GUNLAKE CONCRETE

ENVIRONMENTAL PRODUCT DECLARATION

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

Ready Mixed Concrete

EPD Registration no. S-P-05478 | Version 1.0
Publication date: 30 August 2022
Version date: 30 August 2022
Valid until 30 August 2027
Geographical Scope NSW Australia
Type of EPD: Average of five manufacturing locations

ECO PLATFORM EPD VERIFIED

AUSTRALASIA EPD
ENVIRONMENTAL PRODUCT DECLARATION

Contents

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Program Information & Verification

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 environmental indicators for Gunlake Concrete's ready-mixed concrete products produced at our five plants in the Greater Sydney region, New South Wales, Australia. This EPD is a "cradle-to-gate with modules C1–C4 and module D (A1–A3, C and D)" declaration covering cradle-to-gate production of ready-mixed concrete, plus the end-of-life.

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.

Gunlake Concrete, as the EPD owner, has the sole ownership, liability, and responsibility for the EPD.

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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

Introduction

Gunlake is the largest independent supplier of concrete and quarry products in the Sydney Region and NSW. Over the last 10 years Gunlake have developed a cycle of continuous growth building state-of-the-art concrete batch plants. Currently we have five concrete plants in operation and another in the planning phase.
The Gunlake Group are a proudly Australian owned, family company spanning four generations in the quarrying and concrete industry in Australia. We strive to deliver;

- Industry leading service
- High quality products; and
- Innovative solutions to support our customers requirements

Beginning with one concrete plant and plans for a quarry in 2007, Gunlake Group has grown in 2022 to five operational concrete plants. We have a fleet of 95 concrete agitators with more to come.

Gunlake Quarries is a supplier of premium quarry materials across New South Wales. Gunlake Quarries is proud to deliver premium aggregate to Gunlake Concrete, as well as some of Australia's largest infrastructure projects. The quarry at Marulan is currently consented for 2.6 million tonnes per annum and services the concrete, asphalt, civil and infrastructure markets.

Ready-Mixed Concrete

Gunlake produces concrete in both dry-mix and wet-mix plants. The concrete is batched in line with Australian Standards, AS1379 Specification and Supply of Concrete.
The concrete produced is primarily used in the;

- Civil
- Housing
- Multi-residential
- Commercial
- Industrial, and
- Infrastructure segments

The products outlined in this Environmental Product Declaration are manufactured at Gunlake Concrete's five concrete plants in the Greater Sydney region in New South Wales, Australia. The concrete products have been grouped together across the plants, as the mix designs are identical and variation in environmental profiles between different plants is minimal. The plants covered by this EPD include.

- Smeaton Grange
- Prestons
- Glendenning
- Silverwater, and
- Banksmeadow

Ready-Mixed Concrete

Declared unit

1 cubic metre (m3) of ready mixed concrete, as ordered by our clients.

Our product range covered by this EPD:

- Normal Class 20MPa - straight cement
- Normal Class 25MPa - straight cement
- Normal Class 32MPa - straight cement
- Normal Class 40MPa - straight cement
- Normal Class 50MPa - straight cement
- Normal Class 20MPa (NC2028PCI) - cement and fly-ash
- Normal Class 25MPa (NC2528PCI) - cement and fly-ash
- Normal Class 32MPa (NC3228PCI) - cement and fly-ash
- Normal Class 40MPa (NC4028PCI) - cement and fly-ash
- Normal Class 50MPa (NC5028PCI) - cement and fly-ash
- Normal Class 20MPa (NC2028PD) - cement, slag and fly-ash
- Normal Class 25MPa (NC2528PD) - cement, slag and fly-ash
- Normal Class 32MPa (NC3228PD) - cement, slag and fly-ash
- Normal Class 40MPa (NC4028PD) - cement, slag and fly-ash
- Normal Class 50MPa (NC502APD) - cement, slag and fly-ash

- Special Class 40MPa (ES4022@3AB) - post-tensioned mix with cement and fly-ash
- Special Class 40MPa (ES4022@4) - post-tensioned mix with cement and fly-ash
- Special Class 40MPa (ES4022@5) - post-tensioned mix with cement and fly-ash
- Special Class 20MPa (GS202AP2) - green star mix with cement, high slag and fly-ash
- Special Class 25MPa (GS252AP2) - green star mix with cement, high slag and fly-ash
- Special Class 32MPa (GS322AP2) - green star mix with cement, high slag and fly-ash
- Special Class 40MPa (GS402AP2) - green star mix with cement, high slag and fly-ash
- Special Class 50MPa (GS502AP2) - green star mix with cement, high slag and fly-ash
- Special Class 65MPa (HS651DPD) - high-strength with cement, high slag and fly-ash
- Special Class 80MPa (HS801DPD) - high-strength with cement, high slag, fly-ash and silica fume

Ready mixed concrete products are classified under UN CPC 375 (Articles of concrete, cement and plaster) and ANZSIC 20330 (Concrete – ready mixed – except dry mix).

