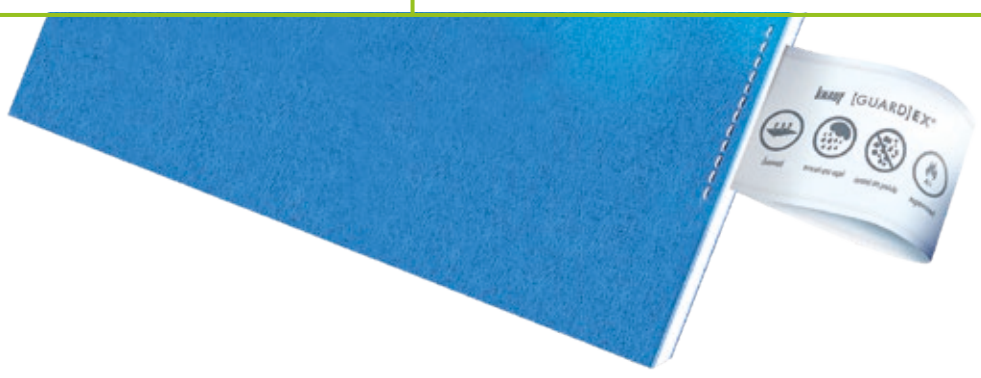
EPD®
THE INTERNATIONAL EPD® SYSTEM

KNAUF

ENVIRONMENTAL PRODUCT DECLARATION OF KNAUF GUARD[EX]® BOARDS

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC 2021

EPD PROGRAM	The international EPD System, https://environdec.com/
PROGRAM OPERATOR	EPD INTERNATIONAL AB
CPC CODE	37530 Articles of plaster or of composition based on plaster
EPD REGISTRATION NUMBER	S-P-07073
PUBLICATION DATE	2022-11-25
VALID UNTIL	2027-11-25
GEOGRAPHICAL SCOPE	Global



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Company Information

Knauf is one of the world's leading manufacturers of modern insulation materials, drylining systems, plasters and accessories, thermal insulation composite systems, paints, floor screeds, dry floor systems, and construction equipment and tools.

Knauf's factory in Stanos, Amphilochia, Greece, covers 100 acres of land, of which 13 acres is building cover. In the same geographical area, it operates a gypsum quarry (180 acres) owned by the company. The factory operates on a 24-hour basis while a significant part of its production is exported to the Balkan countries, Eastern Mediterranean and North Africa. Knauf has a vertical production from the raw material, gypsum, a product of its own mining that is processed in its facilities into complete structural elements (gypsum, plasterboard) with maximum added value. Inspection of all raw materials is carried out daily by the well-equipped quality control department, before their use in the production lines.

Product Information

This is a specific EPD for Knauf GUARD[**EX**]® Boards produced by Amphilochia plant in Greece. Knauf GUARD[**EX**]® is a non-combustible, lightweight, eco-friendy, mold, water, humidity and weather resistant sheathing board by means of a specially treated gypsum core and fiber glass fleece on both sides. It can be used as a sheathing board in the following applications:

- **Exterior Thermal Insulation Composite Systems (ETICS)**
- **Ventilated façades**

GUARD[**EX**]® Exterior Wall with ETICS is composed by a light gauge steel frame, fixed on the load bearing elements of the building, cladded externally with the Guardex board and internally with plasterboards. The ETICS system is directly bonded and mechanically fixed on the Guardex board.

Technical specification	Units	Performance	Standard
Type	-	GM-FH1R	EN 15283-1+A1
Fire resistance	-	A1	EN 13501-1
Thermal conductivity	W/mK	0,25	EN ISO 10456
Specific weight	kg/m^3	≥ 920	-
Weight	kg/m^2	11,5	-
Water resistance	%	≤3	EN 15283-1

A composition for the product is presented in Table below:

Material	Percentage (%) by mass	Mass (kg) per declared unit
Gypsum	90-94	10,35-10,80
Glass	4-7	0,46-0,81
Other minerals & additives	1-3	0,12-0,35

Packaging material	Mass (kg) per declared unit
Wooden pallets	5,01E-01
Polyethylene film	7,27E-03

No substance in the "Candidate List of Substances of Very High Concern (SVHC) for authorization" exceeds 0.1% wt in the final products.

