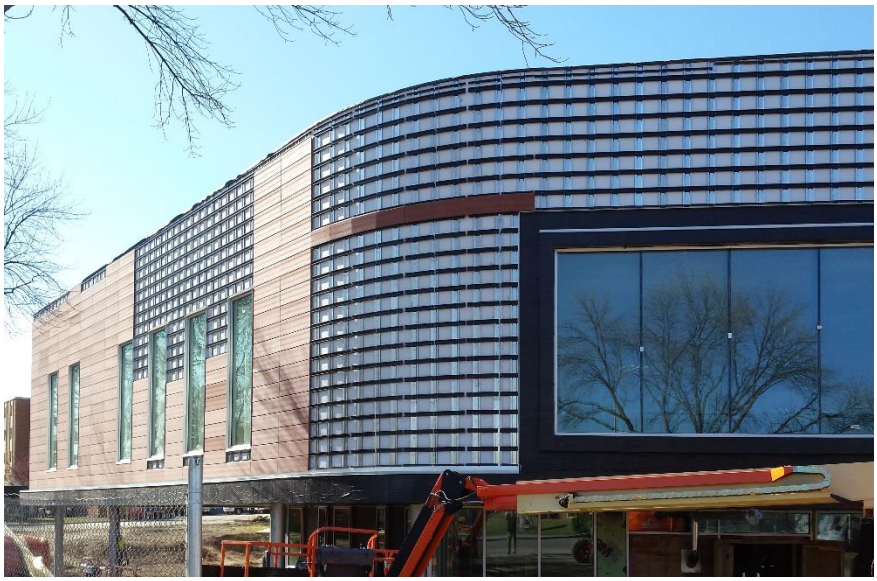
ENVIRONMENTAL PRODUCT DECLARATION

POLYISO WALL INSULATION BOARD

BUILDING ENVELOPE THERMAL INSULATION



Founded in 1998, Hunter Panels is synonymous with high-quality, innovative commercial roofing and wall materials. Hunter Panels remains dedicated to providing construction professionals with the best products, services, and warranty programs on the market. Product offerings have grown and Hunter Panels is now the world's largest supplier of commercial roof and wall materials. The company's mission remains much the same as it was when we began: developing and manufacturing the industry's most innovative, highest-quality products to enhance building performance and promote sustainability. Hunter Panels lightweight, cost-effective polyisocyanurate (polyiso) insulation products provide energy-efficient solutions for buildings in any region and climate with an outstanding return on investment offering significant energy savings. With an industry leading seven polyiso manufacturing lines strategically positioned throughout North America, Hunter Panels delivers its innovative insulation products to any job site or warehouse.

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

POLYISO WALL INSULATION BOARD
BUILDING ENVELOPE THERMAL INSULATION

According to ISO 14025 and ISO 21930:2007

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Hunter Panels
DECLARATION NUMBER	4788092227.102.1
DECLARED PRODUCT	Polyiso Roof Insulation Boards
REFERENCE PCR	UL. (2016). PCR: Building Envelope Thermal Insulation; Mechanical Insulation.
DATE OF ISSUE	May 2, 2017
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications

The PCR review was conducted by:	PCR Review Panel
	Peer review report available upon request
	cert@astm.org
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	Grant R. Martin
	Grant R. Martin, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria
	Thomas P. Gloria, Industrial Ecology Consultants

This EPD conforms with ISO 21930:2007

Product Definition

Description of Product

Cellular polyiso insulation produced by Hunter Panels is a rigid insulation panel composed of a closed cell foam bonded to two facers in the manufacturing process. Polyiso is available in a variety of thicknesses, sizes and r-values, depending on the design specifications.

Rigid cellular Polyiso insulation boards are used as interior and exterior wall insulation boards in commercial construction in North America. In commercial wall assemblies, Polyiso is placed on the exterior of the wall (typically steel, concrete, CMU or wood) and behind the wall cladding. Polyiso may also be used on the interior wall or ceiling applications. Polyiso is widely used for its light weight, high R-value, and ease of installation in many wall applications.

