Environmental Product Declaration

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

UK Average Portland Cement Sector EPD

from

Mineral Products Association (MPA) UK

Programme:	The International EPD® System, www.environdec.com
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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
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CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product category rules (PCR): PCR 2019:14 – Construction Products – Version 1.11 c-PCR-001 Cement and building limes (EN 16908)
PCR review: This PCR was developed within CEN standardisation, and adopted as a c-PCR by the International EPD® System. There was thus no additional open consultation period and no additional review in addition to those within standardisation.
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: Angela Schindler, Umweltberatung, Salem, Germany 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 from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. For further information about comparability, see EN 15804 and ISO 14025.

Company information

Owner of the EPD: Mineral Products Association (MPA) UK
https://mineralproducts.org/
Contact: Dr Rachel Capon (rachel.capon@mineralproducts.org)
Description of the organisation: MPA is the industry trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries. MPA represents the vast majority of UK mineral products operating companies across its 14 product groups. These include most of the independent SME quarrying companies throughout the UK, as well as the 9 major international and global companies. MPA covers 100% of UK cement and lime production, 90% of GB aggregates production, 95% of asphalt and over 70% of ready-mixed concrete and precast concrete production.
Product-related or management system-related certifications: MPA is a trade association. Data has been provided by MPA members, who have one or more of the following certifications: ISO 9001, ISO 14001, ISO 50001, ISO 45001, BES 6001, under which data has been collated.
Name and location of production site(s):
MPA is the industry trade association which represents 100% of UK cement production and all five UK cement producers. Data has been collected from the following members' production sites.
Aggregate Industries: Clinker and cement production: Cauldon, Cookstown
Breedon: Clinker and cement production: Hope
CEMEX UK: Clinker and cement production: Rugby, South Ferriby (Note: South Ferriby cement works ceased production in April 2020 and is now mothballed); Cement grinding and blending: Tilbury
Hanson UK: Clinker and cement production: Ketton, Padeswood, Ribblesdale
Tarmac: Clinker and cement production: Aberthaw, Dunbar, Tunstead;
Cement blending only: Scotash, Seaham, West Thurrock

Product information

Product name: UK average Portland cement
Product identification: Cement according to BS EN 197 Part 1
Product description: Cement is a hydraulic binder. It is a finely ground inorganic material which, when mixed with water, forms a paste which sets and hardens by means of hydration reactions and processes. After hardening, it retains its strength and stability even under water.
The declared cement is a sector average cement, consisting of:

- MPA UK average clinker: 87.34 %
  MPA members are responsible for 100% of clinker production in the UK. The MPA UK average clinker is based on aggregated data from MPA member clinker and cement production sites. The components of clinker are mainly calcium oxide (CaO) and silica (SiO_2), and small amounts of aluminium oxide (Al_2O_3) and iron oxide (Fe_2O_3).
- Gypsum: 5.05 % (0.07% from flue gas desulphurisation) *added to control the setting time of the cement.*
- Limestone: 5.21 %
- Pulverised Fuel Ash (Fly Ash): 1.03%
- Ground Granulated Blast Furnace Slag: 0.05%
- Demolition Fines: 0.28%
- Dust: 0.10%
- Residues, from processing: 0.71%
- Additives (ferrous sulphate, grinding aids): <1%

