Environmental Product Declaration

EnergyGuard™ NH Polyiso Insulation

GAF, a Standard Industries company, is the leading roofing and waterproofing manufacturer in North America. For more than 135 years, GAF has been trusted to protect what matters most for families, communities and business owners with its innovative solutions and focus on customer service. GAF's leadership extends to its commitment to making a positive impact on its communities, industry, and planet. Learn more at www.GAF.com.

Certified Environmental Product Declaration
www.nsf.org

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025 and ISO 21930-2017. 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.

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	NSF International, 789 N. Dixboro Rd, Ann Arbor, MI 48105,www.nsf.org
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	NSF Certification Policies for Environmental Product Declarations (EPD): November 1, 2022
MANUFACTURER NAME AND ADDRESS	GAF 1 Campus Drive Parsippany, NJ 07054
DECLARATION NUMBER	EPD10151
DECLARED PRODUCT & FUNCTIONAL UNIT OF DECLARED UNIT	EnergyGuard™ NH Polyiso Insulation Functional Unit = 1 m² of installed insulation material with a thickness that gives an average thermal resistance RSI = 1 m²K/W with a building service life of 75 years over a 75 year building lifetime
REFERENCE PCR AND VERSION NUMBER	UL Part B v2.0: Building Envelope Thermal Insulation EPD Requirements Valid through November 15, 2021.
DESCRIPTION OF PRODUCT APPLICATION/USE	Thermal Insulation for Roofing Applications
PRODUCT RSL DESCRIPTION	40 Years
MARKETS OF APPLICABILITY	Global
DATE OF ISSUE	12/08/2023 - 12/08/2028
PERIOD OF VALIDITY	5 Years
EPD TYPE	Product Specific
DATASET VARIABILITY	N/A
EPD SCOPE	Cradle-to-Grave
YEAR(S) OF REPORTED PRIMARY DATA	2021
LCA SOFTWARE & VERSION NUMBER	LCA for Experts v. 10.6 GAF EPD Generator Tool Version 1.0
LCI DATABASE(S) & VERSION NUMBER	Sphera database & USLCI v2.0
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1; CML 4.1
The sub-category PCR review was conducted by:	
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v3.2 (Dec 2018), based on ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017) ☐ INTERNAL ☒ EXTERNAL	Jack Geibig, EcoForm, LLC jgeibig@ecoform.com
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Sustainable Solutions Corporation
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Jack Geibig, EcoForm, LLC jgeibig@ecoform.com

Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance using EPD information shall consider all relevant information modules over the fulllife cycle of the products within the building. Comparison of the environmental performance of Building Envelope Thermal Insulation 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. This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. It should be noted that different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared. Full conformance with the PCR for Building Envelope Thermal Insulation allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

General Information

Description of Company/Organization

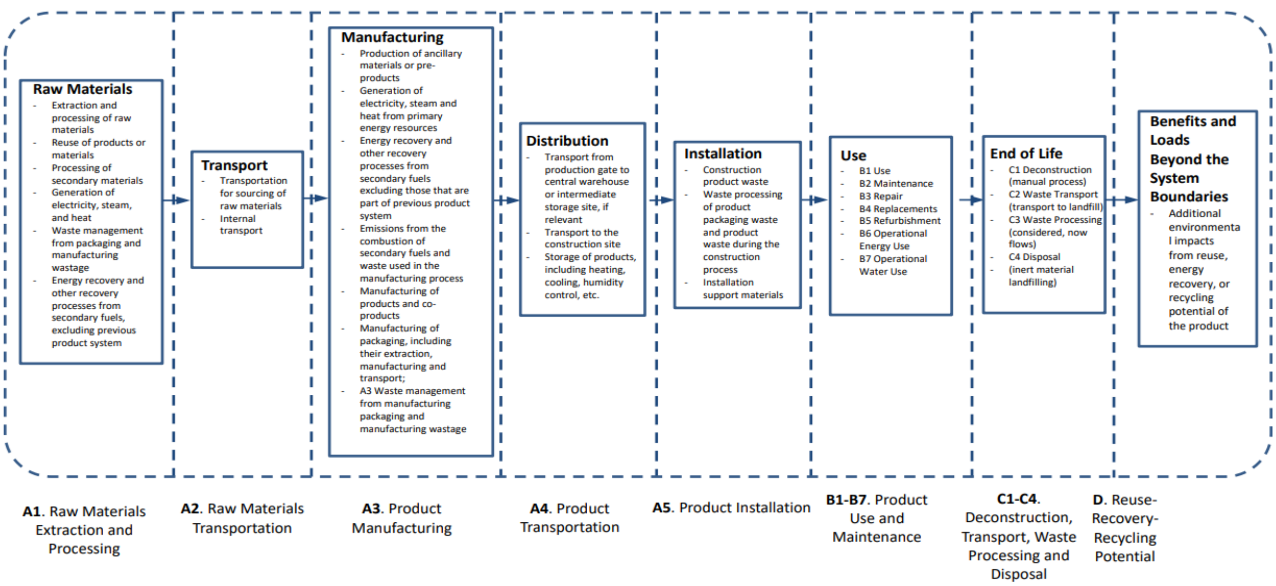
Founded in 1886, GAF is the leading roofing manufacturer in North America. As a member of the Standard Industries family of companies, GAF is part of the largest roofing and waterproofing business in the world. The company's products include a comprehensive portfolio of roofing and waterproofing solutions for residential and commercial properties as well as for civil engineering applications. The full GAF portfolio of solutions is supported by an extensive national network of factory-certified contractors. GAF continues to be the leader in quality and offers comprehensive warranty protection on its products and systems. The company's success is driven by a commitment to empowering its people to deliver advanced quality and purposeful innovation. For more information about GAF, visit www.gaf.com.

