Environmental Product Declaration

In accordance with ISO 14025 for:

FutureCEM® cement CEM II/B-M (Q-LL) 52,5 N

Aalborg Portland A/S

Programme:	The International EPD® System www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-01954
Issue date:	2019-08-19
Validity date:	2022-08-18 *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.*
Revision date:	-
Geographical scope:	*Global*

aalborgportland
CEMENTIR HOLDING

Owner of the declaration		Manufacturer	
Aalborg Portland A/S		Aalborg Portland A/S	
Contact person:	Jesper Sand Damtoft	Rørdalsvej 44, 9220 Aalborg	
Phone:	+45 99 33 77 34	Phone:	+45 98 16 77 77
e-mail:	jesper.damtoft@aalborgportland.com	e-mail:	cement@aalborgportland.dk

Place of production	International Standard Industrial Classification
Aalborg, Denmark	2394 - Manufacture of cement, lime and plaster

The Portland composite cement product covered by this EPD is produced at Aalborg Portland A/S, founded in 1889 and located in Northern Jutland, Denmark. Aalborg Portland A/S is the only Portland cement producer in Denmark. The production of cement relies on a semi-dry calcination process, where the limestone is extracted below sea level, and milled together with gypsum, limestone and calcined clay.

Product

Product description

FutureCEM cement is a grey Portland-composite cement, of strength class 52.5 N, with a minimum clinker content of 65%. FutureCEM cement is characterized by a high standard strength (62 to 68 MPa after 28 days), comparable to CEM I cements, despite a significantly lower clinker content.

FutureCEM cement is prepared by co-milling a mix of Portland cement clinker and gypsum with fine-grained limestone filler and calcined clay. FutureCEM cement can be used in concrete for all purposes and in all environmental classes.

Technical data

1000 kg cement (CEM II/B-M (Q-LL) 52,5 N)

Declarations and other technical information can be download from:
https://www.aalborgportland.dk/downloads/ydeevnedeklarationer/

Market

Norway/Europe

Material Safety Data Sheet

Available online at:
https://www.aalborgportland.dk/downloads/sikkerhedsdatablade/

Product specification

Materials	*kg/1000 kg cement*	*%*
Chalk	931	71%
Clay	169	13%
Fly ash	113	9%
Sand	41	3%
Gypsum	37	3%
Other primary materials	29	2%
Other secondary materials	<1	<1

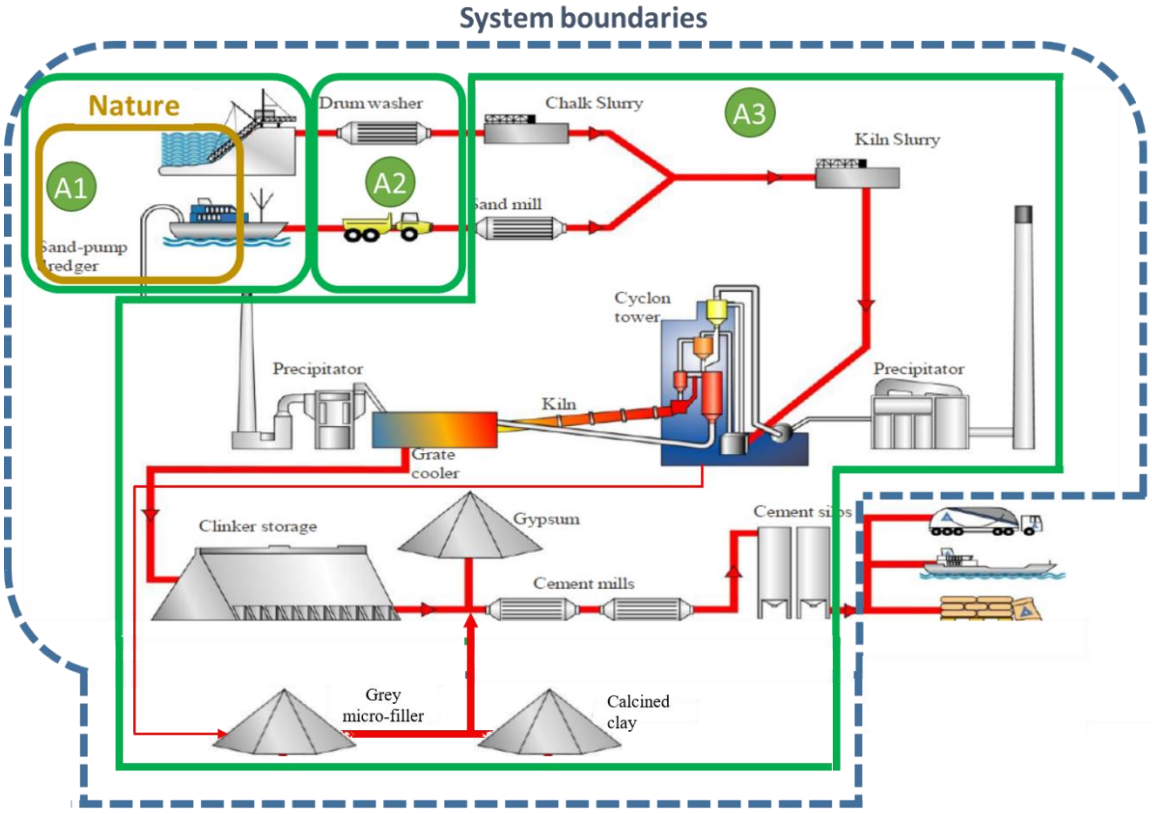
Life Cycle Assessment: calculation rules