For wall applications, the most common facers are Coated Glass (CGF), and a variety of foil facers. Wall Polyiso is available in flat and composites. Hunter Panels manufactures wall polyiso products under the brand Hunter Xci.

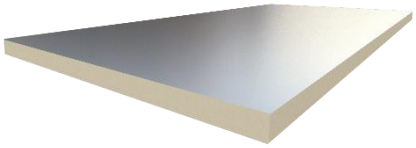


Figure 1: Typical Polyiso wall insulation board

Table 1: Product systems evaluated

R_{IP} / R_{SI}	Thickness (in., cm)	Weight (lbs/ft^2)	Weight (kg/m^2)
R5.68 / R1	0.87, 2.2	0.152	0.742
Alternative results scenarios			
R4.9 / R0.86	0.75, 1.91	0.136	0.664
R9.8 / R1.73	1.50, 3.81	0.253	1.24
R14.6 / R2.57	2.25, 5.72	0.356	1.74
R19.5 / R3.43	3.00, 7.62	0.469	2.29

The relevant standards applicable to the production and testing of Polyiso board are as follows:	**WALL**
ASTM C1289-13 Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board	**X**
ASTM C518 Standard Test Method for Predicting Thermal Resistance of Closed-Cell Foam Insulation	**X**
ASTM E84-12 Standard Test Method for Surface Burning Characteristics of Building Materials	**X**
ASTM E119-12 / UL263-11	**X**
ULC / CAN S704-03 Standard Test Method for Determination of Thermal Resistance of Closed-Cell Thermal Insulating Foams.	**X**

This EPD covers all Polyiso wall insulation boards manufactured by Hunter Panels, as listed in Table 2.

Table 2: Polyiso board classifications

Type 1	Type II			Type V	
Aluminum foil facers – both sides	Class 1 Fibrous felt or glass fiber mat both sides	Class 2 Polymer bonded glass fiber mat both sides	Class 4 Polymer bonded glass fiber mat both sides	Fiberboard one side Fibrous felt or glass fiber mat on other side	OSB on one side Fibrous felt or glass fiber mat on other side
Available in: *Grade 2 (20 psi) standard and Grade 3 (25 psi) (up charge)* · Xci Foil · Xci ConCast · Xci Foil Class A · Xci 286	*Available in:* *Grade 2 (20 PSI) standard and Grade 3 (25 PSI) (up charge)* · Xci CG · Xci CG Class A			*Available in:* *Grade 2 (20 psi) standard and Grade 3 (25 psi) (up charge)* · Xci Ply · Xci NB · Xci Ply Class A	
					1219

Health Safety & Environmental Aspects During Installation

Under normal conditions of use, polyiso does not pose a hazard in the workplace or to the building occupants.

Precautions for Safe Handling: Minimize dust generation and accumulation. Eliminate all sources of ignition. Do not breathe dust. Do not eat, drink or smoke when using this product. Do not get foam dust in eyes. Wear protective gloves and eye/face protection. Wash hands thoroughly after handling. Use only outdoors or in a well-ventilated area. Refer to handling and storage guidelines provided by the manufacturer.

Product Life Cycle Description

Raw Materials Acquisition

Polyiso insulation consists of an “A” side and a “B” side. The material composition of both sides is as follows:

