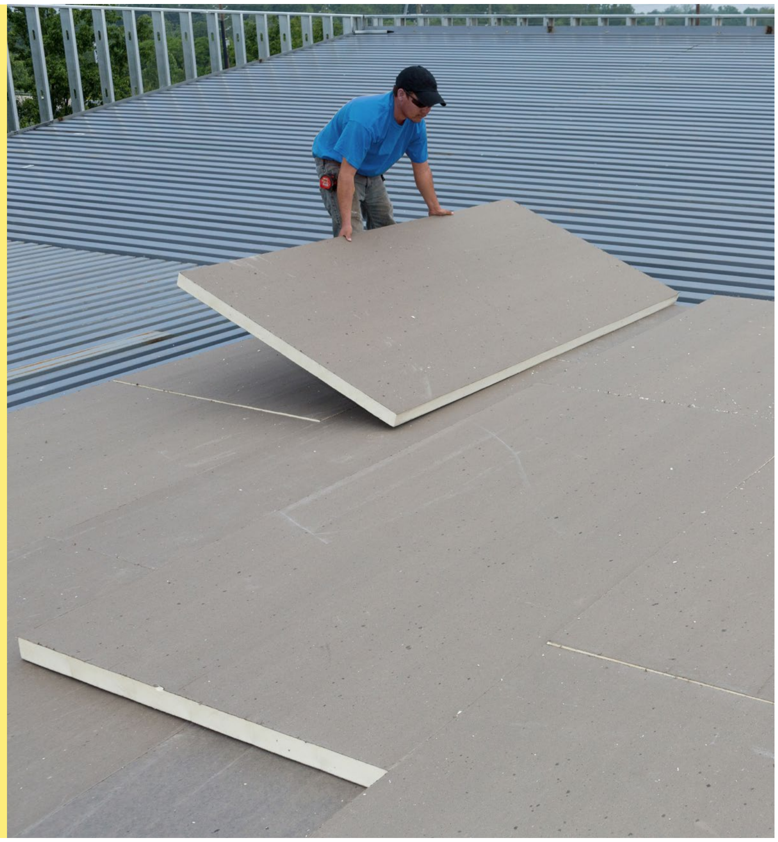
ENVIRONMENTAL PRODUCT DECLARATION

Polyiso Roof Insulation Boards

The Polyisocyanurate Insulation Manufacturers Association (PIMA) represents the leading U.S. manufacturers of Polyiso insulation in the development of product technical standards, certification programs, and energy efficiency advocacy. As a leading advocate of energy efficiency, PIMA has received many environmental awards, including the U.S. Environmental Protection Agency's Climate Protection Award in 2007 for the Association's leadership in promoting energy efficiency and climate protection. The EPA also awarded PIMA and its members the Stratospheric Ozone Protection Award in 2002 for "leadership in CFC phase-out in Polyiso insulation and in recognition of exceptional contributions to global environmental protection."



Primary data from the following PIMA manufacturer members were used for the underlying life cycle assessment. Results in this declaration represent the combined weighted average production for these members.

Atlas Roofing Corporation
2000 River Edge Parkway, Suite 800
Atlanta, GA 30328
www.atlasroofing.com

Firestone Building Products Company
250 West 96th Street
Indianapolis, IN 46260
www.firestonebpco.com

GAF
1 Campus Drive
Parsippany, NJ 07054
www.gaf.com

Hunter Panels
15 Franklin Street
Portland, ME 04104
www.hpanels.com

Johns Manville
717 17th Street
Denver, CO 80202
www.johnsmanville.com

Rmax Operating, LLC
13524 Welch Road
Dallas, TX 75244
www.rmax.com

EPD INFORMATION

Program Operator		NSF International	
Declaration Holder		Polyisocyanurate Insulation Manufacturers Association	
Product Polyiso Roof Insulation Boards	Date of Issue January 1, 2015	Period of Validity 5 Years	Declaration Number EPD10043
This EPD was independently verified by NSF International in accordance with ISO 14025: ❑ Internal ☒ External		Thomas J. Bruursema Bruursema@nsf.org	
This life cycle assessment was independently verified by in accordance with the reference PCR:		J. Renée Morin morin@pre-sustainability.com	

