



ENVIRONMENTAL PRODUCT DECLARATION

IN ACCORDANCE WITH EN 15804+A2 & ISO 14025 / ISO 21930

Concrete roof tiles
Benders Sverige AB



EPD HUB, HUB-1233

Published on 20.03.2024, last updated on 20.03.2024, valid until 20.03.2029.

GENERAL INFORMATION

MANUFACTURER

Manufacturer	Benders Sverige AB
Address	Box 20, 535 21 Kvänum
Contact details	info@benders.se
Website	www.benders.se

EPD STANDARDS, SCOPE AND VERIFICATION

Program operator	EPD Hub, hub@epdhub.com
Reference standard	EN 15804+A2:2019 and ISO 14025
PCR	EPD Hub Core PCR version 1.0, 1 Feb 2022 EN 16757 Product Category Rules for concrete and concrete elements
Sector	Construction product
Category of EPD	Third party verified EPD (60 months)
Scope of the EPD	Cradle to gate with options, A4-A5, and modules C1-C4, D
EPD author	Sofia Bender
EPD verification	Independent verification of this EPD and data, according to ISO 14025: <input type="checkbox"/> Internal certification <input checked="" type="checkbox"/> External verification
EPD verifier	Elma Avdyli, as an authorized verifier acting for EPD Hub Limited

The manufacturer has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programs may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804 and if they are not compared in a building context.

PRODUCT

Product name	Concrete roof tiles
Additional labels	Palema, Exklusiv and Carisma. Coated and natural.
Product reference	N/A
Place of production	Bålsta
Period for data	2022
Averaging in EPD	Multiple products
Variation in GWP-fossil for A1-A3	6 %

ENVIRONMENTAL DATA SUMMARY

Declared unit	1 ton
Declared unit mass	1000 kg
GWP-fossil, A1-A3 (kgCO2e)	1,44E+02
GWP-total, A1-A3 (kgCO2e)	1,41E+02
Secondary material, inputs (%)	2.83
Secondary material, outputs (%)	75.4
Total energy use, A1-A3 (kWh)	330.0
Total water use, A1-A3 (m3e)	5,56E-01

PRODUCT AND MANUFACTURER

ABOUT THE MANUFACTURER

Benders is a Swedish family-owned company that develops, produces and markets competitive high-quality products and services for the construction and civil engineering sector. Benders is being active in several different business areas and is one of the market-leading producers of concrete and natural stone products in the Nordic countries.

PRODUCT DESCRIPTION

Roof tiles made from concrete. This analysis includes both coated and natural roof tiles. Benders' concrete tiles can now be found on six out of every ten Swedish homes. They are the country's most laid roof tiles and are available in three basic formats with a wide selection of colours and finishes. Further information can be found at www.benders.se.

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PRODUCT RAW MATERIAL MAIN COMPOSITION

Raw material category	Amount, mass - %	Material origin
Metals	N/A	
Minerals	99% 1%	Sweden Europe
Fossil materials	N/A	
Bio-based materials	N/A	

BIOGENIC CARBON CONTENT

Product's biogenic carbon content at the factory gate

Biogenic carbon content in product, kg C	
Biogenic carbon content in packaging, kg C	1.2662

FUNCTIONAL UNIT AND SERVICE LIFE

Declared unit	1 ton
Mass per declared unit	1000 kg
Functional unit	
Reference service life	50

SUBSTANCES, REACH - VERY HIGH CONCERN

The product does not contain any REACH SVHC substances in amounts greater than 0,1 % (1000 ppm).

PRODUCT LIFE-CYCLE

SYSTEM BOUNDARY

This EPD covers the life-cycle modules listed in the following table.

Product stage		Assembly stage		Use stage							End of life stage				Beyond the system boundaries	
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
x	x	x	x	x	MN D	MN D	MN D	MN D	MN D	MN D	MN D	x	x	x	x	x
Raw materials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconst./demol.	Transport	Waste processing	Disposal	Reuse Recovery Recycling

Modules not declared = MND. Modules not relevant = MNR.

