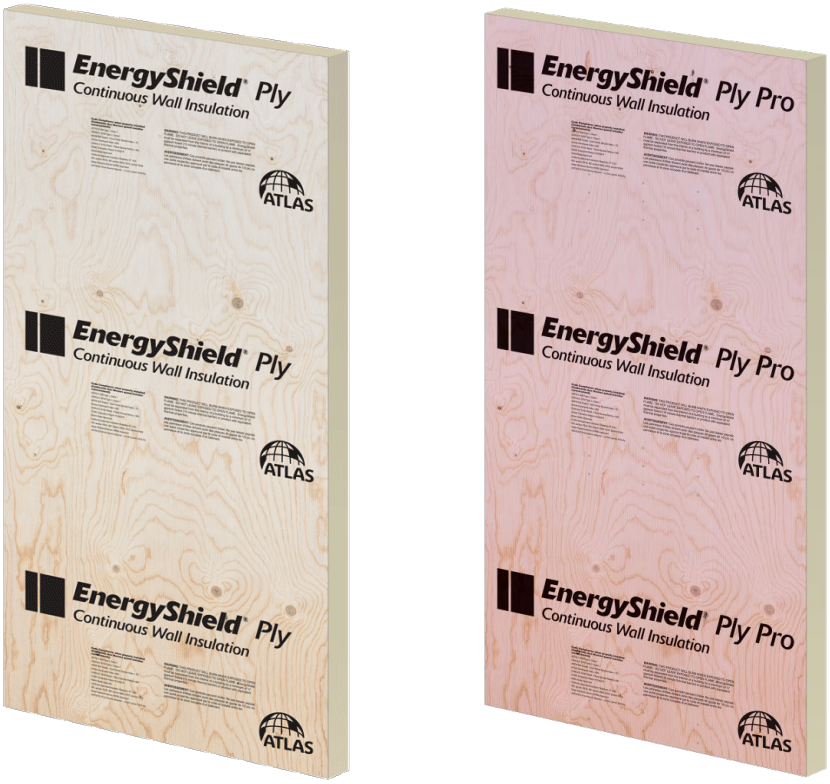
(7) Represents the use of net fresh water calculated from life cycle inventory results, i.e., water consumption using ReCiPe Midpoint (E) 2016.

(8) Calculated from life cycle inventory results, based on datasets classified under "treatment and disposal of hazardous waste." The manufacturer does not generate hazardous waste.

(9) Calculated from life cycle inventory results, based on waste that is neither "hazardous" nor "radioactive" and EPD values.

(10) Calculated from life cycle inventory results, based on ecoinvent waste flow "high-level radioactive waste for final repository." The manufacturer does not generate radioactive waste.

(11) Calculated from life cycle inventory results, based on ecoinvent waste flow "low-level radioactive waste for final repository." The manufacturer does not generate radioactive waste.



[Energy Shield® Ply and EnergyShield® Ply Pro – polyiso portion covered under this EPD, photo courtesy of ATLAS]

5.2. INTERPRETATION

This section details the contribution to the potential environmental impacts and resource use of the different information modules. As can be seen from the figures below, the extraction and upstream production module (module A1) is the main contributor to all potential impact categories, as well as renewable and non-renewable resource consumption.

Furthermore, the sensitivity analysis indicated that variations in foam density, facer density, and the quantities of MDI, polyol, and surfactants influence the potential environmental impacts across one or more impact categories. These sensitive parameters affect the quantity of raw materials used, which the contribution analysis identified as the primary drivers of environmental impacts in several categories.

Therefore, modifications to the datasets selected to represent the various polyiso raw materials—particularly facer material, MDI, polyol, and surfactants—may alter the results, especially for Atlas products with tri-laminate foil facer which consist of aluminum foil and kraft paper rather than glass-fiber–reinforced aluminum foil as modeled.

[EnergyShield® Pro and EnergyShield® CGF Pro, photo courtesy of ATLAS]

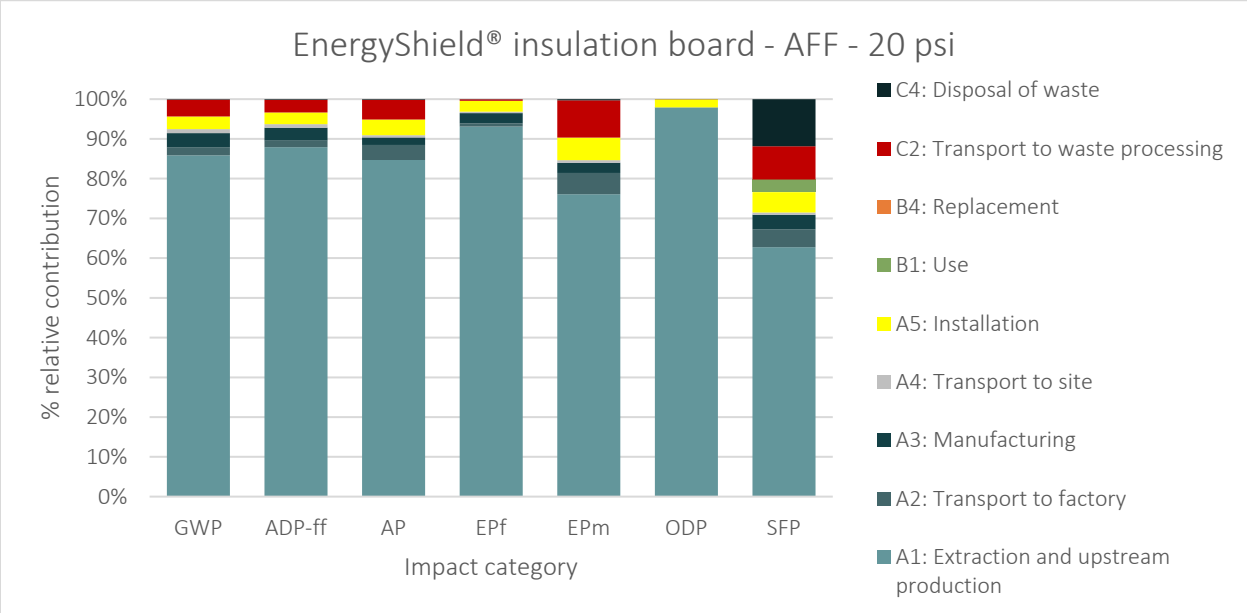


Figure 5: Contribution of life cycle information modules to the potential environmental impacts of 1m² of installed EnergyShield®, AFF, 20 psi, for 75 years.

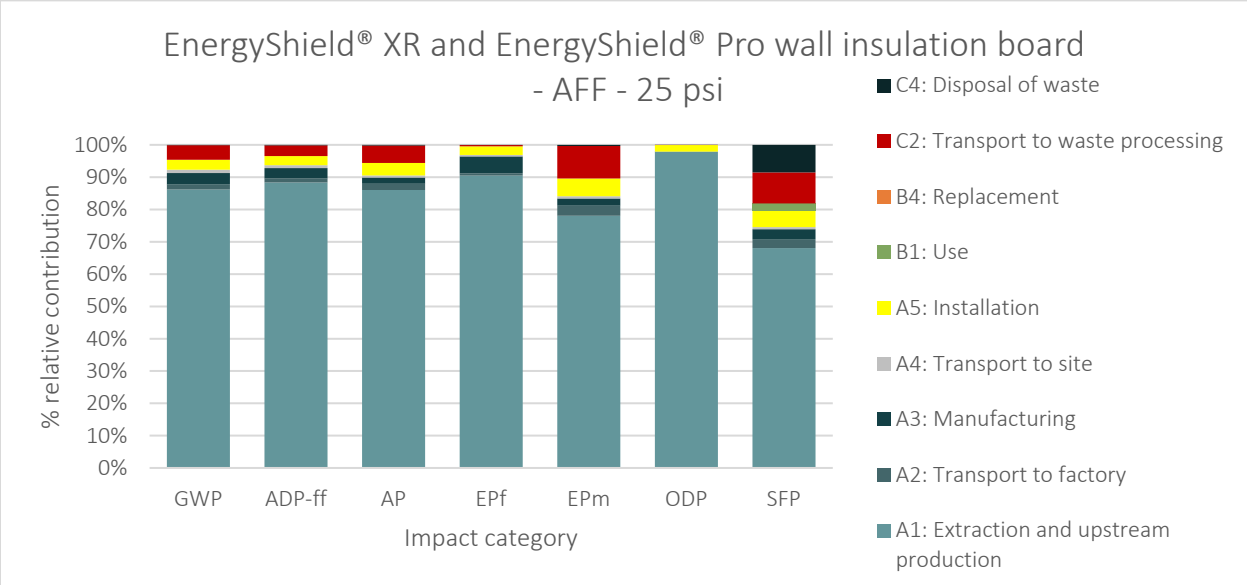


Figure 6: Contribution of life cycle information modules to the potential environmental impacts of 1m² of installed EnergyShield® XR and EnergyShield® Pro, AFF, 25 psi, for 75 years.

