ENVIRONMENTAL PRODUCT DECLARATION

IN ACCORDANCE WITH ISO 21930:2017

SmartEPD-2024-022-0128-01

Johns Manville Mineral Wool Insulation Light Density Board Product

Date of Issue:
May 14, 2024

Expiration:
May 14, 2029

Last updated:
May 14, 2024

General Information

Johns Manville

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Product Name:	Johns Manville Mineral Wool Insulation Light Density Board Product
Functional Unit:	1 m2 of material with RSI = 1m2K/W
Declaration Number:	SmartEPD-2024-022-0128-01
Date of Issue:	May 14, 2024
Expiration:	May 14, 2029
Last updated:	May 14, 2024
EPD Scope:	Cradle to gate with other options A1 - A3, A4, A5, C1 - C4
Market(s) of Applicability:	North America

Reference Standards

Standard(s):	ISO 21930:2017
Core PCR:	UL Part A v4, UL PCR for Building-Related Products and Services Part A v.4, ISO 21930:2017 Date of issue: March 01, 2022
Sub-category PCR:	UL Part B: Building Envelope Thermal Insulation Products v.3 Date of issue: April 10, 2023 Valid until: October 10, 2024
Sub-category PCR review panel:	Contact Smart EPD for more information.
General Program Instructions:	Smart EPD General Program Instructions v.1.0, November 2022

Verification Information

LCA Author/Creator:	Jana Fogarty | TrueNorth Collective | info@truenorthcollective.net
EPD Program Operator:	Smart EPD | info@smartepd.com | www.smartepd.com | 585 Grove St., Ste. 145 PMB 966, Herndon, VA 20170, USA

Verification:

Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071 : External

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Independent external verification of EPD, according to ISO 14025 and reference PCR(s) : External

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Limitations, Liability, and Ownership

Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of products 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 whole building life cycle. EPD comparability is only possible 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.

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

Organization Information

Johns Manville manufactures premium-quality insulation, commercial roofing and fibers and nonwovens for commercial, industrial and residential applications. One way that Johns Manville strives to advance energy efficiency is by promoting the use of mineral wool building insulation products. By creating publicly available Environmental Product Declarations (EPDs) for both light-density and high-density mineral wool batt and board products, Johns Manville provides greater transparency regarding the environmental profile of our mineral wool insulation products.

Johns Manville's residential and commercial insulation products help maintain energy efficiency and lower heating and cooling costs, helping to make buildings more comfortable year-round. As an industry leader, Johns Manville is committed to providing high-quality products, resources, guidance, and support in the building insulation space. Johns Manville's commercial and residential building insulation product line offers outstanding thermal and acoustical performance which support sustainable building practices. Johns Manville commissioned TrueNorth Collective to conduct a Life Cycle Assessment (LCA) and Environmental Product Declaration (EPD) on its light-density and high-density mineral wool insulation products.

Further information can be found at: https://www.jm.com/

Product Description

Mineral wool insulation is used to promote energy efficiency and comes in a variety of forms and sizes. It resists mold, fungi and bacteria growth, offers protection again moisture infiltration and is not corrosive and contains no chemicals that can degrade pipes and wires.

Mineral board materials are used in: curtain walls, commercial roofs, basement walls, floor over unheated or open spaces and other building envelope applications. Further, the greater density of mineral wool insulation allows the materials to achieve higher R-values and insulating power. This results in increased year-round comfort and significant energy savings.

The fibrous composition of mineral wool insulation provides a flexibility and versatility not found in most other insulations. Mineral wool batt and board insulation comes in a wide variety of densities, sizes, and thicknesses with applications including but not limited to:

- Residential (thermal, acoustical, foundation drainage systems).
- Commercial (thermal, fire stopping and containment, and acoustical applications).
- Industrial (thermal, fire stopping and containment, acoustical, emissions control, pipe and mechanical systems, fillers).

This EPD covers Johns Manville light density mineral wool insulation board products; that is, those mineral wool insulation boards with a density less than or equal to 2.5 pounds per cubic foot (PCF).