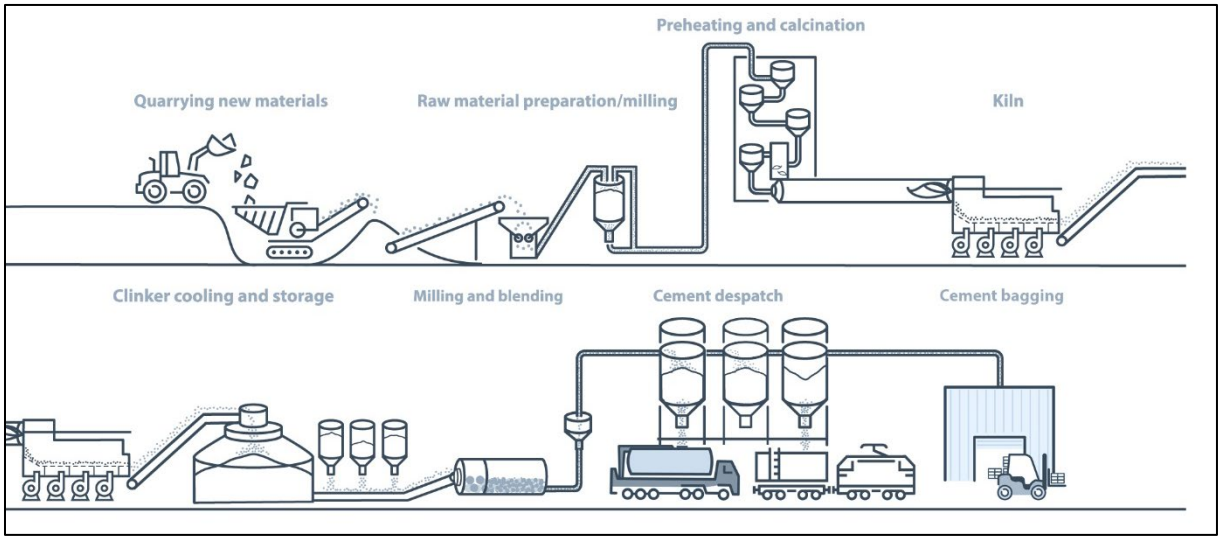
20% of UK produced cement is sold packed in bags via builders' merchants. The bags, made of paper and/or plastic, are loaded onto wooden pallets, which are then wrapped in plastic film.
The remaining 80% of UK produced cement is delivered by bulk tanker, i.e. without any packaging.
The declared cement is a sector representative UK average Portland cement modelled using aggregated data from all MPA member sites which manufacture clinker and cement, or grind and blend cement, or blend cement. It covers 100% of Portland cement produced in the UK, according to

EN 197-1. UK produced cement accounts for around 80% of the UK cement market. (The remaining 20% is accounted for by imports by both MPA members and non-members).
This declared UK sector average Portland cement is a representative average which is not available for purchase on the market. For LCA information for a specific market cement, please contact the individual MPA member manufacturer.
UN CPC code: 3744 Cement
Other codes for product classification: Not applicable

LCA information

Geographical scope: United Kingdom
Functional unit / declared unit: 1 tonne
Reference service life: not applicable
Time representativeness: All material and energy flows within the scope of the study are based on the plant specific data collected for the year 2020.
Database(s) and LCA software used: The LCA software used is the GCCA EPD tool, version 3.1. The GCCA tool uses the ecoinvent database version 3.5 together with GCCA custom emission factors for processes not included in the ecoinvent database, notably cement kiln processes. The LCI methodology is described in detail in the reference document "GCCA Industry EPD Tool for Cement and Concrete (v3.1) - LCA Model, International Version".
Description of system boundaries:
The EPD type is "Cradle to gate" (A1–A3). This system includes the extraction and production of raw materials, transportation of raw materials to the cement plant, cement manufacturing process (including on-site transportation) and treatment of waste produced within processes throughout the cement plant.
Before or during construction, the cement product is physically integrated with other products (e.g. aggregates, chemical admixtures) into downstream products (e.g. concrete, mortar, plaster). During hydration, cement undergoes a chemical transformation. After hydration, the original cement product in the un-hydrated state is not identifiable anymore and cannot be physically separated. None of the constituents of cement contain biogenic carbon. Cement is therefore exempt from the obligation in EN 15804 + A2 to declare modules C and D. All processes related to construction stage, use stage, end-of-life of cement and module D are out of the scope of this EPD.

System diagram:



More information:
Electricity mix
In 2020 nearly all UK cement production sites purchased their electricity on green tariffs, i.e. from low carbon sources. Details of the tariff and corresponding electricity mix were obtained for each site from

MPA members. For the site still using a standard tariff, the UK grid mix for 2020 was obtained from the UK government official National Statistics.
A sector specific mix for electricity purchased from the grid was calculated
for use in the GCCA EPD tool:

Coal and peat	0.19 %
Oil	0.15 %
Gas	3.80 %
Biomass	12.81 %
Waste	5.68 %
Nuclear	33.45 %
Hydro	3.32 %
Geothermal	0.00 %
Solar	6.87 %
Wind	33.74 %

In addition, one clinker and cement production site has on-site electricity generation from a solar farm.