Product Description

Product Name: EnergyGuard™ NH Polyiso Insulation
Product Characteristic: EnergyGuard™ NH Polyiso Insulation contains no potentially hazardous flame retardant chemicals.

Additional features include:
- Easy to Handle: Light weight and easy to cut and install
- Excellent Performance: Highest R value per inch compared to any other type of non polyiso insulation of equivalent thickness.
- Versatile: Approved component in single ply, BUR, and modified bitumen systems with a variety of attachment methods MA, FA Loose laid and ballasted

Flow Diagram



Manufacturer Specific EPD

This product-specific EPD was developed based on the cradle-to-grave (modules A1-C4) Life Cycle Assessment. The EPD accounts for raw material extraction and processing, transport, product manufacturing, distribution, installation, use, and disposal. Manufacturing data were gathered directly from company personnel. For any product group EPDs, an impact assessment was completed for each product. Product grouping was considered appropriate if the individual product impacts differed by no more than ±10% in any impact category.
Additionally, one insulation product can vary by its insulation rating. This EPD reports the environmental impacts of multiple different thicknesses by using "scaling factor" tables. These tables provide an equation to be able to calculate the emissions for any thickness of this product. The impacts will scale linearly by their thickness.

Application

Product Applications: Thermal Insulation for Roofing Applications

Material Composition

The primary product components and/or materials must be indicated as a percentage mass to enable the user of the EPD to understand the composition of the product in delivery status.

The average composition of a EnergyGuard™ NH Polyiso Insulation is as follows:

	Percentage in mass (%)
Material	**Value**
Polyol, MDI, and Flame Retardant A or B	75-80%
Blowing Agent	4.2-6.0%
Water	0.1-0.3%
Catalyst	0.6-1.9%
Surfactant	0.4-0.5%
Paper Facer	13-16%
Total	**100.00%**

**The GAF product modelled in this study contains no substances that are required to be reported as hazardous, nor are any such substances utilized in its production.*

Placing on the Market / Application Rules

The standards and criteria that can be applied for EnergyGuard™ NH Polyiso Insulation are:
-Meets the requirements of ASTM C1289, Type II, Class 1, Grade 2 (20 psi), and available in Grade 3 (25 psi)
- FM Approved
- Classified by UL in accordance with ANSI/UL 1256, UL 790, and UL 263
- UL Evaluation Report ER1306-03
- Miami-Dade County Product Control Approved
- State of Florida Approved

Properties of Declared Product as Shipped

After manufacturing, the product is packaged for shipment to the customer. Packaging includes a plastic film that wraps around the entire product. This may be recyclable in some markets, but for the purposes of this EPD it is assumed to be landfilled. Product is available in 4' x 4' (1.22 m x 1.22 m) and 4' x 8' (1.22 m x 2.44 m) boards. Available in a variety of thicknesses from 1.0" (25.4 mm) to 4.6" (116 mm).

Methodological Framework

Functional Unit

The declaration refers to the functional unit of 1 m² of installed insulation material with a thickness that gives an average thermal resistance RSI = 1 m²K/W with a building service life of 75 years as specified in the PCR.

Name	Value	Unit
Functional unit	1 m² of installed insulation material with a thickness that gives an average thermal resistance RSI = 1 m²K/W with a building service life of 75 years	
Mass	1.27	kg
Thickness to achieve functional unit	0.0253	m
Thickness to achieve functional unit	0.996	inches
R-values is determined in accordance with ASTM C1303		

System Boundary

This is a cradle-to-grave Environmental Product Declaration. The following life cycle phases were considered:

Product Stage			Construction Process Stage		Use Stage							End-of-Life Stage*				Benefits and Loads Beyond the System Boundaries
Raw material supply	Transport	Manufacturing	Transport from gate to the site	Construction/ installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction /demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MND

Description of the System Boundary Stages Corresponding to the PCR

(X = Included; MND = Module Not Declared)

*This includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues.

Reference Service Life

The use phase follows the installation of polyiso roof insulation boards. In a roofing system, the insulation is located on top of a roof deck and below the roof membrane. The roof membrane when installed properly and adequately maintained, protects the insulation from the environmental elements and weather during its use. Therefore, it is expected that polyiso will not sustain damage that affects its performance and function, and does not require maintenance. As defined in the governing PCR, the Building Estimated Service Life (ESL) is 75 years. The necessary steps for providing weather protection are specified by manufacturer installation instructions and are mandated by model building codes. The roof membrane's useful life span is influenced by many variables including roof system design, quality of the installation, type and durability of the membrane, roof system component configuration and maintenance as well as weather conditions and events. However, the real world reroofing scenarios, building owner tendencies, and the expected service life of roof membranes all indicate that reroofing activity will take place during the 75-year building ESL.