Further information can be found at: https://www.jm.com/en/building-insulation/

Product Information

Functional Unit: 1 m2 of material with RSI = 1m2K/W

Mass: 1.56 kg

Product Specificity:

- ✓ Product Average
- ✗ Product Specific

Averaging:

Required data was obtained and the associated flows were normalized to the reference flows based on the functional unit (1 m2 of insulation material with a thickness that gives an average thermal resistance RSI = 1 m2·K/W (RIP = 5.68 ft2·°F·hr/Btu)), system modeling was performed using the commercial LCA software SimaPro (version 9.5.0), developed by PRé Sustainability, the Netherlands. This software allows the calculation of life cycle inventories and impact assessment, contribution analysis, parameterization, and related sensitivity analysis. The LCA values reported in this EPD correspond with the production-volume weighted average of the products covered. Results are reported for 2.5 PCF insulation, which was chosen as the reference product for light density board. Details on extrapolating results to other densities are provided in the section on Environmental Impacts. The study uses a combination of primary and secondary data. Where primary data were not available, default databases were used from ecoinvent v3.9.1 , Cut-off at Classification. For generation of electricity used in manufacturing the DATASMART LCI Package was used. Both databases contain detailed peer reviewed LCI data was used. Secondary data are sourced from a variety of literature sources, verified public reports and widely used databases. Each data point was reviewed and verified individually. Johns Manville collected primary manufacturing data and data from key suppliers. Representative unit processes were customized based on the type of material and recycled content, to represent the characteristics of actual input raw materials to the greatest extent possible. Primary data was collected through customizable templates and reviewed internally to ensure completeness and credibility. Common practices such as mass balance, energy balance and stoichiometry were considered. Final model inputs were reviewed by the client to verify key assumptions. Annual facility-wide manufacturing and production data was provided by Johns Manville for a 12 month reference year (2022). Manufacturing inventories were assigned using a mass allocation approach based on provided data of production volumes. The following activities were excluded from the scope and boundaries for this study: - Modules B1-B7 are not declared, they are identified as optional life cycle stages according to the PCR. Resulting reductions in heating and cooling energy are construction and site specific, use phase energy savings resulting from insulation use are not included in this study. - Human activities (e.g., employee travel to and from work) - R&D (i.e., the laboratory and inputs related to the development of the technologies) - Services (e.g., the use of purchased marketing, consultancy services and business travel). - Construction of capital equipment and maintenance and operation of support equipment - Maintenance and operation of support equipment - Manufacture and transport of packaging materials not associated with final product The end-of-life stages C1 and C3 are declared as having zero impact as deconstruction is done manually and insulation is not recycled. Capital equipment and plant infrastructure are not included in the foreground data however, background data from ecoinvent include the infrastructure components. Emissions listed only account for on-site emissions and do not include any upstream energy production. Supplied emissions data is included for processes for coke and natural gas, accounting for both upstream and combustion emissions. For the processes within the system boundary, all energy and material flows have been included in the model. No known flows are excluded. All upstream and downstream activities are included using a combination of primary and secondary data. While the majority of inventory data are sourced from primary resources, representative proxies are used to close gaps in the absence of primary data.

Variation in GWP Result (Products): -2.2% to +6.8%

Plants

Johns Manville
Phenix City, AL, USA

Product Specifications

Product SKU(s): Light Density Mineral Wool Board Insulation

Product Classification Codes:	Masterformat - 07 21 13.19 EC3 - ThermalMoistureProtection -> Insulation -> BoardInsulation
Form Factor:	ThermalMoistureProtection >> Insulation >> BoardInsulation
Insulation type:	Mineral Wool
Intended Application:	Wall & General
Thermal resistance:	1 m2K/W

Material Composition

Material/Component Category	Origin	% Mass
Basalt	None	71
Dolomite	None	19.2
Limestone	None	7.1
Resin	None	2
Urea	None	0.6
Other additives	None	0.2

Packaging Material	Origin	kg Mass
Polyethylene film	None	3.15E-03
Polypropylene film	None	8.35E-03

Hazardous Materials
No regulated hazardous or dangerous substances are included in this product.

