ViroDecs™ Special

Holcim Australia Ready-Mix Concrete

Victoria – ECOPact Range

Environmental Product Declaration

In accordance with ISO 14025 and EN 15804+A2:2019
Programme: The International EPD® System | www.environdec.com
Programme Operator: EPD Australasia Limited | www.epd-australasia.com
Managed by: Holcim Certified EPD Process
EPD Process Certificate No.04
Verified Accreditation Body: Epsten Group, Inc.
EPD Registration No. S-P-04657
Valid from 12 January 2022 | 26 September 2027
Revision Date: 26 September 2022
Version Number: 2.0
Geographical Scope: Australia

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Version Number	Revision Date	Description of Changes
2.0	26.09.2022	Additional mix designs added. EPD lifecycle assessment updated from EN15804+A1 to EN 15804+A2:2019

Introduction

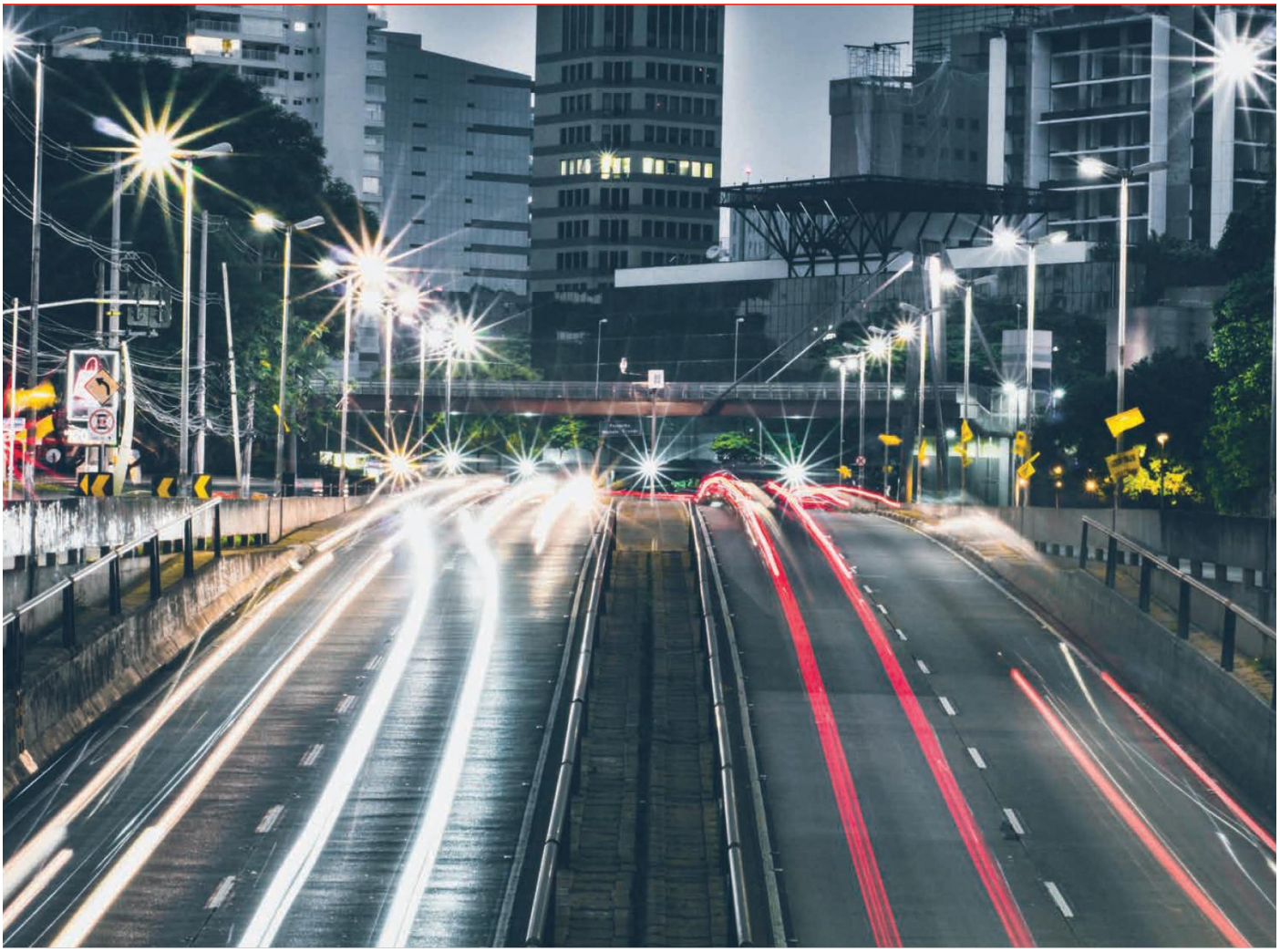
All around the world, the expectation for Governments and organisations to provide enhanced transparency and disclosure of environmental impacts, such as greenhouse gas (GHG) emissions, has been growing. This follows the landmark COP 21 Paris Agreement in 2015 in which all nations agreed to ambitiously pursue efforts to combat climate change and its effects.

At the same time, the global demand for construction materials is also growing due to worldwide population growth and an increase in urbanisation. In fact, concrete is the second most used commodity in the world behind water, and typically a major contributor to the embodied GHG emissions of an infrastructure or property asset.

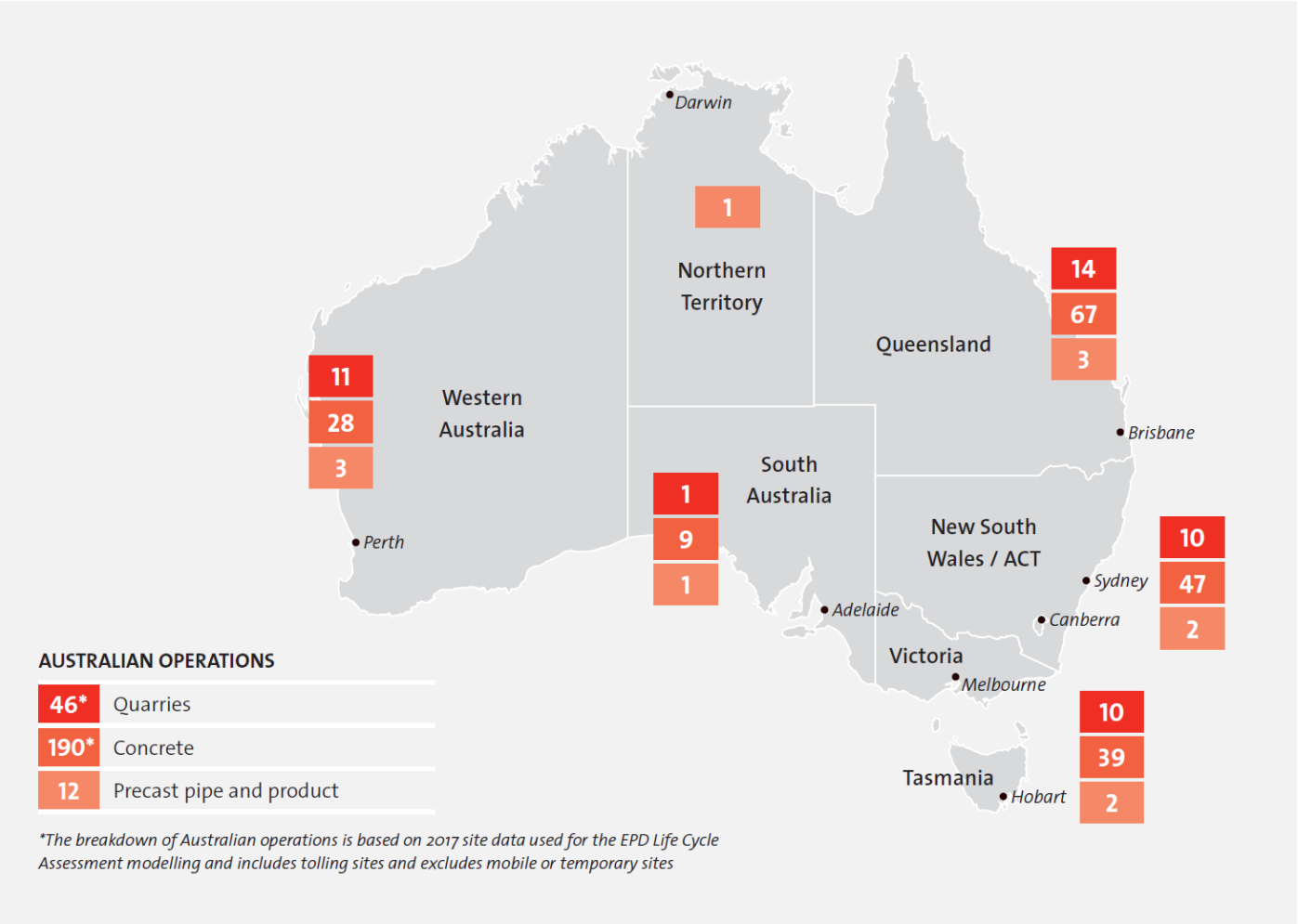
This clearly demonstrates both the essential need for construction materials now and in the future, as well as the necessity for the construction materials industry to be a leading part of the solution addressing climate change.

