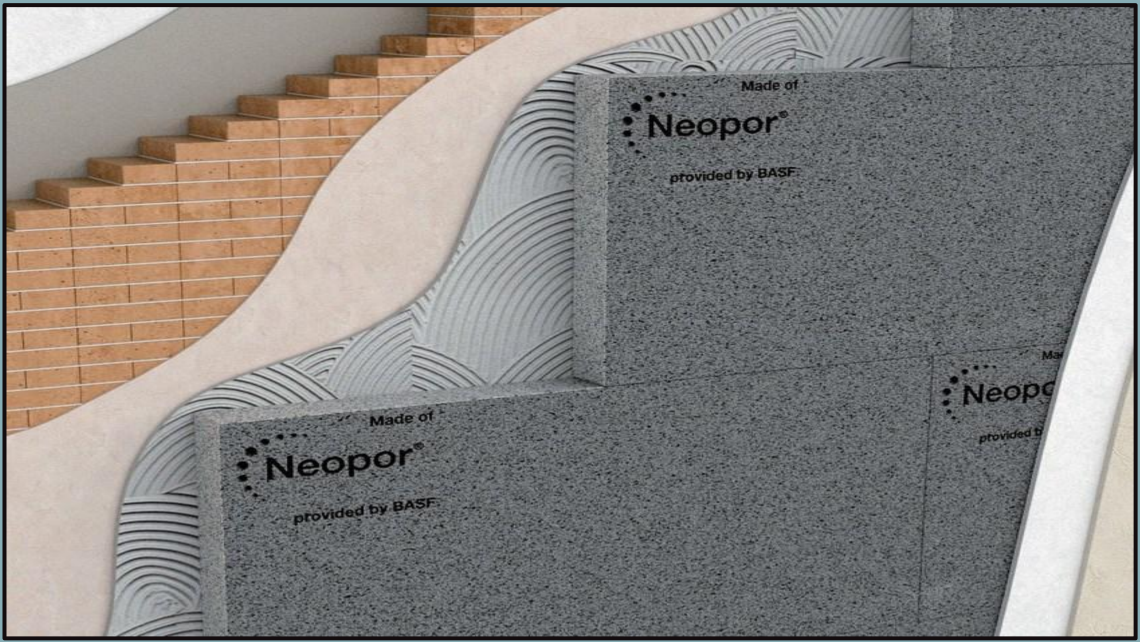
ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14040:2006/AMD 1:2020, ISO 14044:2006+A1+A2:2020, and ISO 21930:2017 for -

Neopor® Plus BMB Insulation (F5200 Plus BMB, F5300 Plus BMB) Type VIII

1 m² of insulation material with a thickness that gives an average thermal resistance RSI = 1 m²K/W and with a building service life of 75 years.



Owner of the Declaration	**BASF Corporation (www.basf.com)**
EPD Program Operator	NSF Certification, LLC (www.nsf.org)
PCR Program Operator	UL Environment
Declaration number	EPD11146
Issue date	2025-12-23
Validity date	2030-12-23

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at http://info.nsf.org/Certified/Sustain/epd_search.asp

1.0 Program Information

EPD PROGRAM OPERATOR

NSF Certification LLC
789 N. Dixboro,
Ann Arbor, MI 48105

www.nsf.org

PCR PROGRAM OPERATOR

UL Environment, Underwriters Laboratories Inc. (UL)

https://www.ul.com/resources/environmental-product-declarations-program

EPD DECLARATION HOLDER

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Florham Park, New Jersey 07932

www.basf.com

The EPD owner, BASF Corporation, has the sole ownership, liability, and responsibility for the EPD.

LCA CONSULTANT

Intertek Deutschland GmbH
Stangenstraße 170771
Leinfelden-Echterdingen, Germany

www.intertek.com

2.0 General Information

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	NSF Certification LLC, 789 N. Dixboro Road. Ann Arbor Michigan 48105, USA www.nsf.org
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	Part A: Life Cycle Assessment Calculations and Report Requirements, Version 4.0
MANUFACTURER NAME AND ADDRESS	BASF Corporation 100 Park Avenue Florham Park, New Jersey 07932 www.basf.com
DECLARATION NUMBER	EPD11146
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	1 m² of installed insulation material with a thickness that gives an average thermal resistance RSI = 1 m²K/W and with a building service life of 75 years (packaging included).
REFERENCE PCR AND VERSION NUMBER	ISO 21930:2017 'Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services' - serves as the core PCR. Part A: Life Cycle Assessment Calculations and Report Requirements, Version 3.1 (2018) Per the ISO 14025 requirements, this Part A was reviewed by the following critical review panel: • Lindita Bushi (Chair), Athena Sustainable Materials Institute, lindita.bushi@athenasmi.org • Hugues Imbeault-Tétreault, Groupe AGÉCO, hugues.i-tetreault@groupeageco.ca • Jack Geibig, Ecoform, jgeibig@ecoform.com Sub-category Part B: Building Envelope Thermal Insulation EPD Requirements, Version 2.0 (2018)
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE (AS IDENTIFIED WHEN DETERMINING PRODUCT RSL)	The performance properties of Neopor® Plus BMB insulation boards make them suitable for use in many applications. The product described in this document is used in applications such as wall insulation, pitched roof insulation, External Insulation and Finish System (EIFS), cavity wall insulation, ceiling insulation, insulation for building equipment and industrial installations.
PRODUCT RSL DESCRIPTION (IF APPL.)	Equal to building service life i.e., 75 years
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	2025-12-23
PERIOD OF VALIDITY	2030-12-23
EPD TYPE	Product Specific
EPD SCOPE	Cradle to Grave
YEAR(S) OF REPORTED MANUFACTURER PRIMARY DATA	2021
LCA SOFTWARE & VERSION NUMBER	SimaPro 9.6 Multiuser
LCI DATABASE(S) & VERSION NUMBER	Ecoinvent 3.8
LCIA METHODOLOGY & VERSION NUMBER	IPCC 2013 (AR5) TRACI v2.1 (July 2012) CML-baseline, v4.7 August 2016

The sub-category PCR review was conducted by	The Part B was reviewed by the following panel: • Thomas Gloria (chair), Industrial Ecology Consultants t.gloria@industrial-ecology.com • Christoph Koffler, thinkstep christoph.koffler@thinkstep.com • Andre Desjarlais, Oak Ridge National Laboratory desjarlaisa@ornl.go
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," v4.0 (August 2022), based on ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017) ☐ INTERNAL ☒ EXTERNAL	[signature] Jack Geibig, Ecoform, jgeibig@ecoform.com
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Intertek Deutschland GmbH Stangenstraße 170771 Leinfelden-Echterdingen, Germany
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	[signature] Jack Geibig, Ecoform, jgeibig@ecoform.com

LIMITATIONS:

Environmental declarations from different programs (ISO 14025) may not be comparable.