EPD Data Specificity

Primary Data Year: calendar year 2022

Manufacturing Specificity:

- ✗ Industry Average
- ✗ Manufacturer Average
- ✓ Facility Specific

Software and LCI Data Sources

LCA Software: SimaPro v. 9.5

LCI Foreground Database(s):	Ecoinvent v. 3.9.1 | Cut-Off by Classification
LCI Background Database(s):	Ecoinvent v. 3.9.1 | Cut-Off by Classification | DATASMART LCI Package v. 2021 | Cut-Off by Classification

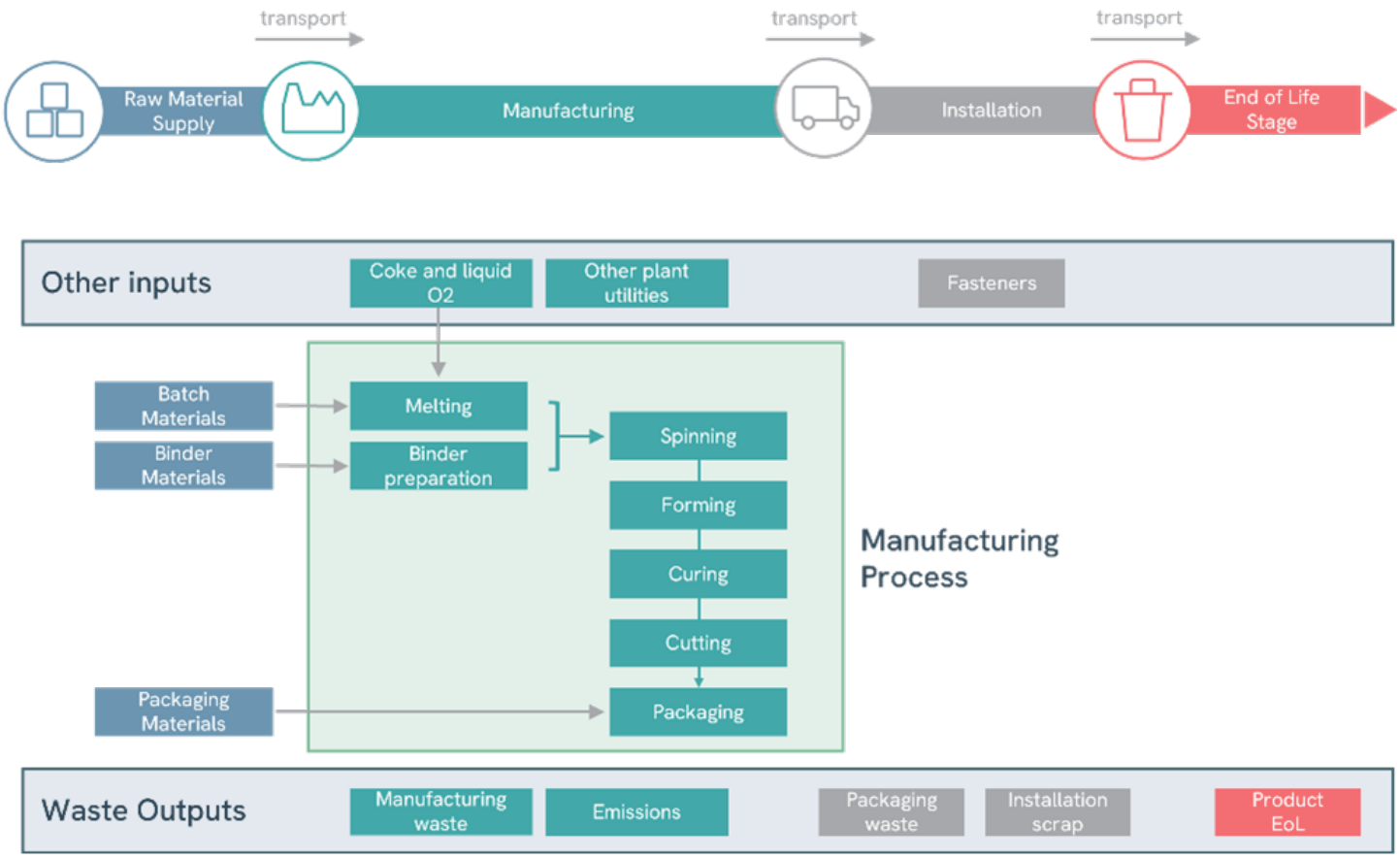
Renewable Electricity

Renewable electricity is used: No

System Boundary

Production	A1	Raw material supply	✓
	A2	Transport	✓
	A3	Manufacturing	✓
Construction	A4	Transport to site	✓
	A5	Assembly / Install	✓
Use	B1	Use	ND
	B2	Maintenance	ND
	B3	Repair	ND
	B4	Replacement	ND
	B5	Refurbishment	ND
	B6	Operational Energy Use	ND
	B7	Operational Water Use	ND
End of Life	C1	Deconstruction	✓
	C2	Transport	✓
	C3	Waste Processing	✓
	C4	Disposal	✓
Benefits & Loads Beyond System Boundary	D	Recycling, Reuse Recovery Potential	ND

Product Flow Diagram



Life Cycle Module Descriptions

Manufacturing of mineral wool insulation products includes several processing steps. 1. Natural rock raw materials are added to a cupola furnace in the amounts specified in the table above. 2. Coke is added to the cupola furnace and oxygen is injected to enhance combustion. This provides the energy to melt the rock and slag. The high melting temperature requires continuous operation and minimal downtime is critical to ensuring energy management is maintained for each kilogram of wool produced. 3. The melted materials are dropped onto a cooled spinning wheel where fiber is formed and rapidly cooled. The centrifugal force of the spinning wheel in combination with the products chemical composition determines the fiber diameter, strength and thermal conductivity of the fiber and wool that is produced. 4. Board formation requires the use of a specific type of binder. The binder used is a water suspension of phenol formaldehyde (phenolic resin). The upstream production of the binder materials is included along with the emissions associated with the curing of the insulation product. The wool fiber produced is coated with the binder suspension and pressurized air is used to form a mat that is then pressed with a consolidation board to achieve the desired gauge and density. Curing is done with hot air through convection (oven is powered with both natural gas and electricity). 