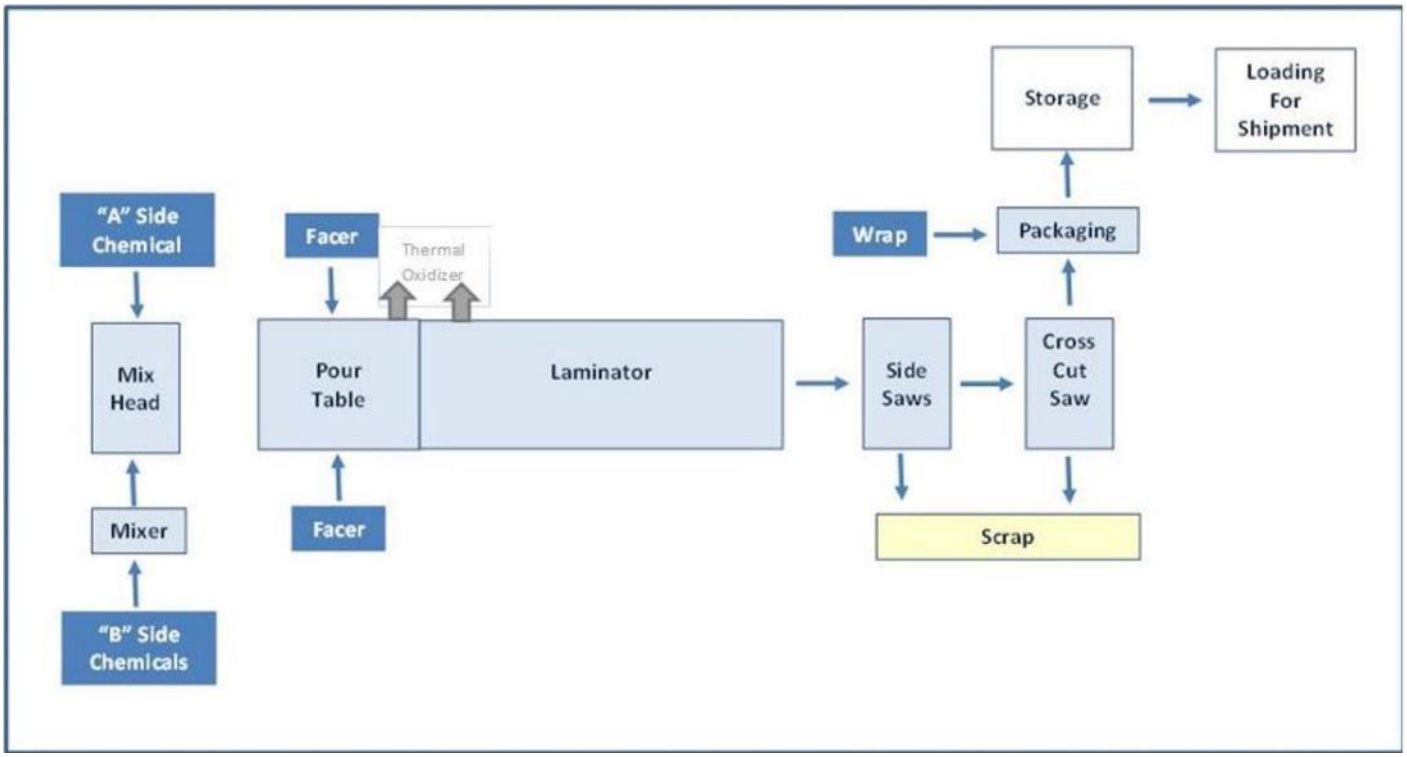
- MDI: The “A” side component for the manufacture of Polyiso.
- Polyester Polyol: the primary “B” side component for the manufacturer of Polyiso.
- TCPP: A flame retardant added to the “B” side.
- Catalyst K-15 (2-ethyl hexanoate): A reaction catalyst added to the “B” side.
- Pentane: A blowing agent.

This stage includes raw material extraction and processing, as well as transport of the materials to the facilities.

