ENVIRONMENTAL PRODUCT DECLARATION

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READY-MIX CONCRETE

Image © Tony Hewitt

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

EPD Registration no. S-P-05491 | Version 1.0
Issued 15 Dec 2022 | Valid until 15 Dec 2027
Geographical Scope: Perth, Australia

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.epd-australasia.com

BGC Concrete

AUSTRALASIA EPD
ENVIRONMENTAL PRODUCT DECLARATION

ECO PLATFORM EPD VERIFIED

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Contents

BGC Concrete

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Building on 60 years of industry experience, BGC Concrete, a Western Australian owned company, is the largest manufacturer of structural and decorative concrete in the Perth metropolitan region.

At BGC Concrete, our vision is to continue the long history of producing and delivering high quality products and services to our customers in Western Australia. We have a commitment to our community and a passion for excellence in everything we do, whether it is a large multistorey building or a small residential slab, we can provide the highest quality products that will stand the test of time.

BGC Concrete operates out of eight (8) concrete batching plants across the Perth Metropolitan area, supported by a large transport fleet enabling the best possible service to all our customers that includes additional support services such as lighting towers, pump hire and concrete supply & install.

All BGC Concrete products are formulated and tested to meet strict Australian Standards, so customers can be assured that what we manufacture will make the grade.

Image © Tony Hewitt

Ready-Mix Concrete

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Our Locations

BGC Concrete operates out of eight (8) concrete batching plants across the Perth Metropolitan area, supported by a large transport fleet enabling the best possible service to all our customers.

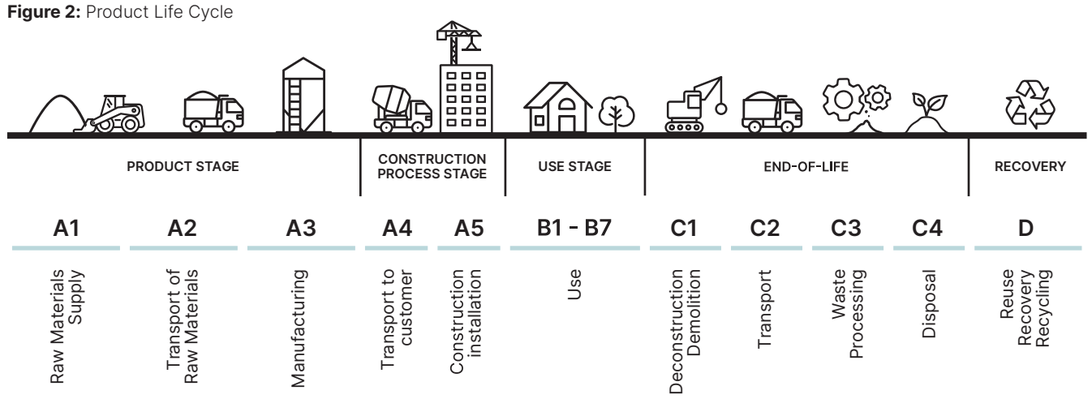
Figure 1: Location of BGC Concrete batching plants

Product Life Cycle

Creating an EPD is an extensive process based on a set of Product Category Rules (PCR) and a Life Cycle Assessment (LCA). Environmental data such as electricity and fuel consumption from the raw material process through to concrete production is evaluated, modelled and the reported through an independently verified EPD.

This EPD is based on a cradle-to-gate LCA with the end-of-life modules C1-C4 and D stages included. The construction process (modules A4-A5) and use stages (B1-B7) have not been modelled as these are best modelled at the building or infrastructure project level.

Figure 2: Product Life Cycle



Ready-Mix Concrete Production

Ready-Mix Concrete mixes covered by this EPD are manufactured with a combination of cement, coarse and fine aggregates, supplementary cementitious materials, admixtures, recycled, bore and town water that are sourced locally.

Ready-Mix Concrete is manufactured at a computer controlled batching plant and delivered to the customer on site in a freshly mixed, workable, plastic state via a truck mixer.

The products considered for this EPD fall into two classes as outlined in AS1379, Normal (N) Class and Special (S) Class that are manufactured at BGC's eight concrete plants in Western Australia. Seven plants in the Perth region have been grouped together and are presented using average values, while our products manufactured at the Mandurah Plant have been excluded.

Product Composition

A brief description of N Class mixes, the BGC Concrete Low Carbon range, and a select number of S Class mixes are outlined in the tables below.

Normal Class Concrete

The following table provides a brief overview of BGC Concrete N Class mixes included in this EPD. There are five strength categories and two cement blends, General Purpose Cement (GP) and a blend of 65% General Purpose Cement with 35% Ground Granulated Blast Furnace Slag (GB).

Table 1: Normal Class Concrete

Description	Normal Class	
Strength (MPa)	**GP**	**GB**
20	R2020A	R2020B
25	R2520A	R2520B
32	R3220A	R3220B
40	R4020A	R4020B
50	R5020A	R5020B

Low Carbon Concrete

The following table provides an overview of the BGC Concrete Low Carbon range included in this EPD. There are five strength categories and a blended cement of General Purpose and Ground Granulated Blast Furnace Slag blend (B).

Table 2: Low Carbon Range

Description	Low Carbon Concrete			
Strength (MPa)	**LC35**	**LC40**	**LC65**	**by design***
20	R2020B	CS2020BGS		
25	R2520B	CS2520BGS	LH2520E	
32	R3220B	CS3220BGS	LH3220E	
40	R4020B	CS4020BGS		
50	R5020B	CS5020BGS		

*Not a part of this scope but currently under test and will be updated in the next review.

Special Class Concrete

The following table provides an overview of BGC Concrete S Class mixes included in this EPD. The S Class mixes include four cement blends, General Purpose Cement (GP), a blend of General Purpose Cement with 35% Ground Granulated Blast Furnace Slag (GB), Low Heat Cement (LH) which is a blend of General Purpose Cement with 65% Ground Granulated Blast Furnace Slag and a triple blend of General Purpose Cement, Ground Granulated Blast Furnace Slag and Silica Fume (T).

Table 3: Special Class Concrete

Strength (MPa)	Cement Blend	Mix Code	Description
25	LH^	LH2520E	Footing
32	LH^	LH3220E	Slab
32	GP	CS3220ASC	Slab
40	T^	TR4010E1	Piling
50	T^	TR5014E1	Piling
25	GB#	KM2510B	Kerb
25	GB#	BF2503B	Blockfill
40	GP	CS4020A9	Precast
P	GP	SD160A	10% Stabilised Quarry Sand
P	GP	SS100A	6% Stabilised Sand

^LC65 #LC35

Content Declaration

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A summary of the materials included in BGC Ready-Mix concrete are listed in Table 4.

Table 4: Product composition per declared unit

Product components	% (by weight)	Post-consumer material % (by weight)	Renewable material % (by weight)
General Purpose Cement	4-19	0	0
Supplementary Cementitious Materials	0-14	0	0
Aggregate	72-85	0	0
Water	5-13	0	0
Admixtures	< 1	0	0

BGC Ready-Mix concrete is delivered in bulk and therefore packaging materials are not relevant for the Ready-Mix concrete products considered in this EPD.

Our Ready-Mix concrete does not contain any biogenic carbon.

The products included in this EPD do not contain any substances of very high concern as defined by European REACH regulation in concentrations > 0.1% (m/m).

Concrete is manufactured at a computer controlled batching plant delivered to the customer on site in a freshly mixed, workable, plastic state.