GWP: Global Warming Potential; **ADP-ff**: Abiotic Resource Depletion Potential of Non-Renewable (Fossil) Energy Resources; **AP**: Acidification Potential; **EP_f**: Eutrophication Potential – Freshwater; **EP_m**: Eutrophication Potential – Marine; **ODP**: Ozone Layer Depletion Potential; **SFP**: Smog Formation Potential.

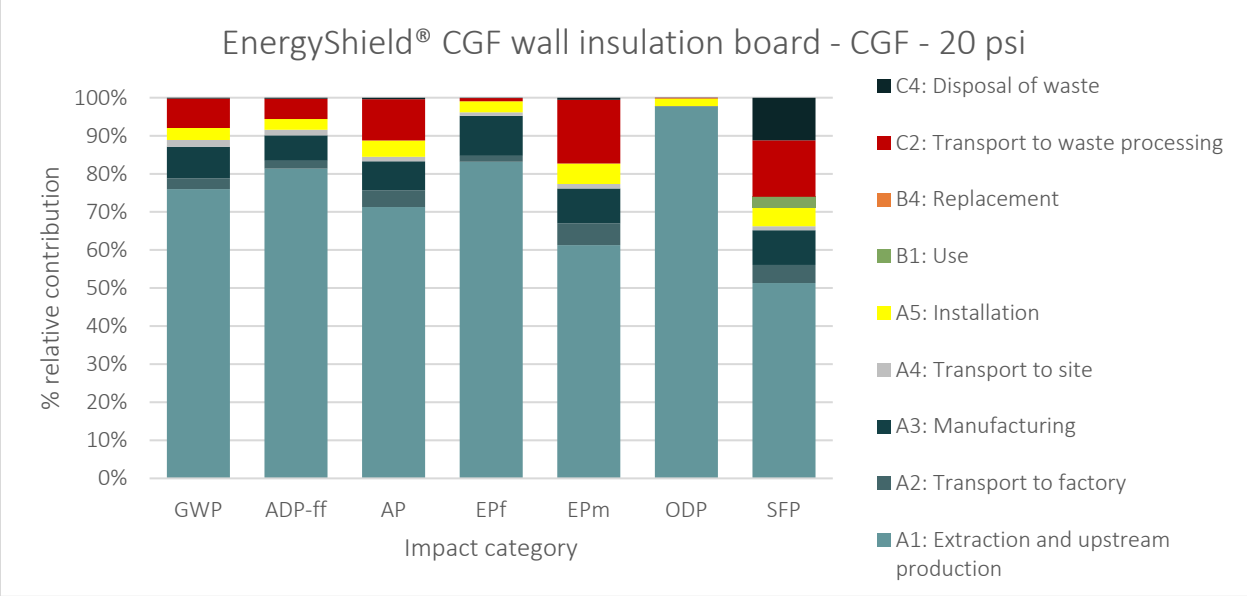


Figure 7: Contribution of life cycle information modules to the potential environmental impacts of 1m² of installed EnergyShield® CGF, 20 psi, for 75 years.

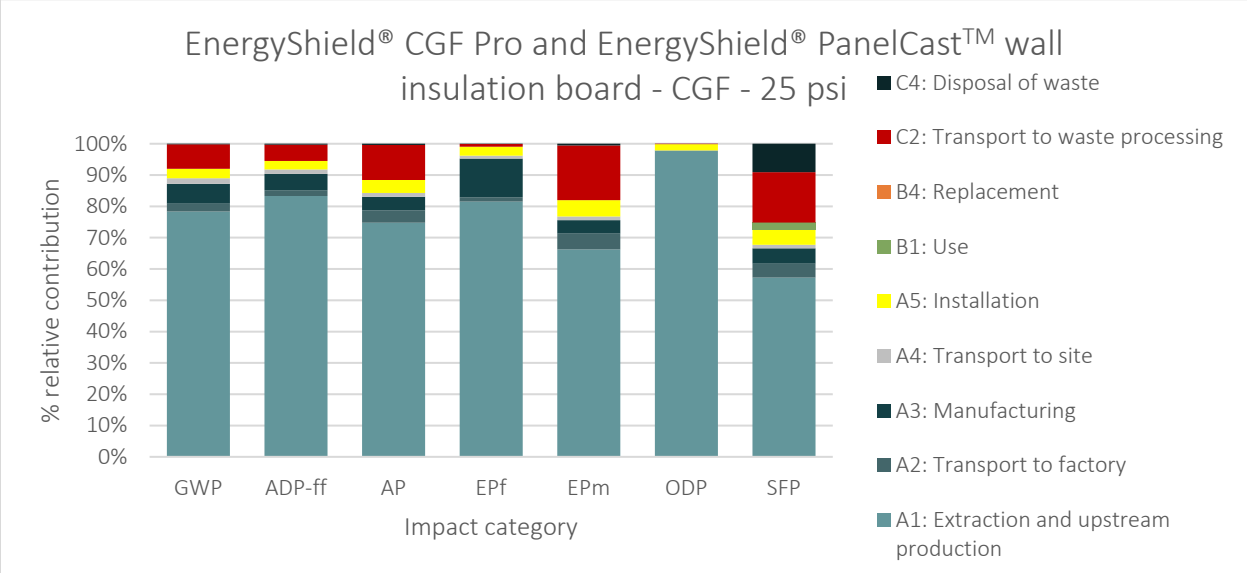


Figure 8: Contribution of life cycle information modules to the potential environmental impacts of 1m² of installed EnergyShield® CGF Pro and EnergyShield® PanelCast™, CGF, 25 psi, for 75 years.

GWP: Global Warming Potential; **ADP-ff**: Abiotic Resource Depletion Potential of Non-Renewable (Fossil) Energy Resources; **AP**: Acidification Potential; **EP_f**: Eutrophication Potential – Freshwater; **EP_m**: Eutrophication Potential – Marine; **ODP**: Ozone Layer Depletion Potential; **SFP**: Smog Formation Potential.

6. ADDITIONAL ENVIRONMENTAL INFORMATION

6.1. CONTENT OF REGULATED HAZARDOUS SUBSTANCES

Polyiso products contain pentane or pentane blends blowing agent (3.7%-6.2%).

6.2. RELEASE OF DANGEROUS SUBSTANCES FROM CONSTRUCTION PRODUCTS

Pentane and pentane blends blowing agent is considered to off-gas very slowly over years/decades during the use and the end-of-life of polyiso products. Freshly expanded or heated foam may off-gas some pentane-blowing agent, which is heavier than air and may accumulate to ignitable concentrations if stored inside a sealed container or within confined areas. Installation methods which include cutting and mechanical fastening may release the blowing agent retained in the product. Provide adequate ventilation to assure localized concentrations in release areas are maintained below the lower flammability limit. Good housekeeping and controlling of dust are necessary for safe handling of products.

Fire Performance: The fire performance of foam plastic insulation products such as polyiso wall insulation boards is evaluated using both material and system (assembly) tests in accordance with the requirements of the International Building Code in the United States and the National Building Code of Canada. At a material level, important fire characteristics include: flame spread index (FSI) and smoke developed index (SDI) conducted in accordance with ASTM E84 “Standard Test Method for Surface Burning Characteristics of Building Materials” or equivalent standards such as UL 723 and NFPA 255. In Canada, the corresponding standard to ASTM E84 is CAN/ULC-S102 “Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.”