LCA INFORMATION

Basis LCA	Life Cycle Assessment of Polyiso Insulation October 14, 2014
LCA Preparer	John Jewell PE Americas 344 Boylston St., Boston, MA 02116
This life cycle assessment was critically reviewed in accordance with ISO 14044 by:	Dr. Deanna Matthews Avenue C Advisors 158 Main Entrance Drive, Pittsburgh, PA 15228

PCR INFORMATION

Program Operator	UL Environment
Reference PCR	UL 110116 Building Envelope Thermal Insulation
Date of Issue	September 23, 2011
PC Review Conducted By:	Wayne B. Trusty Wayne B. Trusty and Associates Limited PO Box 189, 136 Charlotte Street Merrickville, ON, Canada K0G1N0

NSF™

Certified Environmental Product Declaration
www.nsf.org

PRODUCT DESCRIPTION

CSI Master Format Reference: 07220 Roof and Deck Insulation

Brief Product Description: Polyisocyanurate (Polyiso) is a closed-cell, rigid foam board insulation consisting of a foam core sandwiched between two facers. The foam core is composed of closed-cell rigid Polyiso foam produced through the chemical reaction of an "A" side (MDI) and a "B" side (polyester polyol with various additives such as catalysts, surfactants, and flame retardant) plus a blowing agent (pentane). For roofing applications, the most common facer is a glass-reinforced fiber (GRF) material made from over 90% recycled post-consumer and post-industrial fiber. The manufacturing process for Polyiso roof insulation at a typical PIMA member manufacturing plant is illustrated in Figure 1.