Manufacturing

The “A” side and “B” side of Polyiso insulation are manufactured separately. The “B” side and blowing agent are pumped via high pressure pumps through static mixers and then to a mix head where the "A" side is added. The mixture is then injected between the top and bottom facers at the pour table. The MDI and polyester polyol blend react to form a closed-cell foam board that is sandwiched by the facer material. At Hunter Panels, the facer is foil, primarily used for wall applications. The rigid foam board then travels on conveyor belts through a laminator. The heated laminator aids in cell formation and hardens the board, which, upon leaving the laminator, is fed through side saws that trim the board to the desired width and length. The resulting scrap is ultimately disposed of in a landfill. The finished rigid foam boards are stacked, packaged with plastic wrap, labeled, and stored before being loaded onto trucks for shipment to a construction site or distribution center. The laminator can be adjusted so that the final product can be of various foam thicknesses and alternative facer materials can be applied. Emissions of pentane released during manufacturing are often controlled through the use of a thermal oxidizer.

Figure 2: Process diagram of Polyiso insulation production process



Installation and Maintenance

Table 3 presents the installation scenario used, which is identical to the one used in the industry-average LCA, though the weight of the packaging has changed. Diesel consumption accounts for the use of a truck-mounted crane. All primary emissions to air are related to direct combustion of diesel for operation of the crane, with the exception of pentane, which is associated with the disposal of installation waste. Material loss during installation is 1%. No standard maintenance is required over the life of the product (60 years).

Table 3: Unit process for installation of Polyiso insulation, per functional unit

Type	Flow	Value	Unit	Distance [mi]	Mode
Inputs	Polyiso insulation (packaged)	0.733	kg	342	Truck

Type	Flow	Value	Unit	Distance [mi]	Mode
	Diesel	0.00933	kg	-	
Outputs	Polyiso insulation (installed)	0.716	kg	-	
	Waste to landfill (packaging + scrap)	0.0162	kg	20	Truck
	Ammonia to air	7.55E-10	kg	-	
	Carbon dioxide to air	2.88E-05	kg	-	
	Carbon monoxide to air	5.21E-08	kg	-	
	Dust (PM2.5) to air	3.99E-09	kg	-	
	Methane to air	6.94E-11	kg	-	
	Nitrogen oxides to air	1.84E-07	kg	-	
	Nitrous oxide to air	8.21E-11	kg	-	
	NMVOC to air	9.13E-09	kg	-	
	Pentane (n-pentane) to air	2.22E-04	kg	-	
	Sulfur dioxide to air	2.80E-10	kg	-	

Disposal, Reuse and Recycling

At End-of-Life (EoL), all insulation materials are removed by cranes and then transported 20 miles to landfill sites by a dump truck. EoL includes manual insulation removal, transport via a diesel-powered dump truck to a landfill, and disposal of the insulation in a local landfill.

Life Cycle Assessment – Product Systems and Modeling

Functional Unit

As specified by the PCR, the functional unit is: 1 m^2 of insulation material that gives an average thermal resistance of RSI = 1 $K \cdot m^2/W$ (RIP = 5.68 $h \cdot ft^2 \cdot °F/Btu$) and with a building service life of 60 years (packaging included)[1].

Life Cycle Stages Assessed

The life cycle assessment (LCA) conducted includes the raw material acquisition, manufacturing, transportation, installation and maintenance, and disposal/reuse/recycling.

System Boundaries

System boundaries are summarized in Figure 3 for the analysis scope of “cradle-to-building with EoL stage” (i.e., production with installation and EoL stages). The use stage is excluded as the reference service life of the product is equal to the building service life of 60 years so no replacements are necessary. Building operational energy consumption is beyond the scope of the LCA (per the PCR). As is typical of works of life cycle assessment, the construction and maintenance of capital equipment, such as production equipment in the manufacturing stage, are not included in the system, nor are human labor and employee commute.

[1] In the United States, thermal resistance (or R-value) is reported in the units of Inch-Pound (IP).

Assumptions

In cases where no matching life cycle inventories were available to represent a flow, proxy data were applied based on conservative assumptions regarding environmental impacts.

The product composition is a generic formula agreed upon by the industry, rather than being representative of Hunter Panels' exact formulation. This protects the highly confidential nature of polyiso formulas while still allowing PIMA member companies to report on their environmental impacts.

Transportation

Transportation distances and the associated modes of transport are included for the transport of the raw materials, operating materials, and auxiliary materials to production facilities.