At Holcim, we recognise our responsibility to contribute to global emissions reduction targets and we have developed a roadmap with a number of actions to direct our efforts.

Our ViroDecs™ range of ready-mix concrete represented by an Environmental Product Declaration (EPD) is one such initiative for Holcim in Australia.



About Holcim



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 70,000 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.

Holcim builds progress for people and the planet. As a global leader in innovative and sustainable building solutions, Holcim is enabling greener cities, smarter infrastructure and improving living standards around the world. With sustainability at the core of its strategy Holcim is becoming a net zero company, with its people and communities at the heart of its success. The company is driving circular construction as a world leader in recycling to build more with less.

ViroDecs™ Special – a first for ready-mix concrete in Australia

ViroDecs™ Special at a glance

The Holcim ViroDecs™ Special provides project-specific, on-demand Environmental Product Declarations (EPDs) to Holcim's customers. This capability represents a significant step in Holcim's sustainability journey and embodies our multi-disciplinary approach to embedding sustainability into our organisation and operations. With the introduction of our ViroDecs™ Special, third-party verified data will underpin our capability to work with our customers from tender through to design and construction to optimise ready-mix concrete mix designs and report on sustainability performance.

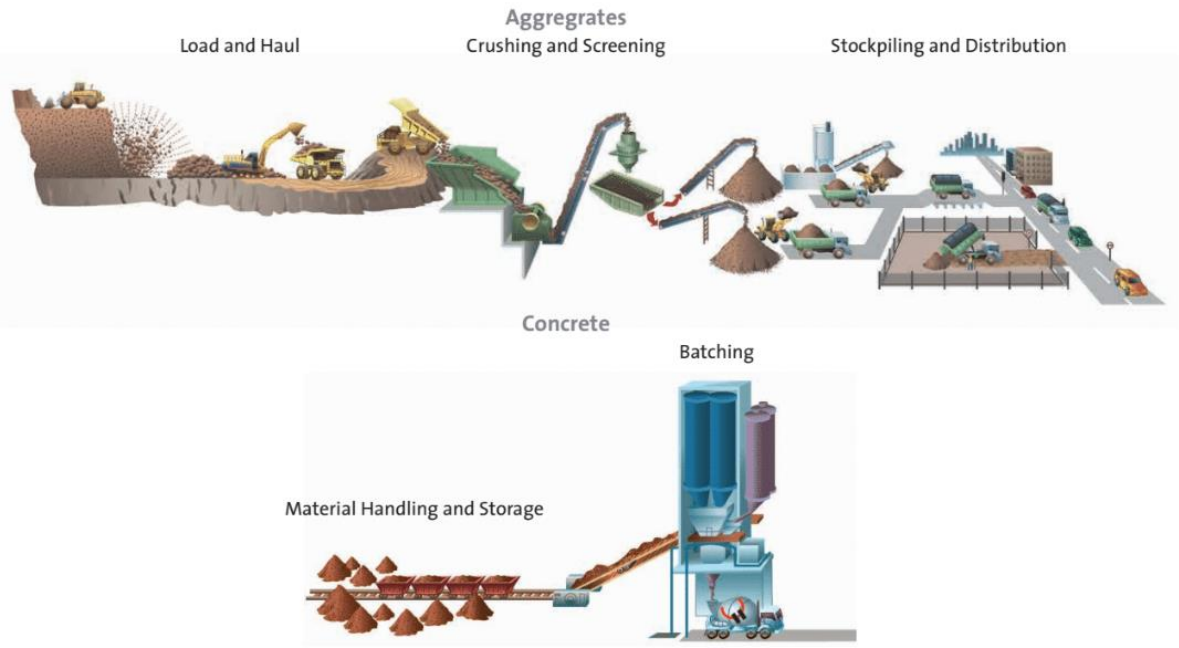
The publication of the original ViroDecs™ EPD in 2019 introduced quality, third-party verified embodied life cycle impact data for ready-mix concrete into the Australian market for the first time. Holcim has been pleased by the positive response from the industry. The message was loud and clear: "we want transparency and we want a evidence-based approach to specification, procurement and reporting". With the introduction of our ViroDecs™ Special, Holcim's customers can now specify concrete sustainability performance in terms of CO_2-e, with the confidence that our claims are backed by our third-party verified EPD Process Certification.

Holcim ViroDecs™ Special is backed by an EPD Process Certification. It's not only a first for concrete but a first for any product in Australia. Our EPD Process Certification is a stamp of approval to produce compliant EPDs in-house, opening up significant capability and flexibility in producing and using life cycle impact data to inform our operations and our customers.

To gain our EPD Process Certification, Holcim invested in embedding Life Cycle Assessment (LCA) into our systems and processes. We have satisfied a rigorous, third-party evaluation in accordance with the relevant ISO standards and guidelines of the International EPD Programme and EPD Australasia.

This EPD has been developed using our EPD Process Certification for Victoria ECOPact Range with production occurring at Holcim Victorian 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 down a number of different 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 residential applications, low rise buildings, paving and driveways etc. Its specification and ordering have been simplified as far as practicable.
- **Special-class –** allows the purchaser to incorporate into the project specification any special requirements for the project. Special-class concrete is typically supplied to major and high-end construction projects from high rise buildings, dams and spillways, roads and 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.

Reference Service Life (RSL)

The RSL is not specified as the scope is from cradle to gate.

Time Representativeness

The plant data for the LCA is based on 2017 calendar year production data. The mix data for the LCA is based on 2022 calendar year production data.

Databases and LCA Software Used

SimaPro® LCA software (v 9.1) was used for the LCA modelling which developed the LCA Calculator, used as per the certified EPD Process. It uses background data from:

1. The Australian National Life Cycle Inventory Database (AusLCI) (2018)
2. Ecoinvent 3.6 (2019)
3. Global Cement and Concrete (GCCA) EPD Tool Project Database version 3.1 (International Version) (2021); and
4. Product specific EPDs for pigments and fibres.

The environmental impacts modelled from the existing EPDs do not include impacts for the additional Green Star (v1.2) impact categories included in the environmental impact tables. 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

No flows were excluded on the basis of cut-off criteria.