MANUFACTURING AND PACKAGING (A1-A3)

The environmental impacts considered for the product stage cover the manufacturing of raw materials used in the production as well as packaging materials and other ancillary materials. Also, fuels used by machines, and handling of waste formed in the production processes at the manufacturing facilities are included in this stage. The study also considers the material losses occurring during the manufacturing processes as well as losses during electricity transmission.

The roof tiles are made of cement, stone and water which are mixed and then pigment is added. The concrete mixture is extruded into casts of aluminium or sheet steel. Before extruding the mixture, the metal casts are mechanically coated with cast oil to prevent the mixture from sticking to the cast. The roof tiles are then stacked on trolleys to be hardened in a hardening chamber at a temperature of about 35 degrees and a humidity

of about 90 percent. The hardening takes about a day. The roof tiles that are surface treated are treated with paint before and after they have hardened. After hardening, the roof tiles are detached from the cast and finally loaded on pallets and packed before they are delivered to the customer

TRANSPORT AND INSTALLATION (A4-A5)

Transportation impacts occurred from final products delivery to construction site (A4) cover fuel direct exhaust emissions, environmental impacts of fuel production, as well as related infrastructure emissions.

The transport distance is defined according to the PCR. Average distance of transportation from production plant to building site is assumed as 100 km and the transportation method is assumed to be lorry. Vehicle capacity utilization volume factor is assumed to be 100 % which means full load. In reality, it may vary but as role of transportation emissions in total results is small, the variety in load is assumed to be negligible. Empty returns are not taken into account as it is assumed that return trip is used by the transportation company to serve the needs of other clients. Transportation does not cause losses as product are fastened properly.

PRODUCT USE AND MAINTENANCE (B1-B7)

This EPD does not cover the use phase.

Air, soil, and water impacts during the use phase have not been studied.

PRODUCT END OF LIFE (C1-C4, D)

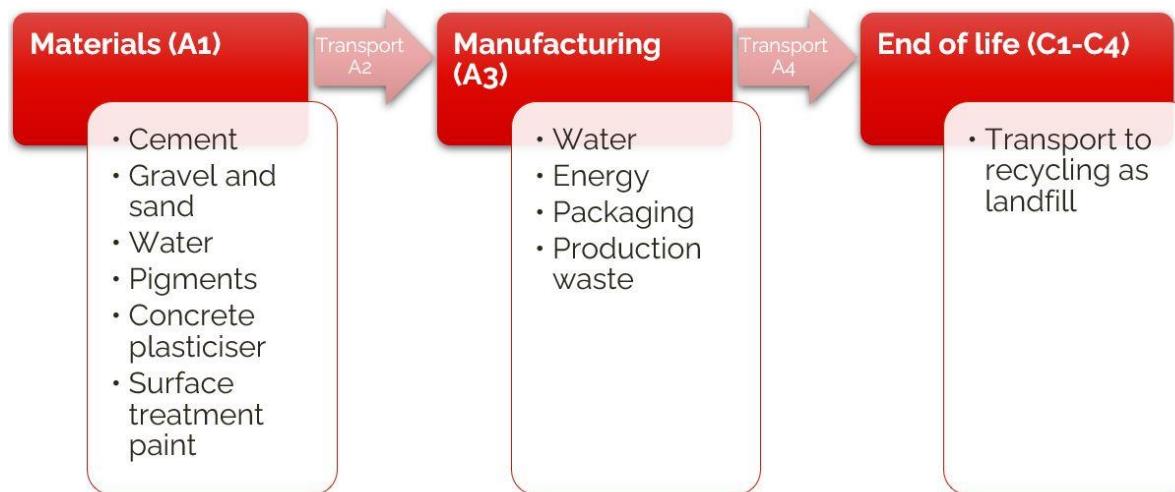
At the end-of-life, in the demolition phase 100% of the waste is assumed to be collected as separate construction waste. The demolition process consumes energy in the form of diesel fuel used by building machines. Energy consumption of a demolition process is on the average 10 kWh/m² (Bozdağ, Ö & Seçer, M. 2007). Basing on a Level(s) project, an average mass of a reinforced concrete building is about 1000 kg/m². We have assumed the same for roof tiles since they are a part of a building. Therefore, energy

consumption demolition is assumed to be $10 \text{ kWh}/1000 \text{ kg} = 0,01 \text{ kWh/kg}$. The source of energy is diesel fuel used by work machines (C1).