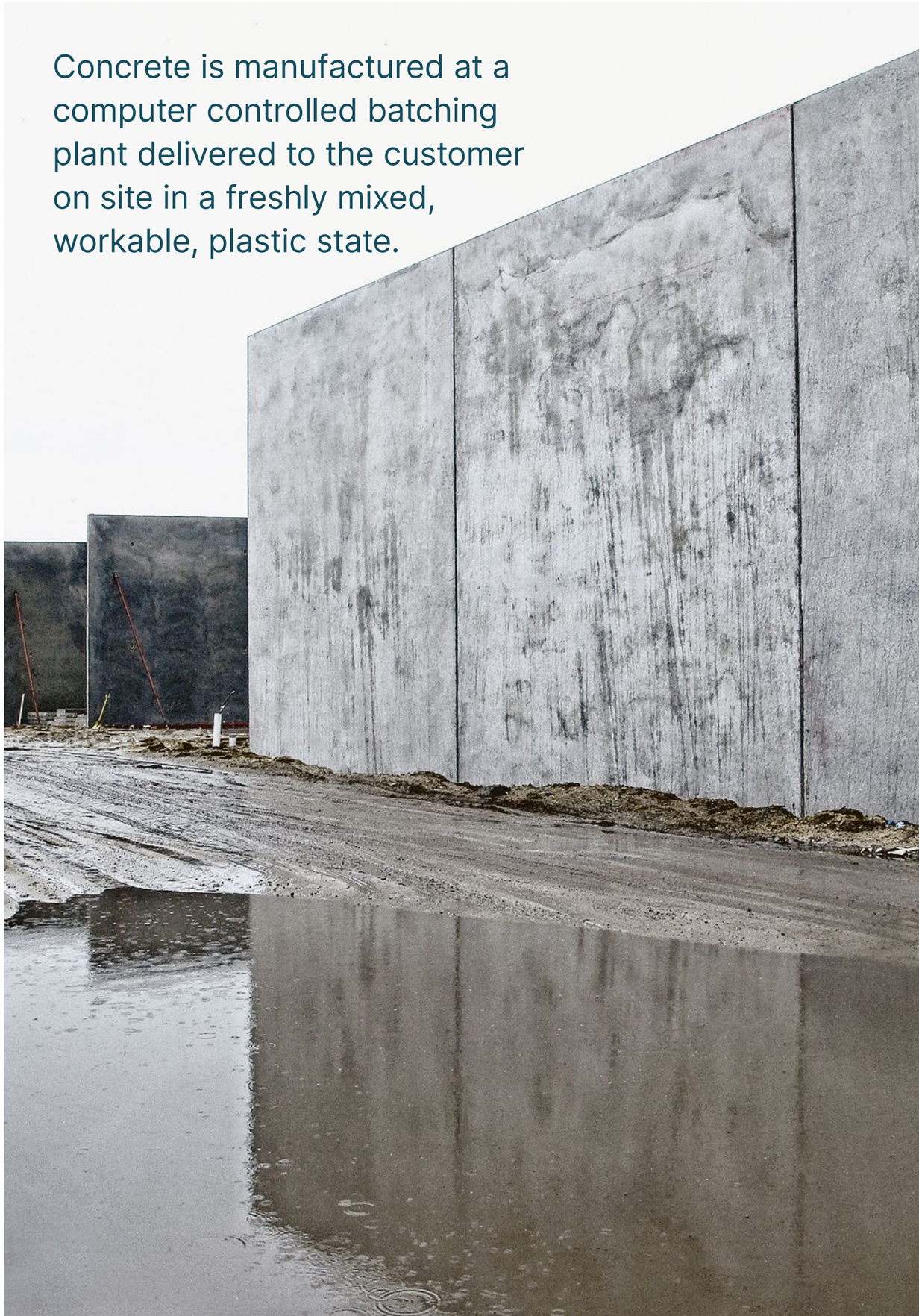

Image © Tony Hewitt

Technical Information

Technical Compliance

BGC Concrete does not simply manufacture concrete but develops innovative solutions based on local knowledge and experience. Our Concrete team consists of highly committed customer and quality focused members with over 80 years combined experience in all aspects of the construction industry.

BGC Concrete offers a special concrete portfolio, comprised of such products as world leading steel fibre reinforced flat floor concrete[1], lightweight concrete, architectural concrete, and pervious concrete to name just a few.

Climate change has motivated BGC Concrete and its customers to work towards a carbon neutral future, the publication of this EPD is an important step in this process. We support science-based research to drive innovation and our lab is working on the next generation of building materials that will have a lower environmental footprint and bring us closer to our goal of carbon neutral concrete.

BGC Concrete maintains an ISO 9001 certified Quality System to ensure we meet Australian Standards in the construction industry. Concrete is sampled and tested by a NATA certified laboratory to ensure compliance with AS1379-2007.

Industry Classification

The UN CPC and ANZSIC codes applicable to Ready-Mix concrete products are listed below:

UN CPC 375 - Articles of concrete, cement and plaster
ANZSIC 20330 - Concrete - Ready-Mix - except dry mix

Declared Unit

1 cubic metre (m^3) of Ready-Mix concrete, as ordered by our clients.

[1](The face companies' 2021 Golden Trowel Awards announced during world of concrete 2022)

System Boundary

This EPD covers the cradle-to-gate plus end-of-life life cycle stages (modules A1-A3, C1-C4, D). Construction and use stages have not been included as we cannot define a typical scenario for our range of concrete products. The modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation are shown in Table 5.

Table 5: Scope of EPD

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	✓	✓	✓	ND	ND	ND	ND	ND	ND	ND	ND	ND	✓	✓	✓	✓	✓
Geography	AU, ID, JP	AU	AU	-	-	-	-	-	-	-	-	-	AU	AU	AU	AU	AU
Specific data used	80-90%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	not relevant			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	<10%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

✓: Module is declared
ND: Module is not declared

Product Stage

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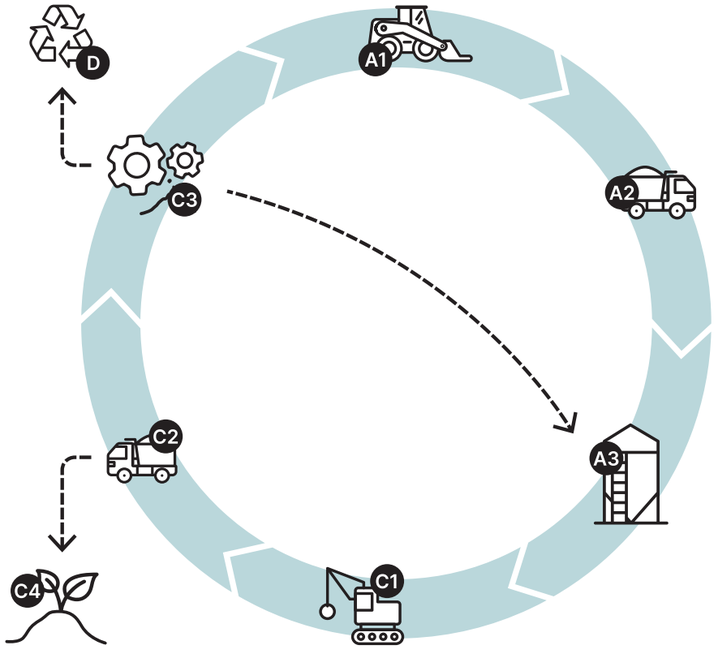
Figure 3: Product Stage (A1-A3) and End-of-Life (C1-C4 & D)



A4-A5 and B1-B7 are excluded from the EPD and therefore not shown in this figure.

Table 6: End-of-life scenario parameters

Processes	Quantity per m3 of concrete	Unit
Collection process specified by type	2,330	kg collected separately
	0	kg collected with mixed construction waste
Transport from demolition site to recovery/disposal sites	50	km transport
Recovery system specified by type	0	kg for re-use
	1,771	kg for recycling
	0	kg for energy recovery
Disposal to landfill	559	kg product or material for final deposition
Assumptions for scenario development	145	MJ of diesel for the demolition process

Product Stage (A1-A3)

Investigates the environmental impacts related to the manufacturing of concrete before it leaves the batch plant.

A1 Raw Material Supply
Extraction and processing of raw materials such as cement, fine and coarse aggregates.

To reduce our reliance on virgin materials, BGC Concrete utilise several recovered materials in our product range, such as ground granulated blast furnace slag (GGBFS), silica fume and reclaimed aggregates from returned concrete through our concrete recyclers.

A2 Transportation
Transport of raw materials to the BGC Concrete Batch Plants.

A3 Manufacturing
Manufacturing of concrete begins with raw material handling, concrete batching, concrete mixing as well as the treatment of waste and water used in this process.

End-of-Life (C1-C4 & D)

Investigates the environmental impacts related to the concrete after it has reached the end of its useful life.

C1 Demolition
Demolition of concrete structure.

C2 Transport
Transport of the concrete waste for processing or to landfill.

C3 Waste Processing
Processing of concrete waste.

C4 Disposal
Land fill of concrete waste.

D Resource Recovery Stage
Reuse, recovery, and recycling potential of the product after its end-of-life.