Product Content

Table 1: Product composition, per declared unit

Product components	Mass, kg	Post-consumer material, mass-%	Renewable material, mass-%
Ready mixed concrete	**1,950 – 2,530**	**0%**	**0%**
General Purpose (GP) cement	6-17%	0%	0%
Ground Granulated Blast Furnace Slag (GGBFS)	0-8%	0%	0%
Fly ash	0-5%	0%	0%
Silica fume	0-1%	0%	0%
Coarse aggregates	40-45%	0%	0%
Manufactured sand	0-10%	0%	0%
Natural sand	20-40%	0%	0%
Water	7-9%	0%	0%
Admixtures	<1%	0%	0%

Ready mixed concrete is supplied in bulk. Packaging materials are not relevant for the products contained in this EPD.
Our ready-mixed 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).

Technical Compliance

Gunlake's concrete is batched in accordance with:

- AS 1379:2007 Specification and supply of concrete.
- Relevant legislation, regulations and industry standards, and
- Project specifications

Gunlake Concrete is certified to AS/NZS ISO 9001-2016: Quality Management Systems – Requirements for the Manufacture and delivery of concrete.

Gunlake can produce concrete with various amounts of embodied CO2. Customers should work with their design engineers and Gunlake's technical team to develop suitable products to meet project and stakeholder requirements. Our research and development culture is innovative and customer focused.

G-Lab Materials Testing Pty Ltd is Gunlake's 100% owned in-house laboratory that is NATA accredited. G-lab drives the highest standards of concrete and quarry material performance.

Scope of Environmental Product Declaration

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 2.

Table 2: 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, JP	AU	AU	-	-	-	-	-	-	-	-	-	AU	AU	AU	AU	AU
Specific data used	80-98%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	not relevant					-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	<5%					-	-	-	-	-	-	-	-	-	-	-	-

Raw material supply, Transportation and Manufacturing (A1-A3)

Gunlake Concrete produces a wide range of ready-mixed concrete products from key raw materials (GP cement, GGBFS, fly-ash, silica fume, coarse aggregates, manufactured sand, natural sand, water and admixtures).

Coarse aggregates and manufactured sand are sourced from Gunlake's Marulan Quarry. Other raw materials are supplied by third parties. All raw materials are typically transported to our sites by truck.

Our production process consists of mixing the concrete constituents in carefully dosed quantities to achieve desired engineering properties.

End-of-life (C1-C4)

The end-of-life modules for ready mixed concrete are based on generic scenarios.
Module C1 covers demolition of the concrete at the end of its service life. As Gunlake Concrete is located in NSW, we have used the end-of-life scenario representative for NSW masonry products based on the National Waste Report 2020 (NWR 2020). This scenario implies that 89.6% of the concrete is recycled and the remaining 10.4% of the concrete is sent to landfill. Module C2 comprises the transport from the demolition site to a recycling centre or landfill site (50 km). Module C3 encompasses the recycling process (i.e. crushing of concrete), while Module C4 represents disposal of concrete in a landfill site.

The concrete reaches end-of-waste status when it is crushed and stockpiled as "recycled crushed concrete" (RCC) aggregates.

We have modelled a single scenario for a concrete with a density of 2,330 kg/m3. This is the (unweighted) average of the concrete mixes covered by the EPD. The impact of this simplification is much smaller than the impact of the scenario and data assumptions applied to the end-of-life modules.

Processes	Quantity per tonne of concrete	Unit
Collection process specified by type	1,000	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
	896	kg for recycling
	0	kg for energy recovery
Disposal to landfill	104	kg product or material for final deposition
Assumptions for scenario development	61.7	MJ of diesel for the demolition process

The scenarios included are currently in use and are representative for one of the most probable alternatives. Due to high uncertainty in the parameters and lack of data, CO2-uptake (carbonation) has not been included at end-of-life.

Loads and benefits beyond the system boundaries (D)

Module D includes any benefits and loads from net flows leaving the product system (that have passed the end-of-waste state). For this EPD, any material collected for recycling and processed in Module C3, is considered to go through to Module D. We have assumed that Recycled Crushed Concrete aggregates replace virgin aggregates (crushed rocks).