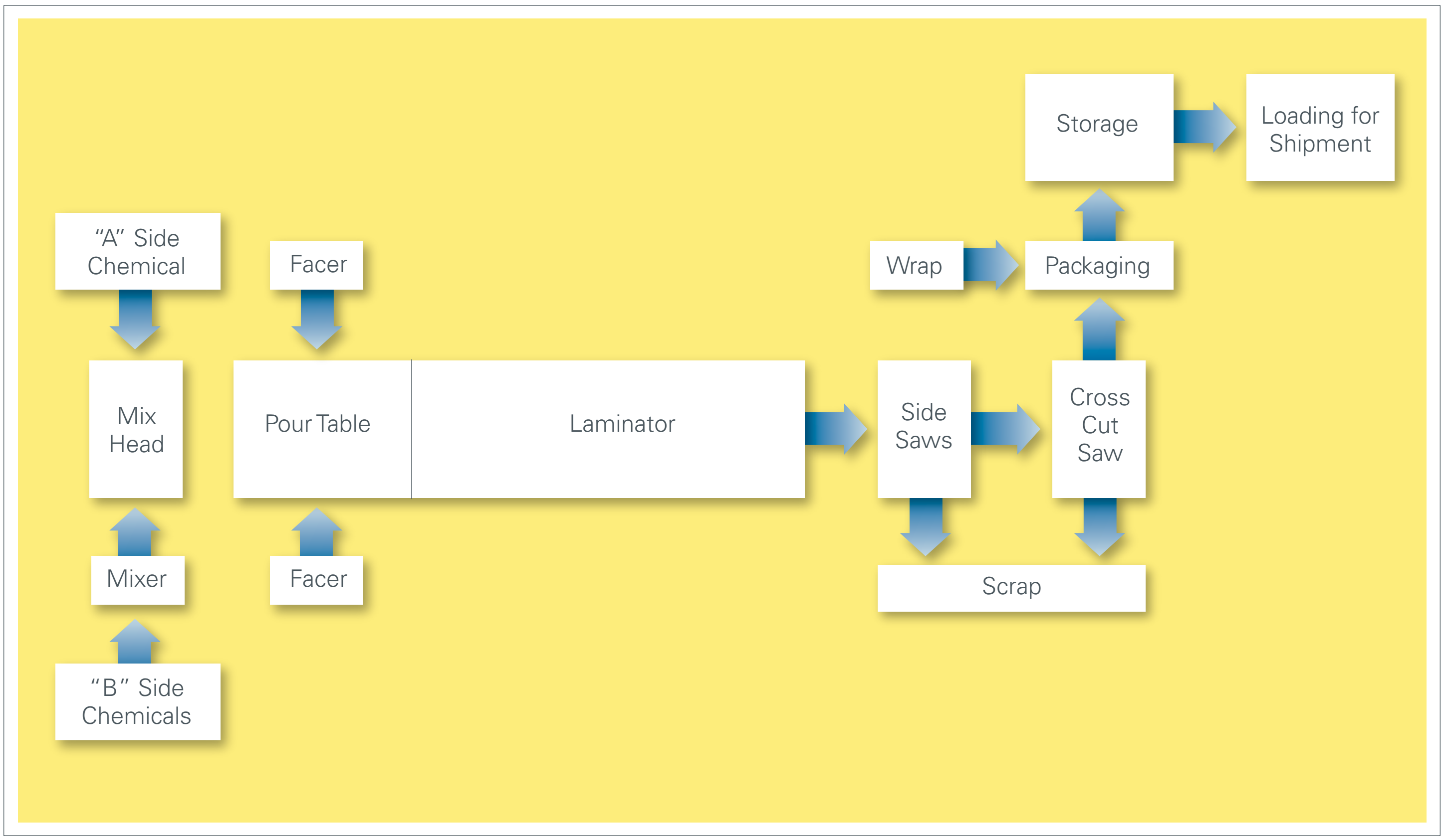


Figure 1:
Polyiso Roof Insulation Manufacturing Process

A typical Polyiso roof insulation board is illustrated in Figure 2.

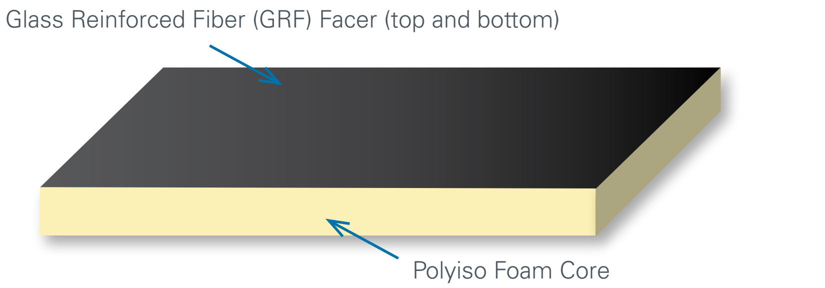


Figure 2:
Typical Polyiso Roof Insulation Board (ASTM C1289-13, Type II, Class 1)

Range of Application: 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 above-deck roofing assembly using Polyiso is illustrated in Figure 3.

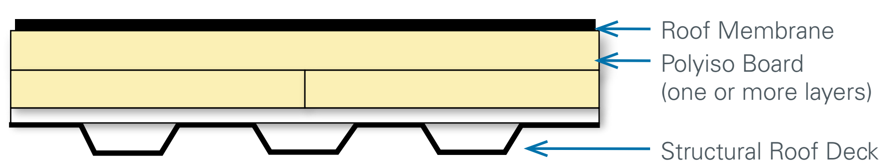


Figure 3:
Typical Above Deck-Roofing Assembly Using Polyiso

Technical Standards:
The following standards are used to test, evaluate, and specify Polyiso roof insulation:

- 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

Thermal Performance: The recognized consensus method for measuring the thermal properties of permeably-faced closed-cell foam insulation boards like Polyiso is based on the concept of Long-Term Thermal Resistance (LTTR) as described in ASTM C1303 and CAN/ULC S770. Grounded in a robust theory of foam aging developed by building materials researchers in the 1990s, LTTR provides a laboratory method of accelerating the normal aging of closed-cell insulation materials so that a thermal resistance value predictive of actual long-term aged thermal performance may be calculated. Since this test method was first published as an ASTM standard in 1995, it has been continuously reviewed and refined to improve its accuracy and validity. All PIMA manufacturer members have adopted the LTTR method as the exclusive means to measure thermal performance of permeable-faced Polyiso roof insulation. Additional information about LTTR is available
in the following PIMA Fact Sheet which may be downloaded from the PIMA website (www.poliso.org).

PIMA LTTR Fact Sheet: Advanced Method for Determining Long-Term Thermal Resistance

REQUIREMENTS FOR UNDERLYING LCA

System Boundaries: In accordance with UL Product Category Rule 110116, life cycle stages and system boundaries for Polyiso roof insulation are illustrated in Figure 4 on the following page. These system boundaries encompass the following processes:

Raw Materials Acquisition

This stage includes extraction/production of raw materials, processing of recycled materials, and transport of raw and recycled materials to the PIMA member manufacturing location. These raw and recycled materials include:

- 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.
- GRF (Glass Reinforced Fiber): A facer containing over 90% post-consumer recycled fiber.
- Low Density Polyethylene: The primary component of the plastic packaging wrap.