5. Finished boards are cut to size and packaged using shrink wrap or bags. Packaging materials are not assumed to be reused and disposal assumptions follow the PCR as no primary data is available. The manufacturing module includes manufacturing of products and co-products: - A3, use of various fuel sources within the manufacturing process - A3, generation of electricity from primary energy resources used in manufacturing including their extraction, refining and transport - A3, water use within the manufacturing process - A3, emissions from the combustion of secondary fuels and waste used in the manufacturing process - A3, waste management from manufacturing and manufacturing wastages transport up to the recycler or disposal Emissions data refers to coke combustion in furnaces and natural gas in curing ovens but may not track all relevant substance emissions. Ecoinvent proxies were used to estimate combustion emissions not measured directly by Johns Manville (including CO2). Substances which are measured by Johns Manville were removed from these proxies and modelled separately, in order to avoid double counting. Only the directly measured emissions are disclosed. Emissions listed only account for on-site emissions and do not include any upstream energy production. Background data in the form of Ecoinvent library processes account for upstream emissions. Transportation modes, distances and mass utilization rates were provided by Johns Manville and calculated using a weighted average. Installation is assumed to last the entire lifetime of the building; no maintenance or replacement is required. Board insulation estimates four 1 ½" fasteners per square meter are necessary for installation and includes a 3% scrap

rate to account for product losses during installation. Removal at the end of life requires only human labor and does not contribute to lifetime environmental impacts. In addition as mineral wool insulation is not recycled, the following modules are included but have zero impacts - Deconstruction (C1) - Waste Processing (C3) After removal, the board is transported to the landfill site and disposed.