Reroofing activity may initially occur at 15-30 years after the installation of the original system and driven by recurring roof leaks that cannot be remedied by patch repairs of the membrane. When reroofing is required, options are available to address the need for a new roof membrane without the need to replace the insulation. The model building codes describe a "Roof Recover" as an acceptable reroofing practice, which occurs when a new roof covering is installed on top of the existing roof system without disturbing or removing the existing roof covering or the insulation below. Roof Recover, as defined by industry practices, involves visual examination and appropriate testing to ensure that all roof components, including insulation, have not sustained damage or deterioration. This approach allows the insulation to be reused instead of being disposed of into a landfill. The Roof Recover approach is a common practice in the roofing industry, it is permitted by model building codes, and allows the service life of a roof system to be extended (without the need to replace the insulation). Although the Roof Recover approach is a common practice, it is often not captured in reroofing studies available in the public domain, which typically contemplate a full roof replacement. Pertinent to this declaration, we recognize a 20-year life span for the original installation of the membrane followed by a Roof Recover, which extends the life of the original roof system to 40 years. This practice establishes a 40-year RSL for polyiso roof insulation boards with a Roof Recover. The model building codes allow a roof to be recovered only once. Where two roof membranes are installed on an existing roof, a reroofing process referred to as a "Roof Replacement" is required. This process involves the removal of all roof components down to the roof deck. This study conservatively assumes all insulation is disposed in the landfill during a Roof Replacement. Therefore, the polyiso roof insulation boards' cradle-to-grave assessment incorporates all life cycle stage environmental impacts connected with the original building construction, a Roof Recover operation at 20-years, as well as the building's Roof Replacement operation at 40-years. This translates to 1.9 replacement cycles during the 75-year building ESL (75-year ESL/40-year RSL = 1.9 replacement cycles).

Allocation

Allocation was determined on a mass basis. Since multiple facilities produced these products, a weighted average by production mass was used to determine manufacturing inputs. When facilities manufacture additional product types, facility allocation is done based on mass of production. No co-products are produced, so no co-product allocation was performed.

Cut-off Criteria

Processes whose total contribution to the final result, with respect to their mass and in relation to all considered impact categories, is less than 1% can be neglected. The sum of the neglected processes may not exceed 5% by mass of the considered impact categories. For that a documented assumption is admissible.

For Hazardous Substances the following requirements apply:

- The Life Cycle Inventory (LCI) of hazardous substances will be included, if the inventory is available.
- If the LCI for a hazardous substance is not available, the substance will appear as an input in the LCI of the product.
- If the LCI of a hazardous substance is approximated by modeling another substance, documentation will be provided.

This EPD is in compliance with the cut-off criteria. No processes were neglected or excluded. Capital items for the production processes (machine, buildings, etc.) were not taken into consideration.

Data Sources

Primary data were collected for every process in the product system under the control of GAF. Secondary data from the Sphera and USLCI databases were utilized when necessary. These data were evaluated and have temporal, geographic, and technical coverage appropriate to the scope of the product category.

Data Quality

The data sources used are complete and representative of global systems in terms of the geographic and technological coverage and are a recent vintage (i.e., less than ten years old). The data used for primary data are based on direct information sources of the manufacturers. Secondary data sets were used for raw materials extraction and processing, end of life, transportation, and energy production flows. Wherever secondary data is used, the study adopts critically reviewed data for consistency, precision, and reproducibility to limit uncertainty. When a material is not available in the available LCI databases, another chemical which has similar manufacturing and environmental impacts may be used as a proxy, representing the actual chemical. Please see Appendix A in the LCA report for the full breakdown of the data sources.

Important data quality factors include precision (measured, calculated, or estimated), completeness (e.g., unreported emissions or excluded flows), consistency (uniformity of the applied methodology throughout the study), and reproducibility (ability for another researcher reproduce the results based on the methodological information provided). Each dataset has an overall rating from one to four, one being “very good” and four being “poor.” The individual datasets were scored and aggregated to determine the data has an overall average rating of 2.1, which is considered good.

Period Under Review

The period under review is the full calendar year of 2021.

Treatment of Biogenic Carbon

The uptake and release of biogenic carbon throughout the product life cycle follows ISO 21930:2017 Section 7.2.7.

Comparability and Benchmarking

A comparison or an evaluation of EPD data is only possible if all data sets to be compared were created according to ISO 21930 and the building context, respectively the product-specific characteristics of performance, are taken into account. Environmental declarations from different programs may not be comparable. When comparing EPDs created using this PCR, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared. In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers as the EPD results may. These 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. Third party verified ISO 14040/44 secondary LCI data sets contribute more than 67% of total impact (either at the unit process level or in aggregate) to any of the required impact categories identified by the applicable PCR.

Units

The LCA results within this EPD are reported in SI units.