System Boundaries

Guardex Fiberboard System Boundaries Diagram

X= Included, MND= Module Not Declared																
	Product stage			Construction stage		Use stage							End-of-life stage				Resource recovery stage
	Raw Materials Supply	**Transport**	**Manufacturing**	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	**De-construction and demolition**	**Transport**	**Waste processing for reuse, recovery and/or recycling**	**Disposal**	**Reuse-Recovery-Recycling-potential**
Module	**A1**	**A2**	**A3**	A4	A5	B1	B2	B3	B4	B5	B6	B7	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	**X**	**X**	**X**	MND	MND	MND	MND	MND	MND	MND	MND	MND	**X**	**X**	**X**	**X**	**X**
Geography	**GLO**	**GLO**	**GR**														
Specific data used	**>90%**																
Variation-products	**Not relevant**																
Variation-sites	**Not relevant**																

A1: Raw Material Supply

The production starts with the material supply. This stage includes the mining and processing of raw materials, the generation of electricity and fuels required for the manufacturing stage. Gypsum ($CaSO_4 \cdot 2H_2O$) is the main raw material while rest are materials such as starch, glass and other additives.

A2: Transportation of raw materials to manufacturer

Transport is relevant for delivery of raw materials from the supplier to the gate of manufacturing plant. The main material for the production, gypsum, is extracted and transported by trucks from owned quarries which are located 10 km from the manufacturing plant, while the rest are transported by trucks and vessels from different countries all over the world.

A3: Manufacturing

Manufacturing starts with the crushing and baking of raw gypsum in specially formed mills to form stucco (calcium sulphate hemihydrate). Manufacturing of the product includes all the processes presented in the flow diagram below. Manufacturing starts with the crushing and baking of raw gypsum in specially formed mills. Baked gypsum is combined with other solid and liquid mixing materials and the produced slurry is transferred in a formatting table in order to obtain a certain width and edge configuration. The slurry ends up in a 250 m length conveyor belt and in the end of this route the glass-fleece plasterboard (after a drying process) takes its final structure.

C1: De-construction, demolition

The deconstruction and demolition of the product takes place with the demolition of the whole building. It is assumed that energy for the fiberboard is minor compared to the other materials of the building, thus the environmental impact of this module is set to be zero.

C2: Transportation of waste

A distance of 100 km by lorry 16-32 tonnes from construction/demolition sites to disposal sites has been chosen as a conservative assumption.

