ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 and EN 15804+A1 for:

NaturBoard VENTACUSTO, NaturBoard VENTACUSTO GVN & NaturBoard VENTACUSTO GVB

From

KNAUF INSULATION

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Programme:	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com
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EPD owner	Knauf Insulation Sprl Rue de Maestricht 95 4600 Visé Belgium
Product Category Rules:	PCR 2012:01. Construction products and construction services. Version 2.3 Sub-PCR-I Thermal insulation products (EN 16783: 2017).
Product group classification:	UN CPC 37
Reference year for the plant data:	2018
Geographical application scope:	Europe

CEN standard EN 15804+A1 serves as the Core Product Category Rules (PCR)
Product category rules (PCR): Construction products and Construction services, 2012:01, version 2.3, Sub-PCR-I Thermal insulation products (EN 16783: 2017),
PCR review was conducted by: The technical Committee of the International EPD@ System
Independent third-party verification of the declaration and data, according to ISO 14025:2006. ☒ EPD process certification ☐ EPD verification
Certified by: Bureau Veritas certification Sverige AB SE006629-1
Procedure for follow-up of data during EPD validity involves third party verifier: ☒ Yes ☐ No

General information

Information about the company

Description of the organisation:
Knauf Insulation has more than 40 years of experience in the insulation industry and is one of the most respected names in insulation worldwide. Knauf Insulation is manufacturing products and solutions mainly in glass and rock mineral wool, as well as wood wool. We operate more than 37 manufacturing sites globally in 15 countries and employ more than 5,000 people.

The Headquarters are located in Belgium, in Visé.

Product-related or management system-related certifications:
All Knauf Insulation sites, including the related site for this EPD, are ISO 9001, ISO 14001, ISO 50001 and ISO 45001 certified under the scope "Design, Development and Production of Insulation Materials and Systems".

Name and location of production site:
The application in construction of the concerned product is Europe. The data utilized for the production stage life cycle assessment are related to production plants located in Surdulica (Serbia) and Novi Marof (Croatia).

Industrijsko naselje Belo Polje bb, 17530, Surdulica, Serbia

Varaždinska ul. 140, 42220, Novi Marof, Croatia

Information about Rock Mineral Wool production

The Rock Mineral Wool Products for Building Construction are available in the form of slabs, boards, lamellas and rolls. RMW slabs are used as a thermal, acoustical and fire insulation product.

In general, the density for rock mineral wool products ranges from 20 to 200 kg/m³. In terms of composition, the inorganic part (92-98%) is composed of volcanic rocks, typically basalt, and some dolomite and with an increasing proportion of recycled material in the form of briquettes, a mix of stone wool scrap, other secondary materials and cement.

The remaining fraction is the bio-organic binder named ECOSE®. The main constituent of the binder is dextrose extracted from plants.

Product information

Product name: NaturBoard VENTACUSTO, NaturBoard VENTACUSTO GVN &NaturBoard VENTACUSTO GVB.

Product identification: The declared insulation product NaturBoard VENTACUSTO, NaturBoard VENTACUSTO GVN &NaturBoard VENTACUSTO GVB, is a compact rock mineral wool faced, unfaced slab of 1 m^2 (considered for this EPD).

For the placing on the construction products market in the European Union/ EFTA (with exception of Switzerland), the Regulation/ (EU) No 305/2011/ applies. The concerned products need Declarations of Performance /DoP R4224MPCPR / R4305MPCPR taking into consideration the harmonized product standard /EN 13162/ and the /CE-mark/.

Product description: The product is intended for thermal and sound insulation, as well as for fire protection of ventilated facades without height limit in metal structures, as a filling between profiled steel elements in the parts of the structure where the sound performance requirements are increased – it can also be used separately, as an absorbing lining.

UN CPC code:
37990: Non-metallic mineral products (including mineral wool, expanded mineral materials, worked mica, articles of mica, non-electrical articles of graphite or other carbon and articles of peat).