Declared unit

1000 kg FutureCEM® cement

System boundary

The overall system boundaries include extraction and transportation of raw materials as well as all manufacturing processes (cradle-to-gate). They also include the calcination of clay and its sourcing. The scope of analysis ends with the cement being ready for dispatch. The flow diagram below shows the supply and manufacture processes as well as the A1-A3 modules definitions.



Process description	Cut-off criteria
Portland-composite cement is made by heating, in a cement kiln, a mixture of raw materials (mainly limestone or chalk) to a calcining temperature of above 600°C and then a fusion temperature, which is about 1,450°C to sinter the materials into clinker. To achieve the desired setting qualities in the finished product, a quantity of gypsum or anhydrite is added to the clinker. The mixture is finely ground with limestone and calcined clay. The use of residual materials is significant in this product system. For example, an amount of sand is regularly dredged out of the local fjord as part of regular maintenance operations, to allow passage for ships. While the dredged material would be deposited, the nearby location of the cement plant allows its reuse in the cement production process.	The cut-off criteria adopted is the following: energy or material flows inferior to 1% of the sum of the mass or energy of the inputs are disregarded. Despite that cut-off criteria, all major raw materials and all the essential energy flows are included. The 1% cut-off rule does not apply for hazardous materials and substances: as such, all flows that have an environmental significance are included. Also, all solid waste emissions, including those that weight less than 1% of the sum of the mass of the inputs, are reported in the end-results. The only noticeable inputs that have been omitted are: • the water consumption at the raw meal preparation level: it is not a net uptake of water from the freshwater network. • the packaging bags and wood pallets for transport: the relational context of this EPD is business-to-business, where the entirety of the cement volume is transported in bulk.
Allocation	**Data sources**
The allocation of co-products used in the cement production process is made in accordance with the provisions of EN 15804. It is either based on physical properties (energy or mass) when the difference in economic return between co-products is small, or on their economic values otherwise. For End-Of-Life waste used in the product system, the End-Of-Waste state starts with any necessary conditioning and preparation processes of the material to be suitable for reuse, as well as its supply.	Data and model concerning the production of cement clinker have been sourced directly from a third party-verified environmental product declaration from 2017, with figures adjusted to represent the production year 2018. Also, the preparation of certain fuels, such as refuse-derived fuel, has been modelled based on company data for the year 2018. Background processes (e.g. electricity generation, transport operations) have been sourced from the ecoinvent v3.4 cut-off LCI database.

Data quality

Considering that company-specific and externally-verified data is used to characterize:

- 90% of the climate-related impacts,
- 94% of the fossil energy use,
- 94% of ozone depletion-related impacts,
- 85% of abiotic elements depletion,
- and 77% of acidification-related impacts,

the quality of the environmental indicators presented in this declaration is deemed **high**.