LCA Discussion

Allocation Procedure

While conducting an LCA, if the life cycles of more than one product are connected, allocation of the process inputs should be avoided by using the system boundary expansion approach. In accordance with the guiding PCR, mass should be used as the primary basis for co-product allocation. The allocations of relevance for calculation (appropriation of impacts across various products) shall be indicated, at least: • Allocation in the use of recycled and/or secondary raw materials. • Allocation of energy, ancillary and operating materials used for individual products in a factory. No multi-output allocation was necessary in the foreground of the study. Allocation of secondary data taken from ecoinvent v3.9.1 cut-off by classification has allocation applied to it.

This study uses the cut-off approach method for recycling. According to this approach, the first life of a material bears the environmental burdens of its production (e.g., raw material extraction and processing) and the second life (e.g., scrap input) bears the burdens of refurbishment (e.g., collection and refining of scrap). The burdens from waste treatment are taken on by the next life of the product and not included in this study.

Cut-off Procedure

For the processes within the system boundary, all energy and material flows have been included in the model. No known flows are excluded.
All upstream and downstream activities are included using a combination of primary and secondary data. While the majority of inventory data are sourced from primary resources, representative proxies are used to close gaps in the absence of primary data.

Data Quality Discussion

Consistency and reproducibility: To ensure consistency, primary data were collected at the same level of granularity. All input and output information, modelling assumptions and dataset choices are provided in this report for the purpose of reproducibility. Representativeness: Refer to the sections above for details about representativeness. There are no exceptions in inclusion of value-add activities and all flows are included in this study. Technology Coverage This study uses a mix of primary and secondary data modeled using Ecoinvent v3.9.1 database to represent the raw material supply, transportation and manufacturing energy inputs. Geographic Coverage This study covers the Johns Manville manufacturing site in Phenix City, Alabama, North America. Time Coverage Primary data from Johns Manville represents operations year 2022. In addition, secondary data are modeled using Ecoinvent v3.9.1. Treatment of Missing data No known data was excluded in this study.

Results

Environmental Impact Assessment Results

IPCC AR5 GWP 100, TRACI 2.1

per 1 m2 of material with RSI = 1m2K/W.

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

Impact Category	Method	Unit	A1A2A3	A4	A5	C1	C2	C3	C4
GWP-total	IPCC AR5 GWP 100	kg CO2 eq	2.9	1.69	0.156	ND	0.116	ND	0.00949
ODP	TRACI 2.1	kg CFC 11 eq	0.0000019	2.88e-8	5.83e-8	ND	1.98e-9	ND	2.95e-10
AP	TRACI 2.1	kg SO2 eq	0.0153	0.00724	0.000722	ND	0.000498	ND	0.0000641
EP	TRACI 2.1	kg N eq	0.00627	0.00163	0.000385	ND	0.000112	ND	0.0000109
POCP	TRACI 2.1	kg O3 eq	0.163	0.188	0.0115	ND	0.0129	ND	0.0017
ADP-fossil	TRACI 2.1	MJ	3.02	3.38	0.204	ND	0.232	ND	0.0344

Abbreviations:

GWP = Global Warming Potential, 100 years (may also be denoted as GWP-total, GWP-fossil (fossil fuels), GWP-biogenic (biogenic sources), GWP-luluc (land use and land use change)), ODP = Ozone Depletion Potential, AP = Acidification Potential, EP = Eutrophication Potential, SFP = Smog Formation Potential, POCP = Photochemical oxidant creation potential, ADP-Fossil = Abiotic depletion potential for fossil resources, ADP-Minerals&Metals = Abiotic depletion potential for non-fossil resources, WDP = Water deprivation potential, PM = Particular Matter Emissions, IRP = Ionizing radiation, human health, ETP-fw = Eco-toxicity (freshwater), HTP-c = Human toxicity (cancer), HTP-nc = Human toxicity (non-cancer), SQP = Soil quality index.

Comparisons cannot be made between product-specific or industry average EPDs at the design stage of a project, before a building has been specified. Comparisons may be made between product-specific or industry average EPDs at the time of product purchase when product performance and specifications have been established and serve as a functional unit for comparison. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted. Any comparison of EPDs shall be subject to the requirements of ISO 21930 or EN 15804. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparison can be inaccurate, and could lead to erroneous selection of materials or products which are higher-impact, at least in some impact categories.