Cut-offs
Further additives (stannous sulphate, stannous chloride, strength enhancer, air entrainer), used in very small quantities (<0.01 %) in UK cement manufacturing, have been cut-off in the EPD calculation.

Data quality
Data is provided by 100% of UK cement producers, who are all MPA members, and covers 100% of UK cement production. MPA members have their own data management quality systems in place. Each site is required to report CO_2 emissions under the EU Emissions Trading Scheme (replaced by UK Emissions Trading Scheme in 2021) and all emissions to air under the UK Pollution Inventory Reporting Requirements. The reported emissions are independently verified by the respective Regulatory authorities.
MPA also collects this input data from its' members on an annual basis, reviews it and performs additional sector-wide analysis. MPA reports sector data on kiln fuel consumption, NCV (or LHV), CEF and CO_2 emissions, together with electricity consumption, to the UK government for inclusion in official statistics.
Therefore, confidence in the data quality is very high.

Manufacturing Process
Quarrying raw materials
The primary raw material used in the manufacture of cement is either limestone or chalk, which contain high proportions of calcium carbonate. A secondary raw material (usually clay) contains oxides of silica, alumina and iron. Materials are often quarried in locations close to the cement production line. Quarried material is crushed to pieces with diameter less than 90 mm and transported by conveyor belt to the raw material preparation and milling stage. Waste derived raw materials can often replace some of the quarried raw material needs.
Raw material preparation/milling
Each of the raw materials is transported separately to silos. Material from the silos is then selected in specific amounts to form the right 'recipe' for the raw mix. This material is ground together in a raw mill until evenly mixed. The raw mill grinds the raw mix to a powder whilst drying the material with exhaust gases from the preheater. The material is then transported to a blending silo where the raw mix is prepared for feeding the preheater.
Preheating and calcination
The raw mix is fed to a preheater tower where it is heated to around 900°C in a number of cyclone stages using heat exiting the kiln. On modern cement manufacturing sites, fuel is added at the bottom of the preheater in a calciner to better prepare the material for the kiln.
Clinker formation in the kiln

From the preheater/calciner, the material, now at a temperature of around 900°C, enters a large horizontal rotary kiln. A range of primary fossil, waste derived fuels and waste biomass fuels are fed through a burner nozzle in the kiln to produce a flame which reaches temperatures of 2000°C. This heats the material to around 1450°C which produces marble sized dark grey nodules called clinker (the primary active ingredient of cement) that resemble volcanic rock.

Clinker cooling and storage

In the cooler, air is blown through a bed of clinker to cool the clinker from 1450°C to around 150°C. The heated air is recovered into the kiln to improve efficiency. The cooled clinker is then conveyed either to the clinker store or directly to the cement mill.

Milling and blending

Clinker is ground with gypsum and often mixed with other materials such as PFA, GGBS and limestone to produce cement, in either ball mills (as shown), or in a vertical spindle mill similar to that used to mill the raw mix. These mills grind the clinker and other materials into a fine well mixed powder. A number of different types of cement are made on site by varying the material proportions and their fineness which can alter the cement properties.

Cement despatch

Cement is stored in silos. 80% of UK produced cement is despatched in bulk tankers by road or rail.

Cement bagging

20% of UK produced cement is first packed into bags made of paper and/or plastic, loaded onto wooden pallets and wrapped in plastic film, then despatched to the customer.

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

	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND
Geography	UK	UK	UK	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND
Specific data used	All foreground data					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products						-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites						-	-	-	-	-	-	-	-	-	-	-	-

LCA variability is discussed in section 'Information related to Sector EPD'.