Follow up

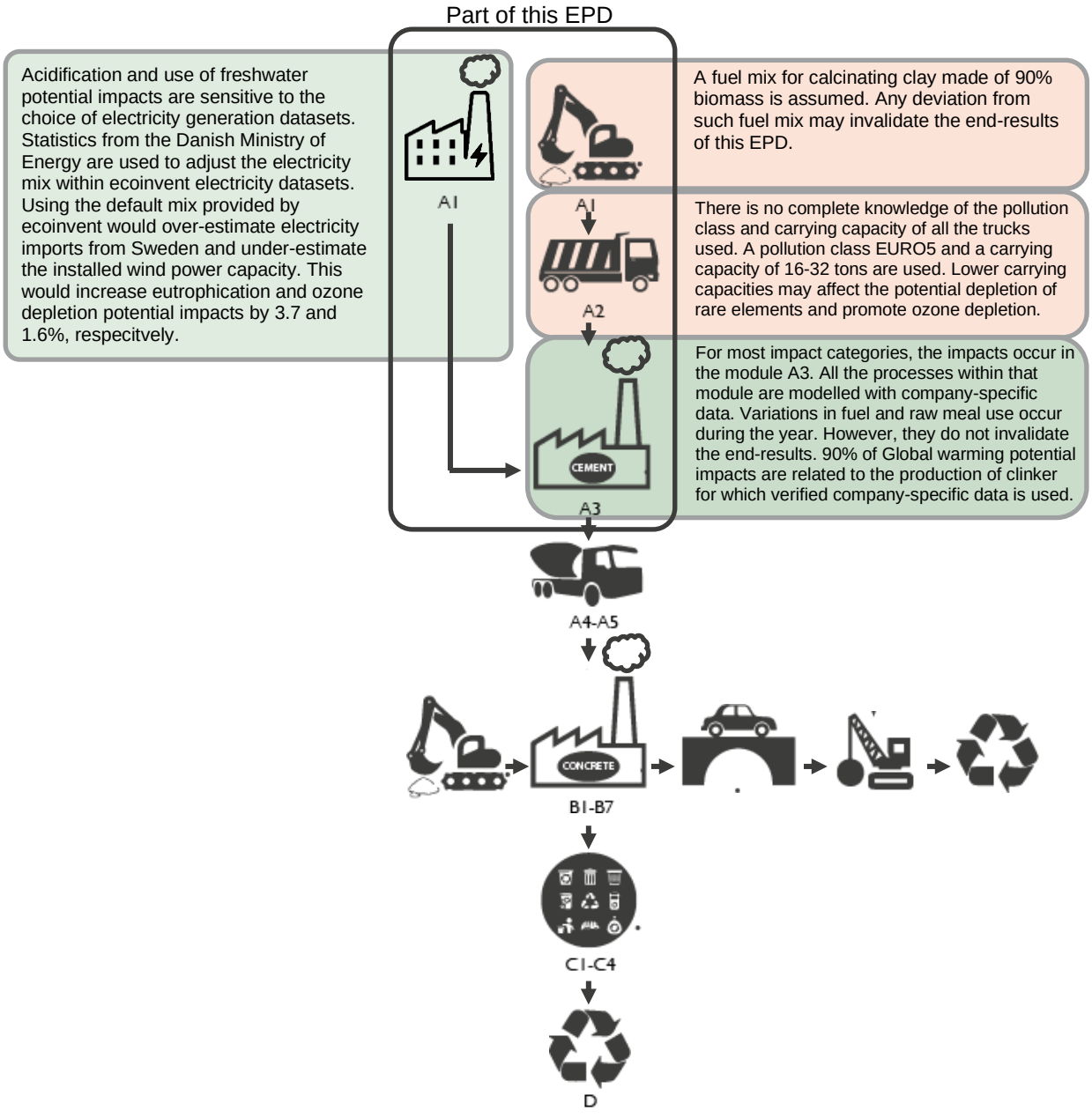
Every year company-specific and externally-verified data is used to update the A3 module of the underlying LCA model.

An internal follow-up procedure ensures that this EPD is updated should any of the environmental indicators presented below increase by more than 10%.

Uncertain and sensitive process

Potentially uncertain and sensitive process

Relatively certain and insensitive process



Content declaration

The declaration only considers cradle-to-gate environmental impacts, including modules A1-A3 as required in EN 15804.

Product stage			Assembly stage		Use stage								End of life stage				Beyond the system boundaries
Raw materials	Transport	Manufacturing	Transport	Assembly	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	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA		MNA

Environmental performance

Use of resources

		Upstream		Core	
Parameter	**Unit**	**A1**	**A2**	**A3**	**A1-A3**
Renewable primary energy resources used as energy carrier	MJ	1.01E+03	0.00E+00	0.00E+00	1.01E+03
Renewable primary energy resources used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total renewable primary energy resources	MJ	1.01E+03	0.00E+00	0.00E+00	1.01E+03
Non-renewable primary energy resources	MJ	2.42E+03	0.00E+00	0.00E+00	2.42E+03
Non-renewable primary energy resources used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total non-renewable primary energy resources	MJ	2.42E+03	0.00E+00	0.00E+00	2.42E+03
Use of secondary materials	Kg	0.00E+00	0.00E+00	1.65E+02	1.65E+02
Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	9.75E+02	9.75E+02
Use of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	1.03E+03	1.03E+03
Use of net freshwater	m^3	3.30E-01	0.00E+00	0.00E+00	3.30E-01