The fire performance of exterior wall assemblies is an important consideration and must be balanced with energy efficiency goals. With respect to wall assemblies in Type I through IV constructions in the United States, NFPA 285 “Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components” is a critical component in the design of code-compliant, high-performance building envelopes that incorporate foam plastic insulation products such as polyiso wall insulation boards. Developed by the National Fire Protection Association, NFPA 285 is a fire test standard that measures the flame propagation characteristics of exterior wall assemblies, and it provides a standardized fire test procedure for evaluating the suitability of exterior wall assemblies constructed using combustible materials or components for installation on buildings where the exterior walls are required to be non-combustible. Atlas Roofing has conducted extensive NFPA 285 testing for applications with various wall assemblies and cladding types. Additional fire evaluation requirements for foam plastic insulations and the use of foam plastics in specific wall applications are contained in the building codes of the United States and Canada.

6.3. ENERGY SAVINGS DURING USE

The use of polyiso wall insulation boards as a component of an air barrier assembly reduces air infiltration and exfiltration across the building enclosure, and improves the energy efficiency of exterior wall assemblies. Polyiso wall insulation may be considered as a component of an air barrier system when tested and installed in accordance with the relevant section(s) of the building codes and the manufacturer’s installation instructions. Model building codes list polyiso insulation as an air barrier material when installed at a minimum 0.5-inch (12.7-mm) thickness. Polyiso wall

insulation boards with the impermeable foil facer may also serve as a water-resistive barrier when tested and installed in accordance with the relevant section of the building codes and manufacturer's installation instructions.

6.4. MARKET SCALING FACTORS AND ESTIMATED IMPACTS OF PRODUCTS AT DIFFERENT R-VALUE THAN THE FUNCTIONAL UNIT

For EnergyShield® continuous wall insulation boards, the environmental impact results in this EPD have been calculated for the functional unit of insulation, which has a surface area of 1 m^2 and a thermal resistance of RSI = 1 m^2 K/W. In Imperial units, this thermal resistance, or R-value, is equivalent to 5.678 ft^2 °F h/Btu. To calculate total impact values for insulation at a specified project-determined thickness and R-value, whichever the environmental indicator or information module, with a specific facing material, the following equation may be used:

$$Results_{thx} = Foam\ results_{RSI=1} * \frac{th_x}{th_{RSI=1}} + Static\ facer\ results$$

Where:

$Results_{thx}$: Indicator value for a foam thickness equal to th_x.

Foam $results_{RSI=1}$: Indicator value for a foam thickness that give an RSI value of 1. See the appropriate product table below (in green).

th_x: Foam thickness (mm).

$th_{RSI=1}$: Foam thickness (mm) for an RSI value of 1. This value is presented in Table 4 or Table 19.

Static facer results: Indicator value for the static facer (both sides). See appropriate product table below (in orange).

For example, the total global warming potential of module A1 for the 25 psi EnergyShield® XR wall insulation board with aluminum foil facer for a thickness of 39.2 mm (1.5 inch) is 5.83 kg CO_2 eq./m^2 (Table 25 for Foam results, Table 19 for Foam thickness for an RSI value of 1 ($th_{RSI=1}$), and Table 24 for Static facer results):

$$Results_{th=76.2mm} = 2.28E+00 * \frac{39.2}{22.3} + 1.82+00 = 5.83E+00\ kg\ CO_2\ eq./m^2$$

Table 16: Polyiso insulation board RSI value (R-value) by foam thickness.

Thickness	RSI (R-Value) m^2 K/W (ft^2 °F h/Btu)	RSI (R-Value) m^2 K/W (ft^2 °F h/Btu)
mm (inch)	EnergyShield® foil-faced (AFF) wall insulation	EnergyShield® Coated coated glass facer (CGF) wall insulation
25.4 (1.0 inch)	1.14 (6.47)	1.06 (6.02)
50.8 (2.0 inch)	2.31 (13.12)	2.13 (12.10)
76.2 (3.0 inch)	3.47 (19.70)	3.26 (18.51)
101.6 (4.0 inch)	4.58 (26.01)	4.40 (24.99)

Table 17: Polyiso insulation board thickness for RSI =1 by product type.

Product	20 psi	25 psi	Unit
EnergyShield® foil-faced (AFF) wall insulation	22.3	22.3	mm
EnergyShield® Coated coated glass facer (CGF)	24.0	24.0	mm

For EnergyShield® continuous wall insulation, an R-Value of 5, 10 or 15 ft^2 °F h/Btu is most often required and, for polyiso products, fulfilled using one layer of EnergyShield® continuous wall insulation board. Additionally, 25.4 mm (1.0-inch), 50.8 mm (2.0-inch) and 76.2 mm (3.0-inch) are commonly used product thicknesses. The two tables below present the global warming potential (GWP) results for the most common product used on the market to achieve the typical R-values for wall applications as well as common product thicknesses.

Table 18: Global warming potential (GWP) for one layer of 20 psi EnergyShield® wall insulation board with aluminum foil facer (AFF) at designed thermal insulation (R-value) and specific product thickness.

	Thickness	RSI (R-Value) m^2 K/W (ft^2 °F h/Btu)	A1	A2	A3	A4	A5	B1	B4	C2	C4
	mm (inch)	Wall – AFF	kg CO_2 eq./m^2								
Per RSI	**19.7 (0.8-inch)**	0.88 (**R5**)	3.51E+00	8.09E-02	1.40E-01	3.88E-02	1.33E-01	0.00E+00	0.00E+00	1.67E-01	4.60E-03
Per RSI	**39.2 (1.5-inch)**	1.76 (**R10**)	5.19E+00	1.43E-01	2.45E-01	6.85E-02	1.76E-01	0.00E+00	0.00E+00	2.95E-01	8.13E-03
Per RSI	**58.7 (2.3-inch)**	2.64 (**R15**)	6.87E+00	2.05E-01	3.50E-01	9.82E-02	2.18E-01	0.00E+00	0.00E+00	4.22E-01	1.17E-02
Per thickness	**25.4 (1.0-inch)**	1.10 (R6.24)	4.00E+00	9.92E-02	1.71E-01	4.75E-02	1.46E-01	0.00E+00	0.00E+00	2.05E-01	5.64E-03
Per thickness	**50.8 (2.0-inch)**	2.28 (R12.92)	6.19E+00	1.80E-01	3.08E-01	8.62E-02	2.01E-01	0.00E+00	0.00E+00	3.71E-01	1.02E-02
Per thickness	**76.2 (3.0-inch)**	3.43 (R19.50)	8.38E+00	2.61E-01	4.44E-01	1.25E-01	2.56E-01	0.00E+00	0.00E+00	5.37E-01	1.48E-02

Table 19: Global warming potential (GWP) for one layer of 20 psi EnergyShield® CGF wall insulation board with coated glass facer (CGF) at designed thermal insulation (R-value) and specific product thickness.

	Thickness	RSI (R-Value) m^2 K/W (ft^2 °F h/Btu)	A1	A2	A3	A4	A5	B1	B4	C2	C4
	mm (inch)	Wall – CGF	kg CO_2 eq./m^2								
Per RSI	**21.3 (0.8-inch)**	0.88 (**R5**)	3.41E+00	1.27E-01	3.81E-01	8.17E-02	1.45E-01	0.00E+00	0.00E+00	3.54E-01	9.47E-03
Per RSI	**41.4 (1.6-inch)**	1.76 (**R10**)	5.10E+00	1.74E-01	5.08E-01	1.11E-01	1.88E-01	0.00E+00	0.00E+00	4.82E-01	1.28E-02
Per RSI	**61.5 (2.4-inch)**	2.64 (**R15**)	6.79E+00	2.20E-01	6.36E-01	1.41E-01	2.31E-01	0.00E+00	0.00E+00	6.10E-01	1.61E-02
Per thickness	**25.4 (1.0-inch)**	1.10 (R6.24)	3.76E+00	1.37E-01	4.07E-01	8.78E-02	1.53E-01	0.00E+00	0.00E+00	3.80E-01	1.01E-02
Per thickness	**50.8 (2.0-inch)**	2.28 (R12.92)	5.89E+00	1.95E-01	5.68E-01	1.25E-01	2.08E-01	0.00E+00	0.00E+00	5.42E-01	1.43E-02
Per thickness	**76.2 (3.0-inch)**	3.43 (R19.50)	8.03E+00	2.54E-01	7.29E-01	1.63E-01	2.62E-01	0.00E+00	0.00E+00	7.03E-01	1.85E-02

Table 20: Static facer results for 20 psi EnergyShield® wall insulation board with aluminum foil facer (AFF).

