ENVIRONMENTAL PRODUCT DECLARATION

POLYISO ROOF INSULATION BOARD

BUILDING ENVELOPE THERMAL INSULATION

Polyiso rigid roof insulation panels

VERSICO ROOFING SYSTEMS

Versico was formed through the acquisition of a major single-ply roofing manufacturer in 1993. Since that time, Versico has positioned itself as one of the top single-ply roofing system suppliers by clearly focusing its efforts on quality products and exceptional service.

One of the simplest ways to support sustainability through construction practices is through the use of insulation. Versico's lightweight, cost-effective polyisocyanurate (polyiso) insulation products provide energy-efficient solutions for buildings in any region and climate, as well as outstanding return on investment and significant energy savings. With an industry leading eight polyiso manufacturing lines strategically positioned throughout North America, Versico is able to provide on-time delivery of its innovative insulation products to any jobsite.

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

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	Versico Roofing Systems
DECLARATION NUMBER	4787622255.104.1
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	Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

Product Definition

Description of Product

Polyiso insulation produced by Versico is a rigid roof insulation panel composed of closed-cell Polyiso foam bonded to two different types of facers. The VersiCore MP-H® brand incorporates glass reinforced felt (GRF) facers while the SecurShield™ brand incorporates Coated Glass Fiber (CGF) facers. Polyiso boards can come in a variety of thicknesses and thus have a range of R-values.

Rigid cellular Polyiso roof insulation board is the most widely used insulating material for above-deck commercial roof construction in North America. In commercial roofing assemblies, one or more layers of Polyiso are placed above the roof deck (typically steel, concrete, or wood) and beneath the roofing membrane. The Polyiso boards may be attached to the roof deck with various mechanical fasteners and construction adhesives or held in place with ballast stones or concrete pavers placed above the roofing membrane. The roofing membrane also may be mechanically attached through the Polyiso insulation, adhered to the top Polyiso facer or held in place with ballast. Additional common elements of this construction may include air retarders, vapor barriers, and thermal barriers placed beneath the Polyiso insulation and cover boards placed between the Polyiso insulation and the roofing membrane.

A typical insulation board is shown in Figure 1. The product systems evaluated in this report are shown in Table 1.

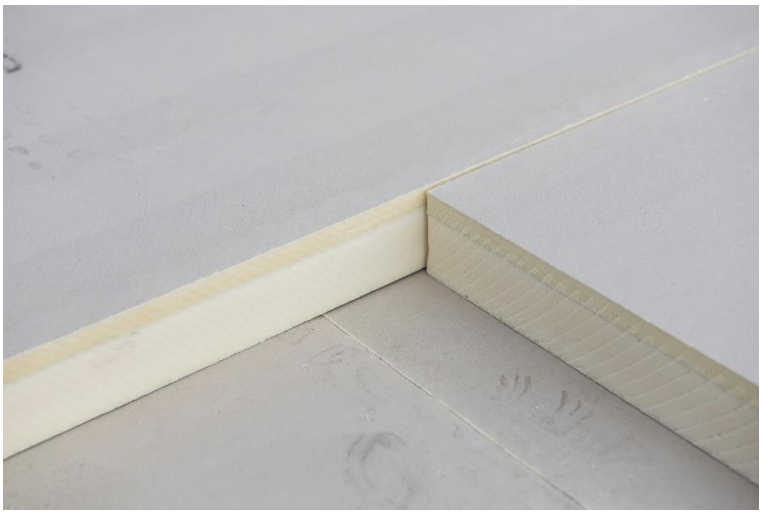


Figure 1: Typical Polyiso roof insulation board

Table 1: Product systems evaluated

R_{IP} / R_{SI}	Thickness (in., cm)	Weight (lbs/ft^2)	Weight (kg/m^2)
R5.68 / R1	0.98, 2.5	0.148	0.723
Alternative results scenarios			
R10.2 / R1.80	1.8, 4.6	0.269	1.31
R15.0 / R2.64	2.6, 6.6	0.391	1.91
R20.5 / R3.61	3.5, 8.9	0.529	2.58

The relevant standards applicable to the production and testing of Polyiso board are as follows:

- ASTM C1289-13 Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
- ASTM C1303-13 Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation
- ASTM E84-12 Standard Test Method for Surface Burning Characteristics of Building Materials
- ASTM E119-12 / UL263-11 / NFPA 251-06 Standard Test Methods for Fire Tests of Building Construction and Materials; ASTM E108-11 / UL790-08 Standard Test Methods for Fire Tests Of Roof Coverings
- FM 4450-08 / 4470-12 Approval Standard for ... Class 1 Roof Deck Constructions
- UL 1256-13 Fire Test of Roof Deck Constructions
- ULC / CAN S770-09 Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.