Period Under Consideration

All primary data were collected for the year 2015. All secondary data come from the GaBi Professional databases and are representative of the years 2010-2013.

Manufacturing Locations

Hunter Panels manufactures polyiso insulation boards in the United States. As such, the geographical coverage for this study is based on US system boundaries for all processes and products. Whenever US background data were not readily available, European data or global data were used as proxies. Data is included for production at the following Hunter Panels facilities: Montgomery, NY (two lines); Chicago, IL; Lake City, FL; Terrell, TX; Tooele, UT; Smithfield, PA; and, Puyallup, WA.

Background Data

The LCA model was created using the GaBi ts software system for life cycle engineering, developed by thinkstep AG. The GaBi Professional database provides the life cycle inventory data for several of the raw and process materials obtained from the background system.

Cut- Off Criteria

No cut-off criteria had to be applied for this study. For the processes within the system boundary, all available energy and material flow data have been included in the model. In cases where no matching life cycle inventories are available to represent a flow, proxy data have been applied based on conservative assumptions regarding environmental impacts.

Data Quality Requirements

As the majority of the relevant foreground data are measured data or calculated based on primary information sources of the owner of the technology or agreed upon by the larger industry association, precision is considered to be high. Seasonal variations were balanced out by using yearly averages. All background data are sourced from GaBi databases with the documented precision. Each foreground process was checked for mass balance and completeness of the emission inventory. No data were knowingly omitted. Completeness of foreground unit process data is considered to be high. All background data are sourced from GaBi databases with the documented completeness.

Allocation

Manufacturing requirements are allocated based on volume of Polyiso board produced. This was selected since the

environmental burden in the industrial process (energy consumption, emissions, etc.) is primarily governed by the volume throughput of each sub-process.

Life Cycle Assessment – Results and Analysis

Use of Material Resources

The material resource consumption associated with the polyiso insulation is presented in Table 3 for the functional unit by life cycle stage. The total life cycle material resource use results are shown in Table 4 for various board thicknesses considered. The water use indicator represents net water consumption.

Table 3: Use of material resources results by life cycle stage per functional unit of 1 m^2 at R_{IP} = 5.7 (R_{SI} = 1.0)

Environmental Indicator	Units	Total	Raw materials	Raw material transport	Mfg.	Install.	End-of-life
Non-renewable material resources	*kg*	**2.71**	2.39	0.00260	0.145	0.0102	0.166
Renewable material resources	*kg*	**29.1**	22.4	0.601	2.59	1.90	1.61
Water use	*kg*	**180**	78.7	1.32	81.4	3.98	14.5

Table 4: Total life cycle use of material resources for various board thicknesses

Environmental Indicator	Units	R_{IP} = 4.9 R_{SI} = 0.83		R_{IP} = 9.8 R_{SI} = 1.73		R_{IP} = 14.6 R_{SI} = 2.57		R_{IP} = 19.5 R_{SI} = 3.43	
		Per 1 ft^2	Per 1 m^2	Per 1 ft^2	Per 1 m^2	Per 1 ft^2	Per 1 m^2	Per 1 ft^2	Per 1 m^2
Non-renewable material resources	*kg*	0.277	2.98	0.435	4.68	0.574	6.18	0.726	7.81
Renewable material resources	*kg*	2.94	31.7	4.67	50.2	6.20	66.8	7.87	84.7
Water use	*kg*	14.6	157	28.9	311	42.4	456	56.4	607

Primary Energy by Life Cycle Stage

The primary energy consumption associated with the polyiso insulation is presented in

Table 5 for the functional unit by life cycle stage. The total life cycle primary energy consumption results are shown in Table 6 for various board thicknesses considered.