Environmental indicator		Unit	A1 (per m2)	A2 (per m2)	A3 (per m2)	A4 (per m2)	A5 (per m2)	B1 (per m2)	B4 (per m2)	C2 (per m2)	C4 (per m2)
IPCC AR5 and TRACI 2.2	GWP[1]	kg CO_2 eq.	1.81E+00	1.85E-02	3.42E-02	8.86E-03	9.04E-02	0.00E+00	0.00E+00	3.86E-02	1.05E-03
	GWP_{fossil}[1]	kg CO_2 eq.	1.81E+00	1.84E-02	3.41E-02	8.86E-03	9.02E-02	0.00E+00	0.00E+00	3.86E-02	1.05E-03
	$GWP_{biogenic}$[1]	kg CO_2 eq.	2.68E-03	5.64E-06	2.94E-05	2.63E-06	1.01E-04	0.00E+00	0.00E+00	3.92E-06	4.26E-07
	$GWP_{LU\&LUT}$[1]	kg CO_2 eq.	3.92E-03	1.12E-05	7.78E-05	4.59E-06	1.09E-04	0.00E+00	0.00E+00	4.84E-06	6.23E-07
	ADP-ff[2]	MJ, LHV	1.84E+01	2.55E-01	5.36E-01	1.35E-01	1.09E+00	0.00E+00	0.00E+00	4.99E-01	2.60E-02
	AP	kg SO_2 eq.	9.56E-03	1.45E-04	8.48E-05	2.13E-05	5.72E-04	0.00E+00	0.00E+00	1.92E-04	7.08E-06
	EP_f	kg P eq.	5.14E-04	1.50E-06	4.79E-06	7.11E-07	1.75E-05	0.00E+00	0.00E+00	6.77E-07	8.22E-08
	EP_m	kg N eq.	4.65E-03	1.32E-04	7.79E-05	1.58E-05	5.42E-04	0.00E+00	0.00E+00	2.34E-04	7.70E-06
	ODP	kg CFC-11 eq.	4.36E-08	3.11E-10	3.98E-10	1.64E-10	1.91E-09	0.00E+00	0.00E+00	6.35E-10	3.22E-11
	SFP	kg O_3 eq.	1.15E-01	3.36E-03	2.14E-03	4.46E-04	1.38E-02	0.00E+00	0.00E+00	6.38E-03	2.00E-04
Resource use	RPR_E[3]	MJ, LHV	1.66E+00	4.57E-03	3.78E-02	1.92E-03	6.11E-02	0.00E+00	0.00E+00	2.20E-03	2.52E-04
	RPR_M[4]	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	1.66E+00	4.57E-03	3.78E-02	1.92E-03	6.11E-02	0.00E+00	0.00E+00	2.20E-03	2.52E-04
	$NRPR_E$[5]	MJ, LHV	1.79E+01	2.58E-01	6.30E-01	1.35E-01	1.10E+00	0.00E+00	0.00E+00	4.98E-01	2.61E-02
	$NRPR_M$[6]	MJ, LHV	2.05E+00	0.00E+00	0.00E+00	0.00E+00	6.93E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	2.00E+01	2.58E-01	6.30E-01	1.35E-01	1.17E+00	0.00E+00	0.00E+00	4.98E-01	2.61E-02
	SM	kg	1.22E-02	0.00E+00	0.00E+00	0.00E+00	2.49E-04	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	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	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	0.00E+00	0.00E+00	0.00E+00
	FW[7]	m^3	1.19E-02	3.56E-05	3.34E-04	1.94E-05	4.82E-04	0.00E+00	0.00E+00	2.43E-05	2.76E-05
Output flows and waste categories	HWD[8]	kg	2.81E+00	8.08E-03	2.53E-02	3.88E-03	9.31E-02	0.00E+00	0.00E+00	3.61E-03	4.38E-04
	NHWD[9]	kg	1.02E-01	1.40E-02	4.16E-03	1.15E-02	9.55E-03	0.00E+00	0.00E+00	2.43E-03	1.72E-01
	HLRW[10]	m^3	9.59E-10	3.40E-12	2.42E-10	1.60E-12	6.41E-11	0.00E+00	0.00E+00	2.00E-12	2.04E-13
	ILLRW[11]	m^3	7.00E-09	1.80E-11	3.26E-10	8.40E-12	3.40E-10	0.00E+00	0.00E+00	1.02E-11	1.10E-12
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	0.00E+00	0.00E+00	2.60E-04	0.00E+00	5.30E-06	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	EP	kg N eq.	4.63E-03	2.04E-05	4.54E-05	7.71E-06	1.87E-04	0.00E+00	0.00E+00	2.01E-05	1.21E-06

Table 21: Foam results for 20 psi EnergyShield® wall insulation boards without aluminum foil facer (AFF), with a thickness that gives an average thermal resistance RSI = 1 m² K/W.

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	GWP[1]	kg CO_2 eq.	1.92E+00	7.08E-02	1.20E-01	3.39E-02	4.85E-02	0.00E+00	0.00E+00	1.46E-01	4.03E-03
	GWP_{fossil}[1]	kg CO_2 eq.	1.90E+00	7.08E-02	1.19E-01	3.39E-02	4.81E-02	0.00E+00	0.00E+00	1.46E-01	4.03E-03
	$GWP_{biogenic}$[1]	kg CO_2 eq.	3.58E-03	2.16E-05	1.11E-04	1.01E-05	7.65E-05	0.00E+00	0.00E+00	1.48E-05	1.63E-06
	$GWP_{LU\&LUT}$[1]	kg CO_2 eq.	1.64E-02	4.30E-05	2.97E-04	1.76E-05	3.42E-04	0.00E+00	0.00E+00	1.83E-05	2.39E-06
	ADP-ff[2]	MJ, LHV	4.72E+01	9.78E-01	1.91E+00	5.16E-01	1.10E+00	0.00E+00	0.00E+00	1.89E+00	9.95E-02
	AP	kg SO_2 eq.	6.20E-03	5.55E-04	2.69E-04	8.14E-05	1.69E-04	0.00E+00	0.00E+00	7.25E-04	2.71E-05
	EP_f	kg P eq.	3.25E-04	5.74E-06	1.82E-05	2.72E-06	7.27E-06	0.00E+00	0.00E+00	2.56E-06	3.15E-07
	EP_m	kg N eq.	4.44E-03	5.08E-04	2.30E-04	6.07E-05	1.36E-04	0.00E+00	0.00E+00	8.85E-04	2.95E-05
	ODP	kg CFC-11 eq.	4.88E-06	1.19E-09	1.34E-09	6.27E-10	9.97E-08	0.00E+00	0.00E+00	2.40E-09	1.23E-10
	SFP	kg O_3 eq.	1.12E-01	1.29E-02	1.12E-02	1.71E-03	4.70E-03	1.15E-02	0.00E+00	2.41E-02	4.28E-02
Resource use	RPR_E[3]	MJ, LHV	1.36E+00	1.76E-02	1.46E-01	7.37E-03	3.15E-02	0.00E+00	0.00E+00	8.32E-03	9.64E-04
	RPR_M[4]	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	1.36E+00	1.76E-02	1.46E-01	7.37E-03	3.15E-02	0.00E+00	0.00E+00	8.32E-03	9.64E-04
	$NRPR_E$[5]	MJ, LHV	1.97E+01	9.89E-01	2.27E+00	5.19E-01	5.43E-01	0.00E+00	0.00E+00	1.88E+00	9.99E-02
	$NRPR_M$[6]	MJ, LHV	2.84E+01	0.00E+00	0.00E+00	0.00E+00	5.80E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	4.81E+01	9.89E-01	2.27E+00	5.19E-01	1.12E+00	0.00E+00	0.00E+00	1.88E+00	9.99E-02
	SM	kg	0.00E+00	0.00E+00	0.00E+00	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	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	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	0.00E+00	0.00E+00	0.00E+00
	FW[7]	m^3	1.35E-02	1.37E-04	1.27E-03	7.44E-05	3.11E-04	0.00E+00	0.00E+00	9.17E-05	1.06E-04
Output flows and waste categories	HWD[8]	kg	6.95E-01	3.10E-02	9.59E-02	1.48E-02	1.76E-02	0.00E+00	0.00E+00	1.36E-02	1.68E-03
	NHWD[9]	kg	1.17E-01	5.39E-02	1.16E-02	4.41E-02	2.56E-02	0.00E+00	0.00E+00	9.17E-03	6.60E-01
	HLRW[10]	m^3	2.31E-09	1.30E-11	9.28E-10	6.12E-12	6.68E-11	0.00E+00	0.00E+00	7.56E-12	7.83E-13
	ILLRW[11]	m^3	1.75E-08	6.92E-11	1.25E-09	3.22E-11	3.87E-10	0.00E+00	0.00E+00	3.86E-11	4.21E-12
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	0.00E+00	0.00E+00	6.30E-04	0.00E+00	1.29E-05	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	EP	kg N eq.	4.25E-03	7.81E-05	1.68E-04	2.96E-05	9.48E-05	0.00E+00	0.00E+00	7.60E-05	4.65E-06