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.

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.

This EPD is not intended to make any comparative assertions.

3.0 Company Information

BASF is a leading chemical company, with presence in more than 90 countries. BASF operates around 240 production sites worldwide – including Ludwigshafen, Germany, the world's largest integrated chemical complex owned by a single company. BASF Verbund plants creates efficient value chains – from basic chemicals to high value-added solutions such as coatings or crop protection products.

Neopor® Plus BMB (**B**io**M**ass **B**alance) resin is produced by BASF in Ludwigshafen, Germany. The Biomass Balance method uses renewable raw materials such as bio-naphtha or biogas in the manufacture of chemical base products by the production network of BASF along with fossil raw materials. The organic content is then allocated in accordance with a certified method /TÜV Süd Standard CMS 71/. BMB products display the same quality as non-BMB products as the product formulation is identical to that of its fossil equivalent. Neopor® Plus BMB granulate is manufactured from biogas extracted from kitchen waste. The biogas used is certified in accordance with the /REDcert/ system. The Neopor® Plus BMB resin is then further processed at various manufacturing plants into insulation boards at one of twenty-two North American manufacturing locations as below –

- Atlas Molded Products (US) – 9 sites
- Beaver Plastic (Canada) – 2 sites
- Insulfoam (US) – 8 sites
- Polar Central (US) – 1 site
- Progressive Foam (US) – 1 site
- Plastifab (Canada) – 1 site

This cradle-to-grave environmental product declaration is for 1 m² of installed insulation material with a thickness that gives an average thermal resistance RSI = 1 m²K/W and with a building service life of 75 years (packaging included). For further information see https: https://neopor.basf.us/.

4.0 Product Information

4.1 Product Identification

For this analysis, Neopor® F5200 Plus BMB and F5300 Plus BMB insulation boards, ASTM C578 Type VIII, are examined. Type VIII thermal insulation board has a minimum density of 1.15 pounds per cubic foot with a minimum thermal resistance of 4.7 per inch thickness at 75 degrees Fahrenheit with a compression strength of 13 PSI as per ASTM C578. The figure below provides a picture of Neopor® Plus BMB insulation boards. Neopor® Plus BMB insulation boards are graphite polystyrene (GPS) with a polymeric flame retardant in uniform distribution (blowing agent: pentane). The insulation boards are manufactured to customer specification.

Figure 1: Neopor® Plus BMB insulation boards

For this analysis Neopor® F 5200 Plus BMB insulation boards and Neopor® F 5200 Plus BMB made specifically from the expansion of Neopor® F 5300 Plus BMB (Type VIII) resin are considered. The same are referred to as Neopor® Plus BMB insulation boards and Neopor® Plus BMB Resin in the rest of the document.

All the Neopor® Plus BMB resin are produced by BASF SE at their Verbund site in Ludwigshafen, Germany. Neopor® Plus BMB resin is supplied to various manufacturing locations listed above as lens-shaped granules. Manufacturers provide insulation boards at various densities and shapes to the construction industry. Manufacturing locations listed above are verified molders under the BASF Neopor® Brand Marketing Agreement that utilize BASF Neopor® resins in their UL certified end-use products.

4.2 Manufacturing Process & Flow Diagram

Neopor® Plus BMB resin is produced by BASF SE at their Verbund site in Ludwigshafen, Germany. For the preparation of flame-retardant polystyrene granules, a polymeric flame retardant (polymer FR) with about 1.1% by mass is added. Polymer-FR is a brominated styrene-butadiene copolymer (CAS No 1195978-93-8) that is not subject to the REACH Regulation for Substances of Very High Concern. To improve the insulation performance, graphite is added. As a result, the reflection and absorption behavior of heat radiation is changed, whereby the insulating performance of the product is improved with low layer thickness and density. The pentane assists in the expansion process and is released partly during and shortly after production (ageing process). The final pentane content with Resin when dispatched from manufacturing site (Germany) is about 5.00% by weight. The Neopor® Plus BMB resin is then transported to various insulation producers located in North America (as described in section 3.0 of this document).

At the insulation manufacturing plant, the Neopor® Plus BMB resin is processed into insulation boards. The conversion process of GPS granules to foamed insulation boards consists of the following manufacturing stages: pre-foaming, conditioning, block molding and finally cutting into the desired sizes. During the pre-foaming stage, the resin is foamed with the aid of steam and the blowing agent pentane. Subsequently, the expanded granules are stored in air-permeable silos. Due to the diffusing air, the GPS foam particles receive the necessary stability for further processing. The most used method of producing GPS insulation boards is block molding followed by cutting. In this process, the GPS foam particles are filled into large block-shaped forms and foamed with steam. Then the blocks are cut into boards using mechanical or thermal cutting equipment. Additional edge profiling (tongue and groove or shiplap) can be added through milling machining. Cut offs are disposed of as waste to landfill. See Figure 2 for more details.

