READY-MIX CONCRETE

Environmental Product Declaration

NSW - Newcastle - ECOPact- NE322L195

In accordance with ISO 14025 and EN15804+A2
Programme: The International EPD® System | www.environdec.com
Programme operator: EPD International AB
Regional Programme: EPD Australasia | www.epd-australasia.com
Managed by: Holcim Certified EPD Process
EPD Process Certificate Number: 04

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EPD Registration No.: EPD-IES-14393:001
Valid from: 16/04/2025 | 16/04/2030
Revision Date: 16/04/2030
Revision Number: 1
EPD Process Geographical Scope: Australia

AUSTRALASIA EPD® ENVIRONMENTAL PRODUCT DECLARATION
EPD INTERNATIONAL EPD SYSTEM
ECO PLATFORM EPD VERIFIED

Programme-related information and verification

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EPD Registration Number	EPD-IES-14393:001	
Valid From	16/04/2025	
Revision Number	1	
Valid Until	16/04/2030	
Product group classification	UN CPC 375 (Articles of concrete, cement and plaster)	
Geographical Scope	Australia	
Reference Year for Data	2022 Plant Data, 2025 Mix/Materials Data	

CEN standard EN 15804:2012+A2:2019/AC:2021 served as the core Product Category Rules (PCR)

Product category rules	PCR 2019:14 Construction Products, Version 1.3.4, 2024-04-30 c-PCR-003 Concrete and Concrete Elements, 2024-04-30
PCR review was conducted by	The Technical Committee of the International EPD System. See www.environdec.com for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact
Independent third-party verification of the declaration and data, according to ISO 14025:2006:	☒ EPD process certification* *For EPD Process Certification, an accredited certification body certifies and reviews the management process and verifies EPDs published on a regular basis. For details about third-party verification procedure of the EPDs, see the GPI.
Process certification	Epsten Group, Inc., Megan Blizzard, is an approved certification body accountable for third-party verification. Third-party verifier is accredited by: A2LA, Certificate #3142.03

Programme-related information and verification:
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.

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Revision Number	Revision Date	Description of Changes
1	16/04/2030	na

INTRODUCTION

Currently, the building environment account for 39% of global CO2 emissions, with construction materials comprising 11% of global CO2 emissions (World Green Building Council). By 2030, the embodied carbon of all construction materials needs to be at least 40% lower. By 2050, all new construction materials need to be net zero (World Green Building Council).

Environmental Product Declarations (EPDs) play a crucial role in promoting transparency and sustainability in the construction industry. By providing comprehensive and standardised information about the environmental performance of products, EPDs enable informed decision-making among stakeholders, including architects, engineers, builders, and consumers.

EPDs include data on a product's life cycle impacts, such as its carbon footprint, energy consumption, and resource use. This transparency empowers stakeholders to make informed selections of products.

EPDs also serve as valuable tools for benchmarking environmental performance and driving the decarbonation of construction materials. Demand for low carbon products backed by an EPD drives and rewards the decarbonisation of the entire supply chain.

As a result, EPDs will play a key role in our mission to decarbonise construction materials and the built environment.

ABOUT HOLCIM

Holcim Australia is a leading supplier of construction materials in Australia, dating back to 1901. Today Holcim continues to supply essential construction materials including aggregates, sand, ready-mix concrete, engineered precast concrete and prestressed concrete solutions to a range of customers and projects throughout Australia.

Holcim operates right across the Australian continent supplying concrete from a network of concrete plants, quarries, precast and concrete pipe places, and mobile and on-site project facilities.

Sustainability is at the core of our strategy, with our industry’s first 2050 net-zero targets, endorsed by the Science Based Targets initiative (SBTi).

Globally, Holcim is 63,000 people around the world who are passionate about building progress for people and the planet through four business segments: Cement, Ready-Mix Concrete, Aggregates and Solutions & Products.

A FIRST FOR READY-MIX CONCRETE IN AUSTRALIA

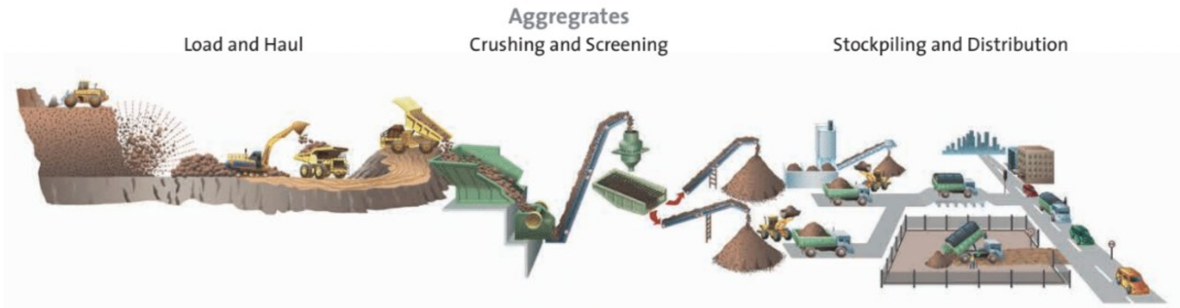
In 2019, Holcim published the first EPD for ready-mix concrete. This was an Australian first for ready-mix concrete and covered Holcim’s Normal-class concrete range across Australia. The EPD had 147 datasets for normal-class concrete that representative of over 4,000 mix designs. The EPD also provided Special-class concrete data for a major Infrastructure Sustainability and Green Star building project. This EPD heralded the introduction of rigorously verified life cycle impact data, setting a new benchmark in transparency and accountability within the Australian construction sector.