Table 22: Static facer results for 25 psi EnergyShield® XR and EnergyShield® Pro wall insulation board with aluminum foil facer (AFF).

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	$GWP^{(1)}$	kg CO_2 eq.	1.82E+00	1.30E-02	3.24E-02	8.86E-03	9.05E-02	0.00E+00	0.00E+00	3.86E-02	1.05E-03
	$GWP_{fossil}^{(1)}$	kg CO_2 eq.	1.82E+00	1.30E-02	3.23E-02	8.86E-03	9.03E-02	0.00E+00	0.00E+00	3.86E-02	1.05E-03
	$GWP_{biogenic}^{(1)}$	kg CO_2 eq.	2.69E-03	4.27E-06	2.37E-05	2.63E-06	1.01E-04	0.00E+00	0.00E+00	3.92E-06	4.26E-07
	$GWP_{LU\&LUT}^{(1)}$	kg CO_2 eq.	3.94E-03	7.65E-06	2.85E-05	4.59E-06	1.08E-04	0.00E+00	0.00E+00	4.84E-06	6.23E-07
	$ADP\text{-}ff^{(2)}$	MJ, LHV	1.85E+01	1.83E-01	5.13E-01	1.35E-01	1.09E+00	0.00E+00	0.00E+00	4.99E-01	2.60E-02
	AP	kg SO_2 eq.	9.60E-03	6.87E-05	7.82E-05	2.13E-05	5.72E-04	0.00E+00	0.00E+00	1.92E-04	7.08E-06
	EP_f	kg P eq.	5.16E-04	1.17E-06	9.15E-06	7.11E-07	1.76E-05	0.00E+00	0.00E+00	6.77E-07	8.22E-08
	EP_m	kg N eq.	4.67E-03	7.18E-05	6.29E-05	1.58E-05	5.42E-04	0.00E+00	0.00E+00	2.34E-04	7.70E-06
	ODP	kg CFC-11 eq.	4.38E-08	2.20E-10	3.68E-10	1.64E-10	1.91E-09	0.00E+00	0.00E+00	6.35E-10	3.22E-11
	SFP	kg O_3 eq.	1.16E-01	1.85E-03	1.71E-03	4.46E-04	1.37E-02	0.00E+00	0.00E+00	6.38E-03	2.00E-04
Resource use	$RPR_E^{(3)}$	MJ, LHV	1.66E+00	3.60E-03	3.89E-02	1.92E-03	6.12E-02	0.00E+00	0.00E+00	2.20E-03	2.52E-04
	$RPR_M^{(4)}$	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	1.66E+00	3.60E-03	3.89E-02	1.92E-03	6.12E-02	0.00E+00	0.00E+00	2.20E-03	2.52E-04
	$NRPR_E^{(5)}$	MJ, LHV	1.80E+01	1.86E-01	5.59E-01	1.35E-01	1.10E+00	0.00E+00	0.00E+00	4.98E-01	2.61E-02
	$NRPR_M^{(6)}$	MJ, LHV	2.06E+00	0.00E+00	0.00E+00	0.00E+00	6.95E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	2.01E+01	1.86E-01	5.59E-01	1.35E-01	1.17E+00	0.00E+00	0.00E+00	4.98E-01	2.61E-02
	SM	kg	1.23E-02	0.00E+00	0.00E+00	0.00E+00	2.50E-04	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	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	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	0.00E+00	0.00E+00	0.00E+00
	$FW^{(7)}$	m^3	1.20E-02	2.75E-05	1.34E-04	1.94E-05	4.79E-04	0.00E+00	0.00E+00	2.43E-05	2.76E-05
Output flows and waste categories	$HWD^{(8)}$	kg	2.82E+00	6.31E-03	4.80E-02	3.88E-03	9.38E-02	0.00E+00	0.00E+00	3.61E-03	4.38E-04
	$NHWD^{(9)}$	kg	1.03E-01	1.10E-02	5.08E-03	1.15E-02	9.69E-03	0.00E+00	0.00E+00	2.43E-03	1.72E-01
	$HLRW^{(10)}$	m^3	9.63E-10	2.65E-12	2.61E-11	1.60E-12	5.98E-11	0.00E+00	0.00E+00	2.00E-12	2.04E-13
	$ILLRW^{(11)}$	m^3	7.03E-09	1.41E-11	2.11E-10	8.40E-12	3.38E-10	0.00E+00	0.00E+00	1.02E-11	1.10E-12
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	0.00E+00	0.00E+00	1.87E-04	0.00E+00	3.81E-06	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	EP	kg N eq.	4.65E-03	1.43E-05	7.88E-05	7.71E-06	1.88E-04	0.00E+00	0.00E+00	2.01E-05	1.21E-06

Table 23: Foam results for 25 psi EnergyShield® XR and EnergyShield® Pro wall insulation boards without aluminum foil facer (AFF), with a thickness that gives an average thermal resistance RSI = 1 m² K/W.