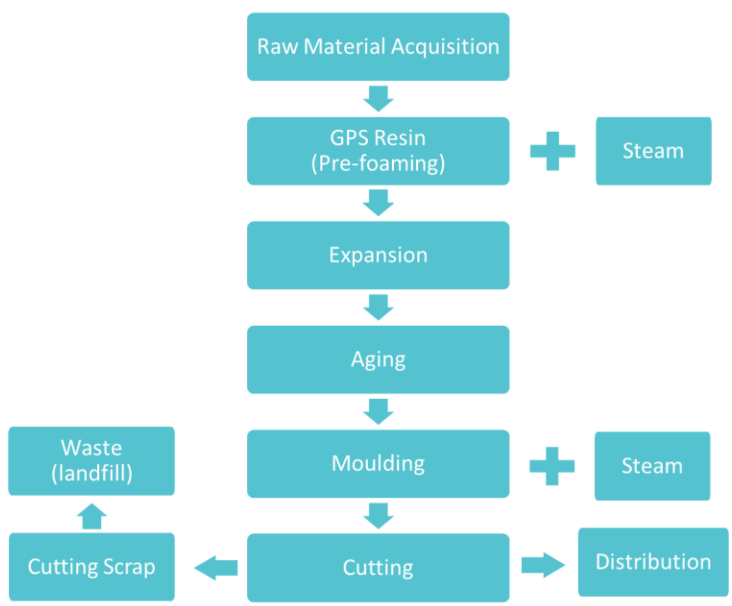


Figure 2: EPS Manufacturing Process

4.3 Product Average

The data from the different manufacturing sites was horizontally averaged out to represent the average manufacturing of insulation boards. The average unit process data were calculated by taking a horizontal weighted average across facilities based on % of total production.

4.4 Application

The product described in this document is used in applications such as wall insulation, roof insulation, External Insulation and Finish System (EIFS), cavity wall insulation, interior insulation, insulation for building equipment and industrial installations.

4.5 Technical Requirements

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation –

Grades	Product type	Density (lbs/ft^3)	R-Value (ft^2.hr. ^{0}F/Btu-in) at 75^0 F	Compression Strength (ASTM C578) PSI
F 5200 PLUS BMB, F 5300 PLUS BMB	XI	0.70	4.60	5
	I	0.90	4.70	10
	VIII	1.15	4.70	13
	II	1.35	4.70	15
	II+	1.45	4.70	20
	IX	1.80	4.70	25

Note - Units reported are the stipulated units in the ASTM C578 standard.

Overall, Neopor® Plus BMB insulation boards were evaluated for the following properties:

- Surface Burning Characteristics (ANSI/UL723, ASTM E84)
- Physical Properties (ASTM C578)
- Roofing Systems for Exterior Fire Exposure (ANSI/UL790, ASTM E108)
- Roof Deck Construction Material with Resistance to Internal Fire Exposure (ANSI/UL1256)
- Flammability Testing for Use in Attics and Crawl Spaces (AC12, App. A and B)
- For Use on Exterior Commercial Walls (NFPA 285)
- Material Emissions (UL2818 and California Department of Public Health, CDPH/EHLB/Standard Method)
- ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

4.6 Material Composition

Neopor® Plus BMB insulation boards are made from the expansion of Neopor® resin through the use of a blowing agent. The Neopor® F5300 Plus BMB resin consists of polystyrene, a blowing agent, graphite, and a flame retardant. The composition range for the resin is: polystyrene (85% - 90% by weight), pentane/isopentane (3% - 7% by weight), graphite (3% - 7% by weight) and a polymeric flame retardant (0.5% - 2.0% by weight). For the preparation of flame-retardant polystyrene granules, a polymeric flame retardant (polymer FR) with about 1.1% by mass is added. Polymer-FR is a brominated styrene-butadiene copolymer (CAS No 1195978-93-8) that is not subject to the REACH Regulation for Substances of Very High Concern. To improve the insulation performance, graphite is added. According to Regulation 2012 OSHA Hazard Communication Standard; 29 CFR Part 1910.1200, there is no need for classification according to GHS criteria for this Neopor foam. In addition, this product does not require any hazard warning labels in accordance with GHS criteria. As per the Resource Conservation and Recovery Act (RCRA), Subtitle C, the Neopor product as installed and ultimately disposed of is not classified as a hazardous substance. No substances required to be reported as hazardous are associated with this construction product.

The raw material composition of Neopor® Plus BMB insulation board is shown below –

Raw Materials	%
Resin	92.84%

Recycled insulation Regrind (Internal)	3.82%
Recycled insulation Regrind (external)	0.48%
Laminating Film	0.42%
PP film	1.10%
Other film products (styrene)	1.24%
Others (Borate, Dye & Adhesive)	0.09%
Total	**100.00%**

The outgoing packaging details with the product (per 1000 kg Insulation board) is provided below -

Outgoing packaging	Kg
Stretch Wrap	4.226
Bags/shrouds	7.608
Other plastic	0.094
Pallets	0.040
Tape	0.144
Paper boxes/Label	0.064
Total	12.177

4.7 Environment and Health during Manufacturing

During the storage (aging) and processing of Neopor® Plus BMB insulation boards, pentane escapes the panels. Especially when cutting the foam with heated wires, good ventilation in the working area is necessary. This is because the vapor contains pentane and small amounts of styrene. Therefore, manufacturing areas should be well-ventilated and maximum workplace concentrations for styrene and pentane must be considered.

No ozone depleting substances as regulated by the EPA, such as CFC or HCFCs, are used as blowing agents for the production of Neopor® Plus BMB insulation materials.

This product contains styrene, which is listed as a hazardous air pollutant (Clean Air Act). This product contains pentane and residual styrene monomer, which OSHA defines as a hazardous chemical (SARA Title III Regulations). This product may be portable under SARA sections 311 and 312, depending on the maximum on-site storage volumes. This product contains a substance subject to a Significant New Use Rule (SNUR) or consent order restriction: TSCA § 5(a) final Significant New Use Restriction (SNUR) 40 CFR 721.10280. Pentane has a CERCLA recordable quantity (RQ) of 100 pounds. All ingredients are listed on the TSCA inventory. This material contains detectable amounts of some chemicals known to the State of California to cause cancer. Styrene oxide is listed as known to the State of California to cause cancer. Styrene oxide is a metabolite of styrene monomer. Pentane, isopentane and graphite are covered by PA, MA and NJ Right To Know (RTK) acts.

The Neopor ® products do not contain as intentionally added raw materials any of the substances of very high concern (SVHC) above a limit of 0.1 % w/w according to the candidate list, article 59 (1, 10) European REACH regulation (EC) No. 1907/2006. To the best of our knowledge, none of these materials are generated during production.