Content information

Product components	Weight, kg	Post-consumer material, weight-%	Renewable material, weight-%
Clinker	873.43	-	-
Gypsum	49.79	-	-
Ground limestone	52.11	-	-
Fly ash, from hard coal	10.31		
Gypsum, residual, from flue gas desulphurisation	0.75		
Slag, granulated, with drying	0.55		
Demolition fines	2.79		
Dust	0.97		
Residues, from processing	7.06		
Ferrous sulphate	2.13	-	-
Grinding aids (additives)	0.12	-	-
TOTAL	1000	-	-
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	
Paper bags	0.24	0.024%	
Plastic bags	0.29	0.029%	
Wooden pallets	0.2 pallets	0.020%	
Plastic film	0.26	0.026%	

Environmental Information

Potential environmental impact – mandatory indicators according to EN 15804

Results per functional or declared unit		
Indicator	**A1-A3 (Total)**	**Unit**
Global Warming Potential total	812.3	kg CO_2 eq.
Global Warming Potential fossil fuels[1)]	812.0	kg CO_2 eq.
Global Warming Potential biogenic[2)]	0.2047	kg CO_2 eq.
Global Warming Potential land use and land use change	5.705E-2	kg CO_2 eq.
Depletion potential of the stratospheric ozone layer	1.027E-5	kg CFC 11 eq.
Acidification potential, Accumulated Exceedance	2.010	mol H+ eq.
Eutrophication potential, fraction of nutrients reaching freshwater end compartment	0.2139	kg PO_4 eq.
Eutrophication potential, fraction of nutrients reaching freshwater end compartment	6.977E-2	kg P eq.
Eutrophication potential, fraction of nutrients reaching marine end compartment	5.016E-3	kg N eq.
Eutrophication potential, Accumulated Exceedance	6.451	mol N eq.
Formation potential of tropospheric ozone	1.567	kg NMVOC eq.
Abiotic depletion potential for non- fossil resources*	1.663E-4	kg Sb eq.
Abiotic depletion for fossil resources potential*	2738	MJ, net calorific value
Water (user) deprivation potential, deprivation-weighted water consumption*	45.16	m³ world eq. deprived

1) The indicated Global Warming Potential fossil fuels (GWP-fossil) value includes CO_2 emissions from combustion of both fossil and waste-derived fuels. The 'net' value of GWP-fossil, excluding combustion of waste-derived fuel, is 729.3 kg $CO_{2\,eq.}$
2) The indicated Global Warming Potential biogenic (GWP-bio) value includes CO_2 emissions from combustion of waste biomass. The 'net' value of GWP-bio, excluding combustion of biomass in waste-derived fuels, is 0.07 kg $CO_{2\,eq.}$
** 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.*

Potential environmental impact – additional mandatory and voluntary indicators

Results per functional or declared unit		
Indicator	**A1-A3 (Total)**	**Unit**
GWP-GHG	812.3	kg CO_2 eq.

Additional voluntary environmental impact indicators (EN 15804 Table 4) are not declared.

Use of resources

Results per functional or declared unit		
Indicator	**A1-A3 (Total)**	**Unit**
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	568.9	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	89.08	MJ, net calorific value
Total use of renewable primary energy resources	657.9	MJ, net calorific value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	2712	MJ, net calorific value
Use of non-renewable primary energy resources used as raw materials	26.03	MJ, net calorific value
Total use of non-renewable primary energy resources	2738	MJ, net calorific value
Use of secondary materials	78.52	kg
Use of renewable secondary fuels	411.2	MJ, net calorific value
Use of non-renewable secondary fuels	757.0	MJ, net calorific value
Net use of fresh water	1.071	m^3

Waste production and output flows

Waste production

Indicators not declared

Output flows

Results per functional or declared unit		
Indicator	**A1-A3 (Total)**	**Unit**
Components for re-use	0	kg
Materials for recycling	0	kg
Materials for energy recovery	0	kg
Exported energy	0	MJ per energy carrier

Information on biogenic carbon content

Results per functional or declared unit		
BIOGENIC CARBON CONTENT	**QUANTITY**	**Unit**
Biogenic carbon content in product	0	kg C
Biogenic carbon content in packaging	2.9	kg C

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO_2.

Additional information

UK Concrete and Cement Industry Roadmap to Beyond Net Zero

https://thisisukconcrete.co.uk/Resources/UK-Concrete-and-Cement-Roadmap-to-Beyond-Net-Zero.aspx

The UK concrete and cement industry has developed a roadmap to beyond net zero by 2050 – removing more carbon dioxide from the atmosphere than it emits each year.