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	GWP[1]	kg CO_2 eq.	2.28E+00	5.90E-02	1.37E-01	4.03E-02	5.71E-02	0.00E+00	0.00E+00	1.74E-01	4.78E-03
	GWP_{fossil}[1]	kg CO_2 eq.	2.25E+00	5.90E-02	1.37E-01	4.03E-02	5.66E-02	0.00E+00	0.00E+00	1.74E-01	4.78E-03
	$GWP_{biogenic}$[1]	kg CO_2 eq.	3.80E-03	1.93E-05	1.07E-04	1.20E-05	8.10E-05	0.00E+00	0.00E+00	1.77E-05	1.94E-06
	$GWP_{LU\&LUT}$[1]	kg CO_2 eq.	1.77E-02	3.46E-05	1.28E-04	2.08E-05	3.65E-04	0.00E+00	0.00E+00	2.18E-05	2.83E-06
	ADP-ff[2]	MJ, LHV	5.55E+01	8.30E-01	2.20E+00	6.12E-01	1.28E+00	0.00E+00	0.00E+00	2.25E+00	1.18E-01
	AP	kg SO_2 eq.	7.26E-03	3.11E-04	3.05E-04	9.66E-05	1.92E-04	0.00E+00	0.00E+00	8.64E-04	3.22E-05
	EP_f	kg P eq.	3.50E-04	5.30E-06	4.14E-05	3.23E-06	8.27E-06	0.00E+00	0.00E+00	3.05E-06	3.73E-07
	EP_m	kg N eq.	5.32E-03	3.25E-04	2.24E-04	7.20E-05	1.57E-04	0.00E+00	0.00E+00	1.06E-03	3.50E-05
	ODP	kg CFC-11 eq.	4.75E-06	9.95E-10	1.51E-09	7.44E-10	9.71E-08	0.00E+00	0.00E+00	2.87E-09	1.46E-10
	SFP	kg O_3 eq.	1.33E-01	8.37E-03	9.43E-03	2.03E-03	4.88E-03	8.25E-03	0.00E+00	2.88E-02	3.10E-02
Resource use	RPR_E[3]	MJ, LHV	1.46E+00	1.63E-02	1.83E-01	8.74E-03	3.44E-02	0.00E+00	0.00E+00	9.93E-03	1.14E-03
	RPR_M[4]	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	1.46E+00	1.63E-02	1.83E-01	8.74E-03	3.44E-02	0.00E+00	0.00E+00	9.93E-03	1.14E-03
	$NRPR_E$[5]	MJ, LHV	2.24E+01	8.40E-01	2.41E+00	6.16E-01	6.12E-01	0.00E+00	0.00E+00	2.25E+00	1.19E-01
	$NRPR_M$[6]	MJ, LHV	3.42E+01	0.00E+00	0.00E+00	0.00E+00	6.98E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	5.65E+01	8.40E-01	2.41E+00	6.16E-01	1.31E+00	0.00E+00	0.00E+00	2.25E+00	1.19E-01
	SM	kg	0.00E+00	0.00E+00	0.00E+00	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	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	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	0.00E+00	0.00E+00	0.00E+00
	FW[7]	m^3	1.54E-02	1.25E-04	6.01E-04	8.83E-05	3.38E-04	0.00E+00	0.00E+00	1.09E-04	1.25E-04
Output flows and waste categories	HWD[8]	kg	7.46E-01	2.86E-02	2.17E-01	1.76E-02	2.12E-02	0.00E+00	0.00E+00	1.63E-02	1.99E-03
	NHWD[9]	kg	1.34E-01	4.99E-02	1.50E-02	5.23E-02	3.09E-02	0.00E+00	0.00E+00	1.09E-02	7.84E-01
	HLRW[10]	m^3	2.91E-09	1.20E-11	1.18E-10	7.26E-12	6.24E-11	0.00E+00	0.00E+00	9.02E-12	9.29E-13
	ILLRW[11]	m^3	2.22E-08	6.39E-11	9.58E-10	3.82E-11	4.76E-10	0.00E+00	0.00E+00	4.60E-11	5.00E-12
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	0.00E+00	0.00E+00	4.55E-04	0.00E+00	9.28E-06	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	EP	kg N eq.	4.63E-03	6.49E-05	3.53E-04	3.51E-05	1.07E-04	0.00E+00	0.00E+00	9.06E-05	5.51E-06

Table 24: Static facer results for 20 psi EnergyShield® CGF wall insulation board with coated glass facer (CGF).

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	GWP[1]	kg CO_2 eq.	1.62E+00	7.83E-02	2.46E-01	5.02E-02	9.91E-02	0.00E+00	0.00E+00	2.19E-01	5.96E-03
	GWP_{fossil}[1]	kg CO_2 eq.	1.62E+00	7.82E-02	2.46E-01	5.02E-02	9.90E-02	0.00E+00	0.00E+00	2.19E-01	5.96E-03
	$GWP_{biogenic}$[1]	kg CO_2 eq.	2.61E-03	2.54E-05	1.39E-04	1.49E-05	1.03E-04	0.00E+00	0.00E+00	2.22E-05	2.41E-06
	$GWP_{LU\&LUT}$[1]	kg CO_2 eq.	4.40E-04	4.62E-05	1.76E-04	2.60E-05	4.16E-05	0.00E+00	0.00E+00	2.74E-05	3.53E-06
	ADP-ff[2]	MJ, LHV	2.37E+01	1.10E+00	3.70E+00	7.63E-01	1.37E+00	0.00E+00	0.00E+00	2.83E+00	1.47E-01
	AP	kg SO_2 eq.	5.60E-03	4.38E-04	8.22E-04	1.20E-04	5.45E-04	0.00E+00	0.00E+00	1.09E-03	4.01E-05
	EP_f	kg P eq.	2.80E-04	6.96E-06	4.70E-05	4.03E-06	1.39E-05	0.00E+00	0.00E+00	3.84E-06	4.66E-07
	EP_m	kg N eq.	3.61E-03	4.50E-04	8.04E-04	8.98E-05	5.82E-04	0.00E+00	0.00E+00	1.33E-03	4.36E-05
	ODP	kg CFC-11 eq.	2.50E-08	1.32E-09	2.81E-09	9.27E-10	1.72E-09	0.00E+00	0.00E+00	3.60E-09	1.82E-10
	SFP	kg O_3 eq.	9.50E-02	1.15E-02	2.19E-02	2.53E-03	1.50E-02	0.00E+00	0.00E+00	3.62E-02	1.13E-03
Resource use	RPR_E[3]	MJ, LHV	8.77E-01	2.14E-02	1.73E-01	1.09E-02	4.89E-02	0.00E+00	0.00E+00	1.25E-02	1.43E-03
	RPR_M[4]	MJ, LHV	1.03E-02	0.00E+00	0.00E+00	0.00E+00	2.10E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	8.87E-01	2.14E-02	1.73E-01	1.09E-02	4.91E-02	0.00E+00	0.00E+00	1.25E-02	1.43E-03
	$NRPR_E$[5]	MJ, LHV	2.46E+01	1.11E+00	4.03E+00	7.68E-01	1.42E+00	0.00E+00	0.00E+00	2.82E+00	1.48E-01
	$NRPR_M$[6]	MJ, LHV	2.57E+00	0.00E+00	0.00E+00	0.00E+00	7.99E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	2.72E+01	1.11E+00	4.03E+00	7.68E-01	1.50E+00	0.00E+00	0.00E+00	2.82E+00	1.48E-01
	SM	kg	3.21E-02	0.00E+00	0.00E+00	0.00E+00	6.56E-04	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	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	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	0.00E+00	0.00E+00	0.00E+00
	FW[7]	m^3	1.15E-02	1.64E-04	8.76E-04	1.10E-04	4.97E-04	0.00E+00	0.00E+00	1.37E-04	1.56E-04
Output flows and waste categories	HWD[8]	kg	1.72E+00	3.75E-02	2.45E-01	2.20E-02	7.69E-02	0.00E+00	0.00E+00	2.04E-02	2.48E-03
	NHWD[9]	kg	3.68E-01	6.51E-02	3.46E-02	6.52E-02	4.49E-02	0.00E+00	0.00E+00	1.38E-02	9.77E-01
	HLRW[10]	m^3	2.87E-09	1.58E-11	3.30E-10	9.06E-12	1.06E-10	0.00E+00	0.00E+00	1.13E-11	1.16E-12
	ILLRW[11]	m^3	2.30E-08	8.39E-11	1.46E-09	4.76E-11	6.93E-10	0.00E+00	0.00E+00	5.78E-11	6.24E-12
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	4.73E-02	0.00E+00	1.00E-03	0.00E+00	9.86E-04	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	EP	kg N eq.	4.46E-03	8.63E-05	4.33E-04	4.37E-05	1.97E-04	0.00E+00	0.00E+00	1.14E-04	6.88E-06

Table 25: Foam results for 20 psi EnergyShield® CGF wall insulation boards without coated glass facer (CGF), with a thickness that gives an average thermal resistance RSI = 1 m² K/W.