Resource Use Indicators

per 1 m2 of material with RSI = 1m2K/W.

Indicator	Unit	A1A2A3	A4	A5	C1	C2	C3	C4
RPRE	MJ	1.22	0.317	0.0496	ND	0.0218	ND	0.002
RPRM	MJ	ND	ND	ND	ND	ND	ND	ND
RPRT	MJ	1.22	0.317	0.0496	ND	0.0218	ND	0.002
NRPRE	MJ	39.2	25.7	2.1	ND	1.76	ND	0.251
NRPRM	MJ	1.93	ND	0.0579	ND	ND	ND	ND
NRPRT	MJ	41.2	25.7	2.16	ND	1.76	ND	0.251
SM	kg	ND	ND	ND	ND	ND	ND	ND
RSF	MJ	ND	ND	ND	ND	ND	ND	ND
NRSF	MJ	ND	ND	ND	ND	ND	ND	ND
RE	MJ	ND	ND	ND	ND	ND	ND	ND
FW	m3	0.0000314	ND	9.42e-7	ND	ND	ND	ND

Abbreviations:

RPRE or PERE = Renewable primary resources used as energy carrier (fuel), RPRM or PERM = Renewable primary resources with energy content used as material, RPRT or PERT = Total use of renewable primary resources with energy content, NRPRE or PENRE = Non-renewable primary resources used as an energy carrier (fuel), NRPRM or PENRM = Non-renewable primary resources with energy content used as material, NRPRT or PENRT = Total non-renewable primary resources with energy content, SM: Secondary materials, RSF = Renewable secondary fuels, NRSF = Non-renewable secondary fuels, RE = Recovered energy, ADPF = Abiotic depletion potential, FW = Use of net freshwater resources, VOCs = Volatile Organic Compounds.

Waste and Output Flow Indicators

per 1 m2 of material with RSI = 1m2K/W.

Indicator	Unit	A1A2A3	A4	A5	C1	C2	C3	C4
HWD	kg	0.00000718	ND	2.15e-7	ND	ND	ND	ND
NHWD	kg	1.16	ND	0.0924	ND	ND	ND	1.56
HLRW	kg	ND	ND	ND	ND	ND	ND	ND
ILLRW	kg	ND	ND	ND	ND	ND	ND	ND
CRU	kg	ND	ND	ND	ND	ND	ND	ND
MFR	kg	ND	ND	0.00103	ND	ND	ND	ND
MER	MJ, LHV	ND	ND	ND	ND	ND	ND	ND
EE	MJ, LHV	ND	ND	ND	ND	ND	ND	ND

Abbreviations:

HWD = Hazardous waste disposed, NHWD = Non-hazardous waste disposed, RWD = Radioactive waste disposed, HLRW = High-level radioactive waste, ILLRW = Intermediate- and low-level radioactive waste, CRU = Components for re-use, MFR or MR = Materials for recycling, MER = Materials for energy recovery, MNER = Materials for incineration, no energy recovery, EE or EEE = Recovered energy exported from the product system, EET = Exported thermal energy.

Carbon Emissions and Removals

per 1 m2 of material with RSI = 1m2K/W.

Indicator	Unit	A1A2A3	A4	A5	C1	C2	C3	C4
BCRK	kg CO2	ND	ND	ND	ND	ND	ND	ND
BCEK	kg CO2	ND	ND	ND	ND	ND	ND	ND

Abbreviations:

BCRP = Biogenic Carbon Removal from Product, BCEP = Biogenic Carbon Emission from Product, BCRK = Biogenic Carbon Removal from Packaging, BCEK = Biogenic Carbon Emission from Packaging, BCEW = Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes, CCE = Calcination Carbon Emissions, CCR = Carbonation Carbon Removals, CWNR = Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes, GWP-luc = Carbon Emissions from Land-use Change.