The dismantled pavers and blocks is delivered to the nearest construction waste plant. It is estimated that there is no mass loss during the use of the product, therefore the end-of-life product is assumed that it has the same weight with the declared product. Transportation distance to the closest disposal area is estimated as 50 km and the transportation method is lorry which is the most common (C2).

It can be assumed that 100% of the roof tiles are transported to a waste treatment plant and further reused as filling materials for roads and other construction purposes. About 80% of concrete (Betoniteollisuus ry, 2020) are recycled. The process losses of the waste treatment plant are assumed to be negligible (C3). The remaining 20% of concrete is assumed to be send to the landfill (C4).

MANUFACTURING PROCESS



LIFE-CYCLE ASSESSMENT

CUT-OFF CRITERIA

The study does not exclude any modules or processes which are stated mandatory in the reference standard and the applied PCR. The study does not exclude any hazardous materials or substances. The study includes all major raw material and energy consumption. All inputs and outputs of the unit processes, for which data is available for, are included in the calculation. There is no neglected unit process more than 1% of total mass or energy flows. The module specific total neglected input and output flows also do not exceed 5% of energy usage or mass.

ALLOCATION, ESTIMATES AND ASSUMPTIONS

Allocation is required if some material, energy, and waste data cannot be measured separately for the product under investigation. All allocations are done as per the reference standards and the applied PCR. In this study, allocation has been done in the following ways:

Data type	Allocation
Raw materials	Allocated by mass or volume
Packaging materials	Allocated by mass or volume
Ancillary materials	Allocated by mass or volume
Manufacturing energy and waste	Allocated by mass or volume

AVERAGES AND VARIABILITY

Type of average	Multiple products
Averaging method	Averaged by shares of total mass
Variation in GWP-fossil for A1-A3	6 %

Some of products included are coated but some are uncoated. The main part of the product (concrete) is the same.

LCA SOFTWARE AND BIBLIOGRAPHY

This EPD has been created using One Click LCA EPD Generator. The LCA and EPD have been prepared according to the reference standards and ISO 14040/14044. The EPD Generator uses Ecoinvent v3.8, Plastics Europe, Federal LCA Commons and One Click LCA databases as sources of environmental data.