This product is not regulated by Resource Conservation and Recovery Act (RCRA) applicable in North America.

4.8 Packaging

External factors, such as solar energy conveyed via reflective surfaces, can create excessive heat build-up within insulation products made of Neopor® Plus BMB foam, which can damage the products. Precautionary measures taken in the packaging, storage, transportation, and installation of insulation products can help minimize the potential for damage. Insulation products and foam surfaces should be always protected from reflected sunlight and prolonged solar exposure. Neopor® Plus BMB insulation boards should be packed in white opaque polyethylene plastic bags. Finally, this opaque film packaging is recyclable and can be recycled where suitable return systems exist. However, the recycling of the packaging film is not considered in this EPD. Disposal pathways for the packaging are defined in section 6.0 of this EPD document.

4.9 Transportation

For domestic transportation purposes, this product is not regulated as a hazardous material by the US Department of Transportation (DOT) under Title 49 of the Code of Federal Regulations. Distribution of the insulation board is split between transport directly to end-users and transport to distribution centers, then to end-users. The product is shipped by road and the average transportation distance 273 km. Additional details for the scenario are provided is section 6.0 of this document.

4.10 Product Processing/Installation

Thermally insulating a building with Neopor® Plus BMB insulation boards products is an effective path toward sustainable energy savings. Additionally, Neopor® Plus BMB insulation boards are relatively light weight making them easy to process and to work with. The insulation boards are dimensionally stable and absorb virtually no moisture. This is not only of great importance for the entire life cycle of the building but also for the construction phase.

For all applications, the relevant standards and building codes as well as manufacturer instructions must be observed. 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.

Depending on the application, Neopor® Plus BMB insulation panels can be adhered to a wall with system approved adhesives or can be mechanically fastened. Different systems require different fastening requirements so consult your system supplier guidelines. Installation does not require any energy or water usage.

4.11 Condition of Use

Water pick-up by capillarity does not occur with Neopor® Plus BMB insulation boards due to the closed cell structure. The thermal insulation performance of Neopor® Plus BMB insulation boards is practically unaffected by exposure to water or water vapor due to its drying capability should it ever become wet.

Properly installed Neopor® Plus BMB insulation boards are durable with respect to their insulation, structural and dimensional properties. They are water resistant, resistant against microorganisms and against most chemical substances. It should not, however, be brought into contact with organic solvents.

The application of insulation material has a positive impact on energy efficiency of buildings. Quantification is only possible in context with the construction system of the building.

Dependent on the specific material and the frame conditions of installation, residual pentane may diffuse. Quantified measurements and release profiles cannot be declared.

4.12 Environment and Health during Use

Neopor® Plus BMB insulation boards in most applications are neither in direct contact with the environment nor with indoor air. However, when naked products were tested for VOC emissions, the emissions proved to be below the limit values in countries with such regulation (see section 8.1). Neopor® Plus BMB insulation boards have also achieved GREENGUARD Gold certification to UL 2818, product certification for low chemical emissions for building materials, finishes and furnishings.

4.13 Reference Service Life

If applied correctly, the lifetime of Neopor® Plus BMB insulation boards is equal to the building lifetime, usually without requiring any maintenance. The reference service life considered is 75 years. To maintain the desired properties of Neopor® Insulation systems and to achieve the desired RSL (75 years), 1. the raw material resin should always be stored in a dry and cool location (below 20 °C) and processed within three months. 2. During production, Neopor® resin must not be mixed with other raw materials. 3. Final Neopor® Insulation boards must not be packaged in transparent films, rather the use of opaque white or opaque colored film is strongly recommended. 4. Installation of the finished Neopor® insulation boards must be installed in accordance of the applicable IBC (International Building Code) and/or IRC (International Residential Code) sections.

4.14 Extraordinary Effects

The following is a listing of the standards required for the testing, evaluation and approval of Neopor® Plus BMB insulation boards for use in the intended applications and markets as identified in this document.

Fire

Neopor® Plus BMB insulation boards are fire and code approved by UL and ICC for ASTM E84, NFPA 285 and NFPA 286 for use in commercial cavity wall with a wide range of cladding approvals. Finished Neopor® Plus BMB insulation boards manufactured from Neopor® Plus BMB resins up to a maximum density of 2.0 lbs./ft^3 and a maximum thickness of 6 ins. are qualified to bear a label with a flame-spread index of 25 or less and a smoke-developed index of 450 or less when tested in accordance with ANSI/UL723 (ASTM E84), provided the finished boards are listed and labeled by an approved agency.

Neopor® Plus BMB granules achieve the fire classification Euroclass E according to [DIN EN 13501-1] and according to B1 [DIN 4102-1].

Water

Neopor® Plus BMB insulation boards are chemically neutral and not water soluble. No water-soluble substances are released, which could lead to pollution of ground water, rivers or lakes. Because of the closed cell structure, Neopor® Plus BMB insulation boards can be used even under moist conditions. In the case of unintended water ingress, e.g., through leakage, there is normally no need for replacement of the insulation board. The insulation value of the board remains almost unchanged in moist conditions and the insulation will dry when the source of moisture is removed.

Mechanical destruction

Not relevant for Neopor® Plus BMB based products that have superior mechanical properties.

In summary, a listing of all standards required for testing, evaluation and approval of Neopor® Plus BMB insulation boards for use in the applications and markets identified are:

- ICC-ES Acceptance Criteria for Foam Plastic Insulation (AC12), dated June 2012
- ICC-ES Acceptance Criteria for Quality Documentation (AC10), dated June 2014
- ANSI/UL723 (ASTM E84), Test for Surface Burning Characteristics of Building Materials
- ANSI/UL790 (ASTM E108), Standard Test Methods for Fire Tests of Roof Coverings
- ANSI/UL1256, Standard for Fire Test of Roof Deck Constructions
- ASTM C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
- UL2818, GREENGUARD Certification Program for Chemical Emissions for Building Materials, Finishes and Furnishings
- NFPA 285, Standard Fire Test for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Assemblies Containing Combustible Components
- California Department of Public Health, CDPH/EHLB/Standard Method V.1.1

4.15 Re-use Phase

The reuse of GPS foam from production waste has been working for many years and has proven itself very well. Production residues due to cut-outs or edge profiles can be reused in the production plants. However, for this analysis, re-use of GPS scrap was not included in the calculation of the LCA results.