Manufacturing

This stage includes manufacturing of Polyiso roof insulation, packaging, manufacturing waste, and associated releases to the air, soil, ground, and surface water. The major raw materials at a Polyiso insulation manufacturing plant consist of chemical liquids stored in tanks onsite. The chemicals for the "A" side (MDI), the "B" side (polyester polyol plus catalysts, surfactants, and flame retardants) and the blowing agent (pentane) are pumped from storage into process tanks. The "B" side and blowing agent are then pumped to a mixer and then to a mix head where they are combined with the "A" side and injected between the top and bottom facers on the pour table. These chemicals combine on the pour table and react rapidly to form a closed-cell foam board that is sandwiched between the top and bottom facers. The rigid foam board then travels within a heated laminator on moving conveyor belts, which aids in cell formation and hardens the board. The board then exits the laminator and is fed through saws that trim the board to the desired width and then through a cross-cut saw that cuts the board into desired lengths. The finished rigid boards are then stacked, packaged with plastic wrap, labeled, and moved via fork truck to a warehouse area for storage and eventual loading onto trucks for shipment. The manufacturing process for Polyiso roof insulation at a typical PIMA member manufacturing plant is illustrated in Figure 1 in the Product Description section of this declaration.

Transportation

This stage includes direct transport from the PIMA member manufacturer to the project job site, which is typical of the overwhelming majority of Polyiso roof insulation shipments. Transport of the finished product is assumed to be by truck, with an average distance of 250 miles.

Installation and Maintenance

This stage includes the unloading of the Polyiso roof insulation from the truck to the roof using a crane or all-terrain forklift. This stage also includes removal of all packaging and the placement of the individual roof insulation boards by a roofing crew on the roof deck prior to the application of the roofing system, including all associated releases to environmental media (air, soil, ground, and surface water). Once installed beneath a watertight roofing system, the Polyiso roof insulation requires no maintenance until the roofing system is replaced.

Disposal, Reuse, Recycling

This stage includes the removal of the insulation during the replacement of the original roofing system, loading of the insulation, and transport of the insulation to a landfill. Transport to the landfill was based on a total 50-mile round trip (25 miles each way) for a dump truck arriving at the pickup site empty and returning to the landfill full.

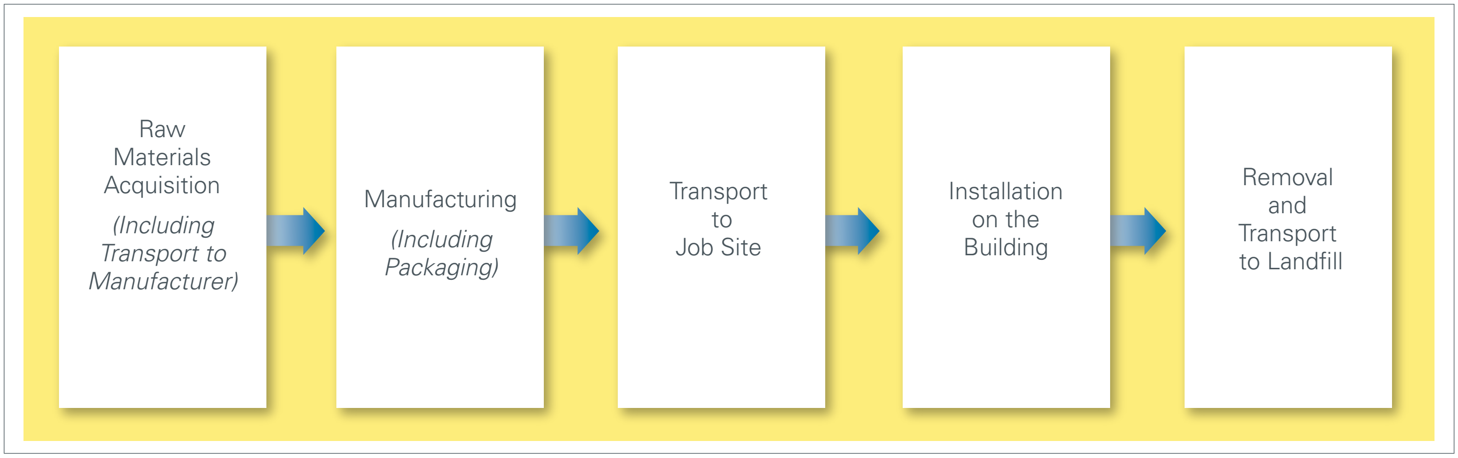


Figure 4:
Life Cycle Stages and System Boundaries for Polyiso Roof Insulation

Functional Unit: UL Product Category Rule 110116 defines the preferred functional unit for building envelope thermal insulation using metric (SI) measures, stated as:

> ***1 m² of insulation material that gives an average thermal resistance of R_{SI} = 1 m²•ºK/W and with a building service life of 60 years (packaging included)***

Because thermal resistance is reported in the United States using Inch-Pound (IP) measures, it should be noted that aproduct with an R_{SI} of 1 is equivalent to a product with an R_{IP} of 5.68.

For Polyiso roof insulation, thermal resistance, or R-value, is determined based on Long-Term Thermal Resistance (LTTR) value as prescribed in ASTM C1289-13 Standard Specification for faced Rigid Cellular Polyisocyanurate Thermal Insulation Board (Type II Class1) and as measured using ASTM C1303-13 Standard Test Method for Predicting the Long-Term Thermal Resistance of Closed-Cell Foam Insulation or CAN/ULC S770-09 Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.

It should be noted that the glass reinforced fiber (GRF) facers on Polyiso roof insulation are an integral part of the product, and their environmental aspects are captured within the system boundaries of the Basis LCA for this disclosure. Considering thematerial dissimilarity between the GRF facers and the foam core (particularly in regard to mass density) the relative impact associated with the facers attached to each insulation board varies with the R-value or thickness of the product. In accordance with UL 110116 Product Category Rule for Building Envelope Thermal Insulation and in order to provide the user of this declaration a meaningful means of comparing Polyiso with other roof insulation products, the relative contribution of the facers is given appropriate consideration in the development of the Functional Unit results as summarized in Table 2 of this declaration. To serve this purpose, a quantitative normalization calculation was performed on a commonly used product thickness, specifically a 2.6 inch thickness of Polyiso roof insulation with an R_{IP}-value of 15.

Cut-Off Rules: The following cut-off criteria were used to ensure that all relevant environmental impacts were represented in the study:

Mass

If a flow is less than 1% of the cumulative mass of all inputs and outputs of the LCI model, it is excluded, provided its environmental relevance is not a concern.

Energy

If a flow is less than 1% of the cumulative energy of all inputs and outputs of the LCI model, it is excluded, provided its environmental relevance is not a concern.

Environmental Relevance

If a flow meets the above criteria for exclusion, yet it is thought to potentially have a significant environmental impact, it is included.

Excluded Material Flows

The sum of all excluded material flows does not exceed 5% of mass, energy, or environmental relevance.

Allocation. Allocation associated with the transport of Polyiso roof insulation is based on volume rather than weight, because volume restricts the amount of product that can be loaded on a truck. No other allocation was necessary in the production of Polyiso roof insulation since there are no co-products.

DATA QUALITY

Data Collection. Primary energy and emissions data regarding manufacturing processes were collected through a plant-by-plant survey of all PIMA member manufacturing plants in the United States and Canada. The survey was conducted in January 2014 and reported annual values based on 2013 plant operations. In addition to energy use, the survey included information with regard to packaging, scrap/waste, and emissions rates associated with the manufacture of Polyiso roof insulation. In addition to data collected directly from PIMA member manufacturing operations, primary data was collected from the following sources:

- All three polyester polyol plants in the US
- Energy/emissions factors from one facer plant for glass reinforced fiber (GRF) facer
- Energy use for insulation installation on a building

Energy/emissions data from life cycle databases, studies in the literature, etc., were used for all other modeling of raw materials, transportation factors, and land disposal.

In all cases, the data collected represented technologies currently in use, and all secondary data was not older than 10 years.

Description of Data

Fuels and Energy

National and regional (when available) averages for electricity grid mixes were obtained from the GaBi 4 database. For each of the polyol and facer manufacturers, a regional dataset was chosen based on the plant location. For the Polyiso manufacture, averaged regional data are based on U.S. average data in the GaBi 4 database.

Raw Materials

When available, primary data and data from the literature were used for the production of Polyiso insulation. Data when applicable were taken from the GaBi 4 database.