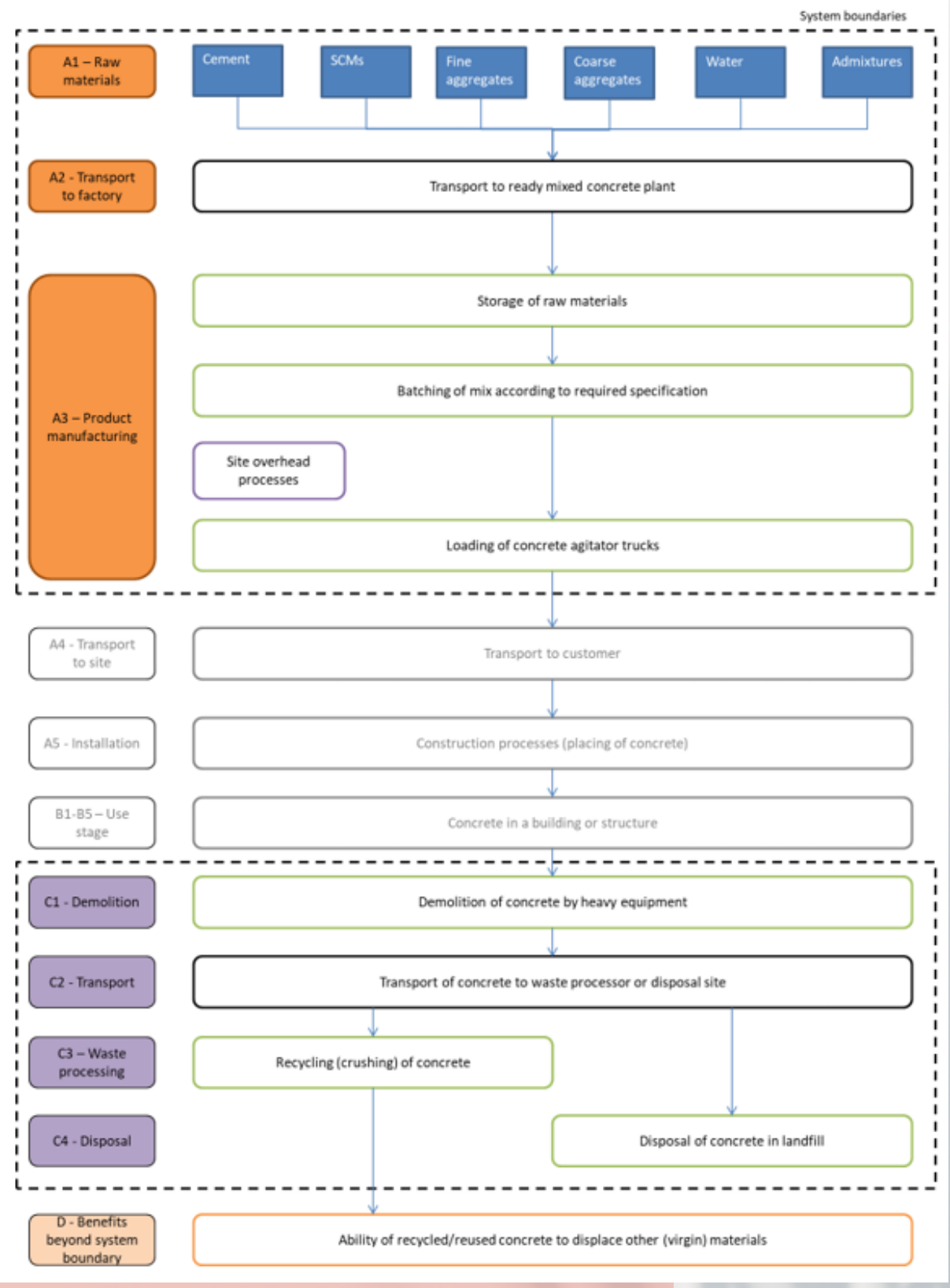

Figure 3: System boundary diagram of ready mixed concrete products

Life Cycle Assessment (LCA) Methodology

Background Data

Gunlake Concrete has collected and supplied the primary data for the ready-mixed concrete LCA based on the FY21 reporting period (1 July 2020 – 30 June 2021). Gunlake Quarries provided data for the coarse aggregates and manufactured sand that they supply to Gunlake Concrete. 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 m3 of ready-mixed concrete products).
- Slag: blast furnace slag (BFS) is a by-product from steelmaking. We have used the AusLCI data for BFS ("blast furnace slag allocation, at steel plant/AU U"), which contain impacts from pig iron production allocated to blast furnace slag (using economic allocation).
- Fly ash: fly ash is a by-product from coal-fired power plants. We have used the AusLCI data for fly ash, in which all environmental impacts of the power plant are allocated to the main product: electricity. Fly ash has only received the burdens of transport to our sites.
- Silica fume: silica fume is a by-product of silicon metal or ferrosilicon alloys production. Economic allocation is used to attribute impacts between silica fume and ferrosilicon production.
- Aggregates: coarse aggregates and manufactured sand 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:

- Our supplier has provided information on their cement (including cement clinker) production process. We have adjusted the generic AusLCI data for cement and clinker production accordingly.
- 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.
- Fly ash does not receive any environmental impacts associated with coal-fired power generation. This allocation decision has an effect on the environmental profile of products containing fly ash.
- 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.

Life Cycle Assessment (LCA) Results

The background LCA serves as the foundation for this EPD. An LCA 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.

First (pages 16-30), we present the cradle-to-gate (module A1-A3) environmental profiles for the various concrete mixes covered by this EPD:

-Normal class – straight cement mixes (p16 to 18)
-Normal class – cement and fly-ash mixes (p19 to 21)
-Normal class – cement, slag and fly-ash mixes (p22 to 24)
-Special class – post tensioned and high strength mixes (p25 to 27)
-Green star – cement, high slag and fly-ash mixes (p28 to 30)

Then (pages 31-33), the environmental profiles for the end-of-life (modules C-D) are presented.

The results are expressed per declared unit (1 m3 of ready-mix concrete). The end-of-life results do not vary significantly between the various types of concrete. Hence why they are presented as one set of values for all our concrete mixes.

We are also providing EN 15804:2012+A1:2013 compliant results 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.

Finally, the carbon footprint of our concrete products is presented as the "GWP-GHG indicator" in a separate table at the end of each set of results. 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 and aligns closest to current Australian greenhouse gas reporting frameworks.