Geographical scope: The product is manufactured in Surdulica (Serbia) and Novi Marof (Croatia) with related country energy mix for electricity. Regarding the market area, the product is mainly marketed in Europe.

Energy:
Electricity mix and gas inputs are taken from related country values taken from reference year 2016.

Technical Characteristics:

Parameter	Value
Thermal conductivity / EN 13162	0.034 W/(mK)
Water vapor diffusion resistance (EN 12086)	1
Thermal Resistance (ISO 8301)	2.94 m^2K/W
Reaction to fire (EN 13501-1)	A1
Declared density range/ EN 1602	70 kg/m^3 (+/-10%)
Melting point of fibers DIN 4102-17	≥ 1000°C

LCA information

Functional unit / declared unit:

The declared unit is 1 m^2 of faced, unfaced Rock Mineral Wool NaturBoard VENTACUSTO, NaturBoard VENTACUSTO GVN &NaturBoard VENTACUSTO GVB.with a thickness of 100 mm. The declared lambda is 0.034 W/mK. The density used for the calculation of this specific LCA is 70 kg/m^3.

Reference service life: The RSL or durability of the reference product is as long as the lifetime of the building equipment in which it is used (at least 50 years).

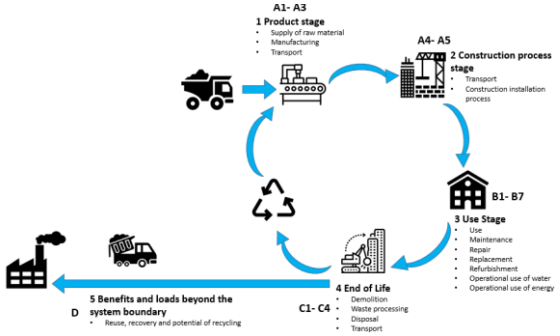
Time representativeness:

Plants production data for the complete year 2018.

Database(s) and LCA software used:

The LCA model, the data aggregation and environmental impacts are calculated with the software GaBi 10.0 and its Service Pack 40 databases.

System diagram:



Description of system boundaries:

The system boundary of the EPD follows the modularity approach defined by the /EN 15804+A1/. **The type of EPD is cradle to grave.**

List and explanation of the modules declared in the EPD.

The product stage (A1-A3) includes:

- A1 - raw material extraction and processing, processing of secondary material input (e.g. recycling processes),
- A2 - transport to the manufacturer and
- A3 - manufacturing.

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 during the product stage.

The LCA results are given in an aggregated form for the product s_V2tage, meaning that the modules A1, A2 and A3 are considered as a unique module A1-A3.

Product Parameters	Value
Declared Density	70 kg/m^3
Rock mineral wool weigth (without facing/coating weight)	7 kg
Surface	1 m^2
Thickness	100 mm
Volume	0.1 m^3
Facing/ coating (GVB)	0.075 kg
Packaging Plastic sheet	0.08 kg
Packaging Wooden pallet	0.3 kg

The construction process stage includes:

- A4 - transport to the construction site and
- A5 - installation into the building.

The transport to the building site (A4) and installation (A5) included in this LCA use the following parameters:

Parameter	Value
Average transport distance	600 km
Type of fuel and vehicle consumption or type of vehicle used for transport.	Truck Euro 6. (28 – 32 t / 22 t payload.) 33 L for 100 km (if 100 % utilization).
Truck capacity utilization (including 30% of empty returns)	26.80 % of the weight capacity
Loss of materials in construction site	2%
Packaging Wooden pallet	40% recycled, 60% incinerated
Packaging Plastic sheet	40% recycled, 60% incinerated

The treatment of the packaging waste after the installation of the product (A5) has been considered.

The Use stage (B1-B7) includes:

- B1: Use
- B2: Maintenance

- B3: Repair
- B4: Replacement
- B5: Refurbishment
- B6: Operational Energy Use
- B7: Operational Water Use

Once installation is complete, no actions or technical operations are required during the use stages till the end of life. Therefore, the mineral wool has no impacts (excluding potential energy savings) on this stage.