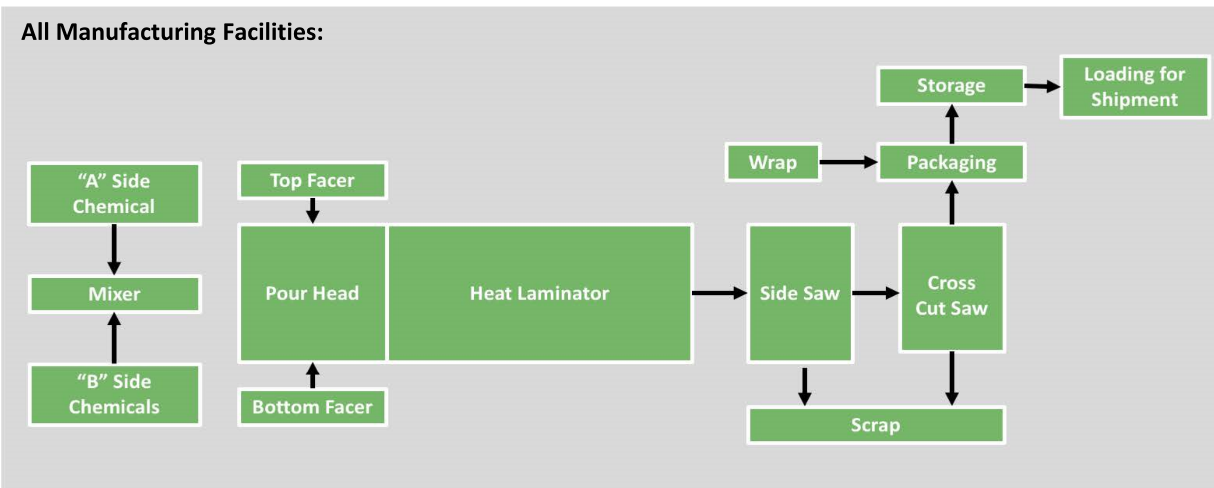
Additional Environmental Information

Background data

For life cycle modeling of the considered products, the GaBi v10.6 Software System for Life Cycle Engineering, developed by Sphera, is used. The Sphera and USLCI databases contain consistent and documented datasets which are documented online. To ensure comparability of results in the LCA, the basic data of the Sphera database were used for energy, transportation, and auxiliary materials. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks" immediately prior to the results.

Manufacturing

Polyiso board insulation is manufactured in Cedar City, Utah; Gainesville, Texas; New Columbia, Pennsylvania; Statesboro, Georgia and begins with the inbound reception of raw materials. The process begins with adding the chemicals for the two side mixtures to a mixer. The mixtures are mixes and then poured onto the top and bottom facers separately. The facers with applied mixtures are sent through a heat laminator where they are cured into a solid piece of board insulation. The board exits the laminator and is sent to a set of saws to refine the dimensions. Once the board dimensions have been refined, the board is sent to packaging where it is palletized on boards made from the scrap material from the saw processes, shrink wrapped, and sent to storage before ultimately being sent out for final distribution.



Packaging

The packaging material is composed primarily of plastic materials. Board insulation products are shipped on pallets made of repurposed board insulation and wrapped in plastic film.

	Quantity (% By Weight)
Material	**Value**
Cardboard	0.00%
Wood	0.00%
Paper	0.00%
Plastic	100.00%
Total	**100.00%**

Transportation

Transport to Building Site (A4)		
Name	**Value**	**Unit**
Fuel type	Diesel	
Liters of fuel	38	l/100km
Vehicle Type	Truck	
Transport distance	734	km
Capacity utilization (including empty runs)	90	%
Gross density of products transported	50	kg/m^3
Weight of products transported	-	kg
Volume of products transported	-	m^3
Capacity utilization volume factor	-	-

Product Installation

Detailed installation instructions are provided online along with the type of fasteners or adhesive required for each product. Installation equipment is required though not included in the study as these are multi-use tools and the impacts per declared unit is considered negligible. 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. At the end-of-life, some of the packaging was sent to incineration and recycling along with landfill.

Installation into the building (A5)		
Name	**Value**	**Unit**
Auxiliary materials	-	kg
Water consumption	-	m^3
Other resources	-	kg
Electricity consumption	-	kWh
Other energy carriers	-	MJ
Product loss per functional unit	-	kg
Waste materials at construction site	-	kg
Output substance (recycle)	-	kg
Output substance (landfill)	1.27	kg
Output substance (incineration)	-	kg
Packaging waste (recycle)	0.00	kg
Packaging waste (landfill)	0.19	kg
Packaging waste (incineration)	0.00	kg
Direct emissions to ambient air*, soil, and water	0	kg CO_2
VOC emissions	-	kg

*CO2 emissions to air from disposal of packaging

Reference Service Life		
Name	**Value**	**Unit**
Reference Service Life	40	years
Estimated Building Service Life	75	years
Number of Replacements	0.9	number

Product Use

No cleaning, maintenance (B2), repair (B3) or refurbishment (B5) activities are required. In addition, the product consumes no water or electricity during its use (B6-B7).

Use (B4)		
Name	**Value**	**Unit**
Replacement Cycle	0.0	Number/RSL
Replacement Cycle	0.9	Number/ESL
Further assumptions for scenario development, e.g. frequency and time period of use	Assumes reroofing every 20 years with a maximum of 1 reroof before replacement	-

Disposal

The packaging waste is assumed to be 100% landfilled in the end-of-life disposal, in accordance with the PCR. Product waste at the end-of-life can de disposed where appropriate, but is assumed to be landfilled based on common practice of these materials. The product and its packaging contain no biogenic content.

End of life (C1-C4)		
Name	**Value**	**Unit**
Collected separately	0.00	kg
Collected as mixed construction waste	1.27	kg
Reuse	0.00	kg
Recycling	0.00	kg
Landfilling	1.27	kg
Incineration with energy recovery	0.00	kg
Energy conversion	-	%

Re-use Phase

Re-use of the product is not common due to the nature of installation of the product into the building envelope.

LCA Results for 0.996" Board

LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

To determine the environmental impacts for insulation products with varying insulation ratings, refer to the section below titled "Scaling Factors for Varying Thicknesses".