Impact Scaling Factors

Product Name	Density (kg/m3)	Thickness to Achieve RSI=1 (mm)	Weight per Functional Unit (kg)	Product Specific Functional Unit Multiplier
2 PCF	32.0	34.2	1.10	0.70
2.5 PCF	40.0	39.0	1.56	1.00

Scenarios

Transport to the building/construction site (A4)

A4 Module

Fuel Type:	Diesel
Liters of Fuel:	44.5 l/100km
Vehicle Type:	Truck
Transport Distance:	1450 km
Capacity Utilization:	20.6 %
Packaging Mass:	0.0115 kg
Gross density of products transported:	37.8 kg/m3
Capacity utilization volume factor:	=1
Assumptions for scenario development:	Utilization ratios were calculated based on the mass of the boards required to fill a 53-ft trailer. A trailer is estimated to have a volume of 3,930 cubic feet and a maximum mass capacity of 45,000 pounds of cargo. Transport distance, capacity utilization and gross density correspond with the average value across products included in this EPD. The packaging mass refers to the amount per functional unit of the reference product.

Installation in to the building/construction site (A5)

A5 Module

Installation Scrap Rate Assumed:	3 %
Ancillary Materials:	0.00463 kg
Product Lost per Functional Unit:	0.0468 kg
Waste Materials at the Construction Site Before Waste Processing:	0.0587 kg
Assumptions for scenario development:	Values refer to the amount per functional unit of the reference product.
Output materials resulting from on-site waste processing: for recycling:	1.03E-03 kg
Output materials resulting from on-site waste processing: for disposal:	5.76E-02 kg
Packaging waste: plastic:	1.18E-02 kg

End of Life

C1 - C4 Modules

Collection Process

Collected Separately:	1.56 kg

Recovery

Landfill:	1.56 kg

Disposal

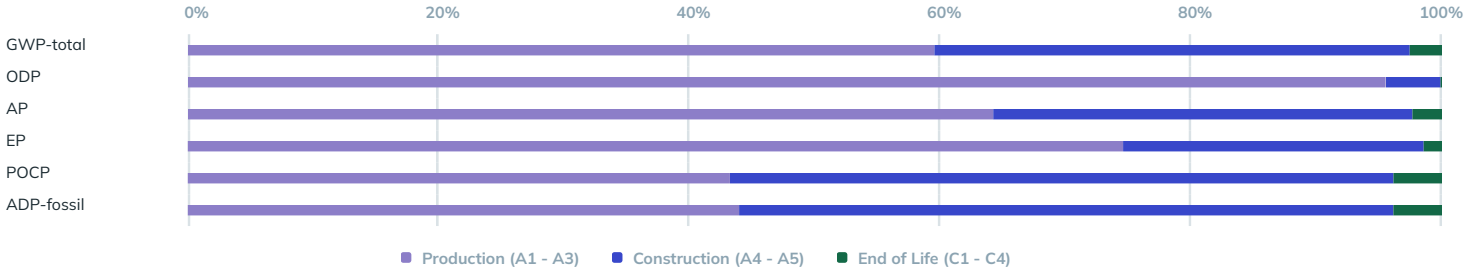
Product or Material for Final Disposal: 1.56 kg

Assumptions for scenario development:

Values refer to the amount per functional unit of the reference product.

Interpretation

For light density mineral wool insulation products analyzed in this study raw material supply (A1), raw material transport (A2), manufacturing (A3) contributed 40% to 95% of all potential impacts. Transportation of products to installation was most significant for smog formation potential (SFP) and abiotic depletion potential (ADP) Fossil. Potential environmental impacts from installation and end-of-life for all products were the least significant contributors. For light density mineral wool board insulation products studied the global warming potential impacts were largely due to emissions from electricity and combustion of hard coals and natural gas within the manufacturing process. While this is expected it also gives the largest opportunity of potential with the expansion of green energy in North America. Efficiency or renewable energy improvements made to support the processes of melting, forming or finishing energy would advance continued impact reduction efforts. Reduction in operations downtime would also optimize impact potential. LCA results are based on a relative approach and indicate potential environmental effects therefore do not predict actual impacts on category impacts.