ENVIRONMENTAL IMPACT DATA

CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP – total ¹⁾	kg CO ₂ e	1,35E+02	4,71E+00	4,69E-01	1,41E+02	1,87E+01	8,17E+00	MND	9,19E-01	4,69E+00	3,09E+00	1,02E+00	-7,92E+00						
GWP – fossil	kg CO ₂ e	1,35E+02	4,73E+00	3,86E+00	1,44E+02	1,87E+01	1,24E-01	MND	9,19E-01	4,69E+00	3,21E+00	1,05E+00	-7,91E+00						
GWP – biogenic	kg CO ₂ e	1,55E-01	-1,87E-02	-3,40E+00	-3,26E+00	0,00E+00	8,05E+00	MND	0,00E+00	3,63E-04	-1,26E-01	-3,07E-02	0,00E+00						
GWP – LULUC	kg CO ₂ e	4,02E-02	2,54E-03	5,42E-03	4,82E-02	6,29E-03	1,14E-04	MND	9,15E-05	1,73E-03	3,20E-04	9,94E-04	-8,99E-03						
Ozone depletion pot.	kg CFC-11e	2,68E-06	1,08E-06	4,53E-07	4,21E-06	4,36E-06	3,22E-09	MND	1,97E-07	1,08E-06	6,87E-07	4,26E-07	-6,68E-07						
Acidification potential	mol H ⁺ e	2,68E-01	2,20E-02	2,72E-02	3,17E-01	7,90E-02	2,88E-04	MND	9,55E-03	1,99E-02	3,34E-02	9,90E-03	-4,37E-02						
EP-freshwater ²⁾	kg Pe	7,04E-04	-4,42E-05	1,11E-04	7,71E-04	1,53E-04	3,68E-06	MND	3,05E-06	3,84E-05	1,06E-05	1,10E-05	-3,67E-04						
EP-marine	kg Ne	1,72E-02	7,45E-03	9,02E-03	3,37E-02	2,37E-02	6,52E-05	MND	4,23E-03	5,90E-03	1,48E-02	3,43E-03	-9,36E-03						
EP-terrestrial	mol Ne	8,52E-01	8,18E-02	1,02E-01	1,04E+00	2,61E-01	6,98E-04	MND	4,64E-02	6,51E-02	1,62E-01	3,77E-02	-1,21E-01						
POCP ("smog") ³⁾	kg NMVOCe	2,35E-01	2,56E-02	3,12E-02	2,92E-01	8,37E-02	2,08E-04	MND	1,28E-02	2,08E-02	4,46E-02	1,10E-02	-3,17E-02						
ADP-minerals & metals ⁴⁾	kg Sbe	1,81E-04	3,00E-05	1,78E-05	2,29E-04	1,80E-04	6,51E-07	MND	4,66E-07	1,10E-05	1,63E-06	2,42E-06	-6,32E-05						
ADP-fossil resources	MJ	5,29E+02	5,66E+01	8,11E+01	6,66E+02	2,86E+02	7,80E-01	MND	1,24E+01	7,05E+01	4,32E+01	2,89E+01	-1,17E+02						
Water use ⁵⁾	m ³ e depr.	1,83E+01	4,27E-02	1,97E+00	2,04E+01	1,17E+00	2,59E-02	MND	3,32E-02	3,15E-01	1,16E-01	9,16E-02	-1,22E+01						

1) GWP = Global Warming Potential; 2) EP = Eutrophication potential. Required characterisation method and data are in kg P-eq. Multiply by 3,07 to get PO4e; 3) POCP = Photochemical ozone formation; 4) ADP = Abiotic depletion potential; 5) EN 15804+A2 disclaimer for Abiotic depletion and Water use and optional indicators except Particulate matter and Ionizing radiation, human health. The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

ADDITIONAL (OPTIONAL) ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Particulate matter	Incidence	3,27E-06	5,85E-07	6,66E-07	4,52E-06	1,93E-06	4,95E-09	MND	2,56E-07	5,41E-07	6,84E-06	1,99E-07	-5,42E-07						
Ionizing radiation ⁶⁾	kBq U235e	7,62E+03	-2,86E-01	3,54E-01	7,62E+03	1,31E+00	1,60E-02	MND	5,68E-02	3,36E-01	1,99E-01	1,31E-01	-1,39E+00						
Ecotoxicity (freshwater)	CTUe	2,19E+02	8,24E+01	6,78E+01	3,70E+02	2,38E+02	1,18E+00	MND	7,43E+00	6,34E+01	2,60E+01	1,88E+01	-1,22E+02						
Human toxicity, cancer	CTUh	1,89E-07	5,29E-09	5,57E-09	2,00E-07	5,96E-09	1,50E-10	MND	2,85E-10	1,56E-09	9,96E-10	4,71E-10	-6,56E-09						
Human tox. non-cancer	CTUh	1,74E-06	7,90E-08	4,67E-08	1,87E-06	2,57E-07	1,38E-09	MND	5,38E-09	6,27E-08	1,88E-08	1,23E-08	-1,17E-07						

SQP ⁷⁾	-	3,32E+02	9,05E+01	3,28E+02	7,50E+02	3,81E+02	6,49E-01	MND	1,61E+00	8,12E+01	5,62E+00	6,18E+01	-9,03E+01						
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6) EN 15804+A2 disclaimer for ionizing radiation, human health. This 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; 7) SQP = Land use related impacts/soil quality.