Classifications

This EPD covers all Polyiso roof insulation boards manufactured by Versico, as listed in Table 2.

Table 2: Polyiso board classifications

Type II	Class 1	VersiCore MP-H Polyiso Insulation
	Class 2	SecurShield Polyiso Insulation SecurShield CD Polyiso (Combustible Deck) Insulation
	Class 4	SecurShield HD Polyiso Insulation SecurShield HD Plus Polyiso Insulation SecurShield HD FR Polyiso Insulation
Type IV		SecurShield HD Composite Polyiso Insulation
Type V		DuraFaceR Polyiso Insulation

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:

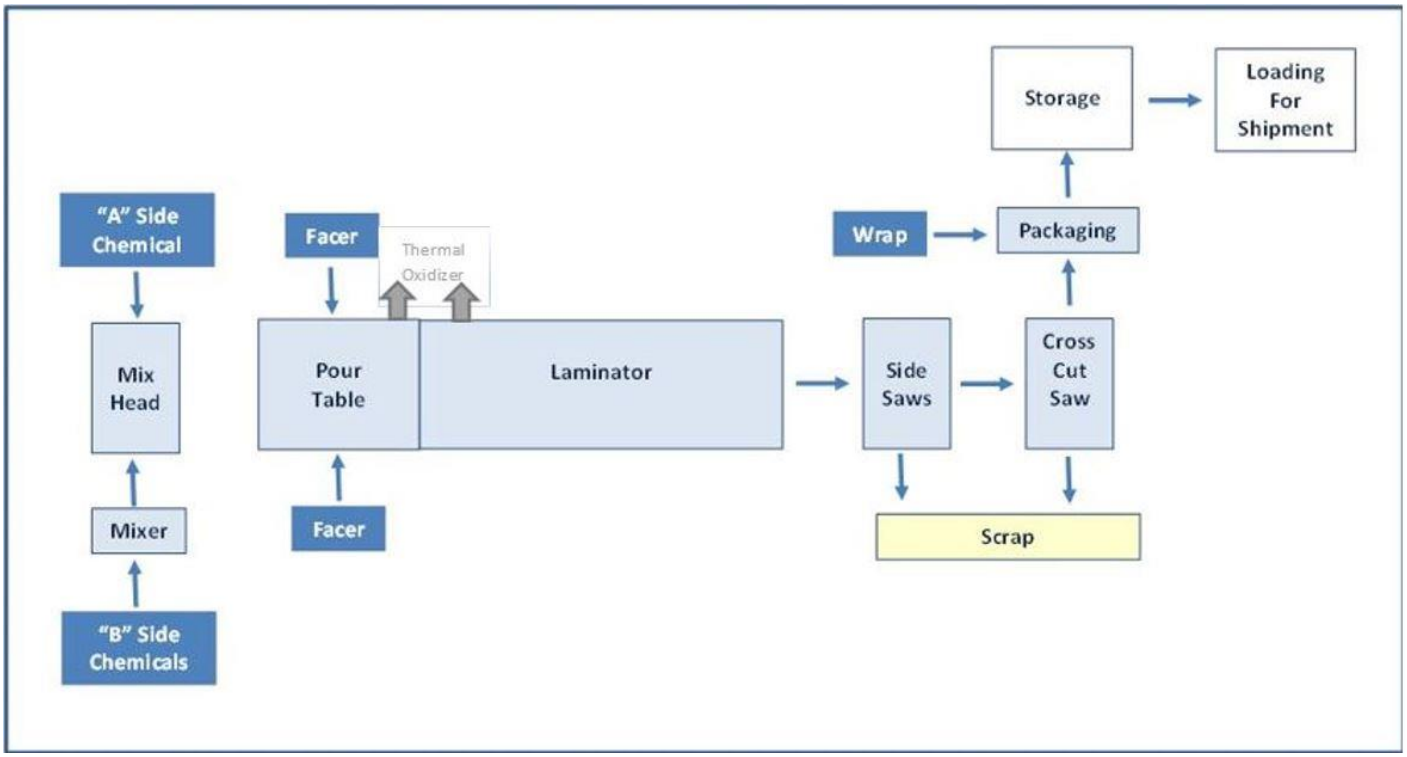
- MDI: The “A” side component for the manufacture of Polyiso.
- Polyester Polyol: the primary “B” side component for the manufacturer of Polyiso.
- TCPP: A flame retardant added to the “B” side.
- Catalyst K-15 (2-ethyl hexanoate): A reaction catalyst added to the “B” side.
- Pentane: A blowing agent.