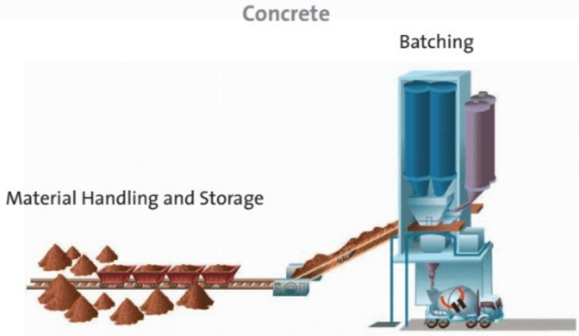
Fast forward to 2021, Holcim achieved Process EPD Certification, a first not just within the concrete industry but across all sectors in Australia. This certification empowers Holcim to develop and register EPDs on demand for ready-mix concrete.

To achieve EPD Process Certification, Holcim integrated Life Cycle Assessment (LCA) processes and procedures into its Management Systems. We then undergo ongoing rigorous third-party verification in accordance with internationally recognized ISO standards and guidelines.

This EPD has been developed using our EPD Process Certification with production occurring at the following sites.

READY-MIX CONCRETE





Summary of properties and classes

Concrete is prepared by mixing cement, coarse and fine aggregates, and water, with or without the addition of auxiliary agents and additives. The fresh concrete is placed on the building site or prefabricated in factory moulds, compacted and hardened in the desired shape by the hydration of cement to form concrete.

General Australian Standard AS 1379 sets out ways of specifying and ordering concrete to promote uniformity, efficiency and economy in production and delivery. It refers to two classes of concrete: normal-class and special-class.

- **Normal-class –** designed for everyday applications such as residential and commercial foundations, driveways and footpaths.

- **Special-class –** typically supplied to major construction projects from high rise buildings, dams and spillways, roads, bridges to public works infrastructure etc.

  Special-class concrete is typically specified in accordance with the technical parameters and performance requirements, which can include high-strength/high-performances concrete, high durability, or marine application, post-tensioned, high-pumpability, super workable, piling concrete, architectural off-form finishes and other decorative applications.

LCA INFORMATION

Declared Unit

1 m^3 of ready-mix concrete.

Scope

The scope of this EPD is cradle to gate (modules A1-A3) with options, modules A4-A5, modules C1-C4 and module D.

Reference Service Life (RSL)

The RSL is not specified as the scope of Holcim's operational control is from cradle to delivery.

Time Representativeness

The plant data for the LCA is based on 2022 calendar year production data. The mix data for the LCA is based on 2025 calendar year production data.

Databases and LCA Software Used

SimaPro® LCA software (v 9.5) was used for the LCA modelling which developed the LCA Calculator, used as per the certified EPD Process. It uses background data with the following preferences:

1. Product specific EPDs for cements, admixtures, pigments and fibres
2. The Australian National Life Cycle Inventory Database (AusLCI v1.42) (2023)
3. Ecoinvent 3.9.1 (2023).

The environmental impacts modelled from the existing EPDs do not include impacts for EN15804+A1, and the additional Green Star (v1.3) impact categories included in the environmental impact tables. These indicators are modelled separately based on generic processes. The following impact categories were calculated manually for the foreground data:

- Use of renewable primary energy resources used as raw materials
- Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
- Use of secondary material
- Use of renewable secondary fuels
- Use of non-renewable secondary fuels

Allocation

Allocation was necessary to proportion inputs and outputs to intermediate flows at the quarry and processes at the batching plant level.
As much as possible, intermediate flows were allocated physically based on weight (quarries) or based on m^2 of concrete (at the batching plant). At the quarry level, whenever physical allocation was not possible, economic allocation was carried out based on Holcim's internal cost system.
Regarding inputs, it was assumed that fly ash and silica fumes are waste products and therefore burden-free. Ground granulated blast furnace slag from steel blast furnace production was allocated economically. Please refer to the "Recycled Material" section for further detail.

Cut-Off Criteria

In accordance with the PCR 2019:14, the following system boundaries are applied to manufacturing equipment and employees:

- Environmental impact from infrastructure, construction, production equipment, and tools that are not directly consumed in the production process are not accounted for in the LCI. Capital equipment and buildings typically account for less than a few percent of nearly all LCIs and this is usually smaller than the error in the inventory data itself. For this project, it is assumed that capital equipment makes a negligible contribution to the impacts as per Frischknecht et al. (2007) with no further investigation.
- Personnel-related impacts, such as transportation to and from work, are also not accounted for in the LCI. The impacts of employees are also excluded from inventory impacts on the basis that if they were not employed for this production or service function, they would be employed for another. It is very hard to decide what proportion of the impacts from their whole lives should count towards their employment. For this project, the impacts of employees are excluded.