Normal Class - Straight Cement Mixes

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

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**20MPa - straight cement**	**25MPa - straight cement**	**32MPa - straight cement**	**40MPa - straight cement**	**50MPa - straight cement**
GWP-total	kg CO_2 eq.	296	317	350	392	438
GWP-fossil	*kg CO_2 eq.*	*295*	*317*	*350*	*392*	*438*
GWP-biogenic	*kg CO_2 eq.*	*4.89E-02*	*4.94E-02*	*5.01E-02*	*5.10E-02*	*5.21E-02*
GWP-luluc	*kg CO_2 eq.*	*1.36E-03*	*1.49E-03*	*1.67E-03*	*1.92E-03*	*2.18E-03*
ODP	kg CFC 11 eq.	1.12E-05	1.15E-05	1.19E-05	1.25E-05	1.31E-05
AP	mol H^+ eq.	1.71E+00	1.81E+00	1.98E+00	2.20E+00	2.43E+00
EP-freshwater	kg P eq.	7.00E-04	7.64E-04	8.59E-04	9.84E-04	1.12E-03
EP-marine	kg N eq.	5.09E-01	5.41E-01	5.91E-01	6.55E-01	7.25E-01
EP-terrestrial	mol N eq.	5.70E+00	6.07E+00	6.62E+00	7.35E+00	8.14E+00
POCP	kg NMVOC eq.	1.36E+00	1.45E+00	1.58E+00	1.76E+00	1.94E+00
ADP-minerals&metals*	kg Sb eq.	1.62E-06	1.67E-06	1.75E-06	1.86E-06	1.97E-06
ADP-fossil*	MJ	2010	2120	2280	2500	2740
WDP*	m^3	3120	3390	3790	4320	4890
Additional indicators						
PM	disease incidence	6.64E-06	6.89E-06	7.27E-06	7.76E-06	8.30E-06
IRP**	kBq U235 eq.	2.95E+00	3.23E+00	3.64E+00	4.18E+00	4.77E+00
ETP-fw*	CTUe	1.39E+03	1.49E+03	1.66E+03	1.87E+03	2.10E+03
HTP-c*	CTUh	2.25E-08	2.44E-08	2.73E-08	3.11E-08	3.52E-08
HTP-nc*	CTUh	1.26E-06	1.37E-06	1.53E-06	1.74E-06	1.97E-06
SQP*	-	2.75E+02	2.79E+02	2.84E+02	2.89E+02	2.97E+02

Acronyms GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption, PM = Particulate matter emissions; IRP = Ionising radiation, human health; ETP-fw = Ecotoxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects; SQP = Land use related impacts / soil quality

**** 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.***

Use of resources, waste production and output flows

Results per declared unit (A1-A3 total)						
Parameter	**Unit**	**20MPa - straight cement**	**25MPa - straight cement**	**32MPa - straight cement**	**40MPa - straight cement**	**50MPa - straight cement**
PERE	MJ	2.43E+01	2.60E+01	2.85E+01	3.17E+01	3.52E+01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.43E+01	2.60E+01	2.85E+01	3.17E+01	3.52E+01
PENRE	MJ	2.08E+03	2.19E+03	2.36E+03	2.58E+03	2.83E+03
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.08E+03	2.19E+03	2.36E+03	2.58E+03	2.83E+03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.04E+00	3.11E+00	3.24E+00	3.42E+00	3.60E+00
HWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	8.31E-02	8.33E-02	8.36E-02	8.40E-02	8.45E-02
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	3.95E+01	3.95E+01	3.95E+01	3.95E+01	3.95E+01
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acronyms	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal					

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

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**20MPa - straight cement**	**25MPa - straight cement**	**32MPa - straight cement**	**40MPa - straight cement**	**50MPa - straight cement**
GWP	kg CO_2 eq	293	314	346	388	434
ODP	kg CFC11 eq	8.98E-06	9.19E-06	9.54E-06	9.98E-06	1.05E-05
AP	kg SO_2 eq	1.19E+00	1.27E+00	1.40E+00	1.57E+00	1.75E+00
EP	kg PO_4^{3-} eq	1.77E-01	1.89E-01	2.06E-01	2.28E-01	2.53E-01
POCP	kg C_2H_4 eq	9.04E-02	9.37E-02	9.88E-02	1.05E-01	1.13E-01
ADPE	kg Sb eq	1.83E-06	1.90E-06	2.01E-06	2.15E-06	2.31E-06
ADPF	MJ_{NCV}	1960	2060	2220	2430	2670
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for elements; ADPF = Abiotic depletion potential for fossil resources					

Carbon footprint in line with Australian climate change reporting frameworks

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**20MPa - straight cement**	**25MPa - straight cement**	**32MPa - straight cement**	**40MPa - straight cement**	**50MPa - straight cement**
GWP-GHG	kg CO_2 eq	293	314	347	389	435