End of life - Waste

		Upstream		Core	
Parameter	**Unit**	**A1**	**A2**	**A3**	**A1- A3**
Hazardous waste	kg	0.00E+00	0.00E+00	2.00E-02	2.00E-02
Non-hazardous waste	Kg	0.00E+00	0.00E+00	2.00E-02	2.40E-02
Dust (total dust and particulates)	Kg	0.00E+00	0.00E+00	28.1E-03	28.1E-03
Radioactive waste disposed	Kg	4.24E-08	0.00E+00	0.00E+00	4.24E-08

Total radioactive waste disposed	Kg	4.24E-08	0.00E+00	0.00E+00	4.24E-08

End of life – Output flows

		Upstream		Core	
Parameter	**Unit**	**A1**	**A2**	**A3**	**A1- A3**
Components for reuse	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	Kg	0.00E+00	0.00E+00	6.00E-01	6.00E-01
Materials for energy recovery	Kg	0.00E+00	0.00E+00	1.3E+00	1.3E+00
Exported electric energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Potential environmental impacts

CML 2001 (Centre of Environmental Science of Leiden University) impact assessment characterization factors Baseline methods pack is used to quantify the potential environmental impacts following the realization of the declared unit. The version 4.4 is used, last updated in April 2015. The pack includes the assessment and indicators regarding the impacts listed in the table below. It gathers the mandatory environmental indicators specified by EN 15804.

Impact category subgroup	Mechanism	Model source	Geographical and temporal span
Global warming potential	Positive gas contribution to Earth's radiative forcing.	Intergovernmental Panel for Climate Change, 2013	Global scale, 100 years
Ozone depletion potential	Models the depletion of ozone in the stratospheric layer by emissions of reactive gases.	World Meteorological Organization (WMO)	Continental scale, infinity
Formation potential of tropospheric photochemical oxidants	Formation of reactive substances (mainly ozone) which are injurious to human health and ecosystems and which also may damage crops.	UNECE Trajectory model	Continental scale, 5 days
Acidification potential	Describes the fate and deposition of acidifying substances.	RAINS 10, International Institute for Applied Systems Analysis	Global scale, infinity
Eutrophication potential	Includes all impacts due to excessive levels of macronutrients in the environment caused by emissions of nutrients to air, water and soil.	Based on the stoichiometric procedure of Heijungs, 1992	Continental scale, infinity
Abiotic depletion potential for non-fossil resources	Determined for each extraction of minerals based on concentration reserves and rate of de-accumulation.	University of Leiden, 2001	Global scale, infinity
Abiotic depletion potential for fossil resources	Determined for each extraction of fossil fuels based on concentration reserves and rate of de-accumulation.	University of Leiden, 2002	Global scale, infinity
Carbon dioxide, biogenic	Release of carbon dioxide of biogenic origin (i.e., biomass).	n/a	n/a

		Upstream		Core	
Parameter	**Unit**	**A1**	**A2**	**A3**	**A1- A3**
Global warming potential	Kg CO_2-eqv	5.50E+01	1.21E+01	5.32E+02	5.99E+02
Ozone depletion potential	Kg CFC11-eqv	6.17E-06	6.32E-07	0.00E+00	6.80E-06
Formation potential of tropospheric photochemical oxidants	Kg C_2H_4-eqv	1.41E-02	6.10E-03	2.30E-02	4.32E-02
Acidification potential	Kg SO_2-eqv	2.66E-01	2.13E-01	3.64E-01	8.42E-01

Eutrophication potential	Kg PO_4^{3-}-eqv	2.48E-01	1.88E-02	6.70E-02	3.34E-01
Abiotic depletion potential for non-fossil resources	Kg Sb-eqv	2.55E-03	0.00E+00	0.00E+00	2.55E-03
Abiotic depletion potential for fossil resources	MJ	2.36E+03	0.00E+00	0.00E+00	2.36E+03
Carbon dioxide, biogenic	Kg of CO_2	2.20E+01	0.00E+00	2.43E+02	2.65E+02

Changes from previous EPD

There is no previous version of the present EPD.

Additional information

Aalborg Portland maintains and develops a process management system that includes external environment, energy and CO_2. The system is certified according to ISO 14001, ISO 50001 and the Danish Energy Agency's additional requirements, as well as registered under the EMAS Regulation.