For End-of-Life options, construction techniques can be employed to maximize the separation of GPS insulation boards at the end of life of a building to maximize the potential for re-use. Another option for re-use is to leave the GPS insulation boards in place when the existing construction is thermally upgraded.

4.16 Disposal

Finished insulation boards are not regulated by either RCRA or CERCLA. Disposal of Neopor® Plus BMB insulation boards should be in accordance with national, state and local regulations. Product should not be discharged into waterways or sewer systems without proper authorization.

The recycling of BMB insulation waste to produce new BMB insulating materials is possible if a separation of building materials by type is guaranteed. Ground recycled material can easily be used as a lightweight aggregate for mortar and concrete. It is also used as an additive for PS-light concrete, plaster for containment and light plaster as well as in the clay industry.

Recycling of BMB insulation boards has not been included in the calculation of the LCA or this EPD. At the end of its life cycle, Neopor® Plus BMB insulation boards can be disposed of to landfill or thermally incinerated. Embedded energy in BMB insulation boards can be recovered in municipal waste incinerators equipped with energy recovery units for steam and electricity generation and for district heating where available. In this EPD end of life is considered with 100% landfill disposal which is currently the most common practice. Additional details for the scenario are provided in section 6.0 of this document.

4.17 Further Information

Additional information can be found at http://www.neopor.basf.us/

5.0 LCA Information

5.1 Functional Unit

In this assessment the cradle to grave life cycle of the product is covered and quantified and the functional unit for the study is defined based on PCR "Part B: Building Envelope Thermal Insulation EPD Requirements" as:

Item	Value	Unit
Functional unit	***1 m² of installed insulation material with a thickness that gives an average thermal resistance RSI = 1 m²K/W***	
Equivalent Mass	0.565	Kg
Equivalent Thickness	0.0307	m
Reference service life	75	years

5.2 System Boundary

Type of EPD: Cradle-to-Grave. The modules considered in the Life Cycle Assessment are:

- A1: Raw materials supply
- A2: Transport to manufacturer
- A3: Manufacturing
- A4: Transport to construction site
- A5: Assembly
- B1: Use of product
- B2: Maintenance
- B3: Repair
- B4: Replacement
- B5: Refurbishment
- B6: Operation energy use
- B7: Operation water use
- C1: Demolition
- C2: Waste transport
- C3: Waste processing
- C4: Disposal

The analysis of the product life cycle includes production of the basic materials, transport of the basic materials, manufacture of the product and the packaging materials and is declared in module A1-A3. Transport of the product is declared in module A4, and disposal of the packaging materials and any insulation trim in module A5. The blowing agent is released during the use of the insulation because this analysis considers a 75-year service life for insulation board, the remaining 11.2% of pentane within the insulation is assumed to be emitted during the use phase and accounted in Module B1. The product does not require any maintenance, repair, replacement, and refurbishment; further the product does not consume any energy and water during operation. Therefore, the impacts in Module B1 to B7 are 'nil'.

The end-of-life scenarios include the manual demolition of the product; therefore, no impacts are accounted in Module C1. The insulation board is recycled at a rate of much less than 1 percent of its production. It is assumed that all insulation boards are discarded to a landfill, commonly a Construction & Demolition landfill, for this analysis. The average transport distance from the building to landfill site is assumed to be 100 km, this is accounted in Module C2. As the waste is directly sent to landfill without any processing, there are no impacts in Module C3. Waste disposal related impacts due to landfilling of product are accounted in Module C4. As all the waste is sent to landfill, the Module D, beyond the system boundary is not applicable.

5.3 Estimated & Assumptions

Assumptions in this study are as follows –

- The study represents the weighted average production of Insulation board manufacturing from 6 manufacturing companies, who provided data for 22 sites spread across U.S. and Canada. The horizontally weighted average of LCI flows is used to populate the final LCA inventory for the study.
- Electricity is assumed to be of US electricity grid. Since the data comes from other geographies as well (Canada) a scenario analysis is included for Canada Grid Mix in the background LCA report.
- As the insulation boards are manufactured to customer specification, it is assumed that there is no installation waste generated.
- Installation of insulation board is performed manually and maintaining the product does not require additional energy or resources.
- Pentane is lost throughout the manufacturing process; primary data is collected from sites about the pentane lost directly or through thermal oxidation process. The balance pentane is assumed to be lost during the use phase.
- The product does not require any maintenance, repair, replacement, and refurbishment; further the product does not consume any energy and water during operation.
- At the end-of-life product is removed manually from the building.
- The average transport distance from the building to landfill site for insulation disposal is assumed to be 100 km.

5.4 Cut Off Rules

In the process of building an LCI it is typical to exclude items considered to have a negligible (aka relatively inconsequential or immaterial) contribution to results. "Criteria for the exclusion of inputs and outputs (cut off rules) in the Life Cycle Assessment and information modules and any additional information are intended to support an efficient calculation procedure.

The cut-off criteria for including or excluding materials, energy and emissions data of the study are as follows:

- Mass – According to ISO guidelines, if a flow is less than 1% of the cumulative mass of the model it may be excluded, providing its environmental relevance is not a concern. For the purpose of this LCA, all known mass flows are reported, and no known flows were deliberately excluded.
- Energy – According to ISO guidelines, if a flow is less than 1% of the cumulative energy of the model it may be excluded, providing its environmental relevance is not a concern. For the purpose of this LCA, all known energy flows are reported, and no known flows were deliberately excluded.
- Environmental relevance – If a flow meets the above criteria for exclusion yet is thought to potentially have a significant environmental impact, it was included. Material flows which leave the system (emissions) and whose environmental impact is greater than 1% of the whole impact of an impact category that has been considered in the assessment must be covered. This judgment was made based on experience and documented as necessary.