Normal Class - Cement and Fly-ash Mixes

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

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**NC2028PCI - 20MPa**	**NC2528PCI - 25MPa**	**NC3228PCI - 32MPa**	**NC4028PCI - 40MPa**	**NC5028PCI - 50MPa**
GWP-total	kg CO_2 eq.	235	263	286	318	418
GWP-fossil	*kg CO_2 eq.*	*235*	*263*	*286*	*318*	*418*
GWP-biogenic	*kg CO_2 eq.*	*5.37E-02*	*5.54E-02*	*5.69E-02*	*6.30E-02*	*6.09E-02*
GWP-luluc	*kg CO_2 eq.*	*1.15E-03*	*1.32E-03*	*1.47E-03*	*1.73E-03*	*2.24E-03*
ODP	kg CFC 11 eq.	1.04E-05	1.08E-05	1.11E-05	1.16E-05	1.28E-05
AP	mol H^+ eq.	1.40E+00	1.54E+00	1.66E+00	1.82E+00	2.33E+00
EP-freshwater	kg P eq.	5.41E-04	6.23E-04	6.92E-04	7.95E-04	1.08E-03
EP-marine	kg N eq.	4.14E-01	4.56E-01	4.91E-01	5.37E-01	6.89E-01
EP-terrestrial	mol N eq.	4.64E+00	5.11E+00	5.50E+00	6.03E+00	7.75E+00
POCP	kg NMVOC eq.	1.11E+00	1.22E+00	1.32E+00	1.44E+00	1.85E+00
ADP-minerals&metals*	kg Sb eq.	1.87E-06	2.00E-06	2.12E-06	2.52E-06	2.52E-06
ADP-fossil*	MJ	1720	1870	1990	2180	2670
WDP*	m^3	2400	2740	3030	3440	4670
Additional indicators						
PM	disease incidence	5.95E-06	6.30E-06	6.60E-06	7.06E-06	8.15E-06
IRP**	kBq U235 eq.	2.20E+00	2.55E+00	2.83E+00	3.23E+00	4.50E+00
ETP-fw*	CTUe	1.09E+03	1.22E+03	1.34E+03	1.50E+03	2.00E+03
HTP-c*	CTUh	1.78E-08	2.03E-08	2.24E-08	2.57E-08	3.42E-08
HTP-nc*	CTUh	9.85E-07	1.12E-06	1.24E-06	1.41E-06	1.89E-06
SQP*	-	2.57E+02	2.62E+02	2.67E+02	2.75E+02	2.86E+02

Acronyms

GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption
PM = Particulate matter emissions; IRP = Ionising radiation, human health; ETP-fw = Ecotoxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects; SQP = Land use related impacts / soil quality

** 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.*

Use of Resources, waste production and output flows

Results per declared unit (A1-A3 total)						
Parameter	**Unit**	**NC2028PCI - 20MPa**	**NC2528PCI - 25MPa**	**NC3228PCI - 32MPa**	**NC4028PCI - 40MPa**	**NC5028PCI - 50MPa**
PERE	MJ	2.02E+01	2.24E+01	2.42E+01	2.70E+01	3.43E+01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.02E+01	2.24E+01	2.42E+01	2.70E+01	3.43E+01
PENRE	MJ	1.79E+03	1.94E+03	2.07E+03	2.26E+03	2.76E+03
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.79E+03	1.94E+03	2.07E+03	2.26E+03	2.76E+03
SM	kg	9.15E+01	9.15E+01	1.12E+02	1.26E+02	1.27E+02
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.71E+00	2.85E+00	2.90E+00	3.03E+00	3.43E+00
HWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	8.40E-02	8.50E-02	8.57E-02	8.91E-02	8.75E-02
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	3.95E+01	3.95E+01	3.95E+01	2.70E+01	3.95E+01
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acronyms	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal					

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

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**NC2028PCI - 20MPa**	**NC2528PCI - 25MPa**	**NC3228PCI - 32MPa**	**NC4028PCI - 40MPa**	**NC5028PCI - 50MPa**
GWP	kg CO_2 eq	233	260	283	315	414
ODP	kg CFC11 eq	8.31E-06	8.64E-06	8.92E-06	9.33E-06	1.03E-05
AP	kg SO_2 eq	9.53E-01	1.06E+00	1.15E+00	1.28E+00	1.67E+00
EP	kg PO_4^{3-} eq	1.45E-01	1.60E-01	1.72E-01	1.89E-01	2.42E-01
POCP	kg C_2H_4 eq	8.03E-02	8.49E-02	8.87E-02	9.40E-02	1.10E-01
ADPE	kg Sb eq	2.04E-06	2.19E-06	2.34E-06	2.77E-06	2.85E-06
ADPF	MJ_{NCV}	1680	1820	1950	2130	2610
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for elements; ADPF = Abiotic depletion potential for fossil resources					

Carbon footprint in line with Australian climate change reporting frameworks

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**NC2028PCI - 20MPa**	**NC2528PCI - 25MPa**	**NC3228PCI - 32MPa**	**NC4028PCI - 40MPa**	**NC5028PCI - 50MPa**
GWP-GHG	kg CO_2 eq	233	261	283	315	414