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment										
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**B4**	**C1**	**C2**	**C3**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	1.84E+00	8.64E-02	1.66E-01	2.30E+00	0.00E+00	1.90E-02	0.00E+00	4.41E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.76E-08	3.27E-12	9.38E-16	4.28E-08	0.00E+00	7.17E-13	0.00E+00	1.70E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	6.18E-03	5.19E-04	9.36E-05	9.11E-03	0.00E+00	1.14E-04	0.00E+00	3.21E-03
EP	Eutrophication potential	kg N-Eq.	4.17E-04	2.87E-05	7.62E-05	1.58E-03	0.00E+00	6.31E-06	0.00E+00	1.23E-03
SP	Smog formation potential	kg O_3-Eq.	7.96E-02	1.43E-02	1.22E-03	9.62E-02	0.00E+00	3.13E-03	0.00E+00	8.61E-03
FFD	Fossil Fuel Depletion	MJ-surplus	6.09E+00	1.53E-01	2.74E-02	5.76E+00	0.00E+00	3.35E-02	0.00E+00	1.02E-01

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment										
Paramete	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**B4**	**C1**	**C2**	**C3**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	1.84E+00	8.67E-02	1.67E-01	2.44E+00	0.00E+00	1.90E-02	0.00E+00	6.08E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.34E-08	3.26E-12	5.46E-14	3.91E-08	0.00E+00	7.15E-13	0.00E+00	9.93E-14
AP	Acidification potential for air emissions	kg SO_2-Eq.	6.06E-03	4.26E-04	8.28E-05	7.07E-03	0.00E+00	9.34E-05	0.00E+00	1.19E-03
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	6.09E-04	7.60E-05	7.92E-05	2.04E-03	0.00E+00	1.67E-05	0.00E+00	1.49E-03
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	7.42E-04	4.98E-05	1.80E-06	9.88E-04	0.00E+00	1.09E-05	0.00E+00	2.93E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	3.57E-06	3.60E-11	1.38E-08	3.25E-06	0.00E+00	7.88E-12	0.00E+00	2.38E-08
ADPF	Abiotic depletion potential for fossil resources	MJ	4.52E+01	1.10E+00	2.28E-01	4.28E+01	0.00E+00	2.42E-01	0.00E+00	7.86E-01

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results below contain the resource use throughout the life cycle of the product.

Resource Use										
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**B4**	**C1**	**C2**	**C3**	**C4**
RPR_E	Renewable primary energy as energy carrier	MJ	1.91E+00	0.00E+00	3.16E-02	1.81E+00	0.00E+00	0.00E+00	0.00E+00	7.60E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	-9.42E+00	1.11E+00	2.38E-01	-6.32E+00	0.00E+00	2.43E-01	0.00E+00	8.04E-01
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	1.07E+01	0.00E+00	0.00E+00	9.67E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	9.53E-01	0.00E+00	0.00E+00	8.58E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	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	Use of nonrenewable secondary fuels	MJ	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	Energy recovered from disposed waste	MJ	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	Use of net fresh water	m^3	1.38E-02	0.00E+00	3.74E-04	1.29E-02	0.00E+00	0.00E+00	0.00E+00	1.80E-04

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results below contain the output flows and wastes throughout the life cycle of the product.

Output Flows and Waste Categories										
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**B4**	**C1**	**C2**	**C3**	**C4**
HWD	Hazardous waste disposed	kg	5.27E-07	0.00E+00	1.16E-11	4.75E-07	0.00E+00	0.00E+00	0.00E+00	3.00E-11
NHWD	Non-hazardous waste disposed	kg	4.13E-02	0.00E+00	2.96E-01	1.30E+00	0.00E+00	0.00E+00	0.00E+00	1.11E+00
HLRW	High-level radioactive waste	kg or m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg or m^3	3.27E-04	0.00E+00	3.98E-06	3.05E-04	0.00E+00	0.00E+00	0.00E+00	7.03E-06
CRU	Components for re-use	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
MR	Materials for recycling	kg	1.69E-02	0.00E+00	0.00E+00	1.52E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	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
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

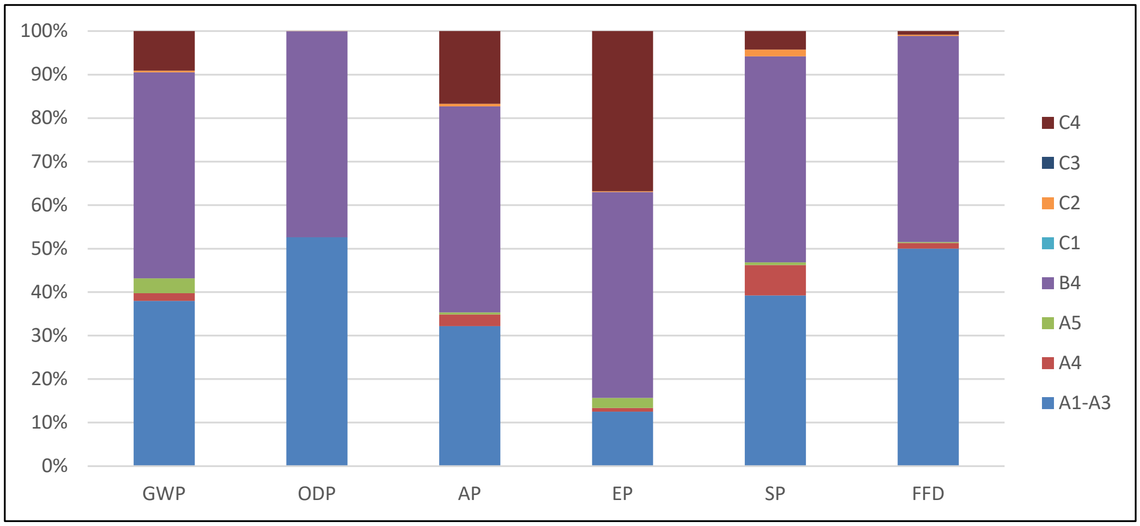
Results below contain direct greenhouse gas emissions and removals throughout the life cycle of the product.