All known mass and energy flows are reported; no known flows were deliberately excluded from the LCA and subsequent EPD. In the case of module C1 (deconstruction), insufficient data for the process was available but expert opinion felt the impacts during this module would fall under the cut off criteria of 1% of the total energy or total mass input assessed in this LCA. No known flows were deliberately excluded from the LCA and subsequent EPD.

5.5 Data Sources

The majority of the data used in the modeling is from primary data from BASF or insulation boards manufacturers, in cases where it was necessary supplemental datasets from an LCA database (Ecoinvent v3.8) were used.

5.6 Data Quality

Data quality was monitored with the use of data quality requirements based on ISO 14044:2006. To ensure the quality of data were sufficient, data quality checks were completed on data quality indicators (DQIs) – Reliability, Representative, Temporal Correlation, Geographical Correlation, & Technological Correlation. Data quality indicators were assessed using a data quality matrix whereby key data were assigned scores between 1 (best) and 5 (worst). The data quality matrix used in this study was adapted from Weidema et al. (2013) and is available in the background LCA report. The overall data quality score for this EPD is 2 (very good) because the study uses primary data on the BMB Resin.

5.7 Period Under Review

Specific data for key raw material Neopor® Plus BMB resin was provided by BASF in form of environmental indicators as required to be disclosed based on PCR for 1 kg of product, this data represents to the average production period of 2019 to 2021. Specific data for insulation boards manufacturing were collected from the sites in US & Canada using data collection sheets via an iterative process and represent a period of twelve months from 2021.01.01 to 2021.12.31.

5.8 Allocation

In terms of the specific primary data for the raw material Neopor® Plus BMB Resin, the BASF uses the allocation approach as defined in their website at link. In terms of the specific primary data from insulation board manufacturers, some sites have used mass allocation to calculate the energy and emission related flows which is according to the basic rules from ISO 14044.

In terms of generic data, the main database used, Ecoinvent v3.8 (cut-off), defaults to economic allocation for most processes. However, in some cases a mass-based allocation is used, where there is a direct physical relationship. The allocation approach of specific Ecoinvent modules is documented on their website and method reports (see www.Ecoinvent.org).

In the case of end-of-life allocation of generic data, Ecoinvent v3.8 with a cut-off by classification end-of-life allocation method was used. In this approach, environmental burdens and benefits of recycled/reused materials are given to the product system consuming them, rather than the system providing them, and are quantified based on recycling content of the material under investigation. This is a common approach in LCA for materials where there is a loss in inherent properties during recycling, the supply of recycled material exceeds demand and recycled content of the product is independent of whether it is recycled downstream. It follows the ISO standards on LCA.

6.0 Scenarios and additional technical information

The following technical information is a basis for the declared modules. The values refer to the functional unit of 1 m^2 of Neopor® Plus BMB insulation board product with a thickness (3.07 cm) that gives an average thermal resistance (RSI) of 1 m^2-K/W with a building service life of 75 years (packaging included).

Transport to the construction site (A4)

Fuel Type	-	Diesel
Liters of fuel (L/100 km)	-	2.55E-3 Liters/100 km
Vehicle type	-	16 to 32 Metric Tons Truck

Transport distance	-	273 km
Capacity utilization (including empty runs, mass based)	-	50%
Gross density of products transported (Type VIII – insulation)	-	18.42 kg/m^3

Installation to the building site (A5)

Ancillary materials	-	0.00 kg
Net freshwater consumption	-	0.00 m^3
Other resources	-	0.00 kg
Electricity consumption	-	0.00 kWh
Product loss per functional unit	-	0.00 kg
Waste materials at the construction site (packaging)*	-	6.88E-03 kg
Output materials from on-site waste processing	-	0.00 kg
Biogenic carbon contained in packaging	-	2.65E-05 kg
Direct emission to ambient air, soil, water (Pentane emissions to air)	-	3.03E-03 kg
VOC content (μg/m^3)	-	Refer section 8.1

* Disposal pathways for packaging are referred from PCR Part B, which requires packaging to be assumed as 100% landfilled at the end of life.

For the installation of insulation boards at the site (Module A5), it is assumed to be performed manually and maintaining the product does not require additional energy or resources.

Reference Service Life

Reference Service Life of the products	-	75 years

End of Life (C1-C4)

The insulation board is recycled at a rate of much less than 1 percent of its production. It is assumed that all insulation boards are discarded to a landfill, commonly a Construction & Demolition landfill, for this analysis. The average transport distance from the building to landfill site is assumed to be 100 km. Additional details for this scenario are –

Collection process (collected with mixed construction waste)	-	0.565 kg
Reuse	-	0.000 kg
Recycling	-	0.000 kg
Landfill	-	0.565 kg
Incineration	-	0.000 kg
Product for final disposal	-	0.565 kg
Removal of biogenic carbon	-	1.820 kg CO_2 eq.
Biogenic carbon content of the product	-	0.496 kg C/ kg product