The industry has a strong track record having taken considerable early action and delivered a 53% reduction in absolute carbon dioxide emissions since 1990 – decarbonising faster than the UK economy as a whole.

However, it is committed to building on this early action and has prepared a detailed and viable roadmap that sets out a clear pathway to reduce emissions to beyond net zero.

Importantly, the roadmap does not rely upon carbon offsetting or offshoring emissions but demonstrates an achievable route to beyond net zero through the application of seven decarbonisation technologies.

The 'Roadmap to Beyond Net Zero' calculates the potential of each technology and the carbon savings which can be achieved.

Five of these technologies focus on production related emissions:

- Indirect emissions from decarbonised electricity
- Decarbonised transport networks
- Low carbon cements and concretes
- Fuel switching
- Carbon capture, usage and storage (CCUS)

Going beyond net zero will be achieved by using on-site carbon capture and by maximising the natural, in-use properties of concrete which include:

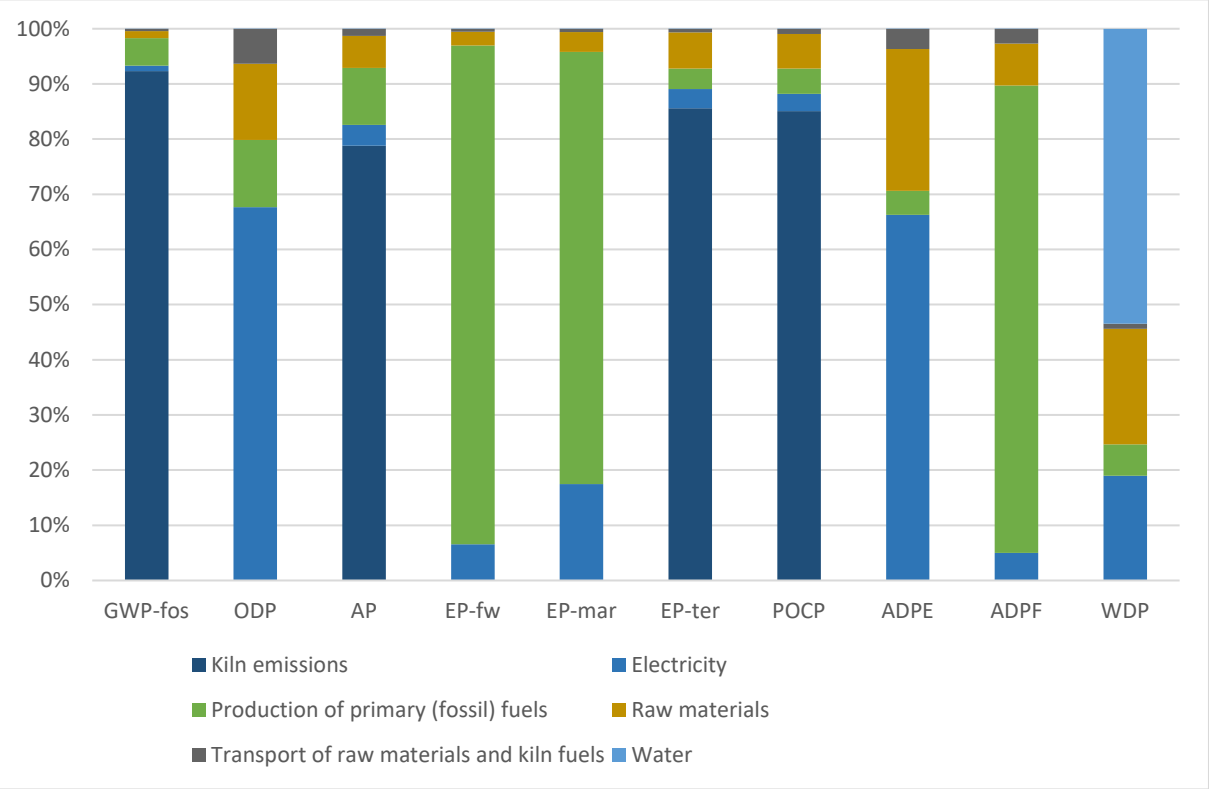
- Carbonation – the natural process where concrete absorbs CO_2 from the atmosphere throughout its lifetime
- Thermal mass – a property of heavyweight materials like concrete and masonry where heat can be absorbed, stored and released, reducing the energy needed to heat and cool buildings