C3: Waste processing for reuse, recovery and/or recycling

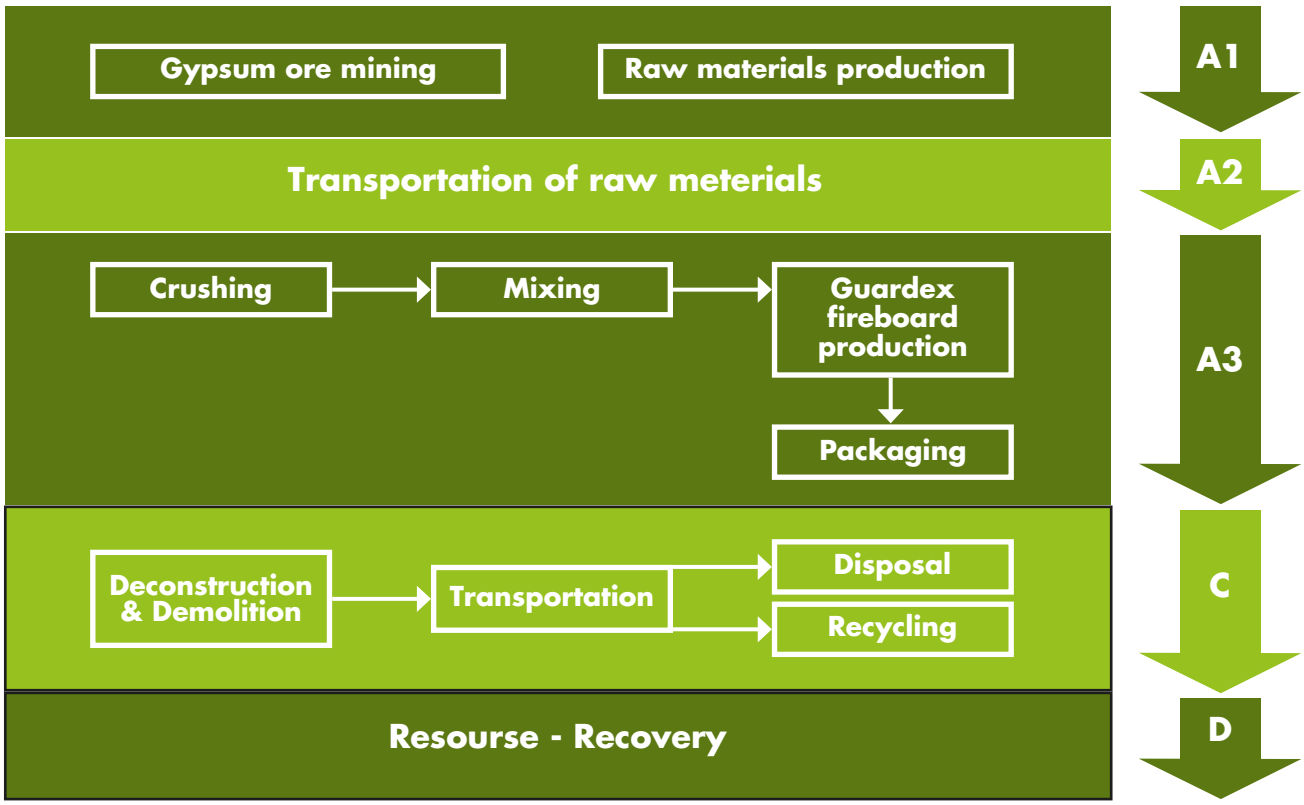
It is assumed that gypsum waste will be 100% landfilled after its life cycle, thus the environmental impact of this module is set to be zero.

C4: Disposal

As it is mentioned above, gypsum waste will be 100% landfilled after its life cycle.

D: Reuse-Recovery-Recycling potential

Since the product is 100% landfilled, the benefits and loads resulting from reuse and recycling is zero.



LCA Information

Declared unit: The declared unit is 1 m^2 of Guardex Fiberboards.

Goal and Scope: This EPD evaluates the environmental impacts of the production of 1 m^2 of fiberboards from Cradle to gate with module C1-C4 and D.

System Boundary: The system boundaries are set to be cradle to gate (A1-A3) with modules C+D

Cut-off rules: The cut-off criteria adopted is as stated in "EN 15804:2012+A2:2019". Where there is insufficient data for a unit process, the cut-off criteria are 1% of the total mass of input of that process. The total of neglected input flows per module is a maximum of 5% of energy usage and mass. The cut-off rule was used in cases of some additives used for the mixing of baked gypsum. The total mass is approximately 0,129%.

Allocations: Wherever possible, allocation was avoided by dividing the unit process to be allocated into two or more sub-processes and collecting the input and output data related to these sub-processes. Where allocation cannot be avoided, the inputs and outputs of the system were partitioned between its different products or functions in a way that reflects the underlying physical or economic relationships between them. In this case, the allocation concerns the electricity for lighting and the diesel consumption for other general utilities in the manufacturing plant and it is based on the mass of the final products.

Assumptions:

Transportation: In modules A2 and C2, a EURO4 lorry 16-32 metric ton was utilized for road transportation and a bulk carrier for dry goods for sea transportation.

Module C1: It is assumed that energy for the fiberboard is minor compared to the other materials of the building, thus the environmental impact of this module is set to be zero.

Module C2: a conservative assumption of 100 km by lorry 16-32 metric ton was used.

Module C3 and C4: There is no provision for fiberboard waste reuse and it is 100% landfilled.

Data quality: ISO 14044 was applied in terms of data collection and quality requirements. The impact of the production of raw materials recovered from Ecoinvent database v.3.8. The data concerning the modules A2 (Transportation) and A3 (Product manufacturing) were provided by Knauf and they were extracted from the company's SAP system and BDE. Regarding electricity mix, the latest (2020) national residual electricity mix as published in DAPEEP SA was utilized. The emission factor for natural gas is provided from National Inventory Report of 2020 for Greece. The end-of-life are based on the most representative scenarios for this product. Background data for these stages are retrieved from Ecoinvent v.3.8.