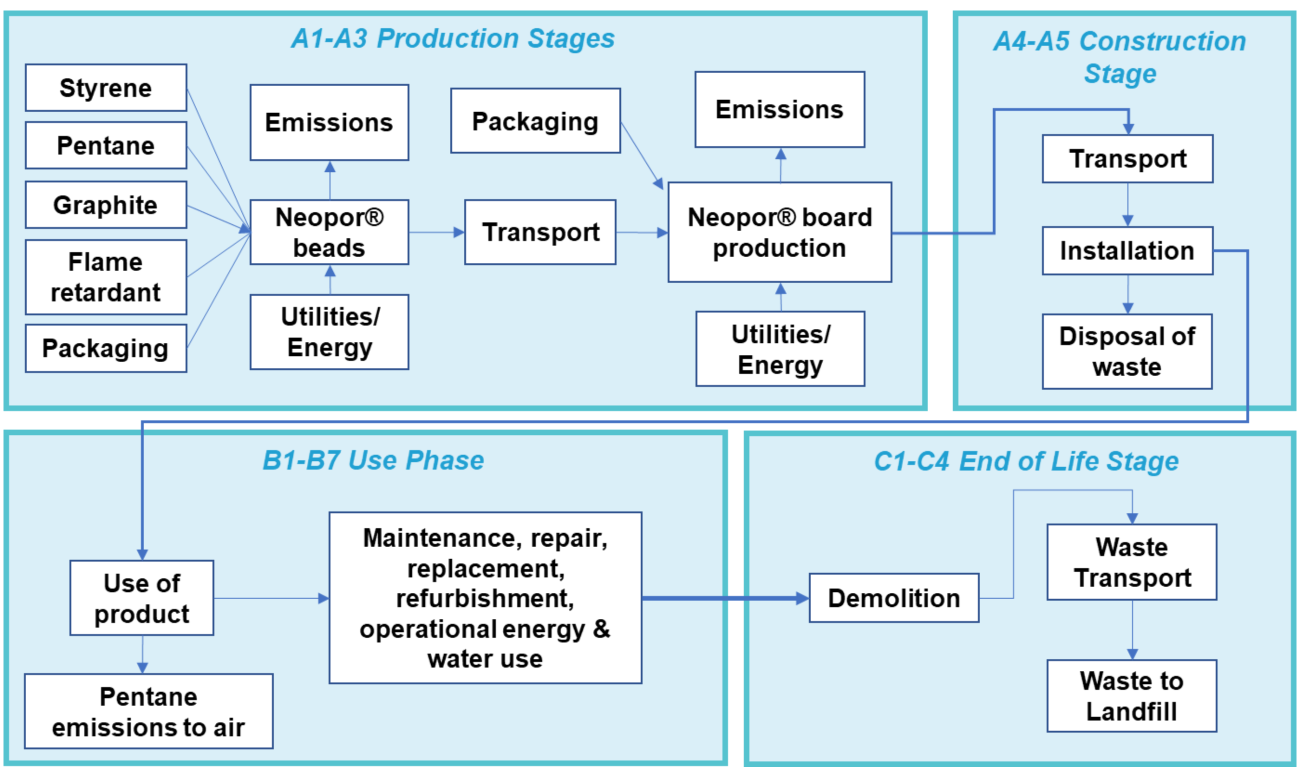
7.0 Environmental Performance

The following tables display the environmental impacts for the assessed base case functional unit of "1 m^2 of installed Neopor® Plus BMB Type VIII insulation board with a thickness that gives an average thermal resistance (RSI) of 1 m^2-K/W with a building service life of 75 years (packaging included)".

The environmental impact categories reported below 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. Additionally, LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. Finally, many factors affect the comparability of EPDs. End users should be extremely cautious when comparing or evaluating EPD data of different EPD publishers. Such comparison or evaluation is only possible if all conditions for comparability listed in ISO 14025 (Section 6.7.2) are met.

Description of the System Boundary (X = Included in LCA; MND = Module not Declared)

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 the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction 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



7.1 Type VIII Insulation Boards (F 5200 Plus BMB, F 5300 Plus BMB)

The results are presented for the functional unit of 1 m² of installed insulation material with an average thermal resistance RSI = 1 m²K/W and with a building service life of 75 years (packaging included). For Type VIII insulation boards this equals to thickness of 3.07 cm or 0.0307 meters and the weight of 0.565 kg. The below results cover the environmental impacts of Neopor ® F 5200 PLUS BMB & Neopor® F 5300 PLUS BMB insulation boards with R-Value of 4.70 ($ft^2.hr.^0F/Btu\text{-}in$) at 75^0F -

		Raw material supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**
North American Life Cycle Impact Assessment Results (GWP – IPCC 2013, ADP_{fossil} – CML baseline v4.7 Aug. 2016, Rest – TRACI 2.1)																	
GWP	kg CO_2 eq.	1.43E+00	1.01E-01	4.39E-01	2.60E-02	3.25E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.16E-02	0.00	2.92E-03
ODP	kg CFC-11 eq.	8.00E-10	2.05E-08	5.56E-08	5.97E-09	2.23E-11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.65E-08	0.00	1.27E-09
AP	kg SO_2 eq.	3.67E-03	1.55E-03	5.45E-04	6.53E-05	1.03E-06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.12E-04	0.00	2.48E-05
EP	kg N eq.	7.80E-04	1.53E-04	7.58E-04	2.50E-05	6.16E-05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.23E-05	0.00	4.85E-06
SFP	kg O_3 eq.	7.82E-02	3.36E-02	2.50E-02	9.69E-04	2.71E-05	3.98E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.17E-02	0.00	6.15E-04
ADP_{fossil}	MJ	1.92E+01	1.32E+00	5.94E+00	3.82E-01	1.66E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.79E-01	0.00	8.22E-02

Note - 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.
Caption: GWP = Global Warming Potential, ODP = Ozone Depletion Potential, AP = Acidification Potential, EP = Eutrophication Potential, SFP = Smog Formation Potential, ADP_{fossil} = Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resource

International Life Cycle Impact Assessment Indicators (CML-baseline, v4.7 August 2016)																	
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**
GWP	kg CO_2 eq.	1.44E+00	1.01E-01	4.35E-01	2.59E-02	3.22E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.15E-02	0.00	2.91E-03
ODP	kg CFC-11 eq.	6.22E-10	1.54E-08	4.62E-08	4.48E-09	1.74E-11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.24E-08	0.00	9.52E-10
AP	kg SO_2 eq.	3.23E-03	1.39E-03	5.28E-04	6.33E-05	8.01E-07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.33E-04	0.00	2.11E-05
EP	kg PO_4^{3-} eq.	7.27E-04	2.13E-04	3.48E-04	1.37E-05	2.28E-05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.13E-05	0.00	4.52E-06
POCP	kg C_2H_4 eq.	3.96E-04	3.79E-05	5.34E-03	3.14E-06	9.75E-08	1.20E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10E-05	0.00	8.85E-07

Caption: GWP = Global Warming Potential, ODP = Ozone Depletion Potential, AP = Acidification Potential, POCP = Photochemical Oxidant Creation Potential