Life Cycle Assessment (LCA) Methodology

Background Data

BGC has collected and supplied the primary data for the Ready-Mix concrete LCA based on the FY21 reporting period (1 July 2020 – 30 June 2021). BGC Cement and BGC Quarries provided data for the ingredients that they supply. Background data (e.g. for other raw materials, energy and transport processes) have predominantly been sourced from AusLCI and the AusLCI shadow database (v1.36) (AusLCI 2021), as well as ecoinvent v3. Background data used are either less than 10 years old or have been reviewed within this period.

Methodological choices have been applied in line with EN 15804; deviations have been recorded.

Allocation

The key processes that require allocation are:

- **Shared production of various concrete mixes:** overhead processes (i.e. energy use) for concrete production have been allocated to concrete mixes based on a volume basis (share in total m^3 of Ready-Mix concrete products).
- **Slag:** blast furnace slag (BFS) is a by-product from steel-making. We have used the AusLCI data for BFS ("blast furnace slag allocation, at steel plant/AU U"), which contain environmental impacts from pig iron production allocated to blast furnace slag.
- **Silica fume:** silica fume is a by-product of silicon metal or ferrosilicon alloy production. Economic allocation is used to attribute impacts between silica fume and ferrosilicon production.
- **Aggregates:** aggregates are produced through crushing of rock, which is graded in different sizes. The energy required for the crushing and screening does not differentiate between products. Therefore, impacts are allocated to products (e.g. crushed rock, manufactured sand) based on the mass of product. In effect, all aggregates have the same environmental profile.

Cut-off Criteria

The cut-off criteria applied are 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of a process, while considering environmental impacts of small flows:

- The amount of packaging used for admixtures is well below the materiality cut-off and these materials have been excluded.

The contribution of capital goods (production equipment and infrastructure) and personnel is excluded, as these processes are non-attributable and they contribute less than 10% to GWP-GHG.

Key Assumptions

The key choices and assumptions in the LCA are:

- Admixture data are based on generic ecoinvent data for organic and inorganic chemicals.
- Silica fume receives some environmental impacts from ferrosilicon production. This allocation decision has an effect on the environmental profile of products containing silica fume.
- Blast furnace slag receives some environmental impacts from pig iron production. This allocation decision has an effect on the environmental profile of products containing GGBFS.

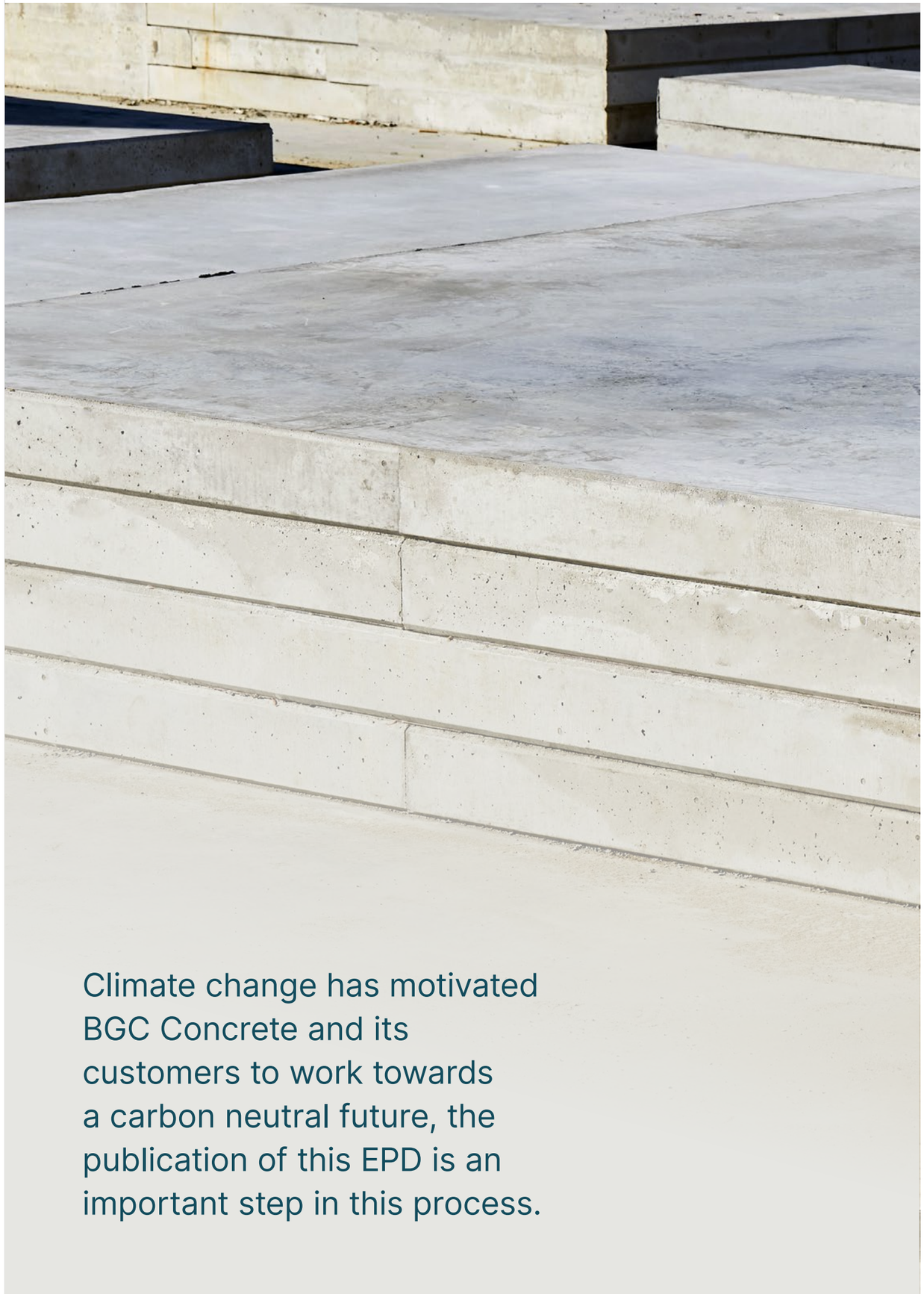


Image © Tony Hewitt

Climate change has motivated BGC Concrete and its customers to work towards a carbon neutral future, the publication of this EPD is an important step in this process.

Environmental Impact Indicators

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Environmental Impact Indicator Legend

The environmental indicators associated with impact categories, resource use, waste categories and output flows described in this EPD are summarised in the table below. All further tables will contain the abbreviation of the indicator for simplicity.

Table 7: Environmental impact indicators included in this EPD

Indicator	Abbreviation	Units
Mandatory Potential Environmental Impact indicators, in accordance to EN 15804:2012+A2:2019		
Global Warming Potential - total	GWP-total	kg CO_2-eq.
Global Warming Potential - fossil fuels	GWP-fossil	kg CO_2-eq.
Global Warming Potential - biogenic	GWP-biogenic	kg CO_2-eq.
Global Warming Potential - land use and land use change	GWP-luluc	kg CO_2-eq.
Depletion Potential of the Stratospheric Ozone Layer	ODP	kg CFC-11-eq.
Acidification potential	AP	mol H^+-eq.
Eutrophication potential - freshwater	EP-freshwater	kg P-eq.
Eutrophication potential - marine	EP-marine	kg N-eq.
Eutrophication potential - terrestrial	EP-terrestrial	mol N-eq.
Formation potential of tropospheric ozone	POCP	kg NMVOC-eq.
Abiotic depletion potential for non-fossil resources	ADP-minerals & metals	kg Sb-eq.
Abiotic depletion potential for fossil resources	ADP-fossil	MJ
Water (user) deprivation potential	WDP	m^3world-eq.deprived
Additional Potential Environmental Impact indicators, in accordance to EN 15804:2012+A2:2019		
Particulate Matter emissions	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
Land use related impacts / soil quality	SQP	dimensionless
Resource use parameters		
Use of renewable primary energy excluding renewable primary energy	PERE	MJ
Use of renewable primary energy resources used as raw materials	PERM	MJ
Total use of renewable primary energy resources	PERT	MJ
Use of non-renewable primary energy excluding non-renewable primary	PENRE	MJ
Use of non-renewable primary energy resources used as raw materials	PENRM	MJ
Total use of non-renewable primary energy resources	PENRT	MJ
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ
Use of non-renewable secondary fuels	NRSF	MJ
Net use of fresh water	FW	m^3
Waste Categories and Output Flows		
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed	RWD	kg
Components for re-use	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported energy - electrical and thermal	EE	MJ
Additional Potential Environmental Impact indicators, in accordance to EN 15804:2012+A1:2013		
Global warming potential	GWP	kg CO_2-eq.
Ozone depletion potential	ODP	kg CFC-11-eq.
Acidification potential	AP	kg SO_2-eq.
Eutrophication potential	EP	kg PO_4^{3-}-eq.
Photochemical ozone creation potential	POCP	kg C_2H_4-eq.
Abiotic depletion potential for non-fossil resources	ADPE	kg Sb-eq.
Abiotic depletion potential for fossil resources	ADPF	MJ
Carbon Footprint		
Global Warming Potential - Greenhouse Gas emissions	GWP-GHG	kg CO_2-eq.