Normal Class - Cement, Slag and Fly-ash Mixes

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

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**NC2028PD - 20MPa**	**NC2528PD - 25MPa**	**NC3228PD - 32MPa**	**NC4028PD - 40MPa**	**NC5028PD - 50MPa**
GWP-total	kg CO_2 eq.	197	196	225	249	307
GWP-fossil	*kg CO_2 eq.*	*197*	*196*	*225*	*249*	*307*
GWP-biogenic	*kg CO_2 eq.*	*6.25E-02*	*6.39E-02*	*6.74E-02*	*7.78E-02*	*8.63E-02*
GWP-luluc	*kg CO_2 eq.*	*8.56E-04*	*8.75E-04*	*1.05E-03*	*1.19E-03*	*1.57E-03*
ODP	kg CFC 11 eq.	9.71E-06	9.48E-06	9.91E-06	1.01E-05	1.09E-05
AP	mol H^+ eq.	1.19E+00	1.18E+00	1.33E+00	1.44E+00	1.74E+00
EP-freshwater	kg P eq.	4.09E-04	4.11E-04	4.94E-04	5.56E-04	7.26E-04
EP-marine	kg N eq.	3.50E-01	3.45E-01	3.88E-01	4.19E-01	5.03E-01
EP-terrestrial	mol N eq.	3.91E+00	3.86E+00	4.35E+00	4.69E+00	5.64E+00
POCP	kg NMVOC eq.	9.41E-01	9.28E-01	1.04E+00	1.13E+00	1.36E+00
ADP-minerals&metals*	kg Sb eq.	1.70E-06	1.75E-06	1.90E-06	2.12E-06	2.50E-06
ADP-fossil*	MJ	1590	1580	1750	1920	2260
WDP*	m^3	1930	1960	2310	2620	3350
Additional indicators						
PM	disease incidence	5.77E-06	5.63E-06	6.07E-06	6.57E-06	7.39E-06
IRP**	kBq U235 eq.	1.62E+00	1.62E+00	1.97E+00	2.20E+00	2.90E+00
ETP-fw*	CTUe	8.87E+02	8.84E+02	1.03E+03	1.14E+03	1.43E+03
HTP-c*	CTUh	1.43E-08	1.44E-08	1.70E-08	1.93E-08	2.47E-08
HTP-nc*	CTUh	8.16E-07	8.20E-07	9.68E-07	1.10E-06	1.40E-06
SQP*	-	2.59E+02	2.42E+02	2.51E+02	2.62E+02	2.74E+02

Acronyms

GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption
PM = Particulate matter emissions; IRP = Ionising radiation, human health; ETP-fw = Ecotoxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects; SQP = Land use related impacts / soil quality

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Use of Resources, waste production and output flows

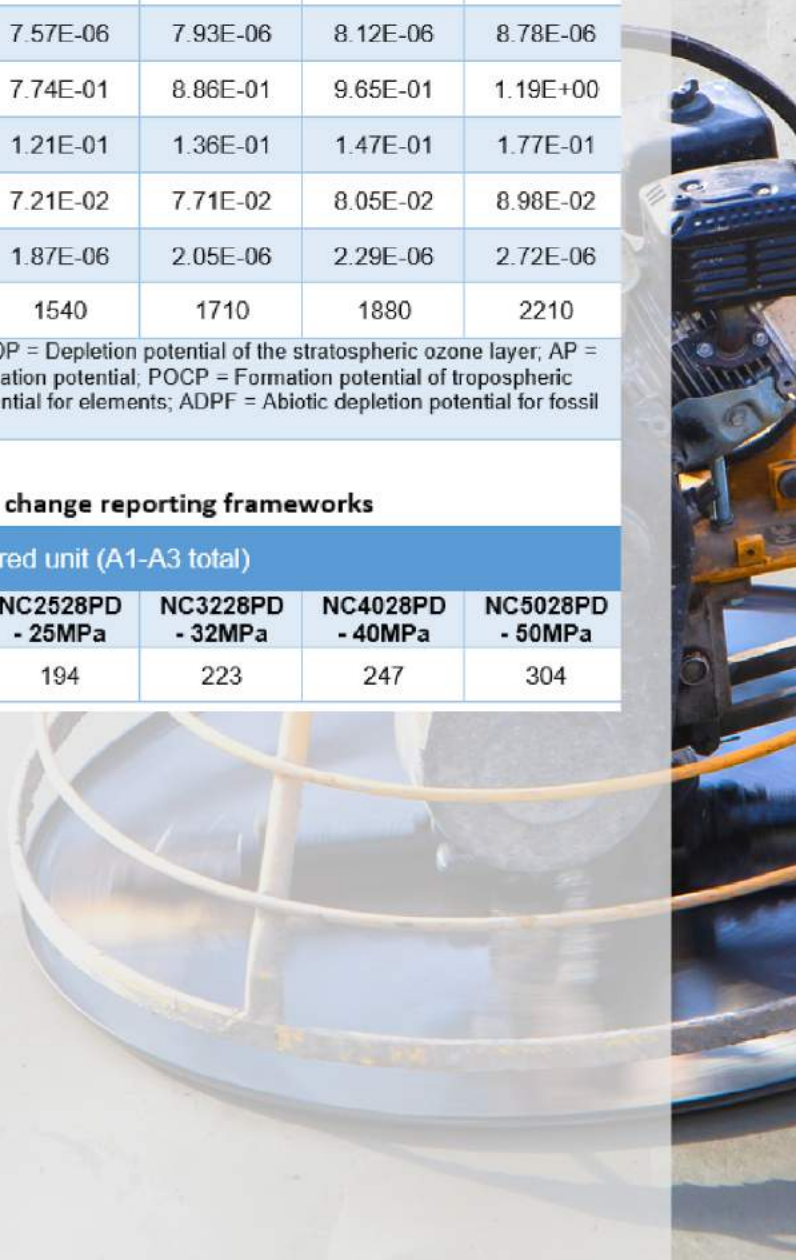
Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**NC2028PD - 20MPa**	**NC2528PD - 25MPa**	**NC3228PD - 32MPa**	**NC4028PD - 40MPa**	**NC5028PD - 50MPa**
PERE	MJ	1.93E+01	1.95E+01	2.21E+01	2.55E+01	3.08E+01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.93E+01	1.95E+01	2.21E+01	2.55E+01	3.08E+01
PENRE	MJ	1.65E+03	1.64E+03	1.81E+03	1.99E+03	2.33E+03
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.65E+03	1.64E+03	1.81E+03	1.99E+03	2.33E+03
SM	kg	1.42E+02	1.52E+02	1.73E+02	1.93E+02	2.08E+02
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.48E+00	2.61E+00	2.69E+00	2.74E+00	3.01E+00
HWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	1.03E-01	1.03E-01	1.07E-01	1.22E-01	1.31E-01
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	3.95E+01	3.95E+01	3.95E+01	3.95E+01	3.95E+01
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acronyms	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal					