Table 5: Primary energy consumption results by life cycle stage per functional unit of 1 m² at R_{IP} = 5.7 (R_{SI} = 1.0)

Environmental Indicator	Units	Total	Raw materials	Raw material transport	Mfg.	Install.	End-of-life
Total primary energy	***MJ***	**54.2**	**48.6**	**0.594**	**2.48**	**1.87**	**0.601**
Non-renewable primary energy	***MJ***	***50.7***	*45.4*	*0.584*	*2.35*	*1.84*	*0.569*
Crude oil	MJ	**23.8**	21.2	0.526	0.0481	1.66	0.344
Hard coal	MJ	**5.83**	5.23	0.00643	0.541	0.0150	0.0355
Lignite	MJ	**0.705**	0.648	5.84E-04	0.0388	0.00221	0.0146
Natural gas	MJ	**16.5**	14.7	0.0479	1.42	0.154	0.162
Uranium	MJ	**3.82**	3.50	0.00313	0.302	0.00723	0.0129
Renewable primary energy	***MJ***	***3.47***	*3.28*	*0.00966*	*0.123*	*0.0299*	*0.0320*
Geothermal	MJ	**0.0489**	0.0456	1.09E-04	0.00282	2.33E-04	1.53E-04
Hydropower	MJ	**1.49**	1.41	9.62E-04	0.0685	0.00261	0.00343
Wind power	MJ	**0.123**	0.0814	4.98E-04	0.0352	0.00125	0.00440
Solar power	MJ	**1.82**	1.74	0.00809	0.0169	0.0258	0.0240
Biomass	MJ	**1.37E-04**	1.37E-04	1.19E-14	7.79E-14	5.58E-14	7.82E-13

Table 6: Total life cycle primary energy consumption results for various board thicknesses

Environmental Indicator	Units	R_{IP} = 4.9 R_{SI} = 0.83		R_{IP} = 9.8 R_{SI} = 1.73		R_{IP} = 14.6 R_{SI} = 2.57		R_{IP} = 19.5 R_{SI} = 3.43	
		Per 1 ft²	Per 1 m²	Per 1 ft²	Per 1 m²	Per 1 ft²	Per 1 m²	Per 1 ft²	Per 1 m²
Total primary energy	**MJ**	5.13	55.2	8.69	93.5	11.9	128	15.3	165
Non-renewable primary energy	***MJ***	4.65	50.0	8.13	87.5	11.2	121	14.6	157
Crude oil	MJ	2.15	23.1	3.82	41.1	5.33	57.4	6.95	74.8
Hard coal	MJ	0.537	5.78	0.935	10.1	1.29	13.8	1.67	18.0
Lignite	MJ	0.0810	0.872	0.113	1.22	0.141	1.52	0.172	1.85
Natural gas	MJ	1.46	15.8	2.65	28.5	3.71	39.9	4.85	52.2
Uranium	MJ	0.418	4.50	0.613	6.60	0.79	8.46	0.97	10.5
Renewable primary energy	***MJ***	0.483	5.20	0.557	6.00	0.623	6.70	0.694	7.47
Geothermal	MJ	0.00417	0.0449	0.00784	0.0844	0.0111	0.119	0.0146	0.157
Hydropower	MJ	0.213	2.29	0.238	2.56	0.261	2.81	0.285	3.07
Wind power	MJ	0.0112	0.121	0.0197	0.212	0.0275	0.296	0.0358	0.385
Solar power	MJ	0.255	2.74	0.291	3.13	0.323	3.48	0.358	3.86
Biomass	MJ	1.49E-05	1.60E-04	2.19E-05	2.36E-04	2.80E-05	3.01E-04	3.47E-05	3.74E-04

Life Cycle Impact Assessment

The environmental impacts associated with the polyiso insulation are presented below in Table 7 for the functional unit by life cycle stage. The total life cycle impacts are shown in Table 8 for the various board thicknesses considered.