Environmental Impact Indicators

An introduction to each environmental impact indicator is provided below, along with the best known cause and effect.

Global Warming Potential (GWP)
Is due to the heat absorbed by greenhouse gases, causing the rise of the global temperature.

Photochemical Smog (POCP)
Is due to a mixture of pollutants which includes volatile organic compounds, particulates, nitrogen oxides and ozone. It's harmful to human health (causing lung irritation problems, coughing and wheezing) and the environment (damage to plants and crops).

Acidification Potential (AP)
Is due to emissions of acids, causing the degradation of materials such as metals, limestone and concrete, and damage to trees and life in lakes and rivers.

Abiotic Resource Depletion (ADP)
Is due to extraction and consumption of non-renewable resources such as oil, coal and metals, causing a decrease in future availability of functions supplied by these resources.

Eutrophication Potential (EP)
Is due to emissions of nutrients, causing blooms of algae. The degradation of dead algae consumes oxygen leading to the loss of plants and animals.

Ozone Depletion Potential (ODP)
Is due to emissions which destroy the ozone layer causing higher levels of UV light to reach earth which damages DNA in humans, animals and plants.

Water Deprivation Potential (WDP)
Is due to water availability versus demand. The less water remaining per area, the more likely another user will be deprived.

Life Cycle Assessment (LCA) Results

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Environmental Profiles for Ready-Mix concrete Perth region

The background Life Cycle Assessment serves as the foundation for this EPD. A Life Cycle Assessment analyses the environmental processes in the value chain of a product. It provides a comprehensive evaluation of all upstream (and sometimes downstream) material and energy inputs and outputs. The results are provided for a range of environmental impact categories, in line with EN 15804:2012+A2:2019.

The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding of threshold values, safety margins and/or risks.

Image © Tony Hewitt

Results A1-A3

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Mandatory Environmental Impact Categories A1-A3

Table 8: Potential environmental impacts – mandatory indicators according to EN 15804:2012+A2:2019

Primary Indicators			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater	EP-marine	EP-terrestrial	POCP	ADP-minerals & metals*	ADP-fossil*	WDP*
Strength (MPa)	Cement Blend	Mix Code	kg CO_2-eq.	kg CO_2-eq.	kg CO_2-eq.	kg CO_2-eq.	kg CFC 11-eq.	mol H^+ eq.	kg P eq.	kg N eq.	mol N eq.	kg NMVOC eq.	kg Sb eq.	MJ (NCV)	m^3
Normal Class															
20	**GP**	R2020A	288	284	3.50	0.0562	6.61E-06	0.99	9.37E-03	0.256	2.89	0.711	4.95E-06	1590	220
	GB	R2020B	211	209	2.33	0.0368	6.74E-06	0.956	6.12E-03	0.240	2.69	0.663	3.73E-06	1360	225
25	**GP**	R2520A	330	326	4.09	0.0657	6.96E-06	1.11	1.10E-02	0.284	3.21	0.789	5.69E-06	1780	226
	GB	R2520B	254	251	2.92	0.0462	7.03E-06	1.07	7.71E-03	0.266	2.99	0.737	4.50E-06	1540	238
32	**GP**	R3220A	369	364	4.61	0.0740	7.37E-06	1.22	1.24E-02	0.310	3.51	0.863	6.37E-06	1950	238
	GB	R3220B	282	279	3.28	0.0520	7.58E-06	1.18	8.67E-03	0.292	3.29	0.811	5.01E-06	1700	251
40	**GP**	R4020A	433	427	5.50	0.0882	7.84E-06	1.39	1.47E-02	0.348	3.95	0.97	7.59E-06	2230	287
	GB	R4020B	322	318	3.80	0.0603	7.99E-06	1.32	1.01E-02	0.322	3.62	0.895	5.77E-06	1890	280
50	**GP**	R5020A	516	509	6.87	0.113	9.06E-06	1.65	1.78E-02	0.409	4.63	1.15	9.04E-06	2660	292
	GB	R5020B	386	382	4.63	0.0736	8.91E-06	1.56	1.23E-02	0.376	4.24	1.05	6.93E-06	2220	296
Low Carbon Range															
20	**B**	CS2020BGS	199	197	2.15	0.0339	6.63E-06	0.943	5.65E-03	0.235	2.63	0.648	3.55E-06	1310	226
25	**B**	CS2520BGS	221	218	2.42	0.0382	7.01E-06	1.03	6.37E-03	0.255	2.86	0.705	3.94E-06	1430	234
32	**B**	CS3220BGS	253	250	2.83	0.0446	7.56E-06	1.17	7.44E-03	0.285	3.20	0.790	4.53E-06	1610	246
40	**B**	CS4020BGS	289	285	3.28	0.0518	8.17E-06	1.31	8.64E-03	0.318	3.58	0.884	5.18E-06	1800	257
50	**B**	CS5020BGS	353	348	4.34	0.0711	9.46E-06	1.58	1.08E-02	0.377	4.24	1.05	6.39E-06	2180	283
Special Class															
25	**LH**	LH2520E	162	160	1.51	0.0230	7.15E-06	1.02	3.83E-03	0.244	2.73	0.674	3.04E-06	1260	247
32	**LH**	LH3220E	181	179	1.72	0.0263	7.66E-06	1.14	4.40E-03	0.269	3.01	0.744	3.41E-06	1390	257
40	**LH**	CS4020E5	219	217	2.16	0.0330	8.57E-06	1.36	5.52E-03	0.315	3.52	0.874	4.20E-06	1640	298
32	**GP**	CS3220ASC	374	369	4.69	0.0752	7.32E-06	1.22	1.26E-02	0.310	3.51	0.865	6.51E-06	1970	260
40	**LH**	TR4010E1	244	241	2.66	0.0434	9.58E-06	1.50	6.20E-03	0.344	3.85	0.96	5.15E-06	1880	361
50	**LH**	TR5014E1	290	286	3.96	0.0713	1.14E-05	1.76	7.71E-03	0.395	4.42	1.12	6.25E-06	2280	408
25	**GB**	KM2510B	292	289	3.43	0.0543	7.49E-06	1.21	9.07E-03	0.296	3.33	0.822	5.29E-06	1740	276
25	**GB**	BF2503B	279	276	3.20	0.0506	7.66E-06	1.22	8.45E-03	0.296	3.33	0.821	5.23E-06	1720	288
40	**GP**	CS4020A9	467	460	5.94	0.095	8.31E-06	1.49	1.59E-02	0.374	4.23	1.04	8.15E-06	2390	289
P	**GP**	SD160A	201	199	2.39	0.0384	5.31E-06	0.726	6.38E-03	0.196	2.21	0.541	3.02E-06	1140	86
P	**GP**	SS100A	129	127	1.51	0.0237	3.40E-06	0.459	3.98E-03	0.116	1.30	0.322	2.46E-06	752	293

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

Results A1-A3

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Additional Impact Categories A1-A3

Table 9: Potential environmental impacts – additional indicators according to EN 15804:2012+A2:2019