Life Cycle Inventory Results: Resource Use																	
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**
RPR_E	MJ	4.61E+01	2.28E-02	1.93E-01	4.52E-03	4.47E-05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.83E-03	0.00	7.09E-04
RPR_M	MJ	1.76E+01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$NRPR_E$	MJ	2.13E+01	1.42E+00	7.16E+00	4.11E-01	1.83E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.04E+00	0.00	8.83E-02
$NRPR_M$	MJ	4.58E-02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SM	Kg	5.12E-01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF	MJ	2.01E-17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF	MJ	2.73E-16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RE	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FW	m^3	7.52E-03	1.74E-04	1.15E-03	4.48E-05	5.34E-06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.65E-05	0.00	8.90E-05

Caption: RPR_E - Renewable primary resources used as energy carrier (fuel), RPR_M: Renewable primary resources with energy content used as material, $NRPR_E$: Non-renewable primary resources used as an energy carrier (fuel), $NRPR_M$: Non-renewable primary resources with energy content used as material, SM: Secondary materials, RSF: Renewable secondary fuels, NRSF: Non-renewable secondary fuels, RE: Recovered energy, FW: Use of net freshwater resources

Life Cycle Inventory Results: Output Flows and Waste Categories																	
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**
HWD	kg	2.77E-09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NHWD	kg	7.23E-03	0.00	7.52E-03	0.00	4.68E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.65E-01
HLRW	kg	3.08E-04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ILLRW	kg	3.08E-07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR	kg	1.23E-05	0.00	1.15E-02	0.00	1.03E-03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EE	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Caption: HWD = Hazardous Waste Disposed, NHWD = Non-Hazardous Waste Disposed, HLRW = High Level Radioactive Waste conditioned to final repository, ILLRW = Intermediate & Low-Level Radioactive Waste conditioned to final repository, CRU = Components for Re-Use, MR = Material for Recycling, MER = Materials for Energy Recovery, EE = Recovered Energy exported from the Product System

Carbon Emissions and Removal indicators																	
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**
BCRP	kg CO_2 eq.	1.82E+00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BCEP	kg CO_2 eq.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.82E+00
BCRK	kg CO_2 eq.	0.00	0.00	2.65E-05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BCEK	kg CO_2 eq.	0.00	0.00	0.00	0.00	2.65E-05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

8.0 Interpretation

All environmental impact categories are significantly influenced by the provision of raw materials and the production process. The raw materials have the highest environmental contribution across the indicators reported (42.51% to 69.03% of the total impacts) except for Ozone Depletion (<1% of the total impacts). The contribution towards Global Warming Potential from this life cycle stage was 69.03%. Transport of the raw materials to the insulation manufacturing site contributes about 4.72% to 24.71% of the total impacts with highest contribution for Acidification Potential (24.71%) & lowest contribution for Abiotic Depletion of Fossil Resources (4.72%) and Global Warming Potential (4.86%). Manufacturing of the insulation has the second highest environmental impacts across the indicators reported (8.69% to 55.24% of the total impacts) with highest contribution for Ozone Depletion Potential (55.24%) & lowest for Acidification Potential (8.69%). The contribution towards Global Warming Potential from this life cycle stage was 21.12%. Distribution of the finished product to end users has significantly lower contribution (0.63% to 5.92% of the total impacts) with highest contribution for Ozone Depletion (5.92%) & lowest contribution for Smog Potential (0.63%). The contribution towards Global Warming Potential from this life cycle stage was 1.25%. Installation phase has significantly lower contribution (0.01% to 3.36% of the total impacts) with highest contribution for Eutrophication Potential (3.36%) and lowest contribution for Abiotic Depletion of Fossil Resources (0.01%). The contribution towards Global Warming Potential from this life cycle stage was 0.16%. The use phase affects only the smog potential impact category due to pentane released in use phase, this contributes about 2.58% of the total smog potential. Transport to disposal site contributes about 2.85% to 16.38% of the total impacts with highest contribution for Ozone Depletion Potential (16.38%) and lowest contribution for Eutrophication Potential (2.85%). The contribution towards Global Warming Potential from this life cycle stage was 3.45%. Final disposal of the product in the landfill contributes about 0.14% to 1.26% of the total impacts with highest contribution for Ozone Depletion Potential (1.26%) and lowest contribution for Global Warming Potential (0.14%).

The results in this EPD are limited to –

- Assumptions as defined in section 5.3 of this EPD document.
- Data collection period as defined in section 2.0 and section 5.7 of this EPD document.
- Methodologies applied as defined in section 2.0 of this EPD document.
- Cut-off rules as specified in section 5.4 of this EPD document.
- The scope & boundaries as defined in section 5.1 to 5.2 of this EPD document.
- The data quality as defined in section 5.6 of this EPD document.

8.1 VOC emissions

Like it is the case for all EPS products insulation boards, Neopor® Plus BMB insulation boards can be used for indoor applications, however they typically are not directly exposed to the indoor air but covered by some kind of covering layer such as gypsum board.

To make it easier for architects and developers to find low-emission materials, the Greenguard label indicates products that meet the strict emissions limits for Volatile Organic Compounds (VOCs). There are limits for over 360 VOCs. All insulation boards with Neopor® PLUS BMB meet not only the demanding criteria of the Greenguard certificate, but also the requirements of the Californian Department of Public Health Services. As a result, the raw material has been given the Greenguard Gold label, which means it may also be used in schools and health facilities accommodating children or elderly people, in addition to commercial buildings.

Manufacturers producing Neopor® Plus BMB insulation boards can also benefit from the certification of the raw material; by applying for an extended license from UL (Underwriter Laboratories), they can have their product labeled as protective of health for indoor spaces.

Within the framework of a European study, emissions by EPS insulation boards have been measured for samples based upon 12 different kinds of EPS raw material. The measurements according to /CEN TS 16516/ and /ISO 16000 3-6-9-11/ were carried out by /Eurofins/ in April 2016. The insulation materials tested comply with the requirements of the /AgBB/ scheme for using construction products in indoor applications. The insulation materials tested can be rated A+ in accordance with the French VOC regulation.

VOC emissions –

Name	Value	Unit
AgBB overview of results (28 days)	25	µg/m3
TVOC (C6 – C16) (3 days)	75	µg/m3
R (dimensionless)	0.084	-
Carcinogenic substances	1	µg/m3

8.2 Leaching performance

Leaching behavior is not relevant for Neopor® Plus BMB insulation board.

9.0 References

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