USE OF NATURAL RESOURCES

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Renew. PER as energy ⁸⁾	MJ	8,20E+01	2,63E+01	7,00E+01	1,78E+02	3,42E+00	1,19E-01	MND	7,07E-02	7,94E-01	2,47E-01	2,51E-01	-8,39E+00						
Renew. PER as material	MJ	1,46E-01	0,00E+00	2,99E+01	3,00E+01	0,00E+00	-2,99E+01	MND	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00						
Total use of renew. PER	MJ	8,22E+01	2,63E+01	9,99E+01	2,08E+02	3,42E+00	-2,97E+01	MND	7,07E-02	7,94E-01	2,47E-01	2,51E-01	-8,39E+00						
Non-re. PER as energy	MJ	5,90E+02	5,67E+01	5,37E+01	7,00E+02	2,86E+02	7,79E-01	MND	1,24E+01	7,05E+01	4,32E+01	2,89E+01	-1,17E+02						
Non-re. PER as material	MJ	6,78E+01	0,00E+00	2,75E+01	9,53E+01	0,00E+00	-2,75E+01	MND	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00						
Total use of non-re. PER	MJ	6,58E+02	5,67E+01	8,11E+01	7,95E+02	2,86E+02	-2,67E+01	MND	1,24E+01	7,05E+01	4,32E+01	2,89E+01	-1,17E+02						
Secondary materials	kg	2,83E+01	9,66E-02	1,30E-01	2,86E+01	3,97E-02	2,16E-03	MND	4,84E-03	1,96E-02	1,69E-02	6,07E-03	-1,04E-01						
Renew. secondary fuels	MJ	1,17E+02	3,83E-04	1,03E+00	1,18E+02	4,01E-04	1,65E-05	MND	1,58E-05	1,97E-04	5,53E-05	1,59E-04	-7,32E-04						
Non-ren. secondary fuels	MJ	1,91E+02	0,00E+00	0,00E+00	1,91E+02	0,00E+00	0,00E+00	MND	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00						
Use of net fresh water	m ³	5,11E-01	-3,24E-03	4,88E-02	5,56E-01	4,84E-02	7,26E-04	MND	7,51E-04	9,13E-03	2,63E-03	3,16E-02	-2,99E-01						

8) PER = Primary energy resources.

END OF LIFE – WASTE

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste	kg	7,85E-01	2,17E-01	1,71E-01	1,17E+00	3,29E-01	8,45E-03	MND	1,66E-02	9,34E-02	5,79E-02	0,00E+00	-5,55E-01						
Non-hazardous waste	kg	7,74E+02	-2,19E+00	7,27E+00	7,79E+02	1,85E+01	2,01E-01	MND	1,16E-01	1,54E+00	4,07E-01	2,00E+02	-1,27E+01						
Radioactive waste	kg	1,51E-01	3,16E-04	2,34E-04	1,52E-01	1,94E-03	4,82E-06	MND	8,71E-05	4,71E-04	3,04E-04	0,00E+00	-4,67E-04						

END OF LIFE – OUTPUT FLOWS

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for re-use	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	MND	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00						
Materials for recycling	kg	2,25E-04	0,00E+00	2,00E+01	2,00E+01	0,00E+00	0,00E+00	MND	0,00E+00	0,00E+00	8,00E+02	0,00E+00	0,00E+00						
Materials for energy rec	kg	4,81E-07	0,00E+00	0,00E+00	4,81E-07	0,00E+00	0,00E+00	MND	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00						
Exported energy	MJ	1,53E-03	0,00E+00	0,00E+00	1,53E-03	0,00E+00	5,35E+01	MND	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00						