Primary Indicators			PM	IRP**	ETP-fw*	HTP-c*	HTP-nc*	SQP*
Strength (MPa)	Cement Blend	Mix Code	Disease incidence	kBq U235 eq.	CTUe	CTUh	CTUh	-
Normal Class								
20	GP	R2020A	8.04E-06	0.295	1220	1.59E-08	1.26E-06	317
	GB	R2020B	6.89E-06	0.198	901	1.36E-08	9.69E-07	292
25	GP	R2520A	8.86E-06	0.344	1400	1.83E-08	1.46E-06	329
	GB	R2520B	7.64E-06	0.247	1080	1.61E-08	1.17E-06	299
32	GP	R3220A	9.63E-06	0.387	1560	2.05E-08	1.64E-06	344
	GB	R3220B	8.35E-06	0.277	1210	1.79E-08	1.30E-06	318
40	GP	R4020A	1.07E-05	0.46	1840	2.42E-08	1.94E-06	347
	GB	R4020B	9.05E-06	0.321	1370	2.06E-08	1.50E-06	319
50	GP	R5020A	1.25E-05	0.82	2250	3.83E-08	2.35E-06	434
	GB	R5020B	1.05E-05	0.391	1650	2.48E-08	1.81E-06	347
Low Carbon Range								
20	**B**	CS2020BGS	6.62E-06	0.184	851	1.33E-08	9.23E-07	280
25	**B**	CS2520BGS	7.13E-06	0.207	944	1.48E-08	1.03E-06	291
32	**B**	CS3220BGS	7.88E-06	0.241	1080	1.70E-08	1.19E-06	307
40	**B**	CS4020BGS	8.71E-06	0.279	1240	1.95E-08	1.37E-06	323
50	**B**	CS5020BGS	1.02E-05	0.611	1570	3.34E-08	1.72E-06	394
Special Class								
25	**LH**	LH2520E	6.23E-06	0.131	700	1.32E-08	8.07E-07	268
32	**LH**	LH3220E	6.76E-06	0.150	785	1.49E-08	9.14E-07	279
40	**LH**	CS4020E5	7.67E-06	0.187	952	1.84E-08	1.12E-06	288
32	**GP**	CS3220ASC	9.59E-06	0.393	1580	2.08E-08	1.66E-06	334
40	**LH**	TR4010E1	8.53E-06	0.488	1110	3.03E-08	1.29E-06	352
50	**LH**	TR5014E1	9.88E-06	1.33	1470	6.22E-08	1.62E-06	505
25	**GB**	KM2510B	8.35E-06	0.290	1250	1.87E-08	1.36E-06	301
25	**GB**	BF2503B	8.30E-06	0.278	1190	1.86E-08	1.31E-06	306
40	**GP**	CS4020A9	1.15E-05	0.497	1980	2.60E-08	2.09E-06	370
P	**GP**	SD160A	6.36E-06	0.196	855	1.07E-08	8.69E-07	291
P	**GP**	SS100A	3.39E-06	0.121	545	7.12E-09	5.51E-07	121.5

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

Resource Use Indicators A1-A3

Table 10: Use of Resources

Primary Indicators			PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Strength (MPa)	Cement Blend	Mix Code	MJNCV	MJNCV	MJNCV	MJNCV	MJNCV	MJNCV	kg	MJNCV	MJNCV	m^3
Normal Class												
20	GP	R2020A	5.41E+01	0.00E+00	5.41E+01	1.75E+03	0.00E+00	1.75E+03	3.86E+00	2.68E+01	6.28E+01	1.09E+01
	GB	R2020B	4.00E+01	0.00E+00	4.00E+01	1.48E+03	0.00E+00	1.48E+03	8.80E+01	1.75E+01	4.09E+01	7.70E+00
25	GP	R2520A	6.23E+01	0.00E+00	6.23E+01	1.96E+03	0.00E+00	1.96E+03	4.51E+00	3.14E+01	7.35E+01	1.24E+01
	GB	R2520B	4.83E+01	0.00E+00	4.83E+01	1.68E+03	0.00E+00	1.68E+03	8.88E+01	2.20E+01	5.16E+01	9.27E+00
32	GP	R3220A	6.96E+01	0.00E+00	6.96E+01	2.16E+03	0.00E+00	2.16E+03	5.09E+00	3.54E+01	8.29E+01	1.38E+01
	GB	R3220B	5.37E+01	0.00E+00	5.37E+01	1.86E+03	0.00E+00	1.86E+03	1.00E+02	2.48E+01	5.80E+01	1.02E+01
40	GP	R4020A	8.22E+01	0.00E+00	8.22E+01	2.47E+03	0.00E+00	2.47E+03	6.07E+00	4.22E+01	9.89E+01	1.64E+01
	GB	R4020B	6.16E+01	0.00E+00	6.16E+01	2.07E+03	0.00E+00	2.07E+03	1.17E+02	2.88E+01	6.74E+01	1.17E+01
50	GP	R5020A	1.12E+02	0.00E+00	1.12E+02	2.95E+03	0.00E+00	2.95E+03	7.22E+00	5.02E+01	1.18E+02	2.57E+01
	GB	R5020B	7.40E+01	0.00E+00	7.40E+01	2.43E+03	0.00E+00	2.43E+03	1.43E+02	3.52E+01	8.24E+01	1.38E+01
Low Carbon Range												
20	**B**	CS2020BGS	3.79E+01	0.00E+00	3.79E+01	1.42E+03	0.00E+00	1.42E+03	1.00E+02	1.61E+01	3.77E+01	7.22E+00
25	**B**	CS2520BGS	4.21E+01	0.00E+00	4.21E+01	1.55E+03	0.00E+00	1.55E+03	1.13E+02	1.82E+01	4.25E+01	7.92E+00
32	**B**	CS3220BGS	4.83E+01	0.00E+00	4.83E+01	1.75E+03	0.00E+00	1.75E+03	1.32E+02	2.12E+01	4.97E+01	8.96E+00
40	**B**	CS4020BGS	5.53E+01	0.00E+00	5.53E+01	1.96E+03	0.00E+00	1.96E+03	1.54E+02	2.47E+01	5.78E+01	1.01E+01
50	**B**	CS5020BGS	8.15E+01	0.00E+00	8.15E+01	2.38E+03	0.00E+00	2.38E+03	1.88E+02	3.01E+01	7.06E+01	1.87E+01
Special Class												
25	**LH**	LH2520E	3.13E+01	0.00E+00	3.13E+01	1.35E+03	0.00E+00	1.35E+03	1.85E+02	1.08E+01	2.54E+01	5.49E+00
32	**LH**	LH3220E	3.52E+01	0.00E+00	3.52E+01	1.49E+03	0.00E+00	1.49E+03	2.12E+02	1.24E+01	2.91E+01	6.02E+00
40	**LH**	CS4020E5	4.29E+01	0.00E+00	4.29E+01	1.76E+03	0.00E+00	1.76E+03	2.66E+02	1.56E+01	3.66E+01	7.25E+00
32	**GP**	CS3220ASC	7.07E+01	0.00E+00	7.07E+01	2.18E+03	0.00E+00	2.18E+03	5.17E+00	3.60E+01	8.42E+01	1.42E+01
40	**LH**	TR4010E1	6.18E+01	0.00E+00	6.18E+01	2.01E+03	0.00E+00	2.01E+03	2.87E+02	1.68E+01	3.93E+01	1.44E+01
50	**LH**	TR5014E1	1.13E+02	0.00E+00	1.13E+02	2.44E+03	0.00E+00	2.44E+03	3.22E+02	1.88E+01	4.41E+01	3.55E+01
25	**GB**	KM2510B	5.60E+01	0.00E+00	5.60E+01	1.90E+03	0.00E+00	1.90E+03	1.06E+02	2.59E+01	6.07E+01	1.08E+01
25	**GB**	BF2503B	5.36E+01	0.00E+00	5.36E+01	1.88E+03	0.00E+00	1.88E+03	1.22E+02	2.41E+01	5.64E+01	1.01E+01
40	**GP**	CS4020A9	8.85E+01	0.00E+00	8.85E+01	2.65E+03	0.00E+00	2.65E+03	6.56E+00	4.57E+01	1.07E+02	1.75E+01
P	**GP**	SD160A	3.72E+01	0.00E+00	3.72E+01	1.26E+03	0.00E+00	1.26E+03	2.62E+00	1.83E+01	4.28E+01	7.13E+00
P	**GP**	SS100A	2.57E+01	0.00E+00	2.57E+01	8.23E+02	0.00E+00	8.23E+02	1.64E+00	1.14E+01	2.67E+01	6.73E+00