It is to note that some environmental aspects, not covered by the present environmental indicators, may exist. For example, direct impacts to marine ecosystems may occur when dredging the sand from the local fjord – thereafter used in the cement product system. However, as the dredging is part of periodical maintenance operations of the fjord, such operation would occur regardless of its subsequent use.

Dangerous substances

Aalborg Portland is conscious of the REACH directive and the impact of the REACH directive on which Aalborg Portland´s business and products have been evaluated. Aalborg Portland certifies that it is not using any chemicals that fall under the REACH regulation.

However, Aalborg Portland continues to evaluate, research and review to fulfil the demands of the regulation, including the Candidate List of Substance of Very High Concern. See the certification letter from the link below.
http://www.aalborgportland.dk/media/pdf_filer/reach_erklaering_epd.pdf

Emissions of mercury in the air, although not reported in the present environment indicators, are constantly measured via sensors and kept under the limits set by the European environmental agency.

Finally, with the addition of ferrous sulphate in the cement, water-soluble chromate is transformed into a non-soluble state that does no longer lead to skin-related health issues.

Release to waters and soils

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

Indoor environment

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

Carbon footprint

The carbon footprint of the declared product has been carried out as part of this EPD and in compliance with ISO 14067. It refers to a **partial carbon footprint** with a cradle-to-gate scope.
The indicator GWP100a is expressed in kg of CO_2-eq. and is calculated from the characterization factors of IPCC. It defines the carbon footprint of this product and is indicated in the Potential Environmental Impacts table under *Global warming potential*. The release of carbon dioxide of biogenic origin is equally specified in the same table, under *Carbon dioxide, biogenic*.

Programme-related information and verification

Programme:	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com
EPD registration number:	S-P-01276
Published:	2019-08-19
Valid until:	2022-08-18
Revision date:	-
Product Category Rules:	EN 15804:2012 + EN-16908:2017
Product group classification:	UN CPC 3744
Reference year for data:	2019
Geographical scope:	Global

Product category rules (PCR): EN 16908:2017 – Cement and building lime. Publication date: 21-11-2016.
PCR review was conducted by: *European Committee for Standardization.*
Independent verification of the declaration and data, according to ISO 14025:2006: ☐ EPD Process Certification (internal) X EPD Verification (external)
Third party verifier*:* *Bureau Veritas Sweden* | *Fabriksgatan 13, 412 50 Göteborg* Accredited by: SWEDAC *Approved by the International EPD System.*

Mandatory statements

The present EPD complies with the principles and methods described in the general Product Category Rule document for Type III Products Environmental Declaration for construction materials EN 15804:2012 + A1:2013 and EN 16908:2017. The applicability of the LCA results and its compliance to the guidelines of the PCR document EN 15804 are done so within the general principles and framework of ISO 14025:2006 for the production of Type III environmental declarations. The life cycle assessment modelling principles adopted are compliant with the ISO 14041-44 standard series.
EPDs within the same product category but from different programmes may not be comparable. Also, EPD of construction products may not be comparable if they do not comply with the requirements of comparability set in EN 15804:2012.

Contact information	
EPD owner	Aalborg Portland A/S, Rørdalsvej 44, 9220 Aalborg Contact: Jesper Sand Damtoft, jesper.damtoft@aalborgportland.com
LCA author	Romain Sacchi, Sustainability Specialist, R&D, Quality and Technical Sales Support, Cementir Holding S.p.A, romain.sacchi@aalborgportland.com
Programme operator	EPD International AB info@environdec.com
	This product/service has a certified Environmental Product Declaration (EPD) giving information about the environmental performance, contents and recycling, which has been controlled and verified according to the requirements of the International EPD® System. Registration number: S-P-01276 More information is available at www.environdec.com.

References

ecoinvent Version 3.4 Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., and Weidema, B., 2016. The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, [online] 21(9), pp.1218–1230.

Energistyrelsen Årlig energistatistik, 2018, https://ens.dk/sites/ens.dk/files/Statistik/tabeller2016.xlsx

EN 15804:2012+A1:2013 Sustainability of construction works - Environmental product declaration - Core rules for the product category of construction products

EN 16908:2017 Cement and building lime – Environmental product declarations – Product category rules complementary to EN 15804

General Programme Instructions of the International EPD® System. Version 3.0.

ISO 14025:2010 Environmental labels and declarations - Type III environmental declarations - Principles and procedures

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

ISO 14067:2014 ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines

ISO 21930:2007 Sustainability in building construction - Environmental declaration of building products

Life Cycle Assessment report 2019 – FutureCEM, Sacchi R, Project report, July 2019

Life Cycle Assessment report 2015 – RAPID, Sacchi R, Project report, January 2017