Additional Environmental Information

The technical specifications apply to products considered in this EPD: - ASTM C553 | Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications - ASTM C612 | Standard Specification for Mineral Fiber Block and Board Thermal Insulation - ASTM C726 | Standard Specification for Mineral Wool Roof Insulation Board Additionally, fire-related standards and test methods apply: - NFPA 220 | Standard on Types of Building Construction - ASTM E136 | Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750C - ASTM E84 | Standard Test Method for Surface Burning Characteristics of Building Materials - NFPA 101 | Life Safety Code EXTRAORDINARY EFFECTS The performance of building materials in a fire is a key factor in protecting the occupants of the building and allowing them to escape safely. Mineral wool insulation is naturally non-combustible and remains this way for the life of the product without the addition of harsh and potentially dangerous chemical fire retardants. The insulation can resist temperatures in excess of 2000F. Because of the high melting temperature there is a wide variety of applications that can utilize these unique properties. Due to these properties, mineral wool insulation can be used as a passive fire protection in many buildings. Manufacturers of these products encourage a balanced design, which includes a combination of active, detective and passive fire protection in building codes to ensure the safety of building occupants. These products should meet NFPA 220 and ASTM E136 standards and test methods and are Class A product tested per ASTM E84 and NFPA 101. HEALTH IMPACTS Johns Manville is committed to ensuring that mineral wool insulation products can be safely manufactured, installed and used. Johns Manville has participated in funding extensive research at leading independent laboratories and universities. The scientific research shows no association between exposure to mineral wool fibers and respiratory disease or cancer in humans. Scientific evidence demonstrates that mineral wool is safe to manufacture, install and use when recommended work practices are followed. Following these work practices will help to reduce any irritation. Irritation is considered a mechanical irritation and does not meet the U.S. OSHA HAZCOM definition of "irritation". USE PHASE IMPACTS An insulating material's resistance to conductive heat flow is measured or rated in terms of its thermal resistance or R-value. Insulation materials work by slowing conductive and convective heat flow. The EPA estimates homeowners can save up to 15% on heating and cooling costs by air sealing their homes and adding insulation in attics, floors over crawl spaces and basements.

References

ACLCA. (2019). ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017. ACLCA. Bare, J., Gloria, T., & Norris, G. (2006). Development of the Method and U.S. Normalization Database for Life Cycle Impact Assessment and Sustainability Metrics. Environmental Science & Technology. Bare, J., Norris, G., Pennington, D., & McKone, T. (2003). TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts. Journal of Industrial Ecology. Frischknecht, R., Jungbluth, N., Althaus, H., Doka, G., Dones, R., Hischier, R., . . . Nemecek, T. (2007). Implementation of Life Cycle Impact Assessment Methods: Data v2.0. Dübendorf, Switzerland: ecoinvent report No. 3, Swiss centre for Life Cycle Inventories. IPCC, I. P. (2013). IPCC Fith Assessment report. The PhysicalSceince Basis. Retrieved from http://www.ipcc.ch/report/ar5/wg1/. ISO 14025. (2006). ISO 14025:2006: Environmental labels and declarations — Type III environmental declarations — Principles and procedures. International Organization for Standardization. ISO 14040. (2006). ISO14040:2006/Amd 1:2020 -- Environmental management -- Life cycle assessment -- Principles and framework. International Organization for Standardization. ISO. (2006). ISO 14044:2006/Amd1:2017/Amd2:2020 Environmental management - Life cycle assessment - Requirements and guidelines. International organization for Standardization (ISO). ISO 21930. (2017). Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services. UL. (2022). Product Category Rules for Building Related Products and Services, Part A: Life Cycle Assessment Calculation Rules and Report Requirements UL 10010, v4. UL. UL. (2023). Product Category Rule (PCR) Guidance for Building-Related Products and Services Part B: Designated Steel Construction Product EPD Requirements, UL 10010–34, v.3. UL. Weidema B P, B. C. (2013). Overview and methodology. Data quality guideline for the ecoinvent database version 3. St. Gallen: The ecoinvent Centre.