Results A1-A3

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Waste Indicators A1-A3

Table 11: Waste Production

Primary Indicators			HWD	NHWD	RWD
Strength (MPa)	Cement Blend	Mix Code	kg	kg	kg
Normal Class					
20	GP	R2020A	0.00E+00	6.51E-02	0.00E+00
	GB	R2020B	0.00E+00	6.62E-02	0.00E+00
25	GP	R2520A	0.00E+00	7.18E-02	0.00E+00
	GB	R2520B	0.00E+00	7.34E-02	0.00E+00
32	GP	R3220A	0.00E+00	7.85E-02	0.00E+00
	GB	R3220B	0.00E+00	8.04E-02	0.00E+00
40	GP	R4020A	0.00E+00	9.20E-02	0.00E+00
	GB	R4020B	0.00E+00	9.07E-02	0.00E+00
50	GP	R5020A	0.00E+00	1.03E-01	0.00E+00
	GB	R5020B	0.00E+00	1.05E-01	0.00E+00
Low Carbon Range					
20	B	CS2020BGS	0.00E+00	6.60E-02	0.00E+00
25	B	CS2520BGS	0.00E+00	7.17E-02	0.00E+00
32	B	CS3220BGS	0.00E+00	8.00E-02	0.00E+00
40	B	CS4020BGS	0.00E+00	8.92E-02	0.00E+00
50	B	CS5020BGS	0.00E+00	1.04E-01	0.00E+00
Special Class					
25	LH	LH2520E	0.00E+00	7.42E-02	0.00E+00
32	LH	LH3220E	0.00E+00	8.17E-02	0.00E+00
40	LH	CS4020E5	0.00E+00	9.81E-02	0.00E+00
32	GP	CS3220ASC	0.00E+00	8.10E-02	0.00E+00
40	LH	TR4010E1	0.00E+00	1.09E-01	0.00E+00
50	LH	TR5014E1	0.00E+00	1.21E-01	0.00E+00
25	GB	KM2510B	0.00E+00	8.45E-02	0.00E+00
25	GB	BF2503B	0.00E+00	8.56E-02	0.00E+00
40	GP	CS4020A9	0.00E+00	9.71E-02	0.00E+00
P	GP	SD160A	0.00E+00	3.99E-02	0.00E+00
P	GP	SS100A	0.00E+00	4.69E-02	0.00E+00

Output Flow Indicators A1-A3

Table 12: Output Flows

Primary Indicators			CRU	MFR	MER	EE
Strength (MPa)	Cement Blend	Mix Code	kg	kg	kg	MJ
Normal Class						
20	GP	R2020A	0.00E+00	8.67E+01	0.00E+00	0.00E+00
	GB	R2020B	0.00E+00	8.67E+01	0.00E+00	0.00E+00
25	GP	R2520A	0.00E+00	8.67E+01	0.00E+00	0.00E+00
	GB	R2520B	0.00E+00	8.67E+01	0.00E+00	0.00E+00
32	GP	R3220A	0.00E+00	8.67E+01	0.00E+00	0.00E+00
	GB	R3220B	0.00E+00	8.67E+01	0.00E+00	0.00E+00
40	GP	R4020A	0.00E+00	8.67E+01	0.00E+00	0.00E+00
	GB	R4020B	0.00E+00	8.67E+01	0.00E+00	0.00E+00
50	GP	R5020A	0.00E+00	8.67E+01	0.00E+00	0.00E+00
	GB	R5020B	0.00E+00	8.67E+01	0.00E+00	0.00E+00
Low Carbon Range						
20	B	CS2020BGS	0.00E+00	8.67E+01	0.00E+00	0.00E+00
25	B	CS2520BGS	0.00E+00	8.67E+01	0.00E+00	0.00E+00
32	B	CS3220BGS	0.00E+00	8.67E+01	0.00E+00	0.00E+00
40	B	CS4020BGS	0.00E+00	8.67E+01	0.00E+00	0.00E+00
50	B	CS5020BGS	0.00E+00	8.67E+01	0.00E+00	0.00E+00
Special Class						
25	LH	LH2520E	0.00E+00	8.67E+01	0.00E+00	0.00E+00
32	LH	LH3220E	0.00E+00	8.67E+01	0.00E+00	0.00E+00
40	LH	CS4020E5	0.00E+00	8.67E+01	0.00E+00	0.00E+00
32	GP	CS3220ASC	0.00E+00	8.67E+01	0.00E+00	0.00E+00
40	LH	TR4010E1	0.00E+00	8.67E+01	0.00E+00	0.00E+00
50	LH	TR5014E1	0.00E+00	8.67E+01	0.00E+00	0.00E+00
25	GB	KM2510B	0.00E+00	8.67E+01	0.00E+00	0.00E+00
25	GB	BF2503B	0.00E+00	8.67E+01	0.00E+00	0.00E+00
40	GP	CS4020A9	0.00E+00	8.67E+01	0.00E+00	0.00E+00
P	GP	SD160A	0.00E+00	8.67E+01	0.00E+00	0.00E+00
P	GP	SS100A	0.00E+00	8.67E+01	0.00E+00	0.00E+00

Results A1-A3

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EN 15804:2012+A1:2013 Compliant Indicators A1-A3

We are also providing EN 15804:2012+A1:2013 compliant results (see Table 13) to assist our customers who want to use this EPD in tools, such as the Green Building Council of Australia's Green Star Tool and the Infrastructure Sustainability Council's Sustainability Rating Tool that are currently based on this method.

Table 13: Potential environmental impacts – mandatory indicators according to EN 15804:2012+A1:2013

			GWP	ODP	AP	EP	POCP	ADPE	ADPF
Strength (MPa)	Cement Blend	Mix Code	kg CO_2 eq	kg CFC-11 eq	kg SO_2 eq	kg PO_4^{3-} eq	kg C_2H_4 eq	kg Sb eq	MJ
Normal Class									
20	GP	R2020A	286	5.26E-06	6.90E-01	1.19E-01	5.96E-02	4.97E-06	2000
	GB	R2020B	209	5.36E-06	6.69E-01	1.03E-01	5.67E-02	3.75E-06	1630
25	GP	R2520A	328	5.54E-06	7.80E-01	1.34E-01	6.48E-02	5.72E-06	2270
	GB	R2520B	252	5.60E-06	7.57E-01	1.17E-01	6.16E-02	4.52E-06	1880
32	GP	R3220A	366	5.87E-06	8.62E-01	1.47E-01	7.01E-02	6.39E-06	2510
	GB	R3220B	280	6.04E-06	8.40E-01	1.29E-01	6.72E-02	5.03E-06	2080
40	GP	R4020A	430	6.25E-06	9.92E-01	1.68E-01	7.74E-02	7.62E-06	2900
	GB	R4020B	320	6.36E-06	9.45E-01	1.44E-01	7.28E-02	5.80E-06	2340
50	GP	R5020A	513	7.25E-06	1.19E+00	1.99E-01	9.05E-02	9.10E-06	3460
	GB	R5020B	384	7.10E-06	1.13E+00	1.70E-01	8.36E-02	6.96E-06	2770
Low Carbon Range									
20	B	CS2020BGS	197	5.27E-06	6.61E-01	9.95E-02	5.54E-02	3.57E-06	1.56E+03
25	B	CS2520BGS	219	5.57E-06	7.29E-01	1.09E-01	5.96E-02	3.96E-06	1.71E+03
32	B	CS3220BGS	251	6.02E-06	8.30E-01	1.23E-01	6.57E-02	4.55E-06	1.94E+03
40	B	CS4020BGS	287	6.50E-06	9.42E-01	1.38E-01	7.24E-02	5.21E-06	2.18E+03
50	B	CS5020BGS	350	7.57E-06	1.15E+00	1.66E-01	8.53E-02	6.44E-06	2.66E+03
Special Class									
25	LH	LH2520E	160	5.69E-06	7.24E-01	9.71E-02	5.77E-02	3.06E-06	1420
32	LH	LH3220E	179	6.10E-06	8.11E-01	1.08E-01	6.29E-02	3.43E-06	1580
40	LH	CS4020E5	217	6.82E-06	9.79E-01	1.27E-01	7.22E-02	4.23E-06	1870
32	GP	CS3220ASC	371	5.83E-06	8.68E-01	1.48E-01	7.00E-02	6.54E-06	2530
40	LH	TR4010E1	241	7.69E-06	1.09E+00	1.40E-01	7.99E-02	5.21E-06	2140
50	LH	TR5014E1	286	9.24E-06	1.29E+00	1.63E-01	9.38E-02	6.39E-06	2610
25	GB	KM2510B	290	5.97E-06	8.63E-01	1.32E-01	6.74E-02	5.32E-06	2140
25	GB	BF2503B	277	6.12E-06	8.68E-01	1.30E-01	6.78E-02	5.26E-06	2100
40	GP	CS4020A9	464	6.62E-06	1.07E+00	1.81E-01	8.26E-02	8.18E-06	3110
P	GP	SD160A	200	4.20E-06	5.02E-01	8.83E-02	4.62E-02	3.03E-06	1430
P	GP	SS100A	128	2.69E-06	3.04E-01	5.25E-02	2.81E-02	2.47E-06	930