ENVIRONMENTAL IMPACTS – EN 15804+A1, CML / ISO 21930

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Global Warming Pot.	kg CO ₂ e	9,54E+00	4,66E+00	3,76E+00	1,80E+01	1,86E+01	1,22E-01	MND	9,09E-01	4,64E+00	3,18E+00	1,03E+00	-7,73E+00						
Ozone depletion Pot.	kg CFC-11e	8,64E-07	8,54E-07	3,68E-07	2,09E-06	3,46E-06	2,79E-09	MND	1,56E-07	8,55E-07	5,44E-07	3,37E-07	-5,54E-07						
Acidification	kg SO ₂ e	4,23E-02	1,67E-02	2,03E-02	7,93E-02	5,01E-02	2,33E-04	MND	6,81E-03	1,54E-02	2,38E-02	7,48E-03	-3,40E-02						
Eutrophication	kg PO ₄ ³⁻ e	3,70E-02	1,38E-03	6,64E-03	4,50E-02	1,09E-02	4,20E-04	MND	1,58E-03	3,52E-03	5,52E-03	1,61E-03	-1,51E-02						
POCP ("smog")	kg C ₂ H ₄ e	4,41E-03	7,88E-04	1,57E-03	6,76E-03	2,41E-03	1,48E-05	MND	1,49E-04	6,03E-04	5,21E-04	3,14E-04	-2,36E-03						
ADP-elements	kg Sbe	1,49E-04	2,93E-05	1,76E-05	1,96E-04	1,79E-04	6,46E-07	MND	4,59E-07	1,07E-05	1,60E-06	2,38E-06	-6,25E-05						
ADP-fossil	MJ	1,91E+02	5,67E+01	8,11E+01	3,29E+02	2,86E+02	7,78E-01	MND	1,24E+01	7,05E+01	4,32E+01	2,89E+01	-1,17E+02						

ENVIRONMENTAL IMPACTS – GWP-GHG - THE INTERNATIONAL EPD SYSTEM

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-GHG ⁹⁾	kg CO ₂ e	1,35E+02	4,73E+00	3,86E+00	1,44E+02	1,87E+01	1,24E-01	MND	MNR	0,00E+00	0,00E+00	0,00E+00	-7,91E+00						

9) This indicator includes all greenhouse gases excluding biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product as defined by IPCC AR 5 (IPCC 2013). In addition, the characterisation factors for the flows - CH₄ fossil, CH₄ biogenic and Dinitrogen monoxide - were updated in line with the guidance of IES PCR 1.2.5 Annex 1. This indicator is identical to the GWP-total of EN 15804:2012+A2:2019 except that the characterization factor for biogenic CO₂ is set to zero.

VERIFICATION STATEMENT

VERIFICATION PROCESS FOR THIS EPD

This EPD has been verified in accordance with ISO 14025 by an independent, third-party verifier by reviewing results, documents and compliancy with reference standard, ISO 14025 and ISO 14040/14044, following the process and checklists of the program operator for:

- This Environmental Product Declaration
- The Life-Cycle Assessment used in this EPD
- The digital background data for this EPD

Why does verification transparency matter? [Read more online](#)

This EPD has been generated by One Click LCA EPD generator, which has been verified and approved by the EPD Hub.

THIRD-PARTY VERIFICATION STATEMENT

I hereby confirm that, following detailed examination, I have not established any relevant deviations by the studied Environmental Product Declaration (EPD), its LCA and project report, in terms of the data collected and used in the LCA calculations, the way the LCA-based calculations have been carried out, the presentation of environmental data in the EPD, and other additional environmental information, as present with respect to the procedural and methodological requirements in ISO 14025:2010 and reference standard.

I confirm that the company-specific data has been examined as regards plausibility and consistency; the declaration owner is responsible for its factual integrity and legal compliance.

I confirm that I have sufficient knowledge and experience of construction products, this specific product category, the construction industry, relevant standards, and the geographical area of the EPD to carry out this verification.

I confirm my independence in my role as verifier; I have not been involved in the execution of the LCA or in the development of the declaration and have no conflicts of interest regarding this verification.

Elma Avdyli, as an authorized verifier acting for EPD Hub Limited
20.03.2024