Table 7: Environmental impact category results per functional unit of 1 m^2 at R_{IP} = 5.7 (R_{SI} = 1.0)

Impact category	Units	Total	Raw materials	Raw material transport	Mfg.	Install.	End-of-life
Global warming potential	*kg CO_2-eq*	**2.42**	2.07	0.0406	0.163	0.109	0.0370
Acidification potential	*kg SO_2-eq*	**0.00957**	0.00788	3.20E-04	2.72E-04	5.78E-04	5.18E-04
Eutrophication potential	*kg N-eq*	**8.06E-04**	5.19E-04	2.62E-05	1.35E-05	5.99E-05	1.88E-04
Smog formation potential	*kg O_3-eq*	**0.159**	0.0924	0.0107	0.00359	0.0183	0.0342
Ozone depletion potential	*kg CFC-11 eq*	**1.13E-07**	1.13E-07	3.62E-13	3.62E-11	8.00E-13	6.86E-13

Table 8: Total life cycle impact category results for various board thicknesses

Impact category	Units	R_{IP} = 4.9 R_{SI} = 0.83		R_{IP} = 9.8 R_{SI} = 1.73		R_{IP} = 14.6 R_{SI} = 2.57		R_{IP} = 19.5 R_{SI} = 3.43	
		Per 1 ft^2	Per 1 m^2	Per 1 ft^2	Per 1 m^2	Per 1 ft^2	Per 1 m^2	Per 1 ft^2	Per 1 m^2
Global warming potential	*kg CO_2-eq*	0.232	2.50	0.388	4.17	0.526	5.66	0.665	7.16
Acidification potential	*kg SO_2-eq*	9.48E-04	0.0102	0.00153	0.0165	0.00205	0.0221	0.00247	0.0266
Eutrophication potential	*kg N-eq*	7.88E-05	8.48E-04	1.29E-04	0.00139	1.74E-04	0.00187	1.67E-04	0.00180
Smog formation potential	*kg O_3-eq*	0.0157	0.169	0.0255	0.275	0.0347	0.374	0.0334	0.360
Ozone depletion potential	*kg CFC-11 eq*	1.25E-08	1.35E-07	1.82E-08	1.96E-07	2.31E-08	2.48E-07	2.84E-08	3.06E-07

Waste Generation

The waste generation results associated with the polyiso insulation are presented below in Table 9 for the functional unit by life cycle stage. The total life cycle waste generation results are shown in Table 10 for the various board thicknesses considered.

Table 9: Waste generation results **per functional unit of 1 m^2 at R_{IP} = 5.7 (R_{SI} = 1.0)**

Environmental Indicator	Units	Total	Raw materials	Raw material transport	Mfg.	Install.	End-of-life
Non-hazardous waste	*kg*	**0.724**	0.0175	2.06E-05	0.00275	0.0126	0.692
Hazardous waste	*kg*	**6.44E-06**	6.43E-06	7.42E-10	1.08E-09	2.42E-09	1.03E-09
Waste to energy	*kg*	**0.00103**	-	-	0.00103	-	-

Table 10: Waste generation results for various board thicknesses

Environmental Indicator	Units	R_{IP} = 4.9 R_{SI} = 0.83		R_{IP} = 9.8 R_{SI} = 1.73		R_{IP} = 14.6 R_{SI} = 2.57		R_{IP} = 19.5 R_{SI} = 3.43	
		Per 1 ft^2	Per 1 m^2	Per 1 ft^2	Per 1 m^2	Per 1 ft^2	Per 1 m^2	Per 1 ft^2	Per 1 m^2
Non-hazardous waste	*kg*	0.0636	0.684	0.116	1.25	0.162	1.75	0.213	2.29
Hazardous waste	*kg*	5.15E-07	5.55E-06	1.03E-06	1.11E-05	1.49E-06	1.60E-05	1.98E-06	2.13E-05
Waste to energy	*kg*	1.65E-04	0.00178	1.65E-04	0.00178	1.65E-04	0.00178	1.65E-04	0.00178

References

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- UL. (2016). *Product Category Rules for preparing an environmental product declaration (EPD) for Product Groups: Building Envelope Thermal Insulation; Mechanical Insulation.*

LCA Development

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