Environmental Product Declaration

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

Clayworks Exterior/Hybrid Exterior Finish

from

Clayworks

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
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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 www.environdec.com



General information

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
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Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): PCR 2019:14 Construction Products and Services ver 1.2.5 and c-PCR 001: Cement and building lime (EN 16908:2017+A1:2022)
PCR review was conducted by: The Technical Committee of the International EPD® System. See [https://environdec.com/about-us/the-international-epd-system-about-the-system] for a list of members.
Life Cycle Assessment (LCA)
LCA accountability: Callum Hill (Renuables Ltd) [www.renuables.co.uk]
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier Third-party verifier Dr. Hudai Kara, Metsims Sustainability Consulting [www.metsims.com] Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☒ No

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

Company information

Owner of the EPD: Clayworks
Contact: Clare Whitney
Description of the organisation: Clayworks was born from a love and belief in natural, sustainable building practices. It stemmed, in 2010, from a decade of restoring old buildings, building new ones and travelling the world to learn about the traditions of clay and other natural finishes such as lime, as building materials. The vision behind, and motivation for our founders' research was to explore the use of natural materials in architecture to foster the balance in a building that is healthy for the environment and the user and beautiful in its design, structure, technique and use of materials. Clayworks is based on one site on the Lizard Peninsula, Cornwall where all research and development takes place. The company works with architects, designers and individuals worldwide to create interior wall finishes. There is an intense focus on developing new colours and textures using only natural materials. The company is also committed to continuous innovation, with experimentation on the formulations ongoing to improve performance, sustainable and health benefits.

Pushing hard at the conventional boundaries of techniques with clay and lime, our focus is concentrated on creating and delivering plasters of the finest quality that speak honestly about the beauty and functionality of natural materials. This culture of learning, discovery and experimentation continues after we launched our own range of natural clay plasters in 2010 and our vision is to play a significant role in the re-imagination of clay as the interior wall finish of the future.

Clayworks was a winner of the 2023 Kings Award for Enterprise – Sustainability.

Name and location of production site(s): Clayworks Limited, Unit 5, Higher Bochym Rural Workshops, Cury Cross Lanes, Helston, Cornwall, TR12 7AZ UK

Product information

Product name: Clayworks Exterior /Hybrid Exterior Finish
Product identification:
Clayworks Exterior Finish natural, mineral wall finish made from Natural Hydraulic Lime (NHL). Cement free render for external application. The active NHL ingredient conforms with British Standard EN 459-1: 2015 'Building Lime'

Clayworks Hybrid Exterior Finish mineral wall finishes made from Hydrated Natural Hydraulic Lime (NHL), white cement CEM 1 and additives as per EN/BS 459.1. Pre-mixed with sand. Cement enhanced render for external application. The active NHL ingredient conforms with British Standard EN 459-1: 2015 'Building Lime'.

Product description: Clayworks Exterior and Hybrid Exterior Finishes are building limes for masonry, rendering and plastering. The products' special composition allows the product to breathe and also permits constant hygrometric exchange between the substrate and the environment. The lime binders (NHL or NL) are pre-mixed with sands and packed in 25 kg bags ready to mix with water and apply on site. The finishes have been formulated to work with Clayworks mineral pigment mixes which are supplied separately. This EPD represents the Life Cycle Analysis of the basic mixes without pigments.

UN CPC code: 374 Plaster. lime and cement
Geographical scope: Modules A1-A3 modelled for UK, A4 represents delivery from Cornwall to London (UK), all other modules modelled using UK scenarios.

LCA information

Functional unit / declared unit: 1 m^2 of Clayworks exterior product (15 mm thickness) including the packaging.

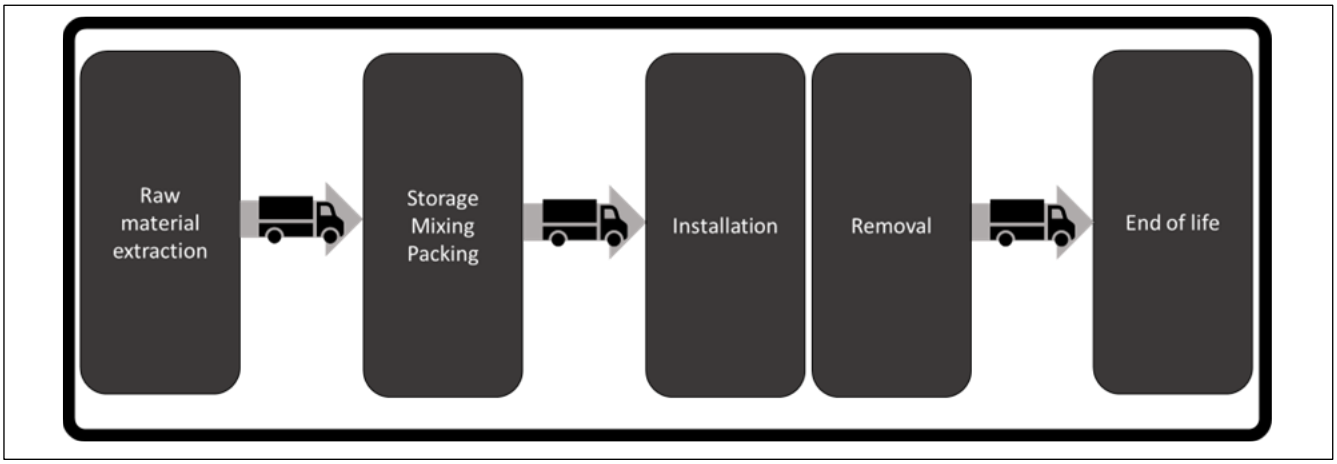
Reference service life: This is assumed to be the reference service life of the building (default 60 years).