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

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**NC2028PD - 20MPa**	**NC2528PD - 25MPa**	**NC3228PD - 32MPa**	**NC4028PD - 40MPa**	**NC5028PD - 50MPa**
GWP	kg CO_2 eq	195	194	223	246	304
ODP	kg CFC11 eq	7.75E-06	7.57E-06	7.93E-06	8.12E-06	8.78E-06
AP	kg SO_2 eq	7.81E-01	7.74E-01	8.86E-01	9.65E-01	1.19E+00
EP	kg PO_4^{3-} eq	1.22E-01	1.21E-01	1.36E-01	1.47E-01	1.77E-01
POCP	kg C_2H_4 eq	7.36E-02	7.21E-02	7.71E-02	8.05E-02	8.98E-02
ADPE	kg Sb eq	1.82E-06	1.87E-06	2.05E-06	2.29E-06	2.72E-06
ADPF	MJ_{NCV}	1550	1540	1710	1880	2210
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for elements; ADPF = Abiotic depletion potential for fossil resources					

Carbon footprint in line with Australian climate change reporting frameworks

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**NC2028PD - 20MPa**	**NC2528PD - 25MPa**	**NC3228PD - 32MPa**	**NC4028PD - 40MPa**	**NC5028PD - 50MPa**
GWP-GHG	kg CO_2 eq	195	194	223	247	304



Post-tensioned and High Strength Mixes

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

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**ES4022@3AB - 40MPa**	**ES4022@4 - 40MPa**	**ES4022@5 - 40MPa**	**HS651DPD - 65MPa**	**HS801DPD - 80MPa**
GWP-total	kg CO_2 eq.	355	337	328	305	320
GWP-fossil	*kg CO_2 eq.*	*355*	*337*	*327*	*305*	*319*
GWP-biogenic	*kg CO_2 eq.*	*6.24E-02*	*6.10E-02*	*6.06E-02*	*9.80E-02*	*7.66E-01*
GWP-luluc	*kg CO_2 eq.*	*1.92E-03*	*1.79E-03*	*1.74E-03*	*1.62E-03*	*1.71E-02*
ODP	kg CFC 11 eq.	1.21E-05	1.18E-05	1.17E-05	1.12E-05	1.19E-05
AP	mol H^+ eq.	2.01E+00	1.92E+00	1.87E+00	1.74E+00	1.85E+00
EP-freshwater	kg P eq.	9.00E-04	8.45E-04	8.18E-04	7.18E-04	1.23E-03
EP-marine	kg N eq.	5.94E-01	5.67E-01	5.52E-01	4.99E-01	5.17E-01
EP-terrestrial	mol N eq.	6.67E+00	6.36E+00	6.20E+00	5.60E+00	5.80E+00
POCP	kg NMVOC eq.	1.60E+00	1.52E+00	1.48E+00	1.35E+00	1.41E+00
ADP-minerals&metals*	kg Sb eq.	2.52E-06	2.41E-06	2.38E-06	2.90E-06	3.29E-06
ADP-fossil*	MJ	2370	2270	2220	2330	2500
WDP*	m^3	3900	3670	3550	3320	3350
Additional indicators						
PM	disease incidence	7.47E-06	7.25E-06	7.12E-06	7.75E-06	8.20E-06
IRP**	kBq U235 eq.	3.70E+00	3.47E+00	3.36E+00	2.80E+00	3.33E+00
ETP-fw*	CTUe	1.69E+03	1.59E+03	1.55E+03	1.41E+03	1.58E+03
HTP-c*	CTUh	2.88E-08	2.71E-08	2.63E-08	2.48E-08	4.46E-08
HTP-nc*	CTUh	1.59E-06	1.49E-06	1.45E-06	1.41E-06	1.55E-06
SQP*	-	2.80E+02	2.79E+02	2.76E+02	2.93E+02	3.81E+02