Carbon Emissions and Removals										
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**B4**	**C1**	**C2**	**C3**	**C4**
BCRP	Biogenic Carbon Removal from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEP	Biogenic Carbon Emissions from Product	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	Biogenic Carbon Emissions from Packaging	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	Biogenic Carbon Emissions from Combustion of Waste from Renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCE	Calcination Carbon Emissions	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CCR	Carbonation Carbon Removal	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CWNR	Carbon Emissions from Combustion of Waste from Non-renewable Sources Used in Production Process	kg CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

LCA Interpretation

The replacements stage, B4, incorporates all impacts times 0.9 of the other stages. It therefore is the singularly most impactful stage. However, for 1 lifetime, the production life cycle stage (A1-A3) dominates the impacts across all impact categories. This is due to the upstream production of materials used in the product, along with natural gas use in the manufacturing of the product. The end-of-life disposal stage (C4) has significant impact in global warming potential, acidification, and eutrophication due to the 100% landfill assumption.



Emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in these categories:

— renewable primary energy resources as energy (fuel), (RPRE);
— renewable primary resources as material, (RPRM);
— non-renewable primary resources as energy (fuel) ,(NRPRE);
— non-renewable primary resources as material (NRPRM);
— secondary materials (SM);
— renewable secondary fuels (RSF);
— non-renewable secondary fuels (NRSF);
— recovered energy (RE);
— abiotic depletion potential for non-fossil mineral resources (ADPelements).
— land use related impacts, for example on biodiversity and/or soil fertility;
— toxicological aspects;
— emissions from land use change [GWP 100 (land-use change)];
— hazardous waste disposed;
— non-hazardous waste disposed;
— high-level radioactive waste;
— intermediate and low-level radioactive waste;
— components for reuse;
— materials for recycling;
— materials for energy recovery; and
— recovered energy exported from the product system.

Scaling Factors for Varying Thicknesses

To determine the environmental impacts for insulation products with varying insulation ratings, use the following equation:
Impact per meter = x + n*y, where
*x is the impact from the static facer
*n is the thickness ratio of the desired product to the baseline product (results shown above)
*y is the impact of foam for 1 additional m2K/W ("For Varying Foam Thickness")

Example: A1-A3 GWP Impact (2" Board) = 9.38E-02 + (2"/0.996") * 1.75E+00
A1-A3 GWP Impact (2" Board) = 9.38E-02 + 0.22 * 1.75E+00
A1-A3 GWP Impact (2" Board) = 3.61 kg CO2-Eq.

Scaling Factors Table - Static Facer Impacts

Parameter	Parameter	Unit	A1-A3	A4	A5	B4	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	x	x	x	x	x	x	x	x
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	x	x	x	x	x	x	x	x
AP	Acidification potential for air emissions	kg SO_2-Eq.	x	x	x	x	x	x	x	x
EP	Eutrophication potential	kg N-Eq.	x	x	x	x	x	x	x	x
SP	Smog formation potential	kg O_3-Eq.	x	x	x	x	x	x	x	x
FFD	Fossil Fuel Depletion	MJ-surplus	x	x	x	x	x	x	x	x

Scaling Factors Table - For Varying Foam Thickness

Parameter	Parameter	Unit	A1-A3	A4	A5	B4	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	y	y	y	y	y	y	y	y
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	y	y	y	y	y	y	y	y
AP	Acidification potential for air emissions	kg SO_2-Eq.	y	y	y	y	y	y	y	y
EP	Eutrophication potential	kg N-Eq.	y	y	y	y	y	y	y	y
SP	Smog formation potential	kg O_3-Eq.	y	y	y	y	y	y	y	y
FFD	Fossil Fuel Depletion	MJ-surplus	y	y	y	y	y	y	y	y

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment - x values

Parameter	Parameter	Unit	A1-A3	A4	A5	B4	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	9.38E-02	3.31E-02	8.31E-02	3.48E-01	0.00E+00	0.00E+00	0.00E+00	1.69E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	3.40E-13	1.25E-12	4.69E-16	1.68E-12	0.00E+00	0.00E+00	0.00E+00	6.53E-16
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.70E-04	1.99E-04	4.68E-05	1.52E-03	0.00E+00	0.00E+00	0.00E+00	1.23E-03
EP	Eutrophication potential	kg N-Eq.	3.00E-05	1.10E-05	3.81E-05	4.96E-04	0.00E+00	0.00E+00	0.00E+00	4.70E-04
SP	Smog formation potential	kg O_3-Eq.	2.91E-03	5.47E-03	6.10E-04	1.21E-02	0.00E+00	0.00E+00	0.00E+00	3.30E-03
FFD	Fossil Fuel Depletion	MJ-surplus	1.30E-01	5.85E-02	1.37E-02	2.29E-01	0.00E+00	0.00E+00	0.00E+00	3.90E-02

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results shown below were calculated using TRACI 2.1 Methodology.