Carbon Footprint A1-A3

Table 14: Carbon footprint in line with Australian climate change reporting frameworks

Primary Indicators			Carbon footprint (IPCC AR5, 100yr)
			GWP-GHG
Strength (MPa)	Cement Blend	Mix Code	kg CO_2-eq.
Normal Class			
20	GP	R2020A	286
	GB	R2020B	210
25	GP	R2520A	328
	GB	R2520B	252
32	GP	R3220A	367
	GB	R3220B	281
40	GP	R4020A	431
	GB	R4020B	320
50	GP	R5020A	513
	GB	R5020B	384
Low Carbon Range			
20	B	CS2020BGS	197
25	B	CS2520BGS	219
32	B	CS3220BGS	251
40	B	CS4020BGS	287
50	B	CS5020BGS	350
Special Class			
25	LH	LH2520E	160
32	LH	LH3220E	180
40	LH	CS4020E5	217
32	GP	CS3220ASC	371
40	LH	TR4010E1	241
50	LH	TR5014E1	287
25	GB	KM2510B	291
25	GB	BF2503B	277
40	GP	CS4020A9	464
P	GP	SD160A	200
P	GP	SS100A	128

The GWP-GHG indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product as defined by IPCC AR 5 (IPCC 2013). This indicator is determined using the IPCC AR5 Global Warming Potentials (GWP) with a 100-year time horizon.

Results C1-C4 & D

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Mandatory Environmental Impact Categories C1-C4 & D

Table 15: Potential environmental impacts – mandatory indicators according to EN 15804:2012+A2:2019

Abbreviation	GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater	EP-marine	EP-terrestrial	POCP	ADP-minerals & metals*	ADP-fossil*	WDP*
Unit	kg CO_2-eq.	kg CO_2-eq.	kg CO_2-eq.	kg CO_2-eq.	kg CFC11-eq.	mol H^+ eq.	kg P eq.	kg N eq.	mol N eq.	kg NMVOC eq.	kg Sb eq.	MJ (NCV)	m^3 world eq. deprived
Module C1 - demolition of concrete	1.21E+01	1.21E+01	1.26E-03	5.96E-06	1.99E-06	1.38E-01	1.80E-06	5.97E-02	6.54E-01	1.57E-01	1.46E-08	1.73E+02	1.01E+01
Module C2 - transport of concrete to disposal	1.52E+01	1.52E+01	1.39E-03	7.04E-06	2.35E-06	1.32E-01	1.05E-06	4.14E-02	4.54E-01	1.11E-01	1.73E-08	2.04E+02	1.11E+01
Module C3 - concrete recycling	7.50E+00	7.49E+00	9.68E-03	3.36E-06	9.17E-07	2.70E-02	6.30E-06	4.46E-03	4.85E-02	1.30E-02	1.80E-06	1.00E+02	9.92E+01
Module C4 - concrete in landfill	1.34E+00	1.34E+00	1.66E-04	6.43E-07	2.17E-07	3.32E-03	2.01E-07	5.90E-04	6.45E-03	1.73E-03	1.55E-09	1.88E+01	1.36E+00
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ recycled aggregates	-5.20E+00	-5.19E+00	-8.93E-03	-2.56E-04	-5.52E-07	-4.63E-02	-8.45E-06	-1.73E-02	-1.95E-01	-4.56E-02	-9.06E-08	-6.94E+01	-5.24E+00
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ virgin aggregates	-8.78E+00	-8.76E+00	-1.51E-02	-4.33E-04	-9.32E-07	-7.82E-02	-1.43E-05	-2.92E-02	-3.29E-01	-7.70E-02	-1.53E-07	-1.17E+02	-8.86E+00

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

Results C1-C4 & D

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Additional Impact Categories C1-C4 & D

Table 16: Potential environmental impacts – additional indicators according to EN 15804:2012+A2:2019

Abbreviation	PM	IRP**	ETP-fw*	HTP-c*	HTP-nc*	SQP*
Unit	Disease incidence	kBq U235 eq.	CTUe	CTUh	CTUh	-
Module C1 - demolition of concrete	3.63E-06	2.54E-04	5.00E+01	6.22E-10	5.74E-08	8.11E-01
Module C2 - transport of concrete to disposal	7.48E-07	2.99E-04	5.88E+01	2.48E-10	2.00E-08	8.96E-01
Module C3 - concrete recycling	1.94E-07	1.46E-03	2.69E+01	1.22E-09	4.07E-08	1.97E+04
Module C4 - concrete in landfill	1.81E-08	2.74E-05	5.35E+00	4.91E-11	4.84E-09	2.04E+01
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ recycled aggregates	-1.08E-06	-2.45E-03	-1.78E+01	-3.39E-10	-2.54E-08	-1.23E+02
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ virgin aggregates	-1.83E-06	-4.15E-03	-3.01E+01	-5.73E-10	-4.30E-08	-2.08E+02

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

Resource Use Indicators C1-C4 & D

Table 17: Use of Resources

Abbreviation	PERE	PERM	PERT	PENRE	PENRM	PENRT	SM	RSF	NRSF	FW
Unit	MJNCV	MJNCV	MJNCV	MJNCV	MJNCV	MJNCV	kg	MJNCV	MJNCV	m^3
Module C1 - demolition of concrete	2.37E-01	0.00E+00	2.37E-01	1.84E+02	0.00E+00	1.84E+02	0.00E+00	0.00E+00	0.00E+00	2.52E-02
Module C2 - transport of concrete to disposal	2.59E-01	0.00E+00	2.59E-01	2.17E+02	0.00E+00	2.17E+02	0.00E+00	0.00E+00	0.00E+00	2.98E-02
Module C3 - concrete recycling	1.59E+00	0.00E+00	1.59E+00	1.05E+02	0.00E+00	1.05E+02	0.00E+00	0.00E+00	0.00E+00	3.74E-02
Module C4 - concrete in landfill	3.26E-02	0.00E+00	3.26E-02	1.99E+01	0.00E+00	1.99E+01	0.00E+00	0.00E+00	0.00E+00	2.74E-03
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ recycled aggregates	-1.41E+00	0.00E+00	-1.41E+00	-7.26E+01	0.00E+00	-7.26E+01	0.00E+00	0.00E+00	0.00E+00	-2.18E-01
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ virgin aggregates	-2.38E+00	0.00E+00	-2.38E+00	-1.23E+02	0.00E+00	-1.23E+02	0.00E+00	0.00E+00	0.00E+00	-3.68E-01

Waste Indicators C1-C4 & D

Table 18: Waste production

Abbreviation	HWD	NHWD	RWD
Unit	kg	kg	kg
Module C1 - demolition of concrete	0.00E+00	1.77E-03	0.00E+00
Module C2 - transport of concrete to disposal	0.00E+00	1.93E-03	0.00E+00
Module C3 - concrete recycling	0.00E+00	1.12E-02	0.00E+00
Module C4 - concrete in landfill	0.00E+00	5.59E+02	0.00E+00
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ recycled aggregates	0.00E+00	-3.53E-03	0.00E+00
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ virgin aggregates	0.00E+00	-5.96E-03	0.00E+00

Output Flow Indicators C1-C4 & D

Table 19: Output Flows

Abbreviation	CRU	MFR	MER	EE
Unit	kg	kg	kg	MJ
Module C1 - demolition of concrete	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Module C2 - transport of concrete to disposal	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Module C3 - concrete recycling	0.00E+00	1.77E+03	0.00E+00	0.00E+00
Module C4 - concrete in landfill	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ recycled aggregates	0.00E+00	-1.23E-02	0.00E+00	0.00E+00
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ virgin aggregates	0.00E+00	-2.08E-02	0.00E+00	0.00E+00

Results C1-C4 & D

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EN 15804:2012+A1:2013 Compliant Indicators C1-C4 & D

We are also providing EN 15804:2012+A1:2013 compliant results (see Table 20) to assist our customers who want to use this EPD in tools, such as the Green Building Council of Australia's Green Star Tool and the Infrastructure Sustainability Council's Sustainability Rating Tool that are currently based on this method.