Based on this guidance, no energy or mass flows, except packaging of materials were excluded. All materials required for manufacturing are delivered via trucks and ships without packaging.

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Data Quality

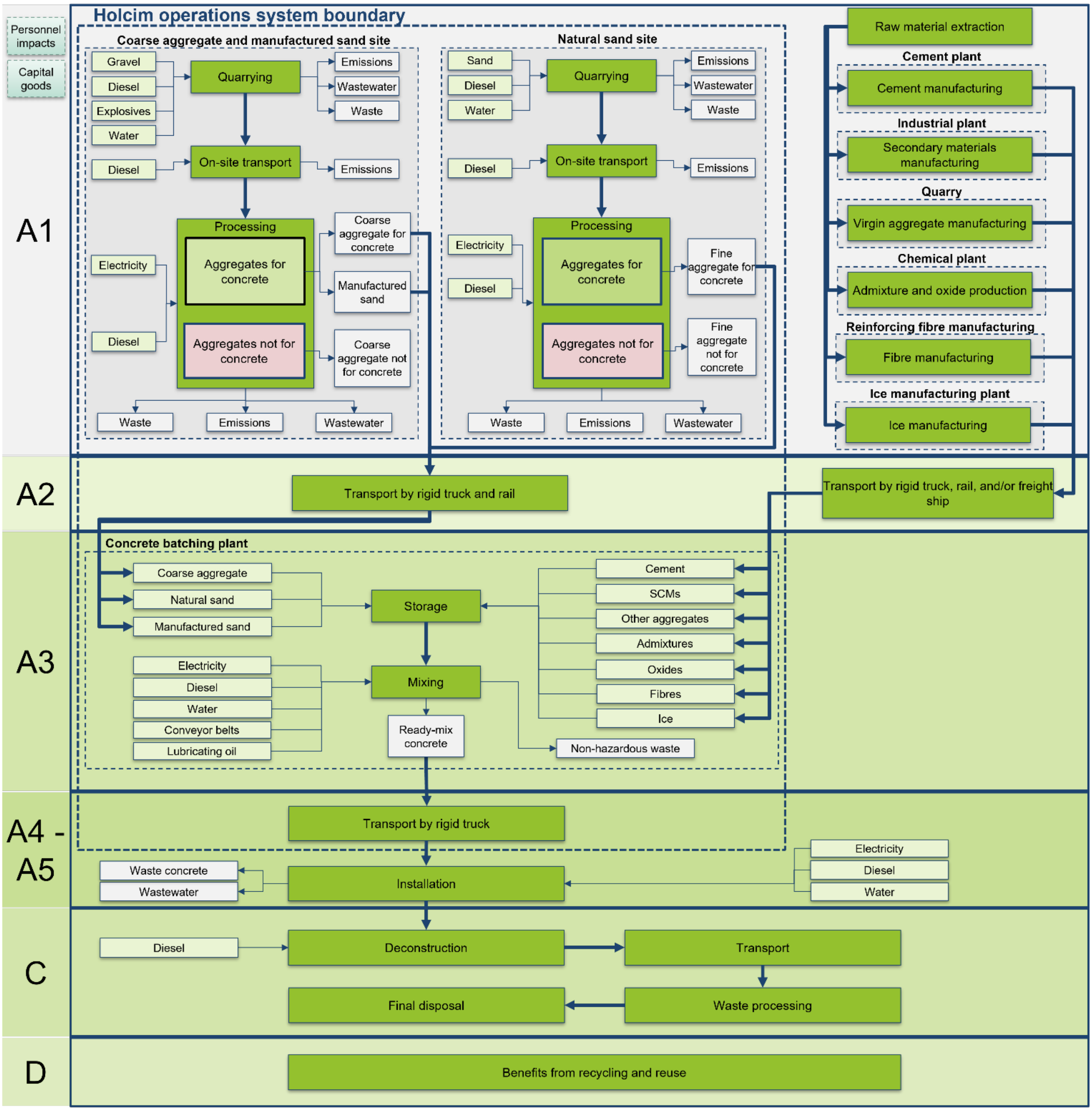
Data quality was assessed in terms of geographic and temporal representativeness. All data sources were scored good or very good.

Background data sources were also assessed with respect to their timeliness, with all data sources being updated within the 10 years required under PCR 2019:14.