Emissions to Air, Water, and Soil

Emissions data associated with the production of Polyiso roof insulation were determined by primary technical contacts familiar with the specific operations. Data for most upstream materials and electricity and energy carriers were obtained from the GaBi 4 database. Emissions associated with transportation were determined by capturing the logistical operations (mode and distance). Energy use and the associated emissions were calculated using pre-configured transportation models from the GaBi 4 database. End-of-life emissions were determined by municipal waste operations data associated with landfilling.

Material Content. The material content for Polyiso roof insulation is provided in Table 1.

BASE MATERIALS			
Component	**Material**	**Availability**	**Origin**
Top /Bottom Facer	Glass Reinforced Fiber (GRF)	Recycled Material, Abundant	U.S.
Polyiso Foam Core	“A” Side Chemical (MDI)	Fossil Resource, Limited	U.S. & Canada
	“B” Side Chemicals (Polyester Polyol, Catalysts, Surfactants, Flame Retardant)	Fossil Resource, Limited	
	Blowing Agent (Pentane)	Fossil Resource, Limited	U.S.

Table 1:
Polyiso Roof Insulation Material Content

DECLARATION OF ENVIRONMENTAL ASPECTS

This declaration represents an average performance for a number of products or manufacturing plant locations for all PIMA member manufacturers identified in this declaration. Declarations from programs different than ISO 14025 may not be compatible with this declaration.

LCA Results and Analysis: Life Cycle Impact Assessment (LCIA) results were calculated for 1 m^2 of Polyiso roof insulation with R_{SI} = 1 m^2• °K•hr/Btu and with a service life of 60 years. As noted previously, LCIA results are based on a commonly used product thickness, specifically a 2.6 inch thickness of Polyiso roof insulation with an R_{IP} value of 15.

LCIA results included the following 5 impact categories as defined in the US EPA TRACI (Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts) Tool:

- Global Warming Potential, measured in kg CO_2 equiv.
- Acidification Potential, measured in mole H+ equiv.
- Eutrophication Potential, measured in kg N equiv.
- Smog Creation Potential, measured in kg O_3 equiv.
- Ozone Depletion Potential, measured in kg R11 equiv.

LCIA results also included 5 environmental indicators:

- Primary Energy Demand (both renewable and non-renewable), measured in MJ
- Resource Depletion (both renewable and non-renewable), measured in kg
- Waste to Disposal (both hazardous and non-hazardous), measured in kg
- Water Use, measured in l
- Waste to Energy, measured in kg

LCIA results are summarized in Table 2.

IMPACT CATEGORY / ENVIRONMENTAL INDICATOR	Measure
Global Warming Potential (kg CO_2 equiv.)	2.80
Acidification Potential (mole H+ equiv.)	9.08E-02
Eutrophication Potential (kg N equiv.)	1.40E-03
Smog Creation Potential (kg O_3 equiv.)	0.180
Ozone Depletion Potential (kg R11 equiv.)	9.40E-08
Primary Energy Demand (MJ)	53.10
Resource Depletion (kg)	5.10
Waste to Disposal (kg)	0.914
Water Use (l)	170.00
Waste to Energy (kg)	3.00E-04

Table 2:
Polyiso Roof Insulation Life Cycle Impact Assessment (LCIA) Results
For 1 m^2 of Polyiso roof insulation with R_{SI} = 1m^2•K/W

ADDITIONAL ENVIRONMENTAL INFORMATION

Additional LCIA Information for Common Polyiso Thicknesses and Configurations

To allow the user of this declaration to evaluate a variety of commonly installed Polyiso roof insulation configurations and to facilitate the integration of this declaration into whole building LCA tools, environmental aspects for additional thicknesses and combinations of thicknesses of Polyiso roof insulation are included as additional information. Table 3 provides LCIA results for common single-layer applications of Polyiso roof insulation, while Table 4 provides results for common multiple-layer applications. Please note the environmental aspects are stated for 1 ft^2 and 1 m^2 of each identified application, because different whole building LCA tools may use either metric or English units of measure in North America.