Address and Contact Information

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Data Quality

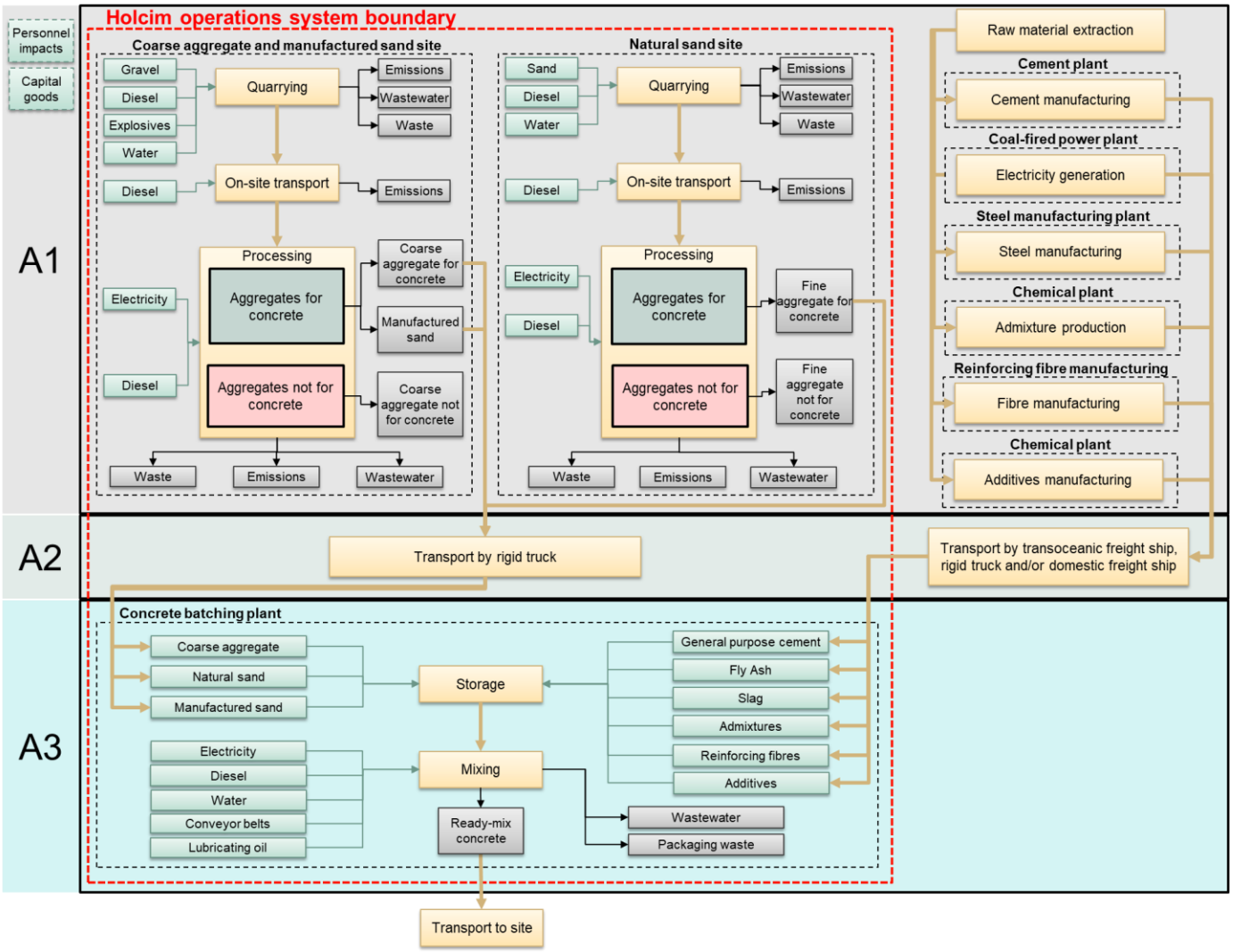
Data quality for the foreground data was assessed in terms of geographic and temporal representativeness. All data sources were scored medium or higher.

Module	Input/outputs	Sub-processes	Data source	Temporal scope	Geographic scope	Quality
A1	Coarse aggregate Manufactured sand Fine aggregate	Electricity	Electricity provider invoices	2017	All states	High
		Diesel	Supplier invoices	2017	All states	High
		Pollutants	National Pollution Inventory (NPI) data	2017	All states	High
		Mains water	Water utility invoices	2017	All states barring NSW	Medium
		Water – other sources (lakes, groundwater, rainwater)	Metered withdrawal data	2017	All states barring NSW	Medium
		Water discharge from site	Measured site data	2017	All states barring NSW	Medium
		Explosives (Manufactured sand and Coarse aggregate only)	Invoices	2017	All states (excluding the Kalgoorlie Quarry in WA which purchases raw feed from an external source)	High
		Gravel	Calculated – spoil + production amount	2017	All states	High
		Spoil	Holcim waste records	2017	All states	High
A2	Aggregate transport	Background data used to model	Actual transport distances and loads per trip	2017	All states (excluding Lynwood Quarry which transports by freight rail)	High
A3	Concrete batching plant	Electricity	Electricity provider invoices	2017	All states	High
		Diesel	Supplier invoices	2017	All states	High
		Mains water	Water metres, with utility invoices as a back-up	2017	All states	High
		Water – other sources (lakes, groundwater, rainwater)	Estimate based on water balance	2017	All states	Medium
		Water discharge from site	Estimate based on Holcim site performance metrics	2017	All states	Medium
		Lubricating oil	AusLCI concrete process	2015	National	Medium
		Conveyor belt				
	Concrete mix designs	Background data used to model	Holcim internal technical database containing mix designs	2017	All states	High
	Packaging waste	Background data used to model	Estimate based on researched packaging material and sizes	N/A	N/A	Medium

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 version 1.11.

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. Life cycle stages beyond Holcim's gate are excluded from the LCA (see figure below).

Environmental impacts relating to personnel, infrastructure and production equipment not directly consumed in the process are excluded from the system boundary as per the Product Category Rules (2019:14 Construction Production version 1.11).

Product Stage			Construction Stage		Use 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
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

*Module not declared (MND)

EPD Product Description and Use

ViroDecs™ Ready-mix concrete Victoria – ECOPact Range

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	Description of use
32	BE324XN	32MPa 14mm NEPEAN EXPOSED ECOPact
40	VE401EVMW	S40 10mm VR400 650 SPREAD ECOPact
50	VE501EVMW	S50 10mm VR400 650SPREAD ECOPact
55	VE552EVR3	S55 20mm VR400 150SL ECOPact
20	VE202E / BE202E	S20 MPa 20mm 100SL ECOPact
20	VE202E56	S20 @56D 20mm 100SL ECOPact
20	VE202EF2	S20 20mm 120SL ECOPact FIBRE
25	VE251EKC	S25 10mm KERB & CHANNEL ECOPact
25	VE252E / BE252E	S25 MPa 20mm 100SL ECOPact
25	VE252E56	S25@56D 20mm 100SL ECOPact
25	VE252EF2	S25 20mm 120SL ECOPact FIBRE
32	VE321EKC	S32 10mm KERB & CHANNEL ECOPact
32	VE322E / BE322E	S32 MPa 20mm 100SL ECOPact
32	VE322E56	S32@56D 20mm 100SL ECOPact
32	VE322EF2	S32 20mm 120SL ECOPact FIBRE
32	VE322P	S32 20mm 150SL ECOPact
40	VE401EAP	S40 10mm 680SPREAD PRCST ECOPact
25	VE252EF26	S25@56D 20mm 100SL Coloured ECOPact
40	VE402E / BE402E	S40 MPa 20mm 100SL ECOPact
40	VE402E56	S40@56D 20mm 100SL ECOPact
50	VE501EAP	S50 10mm 680SPREAD ECOPact PRCST
25	VE251E56	S25@56D 10mm 100SL ECOPact
50	VE502E	S50 MPa 20mm 100SL ECOPact
50	VE502E56	S50@56D 20mm 100SL ECOPact
65	VE651EAV	S65 10mm 680SPREAD VERT ECOPact
80	VE801EAV	S80 10mm 680SPREAD VERT ECOPact
40	VE402EVR2	S40 20mm VR400 120SL ECOPact
50	VE502EVR2	S50 20mm VR400 120SL ECOPact