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	GWP[1]	kg CO_2 eq.	2.01E+00	5.52E-02	1.52E-01	3.55E-02	5.13E-02	0.00E+00	0.00E+00	1.52E-01	3.95E-03
	GWP_{fossil}[1]	kg CO_2 eq.	1.99E+00	5.52E-02	1.52E-01	3.55E-02	5.08E-02	0.00E+00	0.00E+00	1.52E-01	3.95E-03
	$GWP_{biogenic}$[1]	kg CO_2 eq.	3.73E-03	1.79E-05	9.64E-05	1.05E-05	7.92E-05	0.00E+00	0.00E+00	1.55E-05	1.60E-06
	$GWP_{LU\&LUT}$[1]	kg CO_2 eq.	1.79E-02	3.26E-05	1.22E-04	1.84E-05	3.69E-04	0.00E+00	0.00E+00	1.91E-05	2.34E-06
	ADP-ff[2]	MJ, LHV	4.94E+01	7.74E-01	2.33E+00	5.39E-01	1.15E+00	0.00E+00	0.00E+00	1.97E+00	9.76E-02
	AP	kg SO_2 eq.	6.50E-03	3.09E-04	4.71E-04	8.52E-05	1.77E-04	0.00E+00	0.00E+00	7.58E-04	2.66E-05
	EP_f	kg P eq.	3.52E-04	4.91E-06	3.28E-05	2.85E-06	8.11E-06	0.00E+00	0.00E+00	2.68E-06	3.09E-07
	EP_m	kg N eq.	4.63E-03	3.17E-04	4.33E-04	6.35E-05	1.43E-04	0.00E+00	0.00E+00	9.26E-04	2.89E-05
	ODP	kg CFC-11 eq.	3.57E-06	9.30E-10	1.62E-09	6.56E-10	7.30E-08	0.00E+00	0.00E+00	2.51E-09	1.21E-10
	SFP	kg O_3 eq.	1.17E-01	8.14E-03	1.59E-02	1.79E-03	4.94E-03	1.22E-02	0.00E+00	2.52E-02	4.51E-02
Resource use	RPR_E[3]	MJ, LHV	1.45E+00	1.51E-02	1.29E-01	7.71E-03	3.30E-02	0.00E+00	0.00E+00	8.71E-03	9.45E-04
	RPR_M[4]	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	1.45E+00	1.51E-02	1.29E-01	7.71E-03	3.30E-02	0.00E+00	0.00E+00	8.71E-03	9.45E-04
	$NRPR_E$[5]	MJ, LHV	2.08E+01	7.84E-01	2.56E+00	5.43E-01	5.73E-01	0.00E+00	0.00E+00	1.97E+00	9.80E-02
	$NRPR_M$[6]	MJ, LHV	2.97E+01	0.00E+00	0.00E+00	0.00E+00	6.05E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	5.05E+01	7.84E-01	2.56E+00	5.43E-01	1.18E+00	0.00E+00	0.00E+00	1.97E+00	9.80E-02
	SM	kg	0.00E+00	0.00E+00	0.00E+00	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	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	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	0.00E+00	0.00E+00	0.00E+00
	FW[7]	m^3	1.42E-02	1.15E-04	6.06E-04	7.79E-05	3.12E-04	0.00E+00	0.00E+00	9.59E-05	1.04E-04
Output flows and waste categories	HWD[8]	kg	7.41E-01	2.65E-02	1.71E-01	1.55E-02	2.00E-02	0.00E+00	0.00E+00	1.43E-02	1.64E-03
	NHWD[9]	kg	1.26E-01	4.59E-02	1.82E-02	4.61E-02	2.79E-02	0.00E+00	0.00E+00	9.59E-03	6.48E-01
	HLRW[10]	m^3	2.40E-09	1.11E-11	2.32E-10	6.40E-12	5.43E-11	0.00E+00	0.00E+00	7.91E-12	7.68E-13
	ILLRW[11]	m^3	1.82E-08	5.92E-11	1.03E-09	3.36E-11	3.95E-10	0.00E+00	0.00E+00	4.03E-11	4.13E-12
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	0.00E+00	0.00E+00	4.93E-04	0.00E+00	1.01E-05	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	kg N eq.		4.64E-03	4.59E-03	6.09E-05	2.95E-04	3.09E-05	1.04E-04	0.00E+00	0.00E+00	7.95E-05	4.56E-06

Table 26: Static facer results for 25 psi EnergyShield® CGF Pro and EnergyShield® PanelCast™ wall insulation board with coated glass facer (CGF).

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	$GWP^{(1)}$	kg CO_2 eq.	1.62E+00	7.00E-02	1.83E-01	5.02E-02	9.74E-02	0.00E+00	0.00E+00	2.19E-01	5.96E-03
	$GWP_{fossil}^{(1)}$	kg CO_2 eq.	1.62E+00	7.00E-02	1.83E-01	5.02E-02	9.72E-02	0.00E+00	0.00E+00	2.19E-01	5.96E-03
	$GWP_{biogenic}^{(1)}$	kg CO_2 eq.	2.60E-03	2.26E-05	1.27E-04	1.49E-05	1.02E-04	0.00E+00	0.00E+00	2.22E-05	2.41E-06
	$GWP_{LU\&LUT}^{(1)}$	kg CO_2 eq.	4.38E-04	4.10E-05	1.71E-04	2.60E-05	4.13E-05	0.00E+00	0.00E+00	2.74E-05	3.53E-06
	$ADP\text{-}ff^{(2)}$	MJ, LHV	2.36E+01	9.87E-01	2.89E+00	7.63E-01	1.35E+00	0.00E+00	0.00E+00	2.83E+00	1.47E-01
	AP	kg SO_2 eq.	5.58E-03	3.82E-04	4.48E-04	1.20E-04	5.35E-04	0.00E+00	0.00E+00	1.09E-03	4.01E-05
	EP_f	kg P eq.	2.79E-04	6.16E-06	5.46E-05	4.03E-06	1.40E-05	0.00E+00	0.00E+00	3.84E-06	4.66E-07
	EP_m	kg N eq.	3.60E-03	3.86E-04	3.59E-04	8.98E-05	5.70E-04	0.00E+00	0.00E+00	1.33E-03	4.36E-05
	ODP	kg CFC-11 eq.	2.49E-08	1.19E-09	2.00E-09	9.27E-10	1.70E-09	0.00E+00	0.00E+00	3.60E-09	1.82E-10
	SFP	kg O_3 eq.	9.46E-02	9.93E-03	9.76E-03	2.53E-03	1.47E-02	0.00E+00	0.00E+00	3.62E-02	1.13E-03
Resource use	$RPR_E^{(3)}$	MJ, LHV	8.73E-01	1.88E-02	2.15E-01	1.09E-02	4.96E-02	0.00E+00	0.00E+00	1.25E-02	1.43E-03
	$RPR_M^{(4)}$	MJ, LHV	1.03E-02	0.00E+00	0.00E+00	0.00E+00	2.10E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	8.84E-01	1.88E-02	2.15E-01	1.09E-02	4.98E-02	0.00E+00	0.00E+00	1.25E-02	1.43E-03
	$NRPR_E^{(5)}$	MJ, LHV	2.45E+01	9.99E-01	3.13E+00	7.68E-01	1.39E+00	0.00E+00	0.00E+00	2.82E+00	1.48E-01
	$NRPR_M^{(6)}$	MJ, LHV	2.56E+00	0.00E+00	0.00E+00	0.00E+00	7.97E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	2.71E+01	9.99E-01	3.13E+00	7.68E-01	1.47E+00	0.00E+00	0.00E+00	2.82E+00	1.48E-01
	SM	kg	3.20E-02	0.00E+00	0.00E+00	0.00E+00	6.53E-04	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	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	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	0.00E+00	0.00E+00	0.00E+00
	$FW^{(7)}$	m^3	1.15E-02	1.46E-04	7.27E-04	1.10E-04	4.92E-04	0.00E+00	0.00E+00	1.37E-04	1.56E-04
Output flows and waste categories	$HWD^{(8)}$	kg	1.71E+00	3.33E-02	2.85E-01	2.20E-02	7.75E-02	0.00E+00	0.00E+00	2.04E-02	2.48E-03
	$NHWD^{(9)}$	kg	3.66E-01	6.03E-02	2.72E-02	6.52E-02	4.39E-02	0.00E+00	0.00E+00	1.38E-02	9.77E-01
	$HLRW^{(10)}$	m^3	2.86E-09	1.40E-11	1.34E-10	9.06E-12	1.01E-10	0.00E+00	0.00E+00	1.13E-11	1.16E-12
	$ILLRW^{(11)}$	m^3	2.29E-08	7.42E-11	1.07E-09	4.76E-11	6.83E-10	0.00E+00	0.00E+00	5.78E-11	6.24E-12
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	4.71E-02	0.00E+00	1.48E-03	0.00E+00	9.93E-04	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional indicator – TRACI 2.1											
	EP	kg N eq.	4.44E-03	7.61E-05	4.67E-04	4.37E-05	1.97E-04	0.00E+00	0.00E+00	1.14E-04	6.88E-06

Table 27: Foam results for 25 psi EnergyShield® CGF Pro and EnergyShield® PanelCast™ wall insulation boards without coated glass facer (CGF), with a thickness that gives an average thermal resistance RSI = 1 m² K/W.