Module	Input/outputs	Sub-processes	Data source & LCA Factor	Temporal scope	Geographic scope	Quality
A1	Cementitious materials	Cement	Supplier data and EPD factors	2022	All states	Very good
		Supplementary cementitious materials	Supplier data and Ecoinvent factors	2022	National	Good
	Coarse aggregate Manufactured sand Fine aggregate	Electricity	Invoices and AusLCI factors	2022	All states	Very good
		Diesel	Invoices and Ecoinvent factors	2022	All states	Very good
		LPG	Invoices and Ecoinvent factors	2022	All states	Very good
		Pollutants	National Pollution Inventory (NPI) data and Ecoinvent factors	2022	All states	Very good
		Mains water	Invoices and Ecoinvent factors	2022	All states	Very good
		Water – other sources	Metered and Ecoinvent factors	2022	All states	Very good
		Water discharge from site	Metered and Ecoinvent factors	2022	All states	Very good
		Explosives	Supplier data and Ecoinvent factors	2022	All states	Very good
		Gravel	Production data	2022	All states	Very good
	Other aggregates	Recycled aggregates	Ecoinvent database	2023	National	Good
	Admixture	Admixtures	Supplier data and Ecoinvent factors	2023	National	Good
	Oxide	Oxides	Invoices and Ecoinvent / EPD factors	2023	National	Good
	Fibre	Plastic and steel fibres	Invoices and Ecoinvent / EPD factors	2023	National	Good
A2	Raw material transport	Background data used to model	Holcim and supplier actual transport distances and loads per trip and AusLCI factors	2022	All states	Very good
A3	Concrete batching plant	Electricity	Invoices and Ecoinvent factors	2022	All states	Very good
		Diesel	Invoices and Ecoinvent factors	2022	All states	Very good
		Mains water	Water meters, with utility invoices as a back-up and Ecoinvent factors	2022	All states	Very good
		Water – other sources	Estimate based on water balance and Ecoinvent factors	2022	All states	Very good
		Water discharge from site	Estimate based on Holcim site performance metrics and Ecoinvent factors	2022	All states	Very good
		Lubricating oil Conveyor belt	Invoices and Ecoinvent factors	2023	National	Good
	Concrete mix designs	Background data used to model	Holcim internal technical database containing mix designs	2022	All states	Very good
A4	Distribution	Background data used to model	Actual transport data and Ecoinvent factors	2022	All states	Very good
A5	Installation	Electricity Diesel Water	Typical scenario & Ecoinvent factors	2023	National	Good
C1	Deconstruction	Excavation	Typical scenario & Ecoinvent factors	2023	National	Good
C2	Transport	Background data used to model	Typical scenario & Ecoinvent factors	2023	National	Good
C3	Waste processing	Concrete recycling	Typical scenario & Ecoinvent factors	2023	National	Good
C4	Final disposal	Inert waste landfilling	Typical scenario & Ecoinvent factors	2023	National	Good
D	Benefits and loads beyond	Crushed gravel	Typical scenario & Ecoinvent factors	2023	National	Good

System Diagram

The processes included in the LCA are presented in a process diagram in the figure below.



Description of System Boundaries and Excluded Lifecycle Stages

The scope of the LCA and EPD is from cradle to gate (A1-A3) with options, modules A4-A5, modules C1-C4 and module D. The following life cycle stages have not been declared, as they are deemed not applicable for Holcim's ready-mix concrete ranges: Material emissions from usage (B1); Maintenance (B2); Repair (B3); Replacement (B4); Refurbishment (B5); Operational energy use (B6), and Operational water use (B7).

	Product Stage			Construction Stage		Usage Stage							End of Life Stage				Benefits & loads for the next product system
	Raw Material Supply	Transport	Manufacturing	Transport	Construction/installation process	Use	Maintenance incl. transport	Repair incl. transport	Replacement incl. transport	Refurbishment incl. transport	Operational Energy Use	Operational Water Use	De-construction & demolition	Transport	Re-use recycling	Final 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	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	AU & GLO	AU	AU	AU	AU	-	-	-	-	-	-	-	AU	AU	AU	AU	AU
Share of specific data	99.0 %			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Upstream processes

The upstream processes include those involved in Module A1 – Raw material supply. This module includes:

- Extraction, transport and manufacturing of raw materials.
- Generation of electricity from primary and secondary energy resources, also including their extraction, refining and transport for Modules A1 and A3.

Core Processes

The core processes include those involved in Module A2 and Module A3, including:

- External transportation of materials to the core processes and internal transport.
- Manufacturing of concrete (excluding mixing, which occurs in the mixing truck and is considered part of the A4 module).
- Treatment of waste and wastewater generated from the manufacturing processes.

Downstream Processes

The downstream processes include those involved in Module A4 to D, including:

- Distribution of concrete mixes.
- Installation of the ready-mix concrete on the site.
- Wastage of construction products (This is accounted for in module A5. This includes waste concrete on site).
- Transport of equipment and use of materials for deconstruction at the end of life.
- Transport of waste generated at the end of life.
- Treatment of waste generated at the end of life.

Other Environmental Information

Other environmental information includes process involved in Module D. This module indicates the environmental benefits from reuse, recovery, and recycling of deconstructed concrete.

EPD PRODUCT DESCRIPTION AND USE

NSW - Newcastle - ECOPact- NE322L195

A detailed breakdown of the functional properties of the ready-mix concrete included in this EPD are provided below. Product environmental information should only be compared with consideration of the product's requisite function.