Strength (MPa)	Mix code	Description of use
40	VE402EAP	S40 20mm 680SPREAD PRECAST ECOPact
40	VE401EAV	S40 10mm 680SPREAD VERT ECOPact
50	VE501EAV	S50 10mm 680SPREAD VERT ECOPact
55	VE552EVR3	S55 20mm VR400 150SL ECOPact
32	VZ322E5	S32 20mm 200SL ECOPact
40	VE402E5	S40 20mm 200SL ECOPact
50	VE502E5	S50 20mm 200SL ECOPact
32	VE321EK6	S32 10mm 60SL KERB & CHANNEL ECOPACT
25	VE251E2	S25 10mm 120SL ECOPact
25	VE252EF2	S25 20mm 120SL ECOPact FIBRE
32	VE322EF2	S32 20mm 120SL ECOPact FIBRE
40	VE402EF2	S40 20mm 120SL ECOPact FIBRE
40	VE401E56	S40@56D 10mm 100SL ECOPact
50	VE501E56	S50@56D 10mm 100SL ECOPact
40	VE401EAPF	S40 10mm 680SPREAD ECOPact FIBRE
32	VE322EF26	S32@56D 20mm 120SL ECOPact FIBRE
40	VE404EWC	S40 14mm 650SPREAD ECOPact SWC
40	VE402ESW	S40 20mm 650SPREAD ECOPact SWC
50	VE502ESW	S50 20mm 650SPREAD ECOPact SWC

Note: Some customer invoices may have a Z as the second charterer in their mix code (e.g. QZ202E). This indicates that the mix was sold as a carbon neutral ready-mix concrete (i.e. the residual Global Warming Potential was offset). To find the applicable mix code, please substitute the seconded charter in the mix code with an E (e.g. QE202E).

Content Declaration

The following table provides a summary of the materials included in Holcim ready-mix concrete and their relative composition by weight.

Material	Content
General purpose cement	5-21%
Aggregate	67-84%
Supplementary cementitious materials	0-11%
Water	11.6-12%
Admixtures	0.01-0.02%

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.

The gross weight of this declared material makes up a minimum of 99% of the products covered by this EPD.

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 version 1.11 (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.

Environmental Performance

The environmental impacts considered in this EPD are listed in the table below. All further tables from this point will contain abbreviation only.

Impact Category	Abbreviation	Measurement Unit
Potential Environmental Impacts		
Total global warming potential	GWPT	kg CO_2 equivalents (GWP100)
Global warming potential (fossil)	GWPF	kg CO_2 equivalents (GWP100)
Global warming potential (biogenic)	GWPB	kg CO_2 equivalents (GWP100)
Global warming potential (land use/ land transformation)	GWPL	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 PO_4^{3-} equivalents
Eutrophication – aquatic freshwater	EP - freshwater	kg P equivalent
Eutrophication – aquatic marine	EP - marine	kg N equivalent
Eutrophication – terrestrial	EP – terrestrial	mol N equlivalent
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		
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		
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 impacts		
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

Victoria – ECOPact Range

Primary indicators - 1m^3 of ViroDecs™ ready-mix concrete

PRIMARY ENVIRONMENTAL INDICATORS		GWPT	GWPF	GWPB	GWPL	ODP	AP	EP - freshwater	EP - freshwater2	EP - marine	EP – terrestrial	POCP	ADPE	ADPF	WDP
Strength (MPa)	Mix Code	kg CO2 eq.	kg CO2 eq.	kg CO2 eq.	kg CO2 eq.	kg CFC 11 eq.	mol H+ eq.	kg PO43- eq.	kg P eq.	kg N eq.	mol N eq.	kg NMVOC eq.	kg Sb eq.	MJ	m3
32	BE324XN	269	269	0.29	2.12E-03	4.36E-06	1.07E+00	7.95E-01	2.65E-03	3.35E-01	3.75E+00	9.54E-01	1.28E-04	1.00E+03	1.08E+03
40	VE401EVMW	237	237	0.37	9.03E-04	5.99E-06	1.08E+00	5.28E-01	6.75E-03	2.92E-01	3.47E+00	8.70E-01	1.35E-04	1.03E+03	1.18E+03
50	VE501EVMW	272	272	0.38	9.32E-04	6.22E-06	1.19E+00	5.72E-01	7.00E-03	3.33E-01	3.93E+00	9.83E-01	1.45E-04	1.08E+03	1.27E+03
55	VE552EVR3	289	289	0.16	8.04E-04	5.99E-06	1.24E+00	6.09E-01	5.96E-03	3.53E-01	4.10E+00	1.03E+00	1.55E-04	1.14E+03	1.40E+03
20	VE202E / BE202E	197	196	0.26	1.97E-03	3.76E-06	8.24E-01	5.23E-01	2.11E-03	2.53E-01	2.82E+00	7.25E-01	1.05E-04	8.43E+02	8.44E+02
20	VE202E56	208	208	0.26	1.97E-03	3.79E-06	8.59E-01	5.28E-01	2.16E-03	2.67E-01	2.98E+00	7.63E-01	1.06E-04	8.34E+02	8.40E+02
20	VE202EF2	211	210	0.41	2.62E-03	4.17E-06	8.56E-01	5.96E-01	3.12E-03	2.50E-01	2.83E+00	7.25E-01	1.07E-04	1.09E+03	8.70E+02
25	VE251EKC	220	220	0.11	3.69E-04	3.96E-06	9.17E-01	3.89E-01	2.33E-03	2.87E-01	3.22E+00	8.19E-01	1.12E-04	6.99E+02	9.13E+02
25	VE252E / BE252E	213	212	0.27	1.99E-03	3.95E-06	8.83E-01	5.58E-01	2.27E-03	2.70E-01	3.02E+00	7.75E-01	1.12E-04	8.95E+02	9.18E+02
25	VE252E56	229	229	0.27	2.00E-03	4.02E-06	9.34E-01	5.66E-01	2.36E-03	2.90E-01	3.24E+00	8.29E-01	1.14E-04	8.92E+02	9.24E+02
25	VE252EF2	229	228	0.42	2.55E-03	4.12E-06	9.07E-01	6.36E-01	2.27E-03	2.71E-01	3.03E+00	7.82E-01	1.15E-04	1.12E+03	9.46E+02
32	VE321EKC	258	258	0.13	4.19E-04	4.37E-06	1.05E+00	4.43E-01	2.71E-03	3.29E-01	3.69E+00	9.38E-01	1.26E-04	8.04E+02	1.06E+03
32	VE322E / BE322E	233	233	0.30	2.22E-03	4.31E-06	9.62E-01	6.30E-01	2.47E-03	2.92E-01	3.27E+00	8.40E-01	1.22E-04	9.94E+02	1.02E+03
32	VE322E56	250	250	0.28	2.04E-03	4.35E-06	1.01E+00	6.17E-01	2.54E-03	3.14E-01	3.51E+00	8.97E-01	1.24E-04	9.57E+02	1.01E+03
32	VE322EF2	255	255	0.44	2.69E-03	4.74E-06	1.02E+00	6.87E-01	3.52E-03	2.99E-01	3.39E+00	8.66E-01	1.26E-04	1.22E+03	1.06E+03
32	VE322P	192	192	0.26	2.15E-03	4.38E-06	8.52E-01	6.06E-01	3.52E-03	2.40E-01	2.74E+00	7.03E-01	1.13E-04	9.66E+02	9.47E+02
40	VE401EAP	294	293	0.32	2.66E-03	5.83E-06	1.23E+00	8.44E-01	6.19E-03	3.58E-01	4.17E+00	1.04E+00	1.43E-04	1.18E+03	1.16E+03
25	VE252EF26	237	236	0.43	2.75E-03	4.14E-06	9.32E-01	9.36E-01	2.80E-03	2.82E-01	3.18E+00	8.10E-01	1.12E-04	1.09E+03	8.88E+02
40	VE402E / BE402E	262	262	0.29	2.10E-03	4.70E-06	1.07E+00	6.95E-01	2.76E-03	3.25E-01	3.63E+00	9.32E-01	1.35E-04	1.07E+03	1.16E+03
40	VE402E56	283	283	0.30	2.10E-03	4.70E-06	1.13E+00	7.05E-01	2.84E-03	3.51E-01	3.93E+00	1.00E+00	1.36E-04	1.05E+03	1.14E+03
50	VE501EAP	375	375	0.34	2.51E-03	6.40E-06	1.51E+00	8.59E-01	6.88E-03	4.53E-01	5.24E+00	1.30E+00	1.68E-04	1.36E+03	1.48E+03
25	VE251E56	232	231	0.33	3.00E-03	3.97E-06	9.39E-01	1.51E+00	2.28E-03	2.91E-01	3.25E+00	8.31E-01	1.14E-04	9.64E+02	9.20E+02
50	VE502E	303	303	0.32	2.27E-03	5.56E-06	1.24E+00	7.89E-01	4.20E-03	3.67E-01	4.15E+00	1.06E+00	1.54E-04	1.25E+03	1.36E+03
50	VE502E56	341	340	0.33	2.29E-03	5.62E-06	1.35E+00	8.25E-01	4.38E-03	4.13E-01	4.68E+00	1.18E+00	1.58E-04	1.23E+03	1.37E+03
65	VE651EAV	344	344	0.32	2.39E-03	6.61E-06	1.42E+00	8.42E-01	7.03E-03	4.08E-01	4.74E+00	1.19E+00	1.67E-04	1.40E+03	1.53E+03
80	VE801EAV	408	408	0.36	2.67E-03	7.88E-06	1.68E+00	1.02E+00	9.16E-03	4.77E-01	5.59E+00	1.39E+00	1.95E-04	1.65E+03	1.82E+03
40	VE402EVR2	248	247	0.27	2.02E-03	5.06E-06	1.05E+00	6.68E-01	3.75E-03	3.04E-01	3.45E+00	8.84E-01	1.36E-04	1.10E+03	1.18E+03
50	VE502EVR2	279	279	0.29	2.07E-03	5.45E-06	1.16E+00	7.39E-01	4.06E-03	3.38E-01	3.83E+00	9.82E-01	1.50E-04	1.21E+03	1.33E+03