TRACI 2.1 Impact Assessment - y values										
Parameter	Parameter	Unit	A1-A3	A4	A5	B4	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	1.75E+00	5.33E-02	8.31E-02	1.95E+00	0.00E+00	1.17E-02	0.00E+00	2.72E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.76E-08	2.02E-12	4.69E-16	4.28E-08	0.00E+00	4.42E-13	0.00E+00	1.05E-15
AP	Acidification potential for air emissions	kg SO_2-Eq.	6.01E-03	3.20E-04	4.68E-05	7.59E-03	0.00E+00	7.02E-05	0.00E+00	1.98E-03
EP	Eutrophication potential	kg N-Eq.	3.87E-04	1.77E-05	3.81E-05	1.08E-03	0.00E+00	3.89E-06	0.00E+00	7.57E-04
SP	Smog formation potential	kg O_3-Eq.	7.67E-02	8.82E-03	6.10E-04	8.41E-02	0.00E+00	1.93E-03	0.00E+00	5.31E-03
FFD	Fossil Fuel Depletion	MJ-surplus	5.96E+00	9.43E-02	1.37E-02	5.53E+00	0.00E+00	2.07E-02	0.00E+00	6.28E-02

All use phase and disposal stages have been considered and only those with non-zero values have been reported

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment - x values										
Paramete	Parameter	Unit	A1-A3	A4	A5	B4	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	8.10E-02	3.32E-02	8.33E-02	3.94E-01	0.00E+00	7.28E-03	0.00E+00	2.33E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	5.43E-13	1.25E-12	2.73E-14	1.92E-12	0.00E+00	2.74E-13	0.00E+00	3.80E-14
AP	Acidification potential for air emissions	kg SO_2-Eq.	1.32E-04	1.63E-04	4.14E-05	7.46E-04	0.00E+00	3.58E-05	0.00E+00	4.57E-04
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	3.77E-05	2.91E-05	3.96E-05	6.14E-04	0.00E+00	6.38E-06	0.00E+00	5.69E-04
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.58E-05	1.91E-05	9.01E-07	1.37E-04	0.00E+00	4.18E-06	0.00E+00	1.12E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	2.46E-08	1.38E-11	6.88E-09	3.65E-08	0.00E+00	3.02E-12	0.00E+00	9.14E-09
ADPF	Abiotic depletion potential for fossil resources	MJ	1.18E+00	4.22E-01	1.14E-01	1.89E+00	0.00E+00	9.26E-02	0.00E+00	3.01E-01

All use phase and disposal stages have been considered and only those with non-zero values have been reported

Results shown below were calculated using CML 2001 - April 2013 Methodology.

CML 4.1 Impact Assessment - y values										
Paramete	Parameter	Unit	A1-A3	A4	A5	B4	C1	C2	C3	C4
GWP	Global warming potential	kg CO_2-Eq.	1.75E+00	5.35E-02	8.33E-02	2.05E+00	0.00E+00	1.17E-02	0.00E+00	3.75E-01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	4.34E-08	2.01E-12	2.73E-14	3.91E-08	0.00E+00	4.41E-13	0.00E+00	6.13E-14
AP	Acidification potential for air emissions	kg SO_2-Eq.	5.93E-03	2.63E-04	4.14E-05	6.32E-03	0.00E+00	5.76E-05	0.00E+00	7.36E-04
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	5.71E-04	4.69E-05	3.96E-05	1.43E-03	0.00E+00	1.03E-05	0.00E+00	9.17E-04
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	7.26E-04	3.07E-05	9.01E-07	8.51E-04	0.00E+00	6.73E-06	0.00E+00	1.81E-04
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	3.55E-06	2.22E-11	6.88E-09	3.21E-06	0.00E+00	4.86E-12	0.00E+00	1.47E-08
ADPF	Abiotic depletion potential for fossil resources	MJ	4.40E+01	6.80E-01	1.14E-01	4.09E+01	0.00E+00	1.49E-01	0.00E+00	4.85E-01

All use phase and disposal stages have been considered and only those with non-zero values have been reported

Results below contain the resource use throughout the life cycle of the product.

Resource Use - x values

Parameter	Parameter	Unit	A1-A3	A4	A5	B4	C1	C2	C3	C4
RPR_E	Renewable primary energy as energy carrier	MJ	5.76E-01	0.00E+00	1.58E-02	5.59E-01	0.00E+00	0.00E+00	0.00E+00	2.91E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	-4.05E+00	4.26E-01	1.19E-01	-2.79E+00	0.00E+00	9.34E-02	0.00E+00	3.08E-01
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	5.37E+00	0.00E+00	0.00E+00	4.84E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	4.77E-01	0.00E+00	0.00E+00	4.29E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	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	Use of nonrenewable secondary fuels	MJ	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	Energy recovered from disposed waste	MJ	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	Use of net fresh water	m^3	6.61E-04	0.00E+00	1.87E-04	8.25E-04	0.00E+00	0.00E+00	0.00E+00	6.88E-05

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results below contain the resource use throughout the life cycle of the product.