Strength (MPa)	Mix Code	Mix Description	Applications / intended use
32.0	NE322L195	S32/20/100 Concrete ECOPact	General

Production Sites
Wyong, Salamander Bay, Teralba, Tighes Hill, Heatherbrae

Content Declaration

The gross weight of this declared material is 2,400 kg per cubic meter makes up a minimum of 99% of the products covered by this EPD. The following table provides a summary of the materials included in Holcim ready-mix concrete and their relative composition by weight.

Material	% by weight	Post-consumer recycled material, weight % of product	Biogenic material, weight-% of product	Biogenic material, kg C/m^3
General purpose cement	5 - 21	0.0	0.0	0.0
Aggregate	67 - 84	0.0	0.0	0.0
Supplementary cementitious materials	0 - 11	0.0	0.0	0.0
Water	11.6 - 12	0.0	0.0	0.0
Admixtures	0.0	0.0	0.0	0.0

Holcim Ready-mix concrete is classified as Non-Dangerous Goods according to the Australian Code for the Transport of Dangerous Goods by Road and Rail. The safety data sheet for pre-mixed concrete lists all associated hazard phrases. None of the products contain one or more substances that are listed in the "Candidate List of Substances of Very High Concern for authorisation". According to the PCR 2019:14, if one or more substances of the "Candidate List of Substances of Very High Concern (SVHC) for authorisation" are present in a product and their total content exceeds 0.1% of the weight of the product, they need to be reported.

Packaging

Holcim ready-mix concrete is delivered in bulk with no packaging.

Recycled Material

BS EN 16757:2017 specifically lists the following materials relevant to the study as co-products:

- Fly ash,
- Ground granulated blast furnace slag; and
- Silica fume.

As such, the above materials are considered as co-products of their production process and the impacts for their production process are allocated according to PCR 2019:14 Construction Products and Construction Services (co-produced goods, multi-output allocation).
Default background data from LCA databases was used to model the above co-products:

- Fly ash: AusLCI process for fly ash treats it as a waste material and only includes transport impacts.
- Ground granulated blast furnace slag: the AusLCI process for slag is allocated based on economic value, as the product has a significant economic value at the point of collection.
- Silica fume: the ecoinvent process for silica fume treat it as a waste material and only includes transport impacts.

The allocation approach of the AusLCI LCA database was adopted as a default for secondary data and processes (e.g. secondary fuel in cement production). The AusLCI dataset conforms to EN 15804 when applying allocation to its various processes and sub-processes.

Cradle to Gate (Modules A1 – A3)

Raw materials for producing Holcim's ready-mix concrete include cementitious materials, aggregates, admixtures, oxides, fibres, water, and ice. These raw materials are generally transported from various locations around Australia, China, Indonesia, and Europe. The raw materials are stored in silos, hoppers, ground bins or tanks. The materials are feed to batching plant hopper with calibrated scale. Then all the raw materials are discharged via a chute into the ready-mix concrete truck. Water is then weighed, or volume metered and discharged into the mixer truck through the same charging tank.

Holcim's ready-mix concrete is manufactured across ACT, NSW, QLD, SA, VIC, and WA, Australia. State-specific electricity mix available in the AusLCI database is used to model electricity in the foreground processes. The AusLCI dataset was last updated in 2023.

State	Energy source in electricity mix	GWP-GHG (kg CO_2 eq./kWh)
NSW&ACT	Black coal (75%), photovoltaic (17%), natural gas (3%), hydropower (3%), others (2%)	0.72
QLD	Black coal (71%), natural gas (12%), photovoltaic (8%), oil (4%), others (5%)	0.80
SA	Wind power (61%), natural gas (34%), photovoltaic (4%), others (1%)	0.30
VIC	Natural gas (44%), brown coal (41%), wind power (8%), hydropower (3%), others (4%)	0.84
WA	Natural gas (65%), wind power (26%), black coal (8%), others (1%)	0.57

Gate to Site (Module A4)

Distribution is dependent on the market requirements of ready-mix concrete products. All Holcim ready-mix concrete products transported in Australia is by EURO5 28t – 32t trucks. The transport distances from manufacturing gate to the site is 11.77 km. The product weight for 1m^3 ready-mix concrete is the sum of weights from all raw material inputs.

Vehicle	Fuel use (L/tkm)	Fuel type	Carrying capacity	Density of products	Average load factor	Volume capacity utilization factor
EURO 5 Truck	1.97E-02	Diesel	28 t – 32 t	2,400 kg/m^3	50%	<1

Installation (Module A5)

As Holcim does not have operational control over the installation of ready-mix concrete at the construction site, assumptions for construction inputs and installation waste are made based on industrial expertise and experience, and the GCCA tool. The inputs account for the pouring of concrete from a ready-mix truck and pump, excluding any pre-installation activities such as site work and forms. The concrete slabs are then manually finished, and no additional inputs are required to be modelled.