PRIMARY ENVIRONMENTAL INDICATORS		GWPT	GWPF	GWPB	GWPL	ODP	AP	EP - freshwater	EP - freshwater2	EP - marine	EP – terrestrial	POCP	ADPE	ADPF	WDP
Strength (MPa)	Mix Code	kg CO2 eq.	kg CO2 eq.	kg CO2 eq.	kg CO2 eq.	kg CFC 11 eq.	mol H+ eq.	kg PO43- eq.	kg P eq.	kg N eq.	mol N eq.	kg NMVOC eq.	kg Sb eq.	MJ	m3
40	VE402EAP	310	310	0.31	2.43E-03	5.77E-06	1.28E+00	8.21E-01	5.85E-03	3.76E-01	4.35E+00	1.09E+00	1.47E-04	1.19E+03	1.24E+03
40	VE401EAV	279	279	0.29	2.29E-03	5.91E-06	1.19E+00	7.76E-01	5.95E-03	3.34E-01	3.88E+00	9.79E-01	1.46E-04	1.23E+03	1.29E+03
50	VE501EAV	307	307	0.30	2.30E-03	6.11E-06	1.28E+00	7.88E-01	6.19E-03	3.67E-01	4.25E+00	1.07E+00	1.55E-04	1.30E+03	1.40E+03
55	VE552EVR3	289	289	0.16	8.04E-04	5.99E-06	1.24E+00	6.09E-01	5.96E-03	3.53E-01	4.10E+00	1.03E+00	1.55E-04	1.14E+03	1.40E+03
32	VZ322E5	222	221	0.27	2.17E-03	4.50E-06	9.39E-01	5.96E-01	3.80E-03	2.77E-01	3.17E+00	8.03E-01	1.16E-04	9.67E+02	9.64E+02
40	VE402E5	245	245	0.28	2.27E-03	4.97E-06	1.03E+00	6.54E-01	4.56E-03	3.02E-01	3.47E+00	8.75E-01	1.25E-04	1.05E+03	1.07E+03
50	VE502E5	294	294	0.31	2.40E-03	5.75E-06	1.22E+00	7.76E-01	5.54E-03	3.54E-01	4.09E+00	1.03E+00	1.48E-04	1.24E+03	1.30E+03
32	VE321EK6	257	257	0.13	4.18E-04	4.36E-06	1.05E+00	4.43E-01	2.69E-03	3.28E-01	3.69E+00	9.36E-01	1.26E-04	8.02E+02	1.06E+03
25	VE251E2	218	218	0.27	2.11E-03	4.39E-06	9.23E-01	5.83E-01	3.30E-03	2.75E-01	3.12E+00	7.94E-01	1.16E-04	9.49E+02	9.53E+02
25	VE252EF2	214	214	0.27	2.11E-03	4.36E-06	9.10E-01	5.82E-01	3.27E-03	2.70E-01	3.06E+00	7.81E-01	1.14E-04	9.44E+02	9.45E+02
32	VE322EF2	240	239	0.28	2.15E-03	4.67E-06	1.00E+00	6.31E-01	3.51E-03	2.97E-01	3.37E+00	8.60E-01	1.25E-04	1.03E+03	1.06E+03
40	VE402EF2	287	286	0.46	3.08E-03	5.22E-06	1.14E+00	1.34E+00	4.05E-03	3.33E-01	3.78E+00	9.65E-01	1.40E-04	1.35E+03	1.21E+03
40	VE401E56	279	279	0.33	3.18E-03	4.82E-06	1.13E+00	2.26E+00	3.62E-03	3.42E-01	3.87E+00	9.82E-01	1.33E-04	1.09E+03	1.11E+03
50	VE501E56	340	340	0.36	3.22E-03	5.52E-06	1.35E+00	2.29E+00	4.21E-03	4.11E-01	4.64E+00	1.17E+00	1.57E-04	1.26E+03	1.36E+03
40	VE401EAPF	315	315	0.62	4.77E-03	6.04E-06	1.26E+00	1.52E+00	6.65E-03	3.58E-01	4.18E+00	1.04E+00	1.43E-04	1.56E+03	1.15E+03
32	VE322EF26	265	264	0.45	3.23E-03	4.62E-06	1.04E+00	1.72E+00	3.49E-03	3.12E-01	3.53E+00	8.97E-01	1.23E-04	1.19E+03	9.98E+02
40	VE404EWC	241	241	0.13	1.10E-03	5.59E-06	1.07E+00	1.08E+00	5.75E-03	2.98E-01	3.48E+00	8.76E-01	1.32E-04	9.66E+02	1.13E+03
40	VE402ESW	241	241	0.13	1.09E-03	5.58E-06	1.07E+00	1.08E+00	5.73E-03	2.98E-01	3.49E+00	8.76E-01	1.32E-04	9.65E+02	1.13E+03
50	VE502ESW	269	269	0.15	1.13E-03	5.91E-06	1.17E+00	1.09E+00	6.18E-03	3.30E-01	3.86E+00	9.67E-01	1.42E-04	1.05E+03	1.24E+03