Resource Use - y values

Parameter	Parameter	Unit	A1-A3	A4	A5	B4	C1	C2	C3	C4
RPR_E	Renewable primary energy as energy carrier	MJ	1.33E+00	0.00E+00	1.58E-02	1.26E+00	0.00E+00	0.00E+00	0.00E+00	4.69E-02
RPR_M	Renewable primary energy resources as material utilization	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	Nonrenewable primary energy as energy carrier	MJ	-5.37E+00	6.86E-01	1.19E-01	-3.53E+00	0.00E+00	1.50E-01	0.00E+00	4.96E-01
$NRPR_M$	Nonrenewable primary energy as material utilization	MJ	5.37E+00	0.00E+00	0.00E+00	4.84E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SM	Use of secondary material	kg	4.77E-01	0.00E+00	0.00E+00	4.29E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	Use of renewable secondary fuels	MJ	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	Use of nonrenewable secondary fuels	MJ	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	Energy recovered from disposed waste	MJ	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	Use of net fresh water	m^3	1.31E-02	0.00E+00	1.87E-04	1.21E-02	0.00E+00	0.00E+00	0.00E+00	1.11E-04

**All use phase and disposal stages have been considered and only those with non-zero values have been reported*

Results below contain the output flows and wastes throughout the life cycle of the product.

Output Flows and Waste Categories - x values										
Parameter	Parameter	Unit	A1-A3	A4	A5	B4	C1	C2	C3	C4
HWD	Hazardous waste disposed	kg	2.27E-09	0.00E+00	5.78E-12	2.06E-09	0.00E+00	0.00E+00	0.00E+00	1.15E-11
NHWD	Non-hazardous waste disposed	kg	1.31E-02	0.00E+00	1.48E-01	5.26E-01	0.00E+00	0.00E+00	0.00E+00	4.23E-01
HLRW	High-level radioactive waste	kg or m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg or m^3	5.98E-05	0.00E+00	1.99E-06	5.80E-05	0.00E+00	0.00E+00	0.00E+00	2.69E-06
CRU	Components for re-use	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
MR	Materials for recycling	kg	8.45E-03	0.00E+00	0.00E+00	7.60E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	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
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

All use phase and disposal stages have been considered and only those with non-zero values have been reported

Results below contain the output flows and wastes throughout the life cycle of the product.

Output Flows and Waste Categories - y values										
Parameter	Parameter	Unit	A1-A3	A4	A5	B4	C1	C2	C3	C4
HWD	Hazardous waste disposed	kg	5.25E-07	0.00E+00	5.78E-12	4.73E-07	0.00E+00	0.00E+00	0.00E+00	1.85E-11
NHWD	Non-hazardous waste disposed	kg	2.81E-02	0.00E+00	1.48E-01	7.72E-01	0.00E+00	0.00E+00	0.00E+00	6.82E-01
HLRW	High-level radioactive waste	kg or m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	Intermediate- and low-level radioactive waste	kg or m^3	2.68E-04	0.00E+00	1.99E-06	2.47E-04	0.00E+00	0.00E+00	0.00E+00	4.34E-06
CRU	Components for re-use	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
MR	Materials for recycling	kg	8.45E-03	0.00E+00	0.00E+00	7.60E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	Materials for energy recovery	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
EE	Recovered energy exported from system	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

All use phase and disposal stages have been considered and only those with non-zero values have been reported

Additional Environmental Information

Environmental and Health During Manufacturing

During the manufacturing of EnergyGuard™ NH Polyiso Roof Insulation, all legal regulations regarding emissions to air, wastewater discharge, solid waste disposal and noise emissions are followed.

Environmental and Health During Installation

There is no harmful emissive potential. No damage to health or impairment is expected under normal use corresponding to the intended use of the product.

Extraordinary Effects

Fire

As unprotected polyisocyanurate will burn, fire safety precautions should be observed wherever insulation products are used. Direct torching of modified bitumen roofing to EnergyGuard™ NH Polyiso Roof Insulation will present a fire hazard. A properly installed fiberglass base sheet MUST be used over the insulation.

Water

There are no extraordinary effects on the environment due to the application of water on the product.

Mechanical Destruction

EnergyGuard™ NH Polyiso Roof Insulation is a non-structural, non load-bearing material. It is not designed for direct traffic usage unless adequately protected.

Delayed Emissions

Global warming potential is calculated using the TRACI 2.1 and CML 4.1 impact assessment methodologies. Delayed emissions are not considered.

Environmental Activities and Certifications

N/A

Further Information

GAF
1 Campus Drive
Parsippany, NJ 07054

References

-	PCR Part A	UL Environment: Product Category Rules for Building-Related Products and Services in North America, Part A: Life Cycle Assessment Calculation Rules and Report Requirements, v.3.2, December 2018.
-	PCR Part B	UL Environment: Product Category Rules Part B: Building Envelope Thermal Insulation EPD Requirements, v2.0, April 2018.
-	LCA for Experts	thinkstep.one. LCA for Experts (v.10.6).
-	ISO 14025	ISO 14025:2011-10, Environmental labels and declarations — Type III environmental declarations — Principles and procedures.
-	ISO 14040	ISO 14040:2009-11, Environmental management — Life cycle assessment — Principles and framework.
-	ISO 14044	ISO 14044:2006-10, Environmental management — Life cycle assessment — Requirements and guidelines.
-	ISO 21930: 2017	ISO 21930:2017, Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
-	NSF International	NSF Program Operator Rules, NSF International – National Center for Sustainability Standards, 2015
-	Characterization Method	IPPC. 2014. Climate Change 2013. The Physical Science Basis. Cambridge University Press. (http://www.ipcc.ch/report/ar5/wg1/).
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