Geographical Scope: Worldwide

Time representativeness: Data obtained refer to the year 2021

Software used: OpenLCA v.1.10.3

Environmental Performance

ENVIRONMENTAL IMPACTS	Unit	A1-A3	C1	C2	C3	C4	D
GWP-total	kg CO2 eq	2,98E+00	0,00E+00	1,89E-01	0,00E+00	1,49E-01	0,00E+00
GWP-fossil	kg CO2 eq	2,97E+00	0,00E+00	1,89E-01	0,00E+00	1,49E-01	0,00E+00
GWP-biogenic	kg CO2 eq	8,84E-03	0,00E+00	6,38E-05	0,00E+00	5,46E-04	0,00E+00
GWP-luluc	kg CO2 eq	2,35E-03	0,00E+00	6,42E-05	0,00E+00	1,54E-04	0,00E+00
GWP-GHG[1]	kg CO2 eq	2,94E+00	0,00E+00	1,88E-01	0,00E+00	1,46E-01	0,00E+00
ODP	kg CFC-11 eq	5,60E-07	0,00E+00	4,33E-08	0,00E+00	3,85E-08	0,00E+00
AP	mol H+ eq	1,26E-02	0,00E+00	9,48E-04	0,00E+00	3,70E-01	0,00E+00
EP-freshwater[2]	kg PO4-3 eq	2,38E-03	0,00E+00	3,93E-05	0,00E+00	1,01E-04	0,00E+00
EP-freshwater[2]	kg P eq	7,75E-04	0,00E+00	1,28E-05	0,00E+00	3,29E-05	0,00E+00
EP-marine	kg N eq	2,29E-03	0,00E+00	3,31E-04	0,00E+00	3,87E-04	0,00E+00
EP-terrestrial	mol N eq	2,77E-02	0,00E+00	3,61E-03	0,00E+00	4,20E-03	0,00E+00
POCP	kg NMVOC eq	7,56E-03	0,00E+00	1,03E-03	0,00E+00	2,41E-02	0,00E+00
ADPe[3]	kg Sb eq	1,19E-05	0,00E+00	6,87E-07	0,00E+00	4,72E-07	0,00E+00
ADPf[3]	MJ	4,54E+01	0,00E+00	2,89E+00	0,00E+00	3,26E+00	0,00E+00
WDP[3]	m3 eq	1,12E+00	0,00E+00	1,34E-02	0,00E+00	1,43E-01	0,00E+00

[1] GWP-GHG indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide emissions and uptake and biogenic carbon stored in the product, with characterization factors (CFs) based on IPCC (2013).

[2] Eutrophication aquatic freshwater shall be given in both kg PO4 eq and kg P eq.

[3] The results of these environmental impact indicators shall be used with care as the uncertainties of these results are high or as there is limited experienced with the indicator.

RESOURCE USE	Unit	A1-A3	C1	C2	C3	C4	D
PERE	MJ	1,25E+01	0,00E+00	3,89E-02	0,00E+00	1,09E-01	0,00E+00
PERM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	1,25E+01	0,00E+00	3,89E-02	0,00E+00	1,09E-01	0,00E+00
PENRE	MJ	4,54E+01	0,00E+00	2,89E+00	0,00E+00	3,26E+00	0,00E+00
PENRM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	MJ	4,54E+01	0,00E+00	2,89E+00	0,00E+00	3,26E+00	0,00E+00
SM	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	m3	2,60E-02	0,00E+00	3,12E-04	0,00E+00	3,33E-03	0,00E+00