Construction inputs and waste	Value	Unit
Concrete losses that go to landfill	3.00E+00	%
Water use	6.69E+02	L
Electricity use	2.78E+00	kWh
Diesel, in building machine	1.67E+00	L
Wastewater	6.69E-01	L

Deconstruction and End of Life (Modules C1 – C4)

EN 15804 (chapter 7.2.3.3) and applicable PCRs discourage the use of the results of modules A1-A3 & (A1-A5 for services) without considering the results of module C.

Following the supply of ready-mix concrete products, Holcim has no control over the end-of-life fate for their products. The recommended cradle to gate environmental profile will be based on the most common scenario as the majority of construction products are generally deconstructed and transported for recycling. The following assumptions have been used in this study to model deconstruction and end of life scenarios of Holcim's ready-mix concrete:

- Deconstruction is modelled as the physical process of drilling and removing the concrete. Hydraulic excavator is assumed as the operating tool for deconstruction. This process is based on ecoinvent v3.9.1 (2023) database and the diesel used is extracted from the process.
- 100% of the products (2,400 kg) are assumed to be separately collected during deconstruction.
- 25 km delivery distance to landfilling as well as reprocessing facility is assumed for waste collection process since there was no primary data available.
- Assume 80% of the product is reprocess / recycled as Module C3. This is based on the 2022 National Waste Report (DCCEEW, 2023).
- The remaining waste concrete undergoes inert waste landfill as Module C4.

Module	Parameter	Value	Unit
C1 – Deconstruction	Diesel	1.31E-01	L
C2 – Transportation	Distance to processing	2.50E+01	km
C3 – Waste processing	Concrete recycling	1.92E+03	kg
C4 – Final disposal	Inert waste landfill	4.80E+02	kg

Benefits and loads beyond the system boundary (Module D)

The recycling and recovery rate of waste concrete is 80% based on the National Waste Report rate (DCCEEW, 2023). The end-of-life recyclers process the waste concrete into a recycled aggregate, which can be replaced with virgin coarse aggregate for a range of applications depending on the products performance requirements.

ENVIRONMENTAL PERFORMANCE

The environmental impacts considered in this EPD are listed in the table below. EN 15804 reference package based on EF 3.1 (Environmental Footprint) or a later version has been used. All further tables from this point will contain abbreviation only.

Impact Category	Abbreviation	Measurement Unit
Potential Environmental Impact indicators		
Total global warming potential	GWP – T	kg CO_2 equivalents (GWP100)
Global warming potential (fossil)	GWP – F	kg CO_2 equivalents (GWP100)
Global warming potential (biogenic)	GWP – B	kg CO_2 equivalents (GWP100)
Global warming potential (land use/ land transformation)	GWP – Luluc	kg CO_2 equivalents (GWP100)
Ozone depletion potential	ODP	kg CFC 11 equivalents
Acidification potential	AP	mol H+ eq.
Eutrophication – aquatic freshwater	EP – freshwater	kg P equivalent
Eutrophication – aquatic marine	EP - marine	kg N equivalent
Eutrophication – terrestrial	EP – terrestrial	mol N equivalent
Photochemical ozone creation potential	POCP	kg NMVOC equivalents
Abiotic depletion potential (elements)*	ADPE	kg Sb equivalents
Abiotic depletion potential (fossil fuels)*	ADPF	MJ net calorific value
Water Depletion Potential*	WDP	m^3 equivalent deprived
Resource use indicators		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	PERM	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PERT	MJ, net calorific value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ, net calorific value
Use of non-renewable primary energy resources used as raw materials	PENRM	MJ, net calorific value
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PENRT	MJ, net calorific value
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ, net calorific value
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value
Use of net fresh water	FW	m^3

Impact Category	Abbreviation	Measurement Unit
Waste categories and Output flows indicators		
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed/stored	RWD	kg
Components for reuse	CFR	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MFEE	kg
Exported energy	EE - e	MJ per energy carrier
Exported energy, thermal	EE - t	MJ per energy carrier
Additional environmental impact indicators		
Global warming potential, excluding biogenic uptake, emissions and storage	GWP-GHG	kg CO_2 equivalents (GWP100)
Global warming potential, aligned with the IPCC 2013 Fifth Assessment Report *	GWP-GHG (AR5)	kg CO_2 equivalents (GWP100)
Particulate matter	PM	disease incidence
Ionising radiation – human health	IRP	kBq U-235 eq
Eco-toxicity (freshwater)*	ETP-fw	CTUe
Human toxicity potential – cancer effects*	HTP-c	CTUh
Human toxicity potential – non cancer effects*	HTP-nc	CTUh
Soil quality*	SQP	dimensionless
Potential environmental Impact Indicators (EN15804+A1)		
Global warming (GWP100a) – A1	GWP (A1)	kg CO_2 equivalents
Ozone layer depletion (ODP) – A1	ODP (A1)	kg CFC-11 equivalents
Acidification – A1	AP (A1)	kg SO_2 equivalents
Eutrophication – A1	EP (A1)	kg PO_4^{3-} equivalents
Photochemical oxidation – A1	POCP (A1)	kg C_2H_4 equivalents
Abiotic depletion – A1	ADPE (A1)	kg Sb equivalents
Abiotic depletion (fossil fuels) – A1	ADPF (A1)	MJ, net calorific value
Global warming (GWP100a) – A1	GWP (A1)	kg CO_2 equivalents
Additional Greenstar v1.3 Indicators		
Human Toxicity cancer Green Star	HTc (GS)	CTUh
Human Toxicity non-cancer Green Star	HTnc (GS)	CTUh
Land use Green Star	LU (GS)	kg C deficit equivalents
Ionising radiation Green Star	IR (GS)	kBq U-235 equivalents
Particulate Matter Green Star	PM (GS)	kg PM2.5 equivalents
WSI Green Star	WSI (GS)	m^3 equivalents