Time representativeness: Production data for the calendar year 2022 was used.

Database(s) and LCA software used: Ecoinvent 3.9 and Simapro 9.5.

Description of system boundaries: Cradle to grave and module D (A + B + C + D).

System diagram:



More information:
The data is an average of the two products – variation between the two products is less than 10%.

This EPD is based upon an underlying LCA of the Clayworks manufacturing facility, with operational data obtained for 2022. The underlying LCA was conducted by Callum Hill, Senior Consultant, Renuables Ltd (http://renuables.co.uk/). Primary data is assessed as being of high quality for factory parameters and medium quality for materials.

Cut-off criteria were based upon input flows being less than 1% of the total individually, subject to the sum of all flows being less than 5% of the total, and subject to verification that the impacts associated with such flows were not of a magnitude to affect the reported data significantly (less than 5% in total). For characterization factors: the characterization factors stated in EN 15804+A2:2019/AC:2021 were used.

A1-A3
Delivery of ingredients to mixing site in Cornwall. Lime products (NHL5, NL5) delivered from St Astier a distance of 859 km by road and 50 km by rail (channel tunnel). Processing energy and fuel use (drying of sand, on-site transport, electricity use). Wet sand is delivered in bulk bags that contain 1

tonne of wet sand (average distance 274 km) – the bag weighs 0.85 kg and is disposed to landfill after delivery. Assumed distance to disposal facility is 20 km. Electricity supply: Octopus – based on average standard UK grid mix for 2022.

A4
The assumption for module A4 is for transport to construction site in London from production site in Cornwall (a distance of 475 km).

A5
Assumptions for Module A5 are based upon a typical scenario for application:

A 25 kg bag of ingredients is mixed with 8 litres of water and mixed with an electric mixer (2600 W paddle mixer) for 20 minutes. Application is manual, 15 mm thickness, resulting in dry weight of product of 3.18 kg per m^2 coverage. The density of the cured product is 2120 kg/m^3.

B1
The carbonation calculation is based upon the following reference:

[https://www.eula.eu/politecnico-di-milano-literature-review-on-the-assessment-of-the-carbonation-potential-of-lime-in-different-markets-and-beyond/]

It is assumed that 80% of the $Ca(OH)_2$ in the lime is carbonated during the lifetime of the product. This is because the render is typically approximately 15 mm thick and open to the atmosphere (including rain) and a building lifetime of 60 years is assumed. The carbonation was calculated to be -1.97 kg CO_2e/FU.

B2-B7
No maintenance, no operational energy, not replaced during building lifetime.

C1
Use of an electric jack hammer is assumed for removal of render from building prior to demolition. It is assumed that a 1500 W demolition hammer is used for a render coat of 15 mm thickness (density of 2120 kg/m^3), 1 m^2 is removed in 10 minutes.

C2
Transport to waste facility is assumed (20 km).

C3
Waste is processed for disposal. It is assumed that 100% of this material is waste and disposed to landfill.

C4
100% of end of life product disposed to landfill.

D
There is no re-use of the material and therefore there are nil entries for module D.

[https://clay-works.com/product-descriptions/]

Modules declared, geographical scope, share of specific data (in GWP-GHG results) and data variation (in GWP-GHG results):

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	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
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Geography	EUR	EUR	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK
Specific data used	30%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	<10%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	N/A			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Content information (per FU, 31.8 kg)

Product components	Weight, kg	Post-consumer material, weight-%	Biogenic material, weight-% and kg C/kg
Sand	27.67	0.0	0.0
Hydraulic lime	4.13	0.0	0.0
TOTAL	31.8	0.0	0.0
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	**Weight biogenic carbon, kg C/kg**
Kraft paper	0.146	0.48	0.073
Polyethylene liner	0.015	0.02	0.0000
TOTAL	**0.161**	**0.50**	**0.0073**

Dangerous substances from the candidate list of SVHC for Authorisation	EC No.	CAS No.	Weight-% per functional or declared unit
N/A	-	-	-