The end-of-life stage includes:

- C1 - deconstruction, demolition,
- C2 - transport to waste processing,
- C3 - waste processing for reuse, recovery and/or recycling and
- C4 - disposal.

This includes provision of all transports, materials, products and related energy and water use. The common manual dismantling impact of insulation is considered as very small and can be neglected in C1.
Although Rock Mineral Wool products from Knauf Insulation are partly recycled at their end-of-life, an established collection system does not exist yet. Therefore, the assumption chosen in this study, 100% landfill (C4) after the use phase, is the most conservative approach.

Parameter	Value
Disposal type (mineral wool)	100% landfill
Average transport distance waste (C2)	50 km
Type of fuel and vehicle consumption or type of vehicle used for transport.	Truck-trailer Euro 3, 34 - 40t gross weight / 27t payload capacity/ 40 L for 100 km (if 100 % utilization).
Truck capacity utilization	50 % of the weight capacity

Module D includes reuse, recovery and/or recycling potentials. According to /EN 15804+A1/, any declared benefits and loads from net flows leaving the product system not allocated as co-products and having passed the end-of waste state shall be included in module D. Benefits considered in module D originate from packaging recycling or incineration.

Content Declaration

The product does not contain substances from the "Candidate List of Substances of Very High Concern for Authorisation" under the REACH regulation (above 0.1% weight/weight).

Recycled material

The mineral wool waste that is originating from the manufacturing process is recycled internally through the use of briquettes (mineral wool waste and additional cement) that are reinjected into the batch. For 2018 year, external slags and some minor cullet external waste from costumer returns are considered into this specific LCA for each plant considered. The external recycled waste as raw material is 14 % originating (mainly) from slags.

Additional information:

All raw materials for the manufacturing of the declared product, the required energy, water consumption and the resulting emissions are considered into the LCA. Consecutively, the recipe components with a share even less than 1% are included. All neglected processes contribute less than 5% to the total mass or less than 5% to the total energy consumption. For information, the impact of the Rock Mineral Wool plant construction or machines, are not taken into account in the life cycle assessment. Allocation criteria if any are based on mass.

Conversion factor for this EPD is 0.14 for 1 kg. In principal, an insulation product should always be characterized by its thickness and an R value, only taking into account the product's weight could lead to wrong interpretation.

Knauf Insulation adopts a “worst case” approach into its EPDs.

More information:

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Declared Modules

Life cycle stages as defined in the European standard EN 15978 :2011 and the description of the system boundaries for the reference product LCA (X = included in the LCA, MND = module is not declared)

Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
Raw materials	Transport	Manufacturing	Transport	Construction Installation	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	X

Environmental performance

Potential environmental impacts: 1 m² of Rock Mineral Wool NaturBoard VENTACUSTO with a thickness of 100 mm.

PARAMETERS	UNIT	TOTAL A1-A3**	A4	A5	TOTAL B1-B2-B3-B4-B5-B6-B7	C1	C2	C3	C4	D*
Global warming potential (GWP)	kg CO_2 eq.	8.86E+00	5.82E-01	7.16E-01	0.00E+00	0.00E+00	2.47E-02	0.00E+00	9.64E-02	-2.48E-01
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq.	1.93E-14	1.44E-16	1.43E-10	0.00E+00	0.00E+00	6.22E-18	0.00E+00	5.30E-16	-2.28E-13
Acidification potential (AP)	kg SO_2 eq.	4.73E-02	1.15E-03	1.04E-03	0.00E+00	0.00E+00	1.07E-04	0.00E+00	6.18E-04	-3.12E-04
Eutrophication potential (EP)	kg PO_4^{3-} eq.	5.47E-03	2.78E-04	1.28E-04	0.00E+00	0.00E+00	2.63E-05	0.00E+00	6.97E-05	-4.47E-05
Formation potential of tropospheric ozone (POCP)	kg C_2H_4 eq.	2.22E-03	1.21E-04	5.27E-05	0.00E+00	0.00E+00	9.40E-06	0.00E+00	4.65E-05	-3.24E-05
Abiotic depletion potential – Elements	kg Sb eq.	7.58E-06	5.32E-08	1.61E-07	0.00E+00	0.00E+00	2.30E-09	0.00E+00	3.72E-08	-4.28E-08
Abiotic depletion potential – Fossil resources	MJ, net calorific value	1.03E+02	7.83E+00	2.45E+00	0.00E+00	0.00E+00	3.39E-01	0.00E+00	1.37E+00	-4.22E+00