Environmental indicator		Unit	A1	A2	A3	A4	A5	B1	B4	C2	C4
			(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)	(per m2)
IPCC AR5 and TRACI 2.2	GWP[1]	kg CO_2 eq.	2.50E+00	6.12E-02	1.50E-01	4.41E-02	6.26E-02	0.00E+00	0.00E+00	1.90E-01	5.01E-03
	GWP_{fossil}[1]	kg CO_2 eq.	2.48E+00	6.12E-02	1.50E-01	4.41E-02	6.21E-02	0.00E+00	0.00E+00	1.90E-01	5.01E-03
	$GWP_{biogenic}$[1]	kg CO_2 eq.	4.34E-03	1.97E-05	1.12E-04	1.31E-05	9.23E-05	0.00E+00	0.00E+00	1.93E-05	2.03E-06
	$GWP_{LU\&LUT}$[1]	kg CO_2 eq.	1.98E-02	3.58E-05	1.49E-04	2.28E-05	4.10E-04	0.00E+00	0.00E+00	2.39E-05	2.97E-06
	ADP-ff[2]	MJ, LHV	6.09E+01	8.62E-01	2.40E+00	6.70E-01	1.41E+00	0.00E+00	0.00E+00	2.46E+00	1.24E-01
	AP	kg SO_2 eq.	8.01E-03	3.34E-04	3.41E-04	1.06E-04	2.11E-04	0.00E+00	0.00E+00	9.45E-04	3.38E-05
	EP_f	kg P eq.	3.94E-04	5.39E-06	4.78E-05	3.54E-06	9.33E-06	0.00E+00	0.00E+00	3.34E-06	3.92E-07
	EP_m	kg N eq.	5.83E-03	3.38E-04	2.51E-04	7.88E-05	1.71E-04	0.00E+00	0.00E+00	1.16E-03	3.67E-05
	ODP	kg CFC-11 eq.	5.96E-06	1.04E-09	1.58E-09	8.14E-10	1.22E-07	0.00E+00	0.00E+00	3.13E-09	1.54E-10
	SFP	kg O_3 eq.	1.47E-01	8.68E-03	1.09E-02	2.22E-03	5.43E-03	9.92E-03	0.00E+00	3.15E-02	3.72E-02
Resource use	RPR_E[3]	MJ, LHV	1.65E+00	1.65E-02	2.11E-01	9.57E-03	3.89E-02	0.00E+00	0.00E+00	1.09E-02	1.20E-03
	RPR_M[4]	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RPR_T	MJ, LHV	1.65E+00	1.65E-02	2.11E-01	9.57E-03	3.89E-02	0.00E+00	0.00E+00	1.09E-02	1.20E-03
	$NRPR_E$[5]	MJ, LHV	2.49E+01	8.73E-01	2.61E+00	6.74E-01	6.76E-01	0.00E+00	0.00E+00	2.46E+00	1.24E-01
	$NRPR_M$[6]	MJ, LHV	3.72E+01	0.00E+00	0.00E+00	0.00E+00	7.59E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	$NRPR_T$	MJ, LHV	6.21E+01	8.73E-01	2.61E+00	6.74E-01	1.44E+00	0.00E+00	0.00E+00	2.46E+00	1.24E-01
	SM	kg	0.00E+00	0.00E+00	0.00E+00	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	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	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	0.00E+00	0.00E+00	0.00E+00
	FW[7]	m^3	1.71E-02	1.28E-04	6.32E-04	9.67E-05	3.75E-04	0.00E+00	0.00E+00	1.20E-04	1.32E-04
Output flows and waste categories	HWD[8]	kg	8.52E-01	2.91E-02	2.50E-01	1.93E-02	2.41E-02	0.00E+00	0.00E+00	1.78E-02	2.09E-03
	NHWD[9]	kg	1.49E-01	5.27E-02	1.63E-02	5.73E-02	3.36E-02	0.00E+00	0.00E+00	1.20E-02	8.23E-01
	HLRW[10]	m^3	3.14E-09	1.22E-11	1.17E-10	7.95E-12	6.73E-11	0.00E+00	0.00E+00	9.86E-12	9.75E-13
	ILLRW[11]	m^3	2.40E-08	6.49E-11	9.40E-10	4.18E-11	5.12E-10	0.00E+00	0.00E+00	5.03E-11	5.25E-12
	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	0.00E+00	0.00E+00	7.44E-04	0.00E+00	1.52E-05	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	0.00E+00	0.00E+00	0.00E+00
	EE	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional Indicator – TRACI 2.1											
	EP	kg N eq.	5.20E-03	6.65E-05	4.05E-04	3.84E-05	1.20E-04	0.00E+00	0.00E+00	9.91E-05	5.79E-06

6.5. BENCHMARKING AGAINST THE INDUSTRY-AVERAGE RESULTS

Atlas product-specific EPDs were prepared with the same model as the PIMA industry-average EPDs; hence, results may be compared. The difference between results is calculated as follows:

$$Difference\ (\%) = \frac{(Atlas's\ _{product-specific} - PIMA\ _{industry-average})}{PIMA\ _{industry-average}} * 100\%$$

For example, for Atlas's EnergyShield® CGF wall insulation board at 20 psi (A1-A3) global warming potential (GWP) results compared to PIMA's polyiso wall insulation board at 20 psi with coated glass facer (A1-A3) global warming potential (GWP) result, the difference is 0.7%:

$$Differnce\ (\%) = \frac{(4.17 - 4.14)}{4.14} * 100\% = 0.7\%$$

Results by product for A1-A3 and A1-C4 are shown in the tables below.

Table 28: Atlas EnergyShield® continuous wall insulation boards product-specific global warming potential (GWP) A1-A3 results compared to PIMA industry-average results.

Product	Unit	PIMA Industry-average A1-A3		Atlas's product-specific A1-A3		Difference	
		20 psi (per m2)	25 psi (per m2)	20 psi (per m2)	25 psi (per m2)	20 psi %	25 psi %
Wall - AFF	kg CO_2 eq.	4.13E+00	4.44E+00	3.98E+00	4.34E+00	-3.6%	-2.2%
Wall - CGF	kg CO_2 eq.	4.14E+00	4.59E+00	4.17E+00	4.58E+00	0.7%	-0.2%

Table 29: Atlas EnergyShield® continuous wall insulation boards product-specific global warming potential (GWP) A1-C4 results compared to PIMA industry-average results.

Product	Unit	PIMA Industry-average A1-C4		Atlas's product-specific A1-C4		Difference	
		20 psi (per m2)	25 psi (per m2)	20 psi (per m2)	25 psi (per m2)	20 psi %	25 psi %
Wall - AFF	kg CO_2 eq.	4.52E+00	4.87E+00	4.35E+00	4.75E+00	-3.9%	-2.4%
Wall - CGF	kg CO_2 eq.	4.77E+00	5.28E+00	4.79E+00	5.26E+00	0.3%	-0.4%

6.6. FURTHER INFORMATION

Additional information is available on the Atlas Roofing Corporation website: https://www.atlasrwi.com/products/roof/polyiso-roof-insulation.

7. REFERENCES

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