Results of the environmental performance indicators

Mandatory impact category indicators according to EN 15804

Results per 1 m^2 15 mm thickness including packaging

Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq.	6.35E+00	1.33E+00	3.28E-01	-1.97E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.34E-02	5.58E-02	1.74E-01	1.74E-01	0.00E+00
GWP-biogenic	kg CO_2 eq.	-2.67E-01	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	2.78E-05	2.26E-05	8.18E-05	2.68E-01	0.00E+00
GWP-luluc	kg CO_2 eq.	6.28E-03	4.66E-04	2.36E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.22E-05	1.95E-05	9.59E-05	9.59E-05	0.00E+00
GWP-total	kg CO_2 eq.	6.09E+00	1.33E+00	3.28E-01	-1.97E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.35E-02	5.58E-02	1.74E-01	4.42E-01	0.00E+00
ODP	kg CFC 11 eq.	5.31E-07	2.63E-07	3.20E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.16E-09	1.10E-08	5.70E-08	5.70E-08	0.00E+00
AP	mol H^+ eq.	2.12E-02	4.39E-03	8.66E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-04	1.84E-04	1.67E-03	1.67E-03	0.00E+00
EP-freshwater	kg P eq.	7.06E-04	1.03E-04	4.59E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.81E-06	4.30E-06	2.03E-05	2.03E-05	0.00E+00
EP-marine	kg N eq.	4.92E-03	8.95E-04	1.75E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.89E-05	3.75E-05	5.48E-04	5.48E-04	0.00E+00
EP-terrestrial	mol N eq.	5.42E-02	9.74E-03	1.39E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.07E-04	4.08E-04	5.99E-03	5.99E-03	0.00E+00
POCP	kg NMVOC eq.	1.49E-02	2.59E-03	4.25E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.38E-05	1.09E-04	1.50E-03	1.50E-03	0.00E+00
ADP-minerals&metals*	kg Sb eq.	7.63E-06	2.57E-06	3.03E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.56E-08	1.08E-07	1.95E-07	1.95E-07	0.00E+00
ADP-fossil*	MJ	5.39E+01	2.13E+01	4.89E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.10E+00	8.91E-01	4.78E+00	4.78E+00	0.00E+00
WDP*	m^3	2.44E+00	1.53E-01	3.83E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-02	6.40E-03	2.28E-01	2.28E-01	0.00E+00
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; 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; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption															

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

Additional mandatory and voluntary impact category indicators

Results per 1 m^2 15 mm thickness (31.8 kg)																
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-GHG[1]	kg CO_2 eq.	6.36E+00	1.33E+00	3.28E-01	-1.97E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.35E-02	5.58E-02	1.74E-01	1.74E-01	0.00E+00

Resource use indicators

Results per 1 m^2 15 mm thickness (31.8 kg)																
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	7.94E+00	3.12E-01	1.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.71E-01	1.31E-02	1.27E-01	1.27E-01	0.00E+00
PERM	MJ	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	7.94E+00	3.12E-01	1.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.71E-01	1.31E-02	1.27E-01	1.27E-01	0.00E+00
PENRE	MJ	5.96E+01	2.31E+01	6.72E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E+00	9.66E-01	5.16E+00	5.16E+00	0.00E+00
PENRM	MJ	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.02E+03	2.31E+01	6.72E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E+00	9.66E-01	5.16E+00	5.16E+00	0.00E+00
SM	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	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	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
NRSF	MJ	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	0.00E+00	0.00E+00	1.02E+01	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	0.00E+00	0.00E+00	0.00E+00
Acronyms	PERE = Use of renewable primary energy excluding renewable primary energy 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 non-renewable primary energy 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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water															

[1] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero.

Waste indicators

Results per 1 m^2 15 mm thickness (31.8 kg)																
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	6.91E-05	1.18E-05	4.38E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.59E-07	4.95E-07	3.33E-06	3.33E-06	0.00E+00
Non-hazardous waste disposed	kg	1.76E+00	1.85E+00	5.98E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-03	7.74E-02	0.00E+00	3.18E+01	0.00E+00
Radioactive waste disposed	kg	3.04E-04	1.50E-04	4.11E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.24E-06	6.30E-06	3.22E-05	3.22E-05	0.00E+00

Output flow indicators

Results per 1m^2 15 mm thickness (31.8 kg)																
Indicator	**Unit**	**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	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	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	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	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	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Additional environmental information

Using a density of the cured product of 2120 kg m^{-3} = 2.12 kg for 1 mm thickness of 1 m^2. The EPD data refers to a functional unit of 1 m^2 of exterior render of 15 mm thickness including packaging (31.8 kg of dry ingredients). In order to convert to a coverage of 1 m^2 for different thicknesses, please use the conversion factors listed in the table below:

Thickness (mm)	Weight (kg)	Multiply by
5	10.6	0.33
10	21.2	0.66
15	31.8	1.00
20	42.4	1.33
25	53.0	1.66

Additional social and economic information

N/A

Information related to Sector EPD

N/A

Differences versus previous versions

N/A

References

General Programme Instructions of the International EPD® System. Version 4.0.
PCR 2019:14 Construction Products and Services ver 1.2.5
c-PCR 001: Cement and building lime (EN 16908:2017+A1:2022)
EN 15804:2012+A2:2019/AC:2021. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
EN 16908:2017+A1:2022. Cement and building lime – Environmental product declarations – Product category rules complementary to EN 15804.

EPD®

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