Resource use parameters - 1m^3 of ViroDecs™ ready-mix concrete

PARAMETERS DESCRIBING RESOURCE USE		PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength (MPa)	Mix Code	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	kg	MJ_{NCV}	MJ_{NCV}	m^3
32	BE324XN	2.84E+01	3.05E-03	2.84E+01	8.25E+02	3.27E+02	1.15E+03	1.40E+02	3.52E-05	0.00E+00	1.50E-01
40	VE401EVMW	3.00E+01	4.96E-04	3.00E+01	9.36E+02	2.71E+02	1.21E+03	2.43E+02	3.65E-05	0.00E+00	1.49E-01
50	VE501EVMW	3.22E+01	5.31E-04	3.22E+01	9.87E+02	2.67E+02	1.25E+03	2.30E+02	3.66E-05	0.00E+00	1.63E-01
55	VE552EVR3	3.56E+01	5.65E-04	3.56E+01	1.08E+03	2.12E+02	1.30E+03	2.45E+02	1.69E-05	0.00E+00	1.76E-01
20	VE202E / BE202E	2.23E+01	2.76E-03	2.23E+01	6.66E+02	3.46E+02	1.01E+03	1.36E+02	3.69E-05	0.00E+00	1.17E-01
20	VE202E56	2.23E+01	2.76E-03	2.23E+01	6.57E+02	3.45E+02	1.00E+03	1.25E+02	3.69E-05	0.00E+00	1.20E-01
20	VE202EF2	2.82E+01	3.60E-03	2.82E+01	8.25E+02	4.37E+02	1.26E+03	1.76E+02	5.23E-05	0.00E+00	1.18E-01
25	VE251EKC	2.40E+01	3.35E-04	2.40E+01	7.09E+02	1.67E+02	8.76E+02	9.02E+01	7.98E-06	0.00E+00	1.29E-01
25	VE252E / BE252E	2.41E+01	2.79E-03	2.41E+01	7.18E+02	3.42E+02	1.06E+03	1.50E+02	3.73E-05	0.00E+00	1.26E-01
25	VE252E56	2.44E+01	2.79E-03	2.44E+01	7.16E+02	3.42E+02	1.06E+03	1.39E+02	3.73E-05	0.00E+00	1.30E-01
25	VE252EF2	3.01E+01	3.63E-03	3.01E+01	8.80E+02	4.08E+02	1.29E+03	1.91E+02	4.53E-05	0.00E+00	1.28E-01
32	VE321EKC	2.77E+01	3.81E-04	2.77E+01	8.13E+02	1.63E+02	9.75E+02	1.00E+02	1.03E-05	0.00E+00	1.47E-01
32	VE322E / BE322E	2.65E+01	3.12E-03	2.65E+01	7.96E+02	3.64E+02	1.16E+03	1.85E+02	4.04E-05	0.00E+00	1.38E-01
32	VE322E56	2.65E+01	2.85E-03	2.65E+01	7.80E+02	3.40E+02	1.12E+03	1.69E+02	3.72E-05	0.00E+00	1.41E-01
32	VE322EF2	3.29E+01	3.68E-03	3.29E+01	9.63E+02	4.29E+02	1.39E+03	2.16E+02	5.21E-05	0.00E+00	1.42E-01
32	VE322P	2.43E+01	2.86E-03	2.43E+01	7.58E+02	3.70E+02	1.13E+03	2.48E+02	3.77E-05	0.00E+00	1.23E-01
40	VE401EAP	2.96E+01	3.35E-03	2.96E+01	9.06E+02	4.52E+02	1.36E+03	3.05E+02	5.18E-05	0.00E+00	1.63E-01
25	VE252EF26	2.88E+01	3.99E-03	2.88E+01	8.29E+02	4.29E+02	1.26E+03	1.64E+02	4.83E-05	0.00E+00	1.26E-01
40	VE402E / BE402E	3.00E+01	2.93E-03	3.00E+01	8.98E+02	3.36E+02	1.23E+03	2.14E+02	3.74E-05	0.00E+00	1.54E-01
40	VE402E56	2.98E+01	2.93E-03	2.98E+01	8.74E+02	3.32E+02	1.21E+03	1.89E+02	3.74E-05	0.00E+00	1.58E-01
50	VE501EAP	3.78E+01	3.07E-03	3.78E+01	1.11E+03	4.31E+02	1.54E+03	2.10E+02	4.86E-05	0.00E+00	2.01E-01
25	VE251E56	2.42E+01	4.68E-03	2.42E+01	7.12E+02	4.18E+02	1.13E+03	1.55E+02	4.68E-05	0.00E+00	1.30E-01
50	VE502E	3.48E+01	3.03E-03	3.48E+01	1.05E+03	3.51E+02	1.40E+03	2.67E+02	4.52E-05	0.00E+00	1.76E-01
50	VE502E56	3.53E+01	3.05E-03	3.53E+01	1.03E+03	3.49E+02	1.38E+03	2.18E+02	4.53E-05	0.00E+00	1.86E-01
65	VE651EAV	3.86E+01	2.82E-03	3.86E+01	1.16E+03	4.07E+02	1.57E+03	2.84E+02	5.76E-05	0.00E+00	1.95E-01
80	VE801EAV	4.58E+01	3.00E-03	4.58E+01	1.38E+03	4.40E+02	1.82E+03	3.44E+02	6.82E-05	0.00E+00	2.30E-01
40	VE402EVR2	3.03E+01	2.66E-03	3.03E+01	9.24E+02	3.37E+02	1.26E+03	2.44E+02	4.18E-05	0.00E+00	1.51E-01
50	VE502EVR2	3.40E+01	2.73E-03	3.40E+01	1.03E+03	3.30E+02	1.36E+03	2.74E+02	4.20E-05	0.00E+00	1.69E-01
40	VE402EAP	3.17E+01	3.06E-03	3.17E+01	9.48E+02	4.07E+02	1.36E+03	2.80E+02	4.60E-05	0.00E+00	1.71E-01
40	VE401EAV	3.26E+01	2.77E-03	3.26E+01	1.00E+03	3.92E+02	1.40E+03	3.24E+02	5.24E-05	0.00E+00	1.65E-01