Table 20: Potential environmental impacts – mandatory indicators according to EN 15804:2012+A1:2013

Abbreviation	GWP	ODP	AP	EP	POCP	ADPE	ADPF
Unit	kg CO_2 eq	kg CFC-11 eq	kg SO_2 eq	kg PO_4^{3-}-eq	kg C_2H_4 eq	kg Sb eq	MJ
Module C1 - demolition of concrete	12.0	1.57E-06	9.74E-02	2.01E-02	1.14E-02	1.47E-08	1.63E+02
Module C2 - transport of concrete to disposal	14.9	1.86E-06	7.28E-02	1.40E-02	1.58E-02	1.74E-08	2.10E+02
Module C3 - concrete recycling	7.43	7.24E-07	1.37E-02	1.55E-03	1.60E-03	1.80E-06	9.32E+01
Module C4 - concrete in landfill	1.33	1.71E-07	2.57E-03	2.03E-04	3.41E-04	1.56E-09	2.33E+01
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ recycled aggregates	-5.15	-4.36E-07	-2.89E-02	-6.38E-03	-3.13E-03	-9.08E-08	-6.99E+01
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ virgin aggregates	-8.69	-7.37E-07	-4.88E-02	-1.08E-02	-5.28E-03	-1.53E-07	-1.17E+02

Carbon Footprint C1-C4 & D

Table 21: Carbon footprint in line with Australian climate change reporting frameworks

Abbreviation	Carbon footprint (IPCC AR5, 100yr)
	GWP-GHG
Unit	kg CO_2-eq.
Module C1 - demolition of concrete	12.0
Module C2 - transport of concrete to disposal	14.9
Module C3 - concrete recycling	7.44
Module C4 - concrete in landfill	1.33
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ recycled aggregates	-5.13
Module D - benefits and impacts of concrete recycling; Ready-Mix w/ virgin aggregates	-8.66

Image © Tony Hewitt

Interpretation

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An EPD presents quantified environmental data for a product based on information from a life cycle assessment (LCA) that has been developed voluntarily by a company to provide publicly accessible, quality assured and comparable information regarding the environmental performance of their products.

An EPD is one of many tools a procurement team can use to evaluate and choose a low-carbon product for their next construction project. EPDs are highly complex technical documents and the temptation to look at only one number such as Global Warming Potential (GWP) and award a contract to the supplier with the product with the lowest GWP is very appealing.

However, it is not so simple, and we encourage the reader to look further when comparing and evaluating alternative concrete mixes and suppliers because to make a true comparison, all the products must meet the same performance, function, and lifetime requirements. For example, concrete suppliers may only have access to historical data from life cycle databases rather than the ability to measure the true impacts of their operations with real data from their suppliers. BGC Concrete have used real data from their cement supplier, BGC Cement, rather than historical data from the Australian National Life Cycle Inventory Database and therefore BGC Concrete should not be compared directly with other Ready-Mix suppliers in the Perth metropolitan region when using alternate cement data.

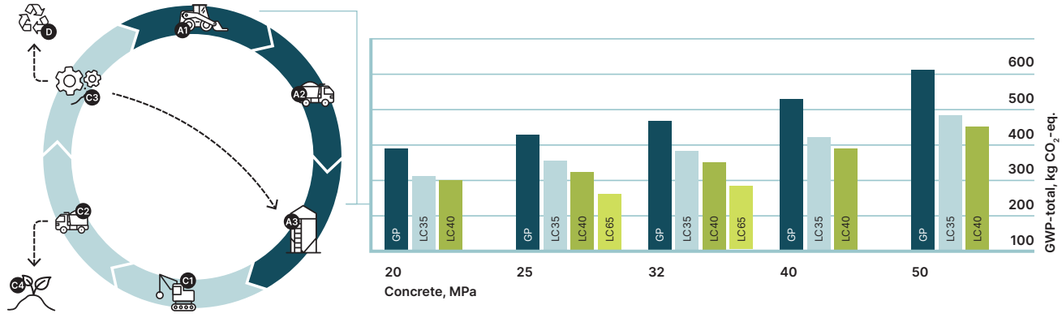
EPDs are not intended to be used as a claim of environmental superiority. The BGC Concrete EPD provides us with a baseline, and we will continue to measure ourselves against this to track our performance. Furthermore, it can be used to compare the environmental performance of different BGC Concrete products based on varying cement blends and aggregate types.

Selected Results at a Glance

Global warming potential (GWP-total)

The determining factor for the GWP can be found in the manufacturing stage of the concrete, particularly in the production of the required raw materials, specifically cement manufacture. As can be seen in the Graph 1 the largest contributor to CO_2 emissions is 100% GP for each grade of concrete mix, and the lowest contributor to CO_2 emissions is concrete with a blend of 65% slag and 35% GP.

Graph 1: Global Warming Potential (A1-A3)



The data has also been displayed in Table 22, presenting the approximate amount of CO_2-e per cubic metre of concrete that can be saved when replacing GP cement with Supplementary Cementitious Materials (SCM). This demonstrates that even a small replacement of GP cement will make a difference to lowering greenhouse gas emissions.

Table 22: Global Warming Potential Savings

% GGBFS \ Concrete, MPa	20	25	32	40	50
10	15	30	35	40	50
35	75	80	85	110	130
40	90	110	115	145	165
65	100	170	185	200	220

GWP-total, kg CO_2-e savings

NB. To visualise the CO_2 savings, consider a standard sized birthday party balloon, one party balloon represents 50 grams of CO_2, 20 party balloons represents 1kg CO_2 and 2000 party balloons represents 100kg CO_2

Interpretation

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Quick Use Guide

This compatibility chart has been created by BGC Concrete to assist with designing your next low carbon project, a structural engineer's guidance should always be sought. Please contact your local BGC Concrete representative for further details.

Application	Low Carbon Concrete (% GP Replacement)	Extra Guidance
Footing	65	Opportunity to maximise CO_2 reduction, for example use early in the building foundations (without hold down bolts)
Column	40	Opportunity to maximise CO_2 reduction if load times permit
Footpath	40	Meets design parameters
Suspended Slab	10	Small replacement of GP to meet stripping time with back propping
Cavity Fill	65	Opportunity to maximise CO_2 reduction
Ground Slab	20	Opportunity to reduce CO_2 emissions in winter without impacting on the finishing time; use accelerators to address initial set time.
Ground Slab	40	This should be the default in summer
Tilt up	10	Require same performance of GP cement but a slight reduction in GP cement should have minimal impact on the building programme
CFA Piling	65	Opportunity to maximise CO_2 reduction, for example use early in all piling applications
AFS Walls	40	Opportunity to maximise CO_2 reduction if load times permit

Image © Tony Hewitt

Program Information and Verification

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An Environmental Product Declaration (EPD) is a standardised way of quantifying the potential environmental impacts of a product or system. EPDs are produced according to a consistent set of rules – Product Category Rules (PCR) – that define the requirements within a given product category. These rules are a key part of ISO 14025 as they enable transparency and comparability between EPDs. This EPD provides cradle-to-gate plus end-of-life environmental indicators for a range of N Class Ready-Mix concrete products and S Class concrete that includes the low carbon concrete range, manufactured by BGC Concrete.

This EPD is verified to be compliant with EN 15804+A2. EPDs of construction products may not be comparable if they do not comply with EN15804. EPDs within the same product category but from different programs or utilising different standards or PCRs may not be comparable.

As the EPD owner, BGC Concrete has the sole ownership, liability, and responsibility for the EPD.

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EPD registration number:	S-P-05491
Published:	15 December 2022
Version:	1.0
Valid until:	15 December 2027 (5 years)
Reference year for data:	2020-07-01 – 2021-06-30
CEN standard EN 15804:2012+A2:2019 served as the core PCR	
PCR:	PCR 2019:14 Construction Products, Version 1.11, 2021-02-05 (valid until 2024-12-20) c-PCR-003: Product Category Rules (PCR) for Concrete and concrete elements (EN 16757) 2019-12-20 (valid until 2024-12-20)
PCR review was conducted by:	The Technical Committee of the International EPD® System. Chair: Claudia A. Peña Contact via info@environdec.com
Independent verification of the declaration and data, according to ISO 14025:	◯ EPD process certification (Internal) ⊘ EPD verification (External)
Procedure for follow-up of data during EPD validity involves third-party verifier:	◯ Yes ⊘ No

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