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 Versico, the facer is a glass reinforced fiber material primarily used for roof 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)	0.227	kg	342	Truck
	Diesel	0.00150	kg	-	
Outputs	Polyiso insulation (installed)	0.223	kg	-	
	Waste to landfill (packaging + scrap)	0.00474	kg	20	Truck
	Ammonia to air	1.21E-10	kg	-	
	Carbon dioxide to air	4.62E-06	kg	-	
	Carbon monoxide to air	8.35E-09	kg	-	
	Dust (PM2.5) to air	6.39E-10	kg	-	
	Methane to air	1.11E-11	kg	-	

Type	Flow	Value	Unit	Distance [mi]	Mode
	Nitrogen oxides to air	2.95E-08	kg	-	
	Nitrous oxide to air	1.32E-11	kg	-	
	NMVOC to air	1.46E-09	kg	-	
	Pentane (n-pentane) to air	0.00649	kg	-	
	Sulfur dioxide to air	4.48E-11	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 R_{SI} = 1 K·m^2/W (R_{IP} = 5.68 h·ft^2·°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).

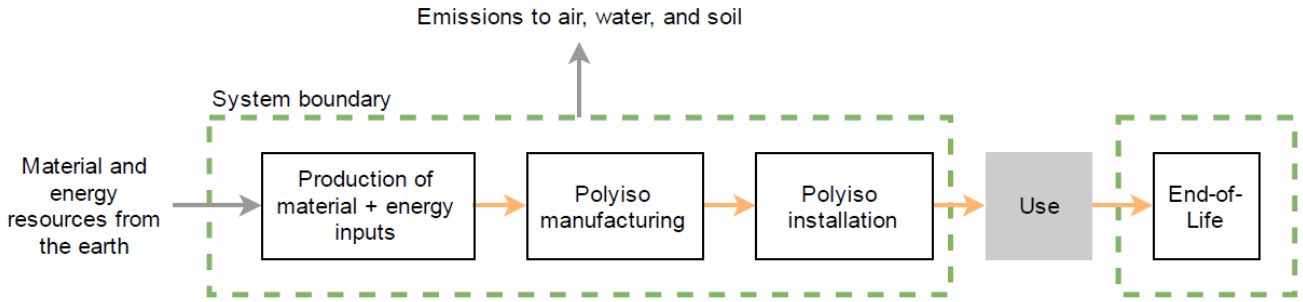


Figure 3: Life cycle stages included in system boundary

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 Versico's 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

Versico manufactures its roof 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 Versico 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 4 for the functional unit by life cycle stage. The total life cycle material resource use results are shown in Table 5 for various board thicknesses considered. The water use indicator represents net water consumption.

Table 4: 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*	**2.61**	2.22	0.00342	0.164	0.00802	0.213
Renewable material resources	*kg*	**27.8**	20.7	0.791	2.93	1.30	2.01
Water use	*kg*	**194**	79.2	1.74	92.2	2.61	18.5

Table 5: Total life cycle use of material resources for various board thicknesses

Environmental Indicator	Units	R_{IP} = 10.2 R_{SI} = 1.8		R_{IP} = 15.0 R_{SI} = 2.6		R_{IP} = 20.5 R_{SI} = 3.6	
		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*	0.472	5.08	0.640	6.89	0.828	8.91
Renewable material resources	*kg*	5.01	54.0	6.81	73.3	8.84	95.1
Water use	*kg*	33.4	360	47.7	513	63.8	686

Primary Energy by Life Cycle Stage

The primary energy consumption associated with the Polyiso insulation is presented in Table 6 for the functional unit by life cycle stage. The total life cycle primary energy consumption results are shown in Table 7 for various board thicknesses considered.

Table 6: 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***	**53.7**	**48.2**	**0.782**	**2.81**	**1.27**	**0.719**
Non-renewable primary energy	***MJ***	***52.6***	***47.2***	***0.769***	***2.67***	***1.26***	***0.679***
Crude oil	MJ	**24.0**	21.7	0.693	0.0541	1.14	0.395
Hard coal	MJ	**6.38**	5.71	0.00846	0.613	0.00752	0.0450
Lignite	MJ	**0.575**	0.510	7.68E-04	0.00440	0.00170	0.0183
Natural gas	MJ	**18.4**	16.5	0.0630	1.61	0.106	0.204
Uranium	MJ	**3.18**	2.81	0.00412	0.342	0.00358	0.0163
Renewable primary energy	***MJ***	***1.12***	***0.906***	***0.0127***	***0.140***	***0.0201***	***0.0402***
Geothermal	MJ	**0.0518**	0.0482	1.44E-04	0.00320	1.03E-04	1.86E-04
Hydropower	MJ	**0.390**	0.305	0.00127	0.0776	0.00156	0.00432
Wind power	MJ	**0.128**	0.0815	6.56E-04	0.0398	6.84E-04	0.00559
Solar power	MJ	**0.549**	0.471	0.0106	0.0192	0.0177	0.0301
Biomass	MJ	**1.38E-04**	1.38E-04	1.56E-14	8.78E-14	4.74E-14	1.00E-12