IMPACT CATEGORY/ ENVIRONMENTAL INDICATOR	1.8 inch thickness (R_{IP} = 10.2)		2.6 inch thickness (R_{IP} = 15.0)		3.5inch thickness (R_{IP} = 20.5)	
	Per 1ft^2	Per 1m^2	Per 1ft^2	Per 1m^2	Per 1ft^2	Per 1m^2
Global Warming Potential (kg CO_2 equiv.)	0.46	4.95	0.62	6.67	0.80	8.61
Acidification Potential (mole H+ equiv.)	1.79-E03	1.93E-02	2.41E-03	2.59E-02	3.10E-03	3.34E-02
Eutrophication Potential (kg N equiv.)	2.47E-04	2.66E-03	3.38E-04	3.64E-03	4.41E-04	4.75E-03
Smog Creation Potential (kg O_3 equiv.)	0.03	0.32	0.04	0.43	0.06	0.65
Ozone Depletion Potential (kg R11 equiv.)	1.70E-08	1.83E-07	2.32E-08	2.50E-07	3.01E-08	3.24E-07
Primary Energy Demand (MJ)	9.47	101.93	13.18	141.87	17.26	185.79
Resource Depletion (kg)	1.17	12.59	1.14	12.27	1.19	12.81
Waste to Disposal (kg)	0.68	7.32	0.92	9.90	1.19	12.81
Water Use (l)	29.50	317.54	42.20	454.24	56.40	607.08
Waste to Energy (kg)	7.2E-05	7.88E-04	7.32E-05	7.88E-04	7.30E-05	7.86E-04

Table 3:
Polyiso Wall Insulation LCIA Results For Common Single-Layer Products
(Per 1ft^2/1m^2 of installed product at specified R_{IP} value)

IMPACT CATEGORY/ ENVIRONMENTAL INDICATOR	2 Layers @ 1.8 inch thickness (Total R_{IP} = 20.4)		1 Layer @ 1.8 inch plus 1 Layer (R_{IP} = 25.2)		2 Layers @ 2.6 inch thickness (Total R_{IP} = 30.0)	
	Per 1ft^2	Per 1m^2	Per 1ft^2	Per 1m^2	Per 1ft^2	Per 1m^2
Global Warming Potential (kg CO_2 equiv.)	0.92	9.90	1.08	11.63	1.24	13.35
Acidification Potential (mole H+ equiv.)	3.58E-03	3.85E-02	4.20E-03	4.52E-02	4.82E-03	5.19E-02
Eutrophication Potential (kg N equiv.)	4.94E-03	5.32E-03	5.85E-04	6.30E-03	6.76E-04	7.28E-03
Smog Creation Potential (kg O_3 equiv.)	0.06	0.65	0.07	0.75	0.08	0.86
Ozone Depletion Potential (kg R11 equiv.)	3.40E-08	3.66E-07	4.02E-08	4.33E-07	4.64E-08	4.99E-07
Primary Energy Demand (MJ)	18.94	203.87	22.65	243.80	26.36	283.74
Resource Depletion (kg)	2.34	25.19	2.42	26.05	2.50	26.91
Waste to Disposal (kg)	1.36	14.64	1.60	17.22	1.84	19.81
Water Use (l)	59.00	635.07	71.70	771.77	84.40	908.47
Waste to Energy (kg)	1.46E-04	1.58E-03	1.46E-04	1.58E-03	1.46E-04	1.58E-03

Table 4:
Polyiso Roof Insulation LCIA Results For Common Double-Layer Products
(Per 1ft^2/1m^2 of installed product at specified R_{IP} value)

Environmental Benefits of the Product during Use:

High Thermal Efficiency

Because it is one of the most thermally efficient building insulations available in today's marketplace, Polyiso requires less total thickness to deliver specified R-value in roof and wall assemblies, reducing overall construction costs, and increasing usable building space.

High Net Return on Embodied Energy

A recent study comparing initial embodied energy to long-term energy savings achieved over 60 years in a typical commercial building suggests that the net energy savings potential of Polyiso roof insulation ranges between 9 and 44 times the initial embodied energy required to produce, transport and install the Polyiso insulation.[1]

Zero Ozone Depletion Potential

All PIMA Polyiso manufacturer members produce rigid foam board with third-generation, zero ozone-depleting blowing agents. The blowing agent (pentane) used in Polyiso also is among the lowest in Global Warming Potential.

Recycled Content

Polyiso insulation typically is manufactured using recycled material. The percentage of the recycled material by weight depends on the individual manufacturer, the thickness of the product and the type of facer.

Opportunity for Reuse

Although this declaration assumes the Polyiso roof insulation boards will be landfilled at the end of the roof system service life, it is possible to salvage and reuse the boards, either at the original site or on another construction site. Used Polyiso roof insulation may be collected and resold by several national logistics firms, including Nationwide Foam Recycling (www.nationwidefoam.com) and the Green Insulation Group (www.greeninsulationgroup.com). In addition, the reuse of existing board insulations in place is being promoted by several leading green building rating systems, such as LEED (www.usgbc.org/LEED), Green Globes (www.greenglobes.com), and RoofPoint (www.roofpoint.org).