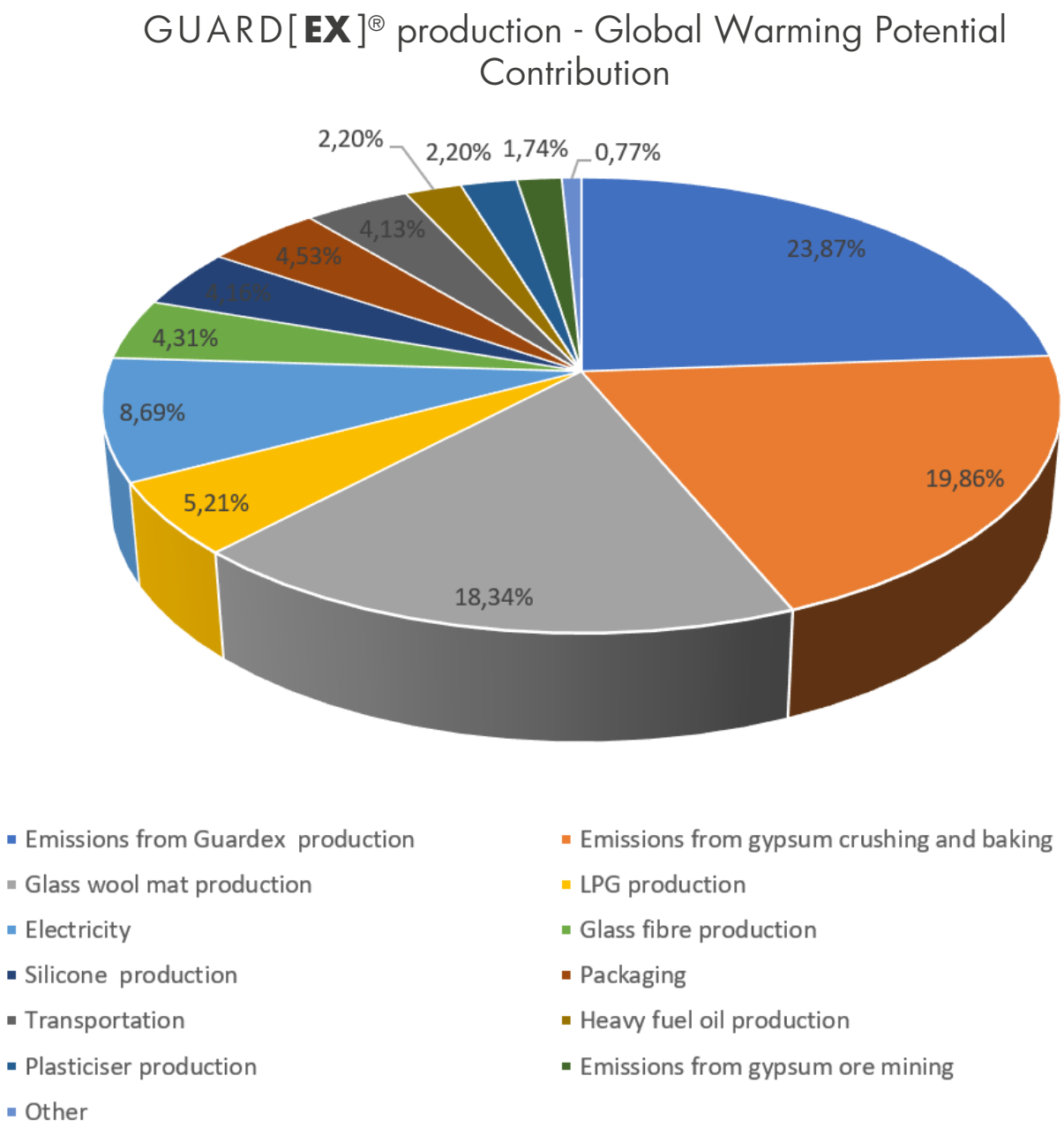
Environmental Performance

OUTPUT FLOWS AND WASTE CATEGORIES	Unit	A1-A3	C1	C2	C3	C4	D
HWD	kg	5,33E-05	0,00E+00	7,52E-06	0,00E+00	4,69E-06	0,00E+00
NHWD	kg	2,33E-01	0,00E+00	1,38E-01	0,00E+00	1,16E+01	0,00E+00
RWD	kg	2,37E-04	0,00E+00	1,98E-05	0,00E+00	1,92E-05	0,00E+00
CRU	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