*: *[Life Cycle D stage covers benefits and loads beyond the system boundary stage (reuse, recovery and recycling potential) therefore, when summing up results, this stage should be considered separately].*

**: *The indicators results are calculated with a reference product based on annual production volume (following the dedicated market share). The indicators results span between the reference product and the 100% sourced product from each dedicated plant may vary more than 10% (concerning A1- A3).*

Use of resources: 1 m² of Rock Mineral Wool NaturBoard VENTACUSTO with a thickness of 100 mm.

PARAMETER		UNIT	TOTAL A1-A3**	A4	A5	TOTAL B1-B2-B3-B4-B5-B6-B7	C1	C2	C3	C4	D*
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	3.54E+00	4.53E-01	2.41E-01	0.00E+00	0.00E+00	1.96E-02	0.00E+00	1.84E-01	-1.87E+00
	Used as raw materials	MJ, net calorific value	9.06E+00	0.00E+00	7.70E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	TOTAL	MJ, net calorific value	1.26E+01	4.53E-01	3.18E-01	0.00E+00	0.00E+00	1.96E-02	0.00E+00	1.84E-01	-1.87E+00
Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value	1.01E+02	7.87E+00	2.53E+00	0.00E+00	0.00E+00	3.40E-01	0.00E+00	1.41E+00	-4.80E+00
	Used as raw materials	MJ, net calorific value	4.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	TOTAL	MJ, net calorific value	1.05E+02	7.87E+00	2.53E+00	0.00E+00	0.00E+00	3.40E-01	0.00E+00	1.41E+00	-4.80E+00
Secondary material		kg	1.01E+00	0.00E+00	2.01E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable secondary fuels		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuels		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water		m3	2.25E-02	5.28E-04	1.71E-03	0.00E+00	0.00E+00	2.28E-05	0.00E+00	3.55E-04	-8.85E-04

*: *[Life Cycle D stage covers benefits and loads beyond the system boundary stage (reuse, recovery and recycling potential) therefore, when summing up results, this stage should be considered separately].* **: *The indicators results are calculated with a reference product based on annual production volume (following the dedicated market share). The indicators results span between the reference product and the 100% sourced product from each dedicated plant may vary more than 10% (concerning A1- A3).*

Waste production and output flows: 1 m² of Rock Mineral Wool NaturBoard VENTACUSTO with a thickness of 100 mm.

Waste production

PARAMETER	UNIT	TOTAL A1-A3**	A4	A5	TOTAL B1-B2-B3-B4-B5-B6-B7	C1	C2	C3	C4	D*
Hazardous waste disposed	kg	1.52E-07	3.64E-07	1.10E-08	0.00E+00	0.00E+00	1.57E-08	0.00E+00	2.15E-08	-1.77E-09
Non-hazardous waste disposed	kg	7.21E-01	1.25E-03	1.68E-01	0.00E+00	0.00E+00	5.39E-05	0.00E+00	7.08E+00	-1.76E-03
Radioactive waste disposed	kg	6.79E-04	1.45E-05	3.32E-05	0.00E+00	0.00E+00	6.27E-07	0.00E+00	1.60E-05	-2.29E-04

*: *[Life Cycle D stage covers benefits and loads beyond the system boundary stage (reuse, recovery and recycling potential) therefore, when summing up results, this stage should be considered separately].*