**Disclaimer – 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.*

***Disclaimer – 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.*
**** - GWP-GHG (IPCC AR5) is an additional GWP100 indicator that is aligned with the Intergovernmental Panel on Climate Change (IPCC) 2013 Fifth Assessment Report (AR5) (IPCC 2013), national greenhouse gas reporting frameworks in Australia and New Zealand and previous versions of the Construction Products PCR (PCR2019:14v1.11). It excludes biogenic carbon and indirect radiative forcing.*

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The use of results of modules A1-A3 or A1-A5, without considering the results of module C may mislead the communication and decision-making. The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.

PRIMARY ENVIRONMENTAL INDICATORS (in accordance with EN 15804:2012+A2:2019) – 1m^3 of ready-mix concrete

Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-Total	kg CO2 eq.	243	1.96	8.81	0.532	3.97	7.57	1.27	-15.7
GWP-Fossil	kg CO2 eq.	243	1.96	8.79	0.532	3.97	7.56	1.27	-15.6
GWP-Biogenic	kg CO2 eq.	0.148	0.000147	0.0240	0.0000409	0.000297	0.00700	0.000229	-0.0215
GWP-Luluc	kg CO2 eq.	0.0239	9.14E-7	0.000263	0.0000227	1.85E-6	3.48E-6	0.0000623	-0.0138
ODP	kg CFC 11 eq.	5.49E-6	3.05E-7	1.06E-7	7.69E-9	6.18E-7	9.49E-7	1.84E-8	-1.11E-7
AP	mol H+ eq.	1.23	0.0125	0.0691	0.00501	0.0253	0.0207	0.0115	-0.0847
EP-F	kg PO43- eq.	0.0452	1.99E-7	0.0000531	3.67E-6	4.03E-7	0.0000360	0.0000370	-0.00498
EP-M	kg P eq.	0.0822	0.00290	0.0295	0.00235	0.00587	0.00368	0.00523	-0.0224
EP-T	kg N eq.	2.74	0.0324	0.320	0.0256	0.0656	0.0402	0.0568	-0.233
POCP	mol N eq.	0.700	0.00798	0.0937	0.00750	0.0162	0.0107	0.0170	-0.0738
ADPE	kg NMVOC eq.	0.00392	2.24E-9	2.65E-7	2.15E-8	4.54E-9	1.86E-6	4.91E-8	-1.68E-6
ADPF	kg Sb eq.	1580	26.5	109	6.85	53.6	102	15.9	-192
WDP	MJ	60.5	0.170	46.5	0.00908	0.345	2.32	0.0221	-26.0

RESOURCE USE PARAMETERS (in accordance with EN 15804:2012+A2:2019) – 1m^3 of ready-mix concrete

Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	MJNCV	52.6	0.0381	2.84	0.0118	0.0118	1.85	0.0708	-16.7
PERM	MJNCV	0	0	0	0	0	0	0	0
PERT	MJNCV	52.6	0.0381	2.84	0.0118	0.0118	1.85	0.0708	-16.7
PENRE	MJNCV	1621	26.5	109	6.85	6.85	102	15.9	-192
PENRM	MJNCV	0	0	0	0	0	0	0	0
PENRT	MJNCV	1621	26.5	109	6.85	6.85	102	15.9	-192
SM	kg	132	0	0	0	0	0	0	0
RSF	MJNCV	16.4	0	0	0	0	0	0	0
NRSF	MJNCV	0	0	0	0	0	0	0	0
FW	m3	1.32	0.00393	0.593	0.000346	0.000346	0.0366	0.000832	-0.632

WASTE CATEGORIES AND OUTPUT FLOWS (in accordance with EN 15804:2012+A2:2019) – 1m^3 of ready-mix concrete

Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HWD	kg	0.00115	6.29E-6	0.000545	0.0000460	0.0000127	0.0000303	0.000102	-0.000464
NHWD	kg	10.00	0.00120	68.7	0.000513	0.00243	0.103	457	-0.676
RWD	kg	0.0000300	1.63E-9	4.00E-6	2.64E-7	3.30E-9	5.92E-7	9.42E-7	-0.000433
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0
MFRE	kg	0	0	0	0	0	0	0	0
EE - e	MJ	0	0	0	0	0	0	0	0
EE - t	MJ	0	0	0	0	0	0	0	0

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS (in accordance with EN 15804:2012+A2:2019) – 1m^3 of ready-mix concrete

Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-GHG	kg CO2 eq.	243	1.96	8.81	0.532	3.97	7.57	1.27	-15.7
GWP-GHG (AR5)	kg CO2 eq.	251	1.94	8.65	0.521	3.93	7.52	1.24	-15.2
PM	disease incidence	0.0000390	1.90E-7	1.76E-6	1.41E-7	3.84E-7	1.38E-7	3.18E-7	-1.27E-6
IRP	kBq U-235 eq	1699	0.0000463	0.0191	0.00132	0.0000938	0.00420	0.00437	-1.78
ETP-fw	CTUe	244	7.70	34.3	2.80	15.6	26.9	6.22	-31.2
HTP-c	CTUh	4.58E-7	6.57E-11	4.05E-10	2.01E-11	1.33E-10	1.25E-9	7.08E-11	-1.54E-9
HTP-nc	CTUh	0.0000128	4.69E-9	3.34E-8	2.33E-9	9.50E-9	3.91E-8	1.11E-8	-1.11E-7
SQP	dimensionless	450	0.119	9.63	0.0119	0.241	20381	18.9	-124

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS (in accordance with EN 15804:2012+A1:2013) – 1m^3 of ready-mix concrete

Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP (A1)	kg CO2 eq.	251	1.94	8.63	0.520	3.92	7.51	1.24	-15.1
ODP (A1)	kg CFC 11 eq.	5.49E-6	3.05E-7	1.06E-7	7.69E-9	6.18E-7	9.49E-7	1.84E-8	-1.11E-7
AP (A1)	kg SO2 eq.	1.23	0.0125	0.0691	0.00501	0.0253	0.0207	0.0115	-0.0847
EP (A1)	kg PO43- eq.	0.118	0.00118	0.0102	0.000805	0.00238	0.00197	0.00188	-0.0229
POCP (A1)	kg C2H4 eq.	0.700	0.00798	0.0937	0.00750	0.0162	0.0107	0.0170	-0.0738
ADPE (A1)	kg SO2 eq.	0.00392	2.24E-9	2.65E-7	2.15E-8	4.54E-9	1.86E-6	4.91E-8	-1.68E-6
ADPF (A1)	MJ	1580	26.5	109	6.85	53.6	102	15.9	-192

ADDITIONAL GREEN STAR (V1.3) IMPACT INDICATORS – 1m^3 of ready-mix concrete

Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HTc (GS)	CTUh	7.58E-9	1.28E-11	1.30E-10	3.31E-12	2.58E-11	1.21E-10	1.26E-11	-2.79E-10
HTnc (GS)	CTUh	1.17E-9	3.98E-12	6.60E-11	2.39E-13	8.06E-12	4.89E-11	6.12E-13	-8.89E-12
LU (GS)	kg C deficit eq.	5.43	0.00178	0.261	0.00592	0.00360	2168	1.35	-390
IR (GS)	kBq U235 eq.	0.131	0.0000463	0.0192	0.00132	0.0000938	0.00420	0.00438	-1.79
PM (GS)	kg PM2.5 eq.	0.0000390	1.90E-7	1.76E-6	1.41E-7	3.84E-7	1.38E-7	3.18E-7	-1.27E-6
WSI (GS)	m3	2.32	0.00557	2.23	0.000430	0.0113	0.101	0.000972	-0.830

OTHER LIFE CYCLE STAGES NOT INCLUDED IN THIS EPD

While the LCA study and EPD only consider the cradle to gate (modules A1-A3) with options modules A4-A5, modules C1-C4 and module D of the environmental impacts of Holcim's ready-mix concrete, practitioners using the EPD for the purpose of whole-of-life building studies or the functional comparison of different building products on a whole-of-life basis will consider concrete's other life cycle stages. Some of the environmental impacts of benefits associated with other life cycle stages not included in this EPD are described in the following sections.

Lifetime absorption of CO_2

Carbonation is a natural process whereby concrete absorbs carbon dioxide (CO_2) from the atmosphere through a chemical reaction between the CO_2 in the ambient air and hydration products within the concrete ($CaOH_2$). Ready-mix concrete can be subject to carbonation from the use stage onward (i.e. after construction and curing). From a life cycle impact accounting perspective, this process can also be referred to as 'reabsorption', since the CO_2 emitted during the cement manufacturing process can be partly offset by the lifetime absorption of CO_2, therefore reducing the net CO_2 emissions associated with concrete over its lifetime.

The carbonisation process is a commonly known process in building design and is typically taken into consideration by engineers when specifying special-class concrete.

The total amount of CO_2 absorption during the life cycle of concrete is subject to a range of factors and varies over time. The calculation has been standardised in the British and European Standard BS EN 16757:2017 *Sustainability of construction works – Environmental Product Declarations – Product Category Rules for concrete and concrete elements.* It is recommended that practitioners make use of this standard when conducting whole-of-life building studies and if the building materials include substantial amounts of concrete. Please note that CO_2 absorption has not been considered in this EPD and is not reflected in the EPD results tables.

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