Table 7: Total life cycle primary energy consumption results for various board thicknesses

Environmental Indicator	Units	R_{IP} = 10.2 R_{SI} = 1.8		R_{IP} = 15.0 R_{SI} = 2.6		R_{IP} = 20.5 R_{SI} = 3.6	
		Per 1 ft²	Per 1 m²	Per 1 ft²	Per 1 m²	Per 1 ft²	Per 1 m²
Total primary energy	**MJ**	**9.50**	**102**	**13.2**	**142**	**17.3**	**186**
Non-renewable primary energy	***MJ***	***9.30***	***100***	***12.9***	***139***	***17.0***	***183***
Crude oil	MJ	**4.20**	45.2	5.89	63.4	7.78	83.7
Hard coal	MJ	**1.14**	12.3	1.57	16.9	2.04	22.0
Lignite	MJ	**0.108**	1.16	0.141	1.52	0.179	1.92
Natural gas	MJ	**3.27**	35.2	4.53	48.7	5.94	64.0
Uranium	MJ	**0.573**	6.17	0.780	8.40	1.01	10.9
Renewable primary energy	***MJ***	***0.200***	***2.15***	***0.275***	***2.96***	***0.358***	***3.86***
Geothermal	MJ	**0.00879**	0.0946	0.0127	0.137	0.0171	0.185
Hydropower	MJ	**0.0689**	0.742	0.0956	1.03	0.126	1.35
Wind power	MJ	**0.0228**	0.246	0.0315	0.339	0.0412	0.444
Solar power	MJ	**0.0995**	1.07	0.135	1.45	0.174	1.88
Biomass	MJ	**2.62E-05**	2.83E-04	3.38E-05	3.64E-04	4.23E-05	4.56E-04

Life Cycle Impact Assessment

The environmental impacts associated with the Polyiso insulation are presented below in Table 8 for the functional unit by life cycle stage. The total life cycle impacts are shown in Table 9 for the various board thicknesses considered.

Table 8: 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*	**2.54**	2.17	0.0533	0.183	0.0810	0.0440
Acidification potential	*kg SO_2-eq*	**0.00972**	0.00798	4.00E-04	3.08E-04	3.85E-04	6.44E-04
Eutrophication potential	*kg N-eq*	**8.12E-04**	4.82E-04	3.32E-05	1.50E-05	4.25E-05	2.39E-04
Smog formation potential	*kg O_3-eq*	**0.154**	0.0962	0.0133	0.00399	0.0121	0.0284
Ozone depletion potential	*kg CFC-11 eq*	**9.35E-08**	9.35E-08	4.76E-13	4.11E-11	3.70E-13	8.48E-13

Table 9: Total life cycle impact category results for various board thicknesses

Impact category	Units	R_{IP} = 10.2 R_{SI} = 1.8		R_{IP} = 15.0 R_{SI} = 2.6		R_{IP} = 20.5 R_{SI} = 3.6	
		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*	0.460	4.95	0.622	6.70	0.805	8.66
Acidification potential	*kg SO_2-eq*	0.00177	0.0191	0.00239	0.0257	0.00308	0.0331
Eutrophication potential	*kg N-eq*	1.47E-04	0.00158	1.99E-04	0.00214	2.58E-04	0.00277
Smog formation potential	*kg O_3-eq*	0.0282	0.304	0.0378	0.407	0.0485	0.522
Ozone depletion potential	*kg CFC-11 eq*	1.69E-08	1.83E-07	2.30E-08	2.47E-07	2.98E-08	3.21E-07

Waste Generation

The waste generation results associated with the Polyiso insulation are presented below in Table 10 for the functional unit by life cycle stage. The total life cycle waste generation results are shown in Table 11 for the various board thicknesses considered.

Table 10: 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*	**0.908**	0.00511	2.70E-05	0.00210	0.0150	0.886
Hazardous waste	*kg*	**4.53E-06**	4.53E-06	9.76E-10	1.22E-09	1.69E-09	1.26E-09
Waste to energy	*kg*	**7.79E-04**	-	-	7.79E-04	-	-

Table 11: Waste generation results for various board thicknesses

Environmental Indicator	Units	R_{IP} = 10.2 R_{SI} = 1.8		R_{IP} = 15.0 R_{SI} = 2.6		R_{IP} = 20.5 R_{SI} = 3.6	
		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*	0.168	1.81	0.223	2.40	0.285	3.07
Hazardous waste	*kg*	7.65E-07	8.23E-06	1.11E-06	1.20E-05	1.51E-06	1.62E-05
Waste to energy	*kg*	7.24E-05	7.79E-04	7.24E-05	7.79E-04	7.24E-05	7.79E-04

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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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