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Output flows

PARAMETER	UNIT	TOTAL A1-A3**	A4	A5	TOTAL B1-B2-B3-B4-B5-B6-B7	C1	C2	C3	C4	D*
Components for reuse	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	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	1.59E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	2.39E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, electricity	MJ	0.00E+00	0.00E+00	7.61E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ	0.00E+00	0.00E+00	1.77E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*: *[Life Cycle D stage covers benefits and loads beyond the system boundary stage (reuse, recovery and recycling potential) therefore, when summing up results, this stage should be considered separately].*

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LCA interpretation

ENVIRONMENTAL IMPACTS

All impact categories, except the ADPE and the ODP, are dominated by manufacturing processes. This can be explained by the huge impact of the energy use (electricity, natural gas and coke) for Rock Mineral Wool production.

The Global Warming Potential (GWP) is clearly dominated by the production processes impact (70%). Mostly due to the CO_2 emissions by the cupola furnace and the energy consumption at different levels. The coke is unfortunately generating quite a lot of CO_2 during the melting process. CO_2 is also generated upstream during the electricity production. However, the bio-based binder allows some sequestration of CO_2 thanks to CO_2 capture during plants growth. The transport to construction site has however an impact of less than 10%.

The Ozone layer Depletion Potential (ODP) is mostly influenced by construction site installation by considering plastic packaging incineration with energy valorisation.

The Acidification Potential (AP) is dominated by the manufacturing due to the emissions related to the raw materials melting process for example sulphur dioxides emissions and the energy consumption.

The Eutrophication Potential (EP) is mostly due to the manufacturing, especially due to the ammonia emission during binder application into the plant.

The Photochemical Ozone Creation Potential (POCP) is dominated by the manufacturing (emissions in the cupola furnace and energy consumption). The main emissions contributing to this impact category are sulphur dioxide and nitrogen oxides.

The Abiotic Depletion Potential Element (ADPe) is mainly due to the cement utilized in the briquettes production process in order to recycle secondary materials from the lines, the briquettes are reinjected into the melting batch. The impact of the raw materials in general, like the volcanic rock basalt, is very minor as this material is very abundant on Earth.

The Abiotic Depletion Potential Fossil (ADPf) is dominated by the use of coke as energy carrier. Next to the coke, we have also the impact of natural gas and upstream the electricity energy mix.

RESOURCES USE

The mains impact on **Primary Energy Demand from Non-Renewable** resources is from the manufacturing process of rock mineral wool products, especially due to the energy carrier, the coke, and the global energy consumption (gas and electricity).

The **Primary Energy Demand from Renewable** resources is dominated by the bio-based binder and the packaging, especially the wooden pallets.

For the Use of Secondary Material (SM), it consists of slags and some minor mineral wool waste.

References

International EPD® System

General Programme Instructions of the International EPD® System. Version 2.5.
Product Category Rules PCR 2012:01. Construction products and construction services. Version 2.3
Sub-PCR-I Thermal insulation products (EN 16783: 2017)

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EN 13162:2012 + A1:2015 - Thermal insulation products for buildings - Factory made mineral wool (MW)

EN 1602
EN 1602: 2013 Thermal insulating products for building applications - Determination of the apparent density

EN 13501-1
EN 13501-1: 2009 Fire classification of construction products and building elements - Part 1: Classification using test data from reaction to fire tests.

DIN 4102 / T17
DIN 4102 / T17: 1990 Fire behaviour of building materials and elements; determination of melting point of mineral fibre insulating materials; concepts, requirements and testing.

EN 12086
EN 12086: 2013 Thermal insulating products for building applications – determination of water vapour transmission properties.

EN 15978: 2011
EN 15978: 2011 Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method.

ISO 8301:1991
Thermal insulation — Determination of steady-state thermal resistance and related properties — Heat flow meter apparatus.

DoP R4224MPCPR, DoP 4305MPCPR
Declaration of Performance

DIN 4102-17
Fire behaviour of building materials and building components - Part 17: Melting point of mineral wool insulating materials - Terms and definitions, requirements and test

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