PARAMETERS DESCRIBING RESOURCE USE		PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength (MPa)	Mix Code	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	MJ_{NCV}	kg	MJ_{NCV}	MJ_{NCV}	m^3
50	VE501EAV	3.54E+01	2.77E-03	3.54E+01	1.07E+03	3.94E+02	1.47E+03	2.94E+02	5.24E-05	0.00E+00	1.78E-01
55	VE552EVR3	3.56E+01	5.65E-04	3.56E+01	1.08E+03	2.12E+02	1.30E+03	2.45E+02	1.69E-05	0.00E+00	1.76E-01
32	VZ322E5	2.50E+01	2.84E-03	2.50E+01	7.54E+02	3.87E+02	1.14E+03	1.72E+02	4.50E-05	0.00E+00	1.30E-01
40	VE402E5	2.75E+01	2.89E-03	2.75E+01	8.28E+02	3.97E+02	1.23E+03	1.95E+02	5.01E-05	0.00E+00	1.42E-01
50	VE502E5	3.33E+01	3.02E-03	3.33E+01	1.00E+03	3.95E+02	1.40E+03	2.53E+02	5.30E-05	0.00E+00	1.69E-01
32	VE321EK6	2.77E+01	3.81E-04	2.77E+01	8.12E+02	1.60E+02	9.71E+02	1.00E+02	9.72E-06	0.00E+00	1.47E-01
25	VE251E2	2.49E+01	2.82E-03	2.49E+01	7.48E+02	3.76E+02	1.12E+03	1.69E+02	4.23E-05	0.00E+00	1.29E-01
25	VE252EF2	2.46E+01	2.82E-03	2.46E+01	7.43E+02	3.73E+02	1.12E+03	1.75E+02	4.23E-05	0.00E+00	1.28E-01
32	VE322EF2	2.74E+01	2.87E-03	2.74E+01	8.25E+02	3.66E+02	1.19E+03	2.00E+02	4.24E-05	0.00E+00	1.41E-01
40	VE402EF2	3.65E+01	4.45E-03	3.65E+01	1.07E+03	4.37E+02	1.51E+03	2.46E+02	5.64E-05	0.00E+00	1.59E-01
40	VE401E56	2.90E+01	5.05E-03	2.90E+01	8.49E+02	3.96E+02	1.24E+03	1.87E+02	5.25E-05	0.00E+00	1.53E-01
50	VE501E56	3.50E+01	5.05E-03	3.50E+01	1.02E+03	3.86E+02	1.41E+03	2.23E+02	5.44E-05	0.00E+00	1.84E-01
40	VE401EAPF	3.59E+01	6.65E-03	3.59E+01	1.06E+03	6.82E+02	1.74E+03	3.64E+02	8.80E-05	0.00E+00	1.63E-01
32	VE322EF26	3.15E+01	4.91E-03	3.15E+01	9.07E+02	4.43E+02	1.35E+03	1.97E+02	5.50E-05	0.00E+00	1.40E-01
40	VE404EWC	2.88E+01	1.15E-03	2.88E+01	8.89E+02	2.48E+02	1.14E+03	2.41E+02	3.38E-05	0.00E+00	1.47E-01
40	VE402ESW	2.88E+01	1.15E-03	2.88E+01	8.90E+02	2.48E+02	1.14E+03	2.41E+02	3.28E-05	0.00E+00	1.47E-01
50	VE502ESW	3.16E+01	1.15E-03	3.16E+01	9.67E+02	2.50E+02	1.22E+03	2.41E+02	3.39E-05	0.00E+00	1.61E-01

Waste categories and output flows - 1m^3 of ViroDecs™ ready-mix concrete

WASTE CATEGORIES AND OUTPUT FLOWS		HWD	NHWD	RWD	CFR	MFR	MFEE	EE - e	EE - t
Strength (MPa)	Mix Code	kg	kg	kg	kg	kg	kg	MJ	MJ
32	BE324XN	1.53E+02	1.52E+01	8.31E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE401EVMW	1.26E+02	8.16E+00	1.14E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	VE501EVMW	1.27E+02	8.70E+00	1.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	VE552EVR3	8.58E+01	8.99E+00	1.12E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	VE202E / BE202E	1.51E+02	1.35E+01	7.86E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	VE202E56	1.51E+02	1.36E+01	7.86E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	VE202EF2	2.24E+02	1.69E+01	1.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	VE251EKC	1.07E+01	6.32E+00	5.56E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	VE252E / BE252E	1.51E+02	1.39E+01	7.92E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	VE252E56	1.51E+02	1.41E+01	7.92E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	VE252EF2	1.98E+02	1.73E+01	1.04E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	VE321EKC	1.38E+01	7.11E+00	6.38E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	VE322E / BE322E	1.69E+02	1.54E+01	8.82E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	VE322E56	1.53E+02	1.46E+01	8.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	VE322EF2	2.26E+02	1.80E+01	1.06E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	VE322P	1.85E+02	1.41E+01	8.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE401EAP	2.56E+02	1.70E+01	9.41E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	VE252EF26	2.17E+02	1.78E+01	1.10E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE402E / BE402E	1.54E+02	1.53E+01	8.14E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE402E56	1.54E+02	1.54E+01	8.14E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	VE501EAP	2.40E+02	1.74E+01	8.59E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	VE251E56	2.11E+02	1.84E+01	1.21E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	VE502E	1.84E+02	1.65E+01	8.37E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	VE502E56	1.84E+02	1.68E+01	8.41E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	VE651EAV	2.37E+02	1.66E+01	7.85E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	VE801EAV	2.81E+02	1.84E+01	8.27E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE402EVR2	1.67E+02	1.46E+01	7.40E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	VE502EVR2	1.68E+02	1.54E+01	7.51E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE402EAP	2.27E+02	1.63E+01	8.53E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE401EAV	2.21E+02	1.54E+01	7.73E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

WASTE CATEGORIES AND OUTPUT FLOWS		HWD	NHWD	RWD	CFR	MFR	MFEE	EE - e	EE - t
Strength (MPa)	Mix Code	kg	kg	kg	kg	kg	kg	MJ	MJ
50	VE501EAV	2.21E+02	1.59E+01	7.73E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
55	VE552EVR3	8.58E+01	8.99E+00	1.12E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	VZ322E5	1.92E+02	1.43E+01	8.10E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE402E5	2.08E+02	1.49E+01	8.23E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	VE502E5	2.23E+02	1.63E+01	8.47E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	VE321EK6	1.34E+01	7.10E+00	6.37E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	VE251E2	1.79E+02	1.42E+01	8.04E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	VE252EF2	1.79E+02	1.42E+01	8.04E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	VE322EF2	1.80E+02	1.48E+01	8.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE402EF2	2.43E+02	2.00E+01	1.18E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE401E56	2.19E+02	1.93E+01	1.20E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	VE501E56	2.21E+02	2.04E+01	1.20E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE401EAPF	4.32E+02	2.72E+01	1.85E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
32	VE322EF26	2.42E+02	1.99E+01	1.25E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE404EWC	1.10E+02	8.84E+00	2.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	VE402ESW	1.09E+02	8.84E+00	2.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	VE502ESW	1.14E+02	9.37E+00	2.13E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Additional indicators 1m^3 of ViroDecs™ ready-mix concrete