Polyiso and LEED

Because it offers high thermal efficiency, zero ozone depletion potential, and high levels of recycled content, Polyiso is an ideal choice for LEED building designs. PIMA Technical Bulletin 116: "An Integral Part of Sustainable Building and LEED Credits" provides detailed information how Polyiso may contribute to specific LEED Prerequisites and Credits.

OTHER RELEVANT INFORMATION

Fire Performance: Polyiso remains the only foam plastic roof insulation to earn FM Class 1 approval for direct application to steel deck when tested in accordance with FM Approval 4450 Class I Insulated Steel Deck Roofs. Polyiso is also classified by UL under UL 1256 Standard for Fire Test of Roof Deck Constructions for direct application to steel deck under both single-ply and asphalt-based roof coverings. Additional information on Polyiso roof insulation fire performance is available in the following PIMA Technical Bulletins, which may be downloaded at the PIMA website (www.polyiso.org).

- PIMA Technical Bulletin 104: Fire Performance in Roof Systems
- PIMA Technical Bulletin 105: Fire Test Definitions
- PIMA Technical Bulletin 111: Class A and Class 1 Roof Assemblies Are Not the Same

Useful Life Span of the Product: Because Polyiso roof insulation is incorporated within a larger roofing system assembly, the most significant determinant of Polyiso insulation service life is the service life of the roofing system itself. Because roofing system service life is influenced by many variables (including system design, durability of components, quality of installation, ongoing maintenance procedures, periodic system refurbishment, severe weather events, and physical abuse), historical studies of roof system performance identify a very wide range of effective roof service life. In addition to historical studies, it is important to recognize that the extension of roof system service life has become a high priority within the building design community and roofing industry, in order to reduce the overall environmental impact of roof systems. As a result, it is very difficult to quantify the service life of Polyiso roof insulation independent of specific design, application, and maintenance conditions.

Because the LCA impact results reported in this declaration are based on a 60-year service life, the data may be interpolated for service lives less than 60 years simply by dividing the data by the lower estimated service life and multiplying the result by 60 years.

Quality Management Program

PIMA QualityMark℠ The Certified LTTR-value

The PIMA QualityMark[cm] Certification program allows participating Polyiso manufacturers to certify the Long Term Thermal Resistance (LTTR) values of their Polyiso insulation products through an independent third party. For over ten years, LTTR values for roof insulation under the QualityMark program have been reported and certified in accordance with the relevant testing requirements of ASTM C1289 "Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board." Additional information about QualityMark is available at the PIMA website.

REFERENCES

- ISO 14044-2006 Environmental Management - Life Cycle Assessment - Requirements and Guidelines. International Organization for Standardization (ISO).
- ISO 14025-2006 Environmental labels and declarations - Type III Environmental Declarations - Principles and Procedures. International Organization for Standardization (ISO).
- ISO 21930-2007 Sustainability in Building construction - Environmental Declaration of Building Products. International Organization for Standardization (ISO).
- Life Cycle Assessment of Polyiso Insulation (Date TBD). Boston, MA: PE Americas
- Phelan, J., Hoff, J., and Pavlovich, G. (2010). The energy and environmental potential of commercial buildings: Implications for energy policy and industry growth through green building market transformation. Proceedings of the RCI, Inc. 25th International Convention and Trade Show: Exploring the Sustainably Built Environment, 213-230. Raleigh, NC: RCI, Inc.
- UL 110116-2011 Product Category Rule for Building Envelope Thermal Insulation. Underwriters Laboratories. 3 September 2011.

[1] See Phelan, Hoff, & Pavlovich (2010). Note: Net energy savings varied from 9 times initial embodied energy in U.S. Climate Zone 2 (Typical city: Houston, Texas) to 44 times initial embodied energy in U.S. Climate Zone 6 (Typical city: Minneapolis, MN). Modeling based on the typical configuration and energy demand of a strip mall shopping center as identified in the U.S. DOE Commercial Building Benchmark Project.

www.Polyiso.org • pima@pima.org
529 14th Street NW, Suite 750, Washington, DC 20045
PHONE: 202.207.1136 Fax: 202.591.2445