ADDITIONAL IMPACTS	Unit	A1-A3	C1	C2	C3	C4	D
PM	Disease incidence	8,29E-08	0,00E+00	1,36E-08	0,00E+00	3,00E-07	0,00E+00
IRP[4]	kBq U235 eq	3,16E-01	0,00E+00	1,51E-02	0,00E+00	2,07E-02	0,00E+00
ETP-FW	CTUe	3,58E+01	0,00E+00	2,12E+00	0,00E+00	3,95E+00	0,00E+00
HTP-c	CTUh	3,18E-09	0,00E+00	7,83E-11	0,00E+00	3,79E-10	0,00E+00
HTP-nc	CTUh	2,80E-08	0,00E+00	2,24E-09	0,00E+00	1,83E-08	0,00E+00
SQP	dimensionless	6,37E+01	0,00E+00	1,93E+00	0,00E+00	3,23E+00	0,00E+00

[4] Ionizing radiation potential (IRP) impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Interpretation



Additional information

The EPD does not give information on release of dangerous substances to soil, water and indoor air because the horizontal standards on measurement of release of regulated dangerous substances from construction products using harmonized test methods according to the provisions of the respective technical committees for European product standards are not available.

Programme related information

Programme	Website	Address	E-mail
The international EPD System	www.environdec.com	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden	info@environdec.com

The CEN standard EN 15804 serves as the core Product Category Rules
PCR 2019:14 Construction products (EN 15804:A2); Version 1.2.4 ; 2022-09-07
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

Verification by:

Business Quality Verification P.C, Accredited by E.S.Y.D, Accreditation No. 1218
144 Septemvriou 3rd Str., Athens 112 51

EPD owner

www.knauf.gr

LCA Accountability

www.envirometrics.gr

Procedure for follow-up during EPD validity involves third party verifier
☐ Yes ☒ No

The EPD owner has the sole ownership, liability and responsibility of the EPD. EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

References

General Programme Instructions of the International EPD® System. Version 4.0, 2021-03-29

PCR 2019:14 v.1.2.4 Construction products. EPD System. Date 2022-09-07. Valid until 2024-12-20

EN 15804:2012+A2:2019, Sustainability of construction works - Environmental Product Declarations — Core rules for the product category of construction products

ISO 14020:2000 Environmental labels and declarations — General principles

ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations — Principles and procedures

ISO 14040:2006 Environmental management - Life cycle assessment-Principles and framework

ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines

Ecoinvent / Ecoinvent Centre, www.Ecoinvent.org

Residual Energy Mix 2020 from Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA)

▶ List of abbreviations

LCA	Life Cycle assessment
EPD	Environmental Product Declaration
PCR	Product category rules
GLO	Global
RER	Europe
RoW	Rest of the world
GWP-total	Global Warming Potential total
GWP-fossil	Global Warming Potential fossil
GWP-biogenic	Global Warming Potential biogenic
GWP-luluc	Global Warming Potential land use and land use change
ODP	Ozone Depletion Potential
AP	Acidification Potential
EP-freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment
EP-marine	Eutrophication Potential fraction of nutrients reaching marine end compartment
EP- terrestrial	Eutrophication potential, Accumulated Exceedance
POCP	Formation potential of tropospheric ozone photochemical oxidants
ADPe	Abiotic depletion potential for non-fossil resources
ADPf	Abiotic depletion potential for fossil resources
WDP	Water use
PERE	Use of renewable primary energy excluding resources used as raw materials
PERM	Use of renewable primary energy resources used as raw materials
PERT	Total use of renewable primary energy resources
PENRE	Use of non-renewable primary energy excluding resources used as raw materials
PENRM	Use of non-renewable primary energy resources used as raw materials
PENRT	Total use of non-renewable primary energy resources
SM	Use of secondary material
RSF	Use of renewable secondary fuels
NRSF	Use of non-renewable secondary fuels
FW	Use of net fresh water
HWD	Hazardous waste disposed
NHWD	Non-hazardous waste disposed
RWD	Radioactive waste disposed
CRU	Components for re-use
MFR	Materials for recycling
MER	Materials for energy recovery
EE	Exported Energy
PM	Particulate matter emissions
IRP	Ionizing radiation, human health
ETP-FW	Ecotoxicity, freshwater
HTP-c	Human toxicity, cancer
HTP-nc	Human toxicity, non-cancer
SQP	Land use related impacts/Soil quality

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ENVIRONMENTAL PRODUCT DECLARATION OF KNAUF GUARD[EX]® BOARDS

In accordance with ISO 14025 and EN 15804:2012+A2:2019

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