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS		PM	IRP	ETP-fw	HTP-c	HTP-nc	SQP
Strength (MPa)	Mix Code	disease incidence	kBq U-235 eq	CTUe	CTUh	CTUh	dimensionless
32	BE324XN	7.02E-06	1.44E+01	1.67E+03	3.32E-08	1.62E-06	2.35E+02
40	VE401EVMW	7.42E-06	2.50E+02	1.59E+03	5.66E-08	2.03E-06	2.35E+02
50	VE501EVMW	8.04E-06	2.50E+02	1.77E+03	6.00E-08	2.21E-06	2.57E+02
55	VE552EVR3	8.50E-06	1.55E+02	1.86E+03	5.23E-08	2.19E-06	2.78E+02
20	VE202E / BE202E	5.58E-06	1.59E+01	1.32E+03	2.64E-08	1.25E-06	1.83E+02
20	VE202E56	5.72E-06	1.59E+01	1.37E+03	2.73E-08	1.30E-06	1.88E+02
20	VE202EF2	5.72E-06	6.91E+01	1.31E+03	3.19E-08	1.37E-06	1.85E+02
25	VE251EKC	6.13E-06	1.59E+01	1.49E+03	2.94E-08	1.41E-06	2.02E+02
25	VE252E / BE252E	5.96E-06	1.61E+01	1.40E+03	2.81E-08	1.34E-06	1.97E+02
25	VE252E56	6.18E-06	1.61E+01	1.48E+03	2.96E-08	1.42E-06	2.04E+02
25	VE252EF2	6.06E-06	1.73E+01	1.42E+03	2.84E-08	1.35E-06	2.00E+02
32	VE321EKC	6.95E-06	2.30E+01	1.68E+03	3.40E-08	1.62E-06	2.31E+02
32	VE322E / BE322E	6.49E-06	2.16E+01	1.51E+03	3.09E-08	1.46E-06	2.15E+02
32	VE322E56	6.67E-06	2.16E+01	1.59E+03	3.23E-08	1.53E-06	2.22E+02
32	VE322EF2	6.76E-06	7.34E+01	1.55E+03	3.71E-08	1.62E-06	2.22E+02
32	VE322P	5.92E-06	7.77E+01	1.31E+03	3.30E-08	1.43E-06	1.92E+02
40	VE401EAP	7.84E-06	1.81E+02	1.84E+03	5.33E-08	2.16E-06	2.54E+02
25	VE252EF26	6.02E-06	4.55E+01	1.44E+03	3.16E-08	1.43E-06	1.97E+02
40	VE402E / BE402E	7.22E-06	2.16E+01	1.67E+03	3.42E-08	1.63E-06	2.42E+02
40	VE402E56	7.40E-06	2.16E+01	1.76E+03	3.58E-08	1.71E-06	2.48E+02
50	VE501EAP	9.58E-06	1.81E+02	2.24E+03	6.15E-08	2.60E-06	3.14E+02
25	VE251E56	6.13E-06	1.44E+01	1.48E+03	2.91E-08	1.40E-06	2.03E+02
50	VE502E	8.31E-06	8.06E+01	1.87E+03	4.48E-08	1.99E-06	2.78E+02
50	VE502E56	8.74E-06	8.06E+01	2.05E+03	4.78E-08	2.14E-06	2.93E+02
65	VE651EAV	9.37E-06	2.17E+02	2.09E+03	6.31E-08	2.50E-06	3.06E+02
80	VE801EAV	1.10E-05	3.02E+02	2.42E+03	7.89E-08	3.04E-06	3.61E+02
40	VE402EVR2	7.21E-06	8.06E+01	1.60E+03	3.93E-08	1.70E-06	2.38E+02
50	VE502EVR2	7.98E-06	8.06E+01	1.76E+03	4.28E-08	1.88E-06	2.66E+02
40	VE402EAP	8.18E-06	1.55E+02	1.92E+03	5.24E-08	2.19E-06	2.67E+02
40	VE401EAV	7.97E-06	1.84E+02	1.77E+03	5.32E-08	2.10E-06	2.60E+02

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS		PM	IRP	ETP-fw	HTP-c	HTP-nc	SQP
Strength (MPa)	Mix Code	disease incidence	kBq U-235 eq	CTUe	CTUh	CTUh	dimensionless
50	VE501EAV	8.57E-06	1.84E+02	1.91E+03	5.60E-08	2.24E-06	2.80E+02
55	VE552EVR3	8.50E-06	1.55E+02	1.86E+03	5.23E-08	2.19E-06	2.78E+02
32	VZ322E5	6.30E-06	9.93E+01	1.45E+03	3.75E-08	1.56E-06	2.03E+02
40	VE402E5	6.88E-06	1.32E+02	1.57E+03	4.35E-08	1.75E-06	2.23E+02
50	VE502E5	8.13E-06	1.58E+02	1.82E+03	5.16E-08	2.09E-06	2.66E+02
32	VE321EK6	6.94E-06	2.26E+01	1.68E+03	3.39E-08	1.62E-06	2.31E+02
25	VE251E2	6.23E-06	7.34E+01	1.44E+03	3.47E-08	1.49E-06	2.02E+02
25	VE252EF2	6.15E-06	7.34E+01	1.42E+03	3.43E-08	1.47E-06	2.00E+02
32	VE322EF2	6.75E-06	7.34E+01	1.55E+03	3.70E-08	1.61E-06	2.21E+02
40	VE402EF2	7.53E-06	8.80E+01	1.71E+03	4.20E-08	1.82E-06	2.49E+02
40	VE401E56	7.27E-06	7.31E+01	1.71E+03	4.02E-08	1.76E-06	2.41E+02
50	VE501E56	8.63E-06	7.88E+01	2.03E+03	4.72E-08	2.10E-06	2.90E+02
40	VE401EAPF	7.83E-06	2.07E+02	1.82E+03	5.57E-08	2.20E-06	2.52E+02
32	VE322EF26	6.67E-06	7.34E+01	1.58E+03	3.73E-08	1.63E-06	2.19E+02
40	VE404EWC	7.21E-06	2.01E+02	1.61E+03	5.15E-08	1.92E-06	2.31E+02
40	VE402ESW	7.21E-06	1.99E+02	1.61E+03	5.12E-08	1.92E-06	2.31E+02
50	VE502ESW	7.85E-06	2.09E+02	1.75E+03	5.52E-08	2.10E-06	2.53E+02

Other life cycle stages not included in this EPD

While the LCA study and EPD only consider the cradle to gate 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.

End of life scenarios

BS EN 16757:2017 presents four end of life scenarios for concrete:

1. Disposal of concrete at a landfill site,
2. Reuse of recovered concrete elements in new construction works,
3. Use of concrete debris, e.g. In land restoration, or
4. Crushing/recycling of concrete:
    a. Crushed concrete substitutes primary material without further processing, or
    b. Substitution of natural aggregates in fresh concrete.

Scenarios 2, 3 and 4 can all result in benefits and loads outside the system boundary and thus should be considered in a whole-of-life building study or when comparing concrete products on a functional basis in line with BS EN 16757:2017.

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Programme-related information and verification

Declaration Owner	Holcim (Australia) Pty Ltd Level 7, 799 Pacific Highway Chatswood NSW 2067, Australia Web: www.holcim.com.au Phone: +61 2 9412 6600	
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EPD Produced by	Holcim (Australia) Pty Ltd Level 7, 799 Pacific Highway Chatswood NSW 2067, Australia Web: www.holcim.com.au Phone: +61 2 9412 6600	
EPD Process Certified by	Epsten Group Suite 2600, 101 Marietta St NW, Atlanta, Georgia 30303, USA Web: www.epstengroup.com	
EPD Registration Number	S-P-04657	
Valid From	12 January 2022	
Version	2.0	
Valid Until	26 September 2027	
Product category rules	PCR 2019:14 Construction Products, Version 1.11, 2021-02-05	
Product group classification	UN CPC 54	
Geographical Scope	Australia	
Reference Year for Data	2017 Plant Data, 2022 Mix/Materials Data	

CEN standard EN 15804:2012+A2:2019 served as the core PCR

Product category rules	PCR 2019:14 Construction Products, Version 1.11, 2019-02-05
PCR review was conducted by	The Technical Committee of the International EPD® System. Chair: Massimo Marino. Contact via info@environdec.com
Independent third-party verification of the declaration and data, according to ISO 14025:2006:	☒ EPD process certification ☐ EPD verification
EPD Process Certifed by	Epsten Group, Inc., Katherine McFeaters: Accredited by: A2LA, Certificate #3142.03
Procedure for follow-up of data during EPD validity involves third party verifier:	☐ Yes ☒ No

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 from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.

Contact your Holcim representative today for more information.

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