Information related to Sector EPD

The declared cement is a sector representative UK average Portland cement modelled using aggregated data from all MPA member sites which manufacture clinker and cement, or grind and blend cement, or blend cement. It covers 100% of average Portland cement produced in the UK. UK produced cement accounts for around 80% of the UK cement market. (The remaining 20% is accounted for by imports by both MPA members and non-members).

Variability of LCA Indicators

The following diagram shows the influencing factors for selected LCA indicators:



The LCA of average Portland cement in the UK is mainly influenced by the following factors, which vary from cement plant to cement plant:

- content of cement clinker and secondary cementitious materials (SCMs) in the cement
- fuel mix and share of fossil fuels/alternative waste-derived fuels in clinker production *(the thermal input from coal ranges from 32% to 69% of the total thermal input in UK cement clinker production, depending on the site)*
- electricity mix in the respective cement plant
- technology/kiln type *(in the UK, there are 6 sites with pre-calciner kilns, 3 with pre-heater kilns and 2 with Lepol Grate kilns)*

Variation in GWP-fossil due to kiln fuel mix

The variation due to the kiln fuel mix of GWP-fossil is < ± 10%.

N.B. The GWP-fossil values reported in this EPD are based on 'gross' CO_2 emissions, including combustion of both fossil and waste-derived fuels (also called 'alternative' or 'secondary' fuels). Some cement EPDs exclude the combustion of waste-derived fuels, and report GWP values based on 'net' CO_2 emissions. When comparing EPDs, it is important to note that 'net' GWP values, which exclude CO_2 emissions from the combustion of waste-derived fuels, will be lower than 'gross' GWP values which include them.

Variation in GWP-fossil due to clinker content

The UK Average Portland Cement EPD is an average over all factory-made cement sales in the UK. The range of clinker content can vary from 58% (some CEM II types) to 91% (CEM I). CEM III types may have even lower clinker content but comprise only 1% of UK factory sales.

78% of factory-made cement sales in the UK are CEM I. This is because, in the UK, further SCMs are typically added after the cement has left the factory, at the concrete mixing plant.

- GWP-fossil for high-clinker CEM I is < +10% greater than the declared GWP-fossil for the UK Average Portland Cement.
- GWP-fossil for a CEM II with a low (58%) clinker content can be ca. 33% below the declared GWP-fossil for the UK Average Portland Cement.

The LCA indicators for average Portland cement in this sector EPD are intended to provide the basis for the environmental assessment of buildings and other construction works in typical UK situations. This declared average Portland cement is a representative average which is not available for purchase on the market. For very detailed calculations requiring LCA data for specific cements, please refer to EPDs from the individual MPA member cement manufacturer.

N.B. Any LCA assessment of buildings and construction works in typical UK situations, should include SCMs added after the cement has left the factory gate, at the concrete mixing plant.

Differences versus previous versions

This EPD supersedes the previous MPA UK Average Portland Cement EPD, EPD-MPA-20170159-CAG1-EN, issued 14/11/2007, valid to 13/11/2022. The previous EPD was created using the GaBi Software System and Database for LifeCycle Engineering version 8.0.0.247 in accordance with EN 15804:2012-04+A1 2013, and registered with the IBU programme.

The EPD was revised 14-03-2024 and the following changes made:

- Document title changed from “UK Average Portland Cement” to “UK Average Portland Cement Sector EPD”,
- Machine-readable EPD file published.

References

General Programme Instructions of the International EPD® System. Version 3.01.

EN 15804:2012 + A2:2019, Sustainability of construction works - Environmental product declarations - core rules for the product category of construction products

BS EN 197-1:2011, Cement Part 1: Composition, specifications,
and conformity criteria for common cements

Quantis, “GCCA Industry EPD Tool for Cement and concrete - LCA model, International Version” (Tool version 3.1), November 2021

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