Acronyms

GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption
PM = Particulate matter emissions; IRP = Ionising radiation, human health; ETP-fw = Ecotoxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects; SQP = Land use related impacts / soil quality

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Use of resources, waste production and output flows

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**ES4022@3AB - 40MPa**	**ES4022@4 - 40MPa**	**ES4022@5 - 40MPa**	**HS651DPD - 65MPa**	**HS801DPD - 80MPa**
PERE	MJ	2.98E+01	2.83E+01	2.76E+01	3.20E+01	6.23E+01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.98E+01	2.83E+01	2.76E+01	3.20E+01	6.23E+01
PENRE	MJ	2.45E+03	2.35E+03	2.30E+03	2.40E+03	2.58E+03
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.45E+03	2.35E+03	2.30E+03	2.40E+03	2.58E+03
SM	kg	8.13E+01	7.12E+01	8.13E+01	2.34E+02	2.44E+02
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	3.26E+00	3.16E+00	3.10E+00	2.97E+00	1.62E+01
HWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	8.90E-02	8.85E-02	8.80E-02	1.45E-01	1.48E-01
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	3.95E+01	3.95E+01	3.95E+01	3.95E+01	3.95E+01
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Acronyms

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water
HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal

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

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**ES4022@3AB - 40MPa**	**ES4022@4 - 40MPa**	**ES4022@5 - 40MPa**	**HS651DPD - 65MPa**	**HS801DPD - 80MPa**
GWP	kg CO_2 eq	352	333	324	302	316
ODP	kg CFC11 eq	9.72E-06	9.50E-06	9.38E-06	9.04E-06	9.68E-06
AP	kg SO_2 eq	1.43E+00	1.35E+00	1.32E+00	1.17E+00	1.27E+00
EP	kg PO_4^{3-} eq	2.09E-01	1.99E-01	1.94E-01	1.76E-01	1.85E-01
POCP	kg C_2H_4 eq	9.99E-02	9.69E-02	9.52E-02	9.15E-02	9.66E-02
ADPE	kg Sb eq	2.80E-06	2.67E-06	2.63E-06	3.13E-06	3.57E-06
ADPF	MJ_{NCV}	2310	2210	2160	2280	2470
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for elements; ADPF = Abiotic depletion potential for fossil resources					

Carbon footprint in line with Australian climate change reporting frameworks

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**ES4022@3AB - 40MPa**	**ES4022@4 - 40MPa**	**ES4022@5 - 40MPa**	**HS651DPD - 65MPa**	**HS801DPD - 80MPa**
GWP-GHG	kg CO_2 eq	352	334	325	302	317

Greenstar Mixes

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

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**GS202AP2 - 20MPa**	**GS252AP2 - 25MPa**	**GS322AP2 - 32MPa**	**GS402AP2 - 40MPa**	**GS502AP2 - 50MPa**
GWP-total	kg CO_2 eq.	223	226	242	267	294
GWP-fossil	*kg CO_2 eq.*	*223*	*226*	*242*	*267*	*294*
GWP-biogenic	*kg CO_2 eq.*	*7.17E-02*	*7.34E-02*	*7.70E-02*	*8.24E-02*	*9.52E-02*
GWP-luluc	*kg CO_2 eq.*	*9.91E-04*	*1.02E-03*	*1.12E-03*	*1.29E-03*	*1.55E-03*
ODP	kg CFC 11 eq.	9.97E-06	1.01E-05	1.03E-05	1.06E-05	1.09E-05
AP	mol H^+ eq.	1.32E+00	1.34E+00	1.42E+00	1.54E+00	1.67E+00
EP-freshwater	kg P eq.	4.75E-04	4.84E-04	5.27E-04	6.01E-04	6.87E-04
EP-marine	kg N eq.	3.85E-01	3.90E-01	4.13E-01	4.47E-01	4.82E-01
EP-terrestrial	mol N eq.	4.30E+00	4.37E+00	4.62E+00	5.01E+00	5.41E+00
POCP	kg NMVOC eq.	1.04E+00	1.05E+00	1.11E+00	1.20E+00	1.30E+00
ADP-minerals&metals*	kg Sb eq.	1.85E-06	1.94E-06	2.03E-06	2.25E-06	2.77E-06
ADP-fossil*	MJ	1770	1800	1900	2050	2250
WDP*	m^3	2270	2290	2480	2800	3180
Additional indicators						
PM	disease incidence	6.27E-06	6.42E-06	6.70E-06	7.07E-06	7.55E-06
IRP**	kBq U235 eq.	1.89E+00	1.91E+00	2.09E+00	2.38E+00	2.68E+00
ETP-fw*	CTUe	1.01E+03	1.03E+03	1.10E+03	1.22E+03	1.36E+03
HTP-c*	CTUh	1.67E-08	1.70E-08	1.84E-08	2.08E-08	2.38E-08
HTP-nc*	CTUh	9.60E-07	9.75E-07	1.06E-06	1.19E-06	1.35E-06
SQP*	-	2.68E+02	2.81E+02	2.87E+02	2.92E+02	2.91E+02

Acronyms

GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption
PM = Particulate matter emissions; IRP = Ionising radiation, human health; ETP-fw = Ecotoxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects; SQP = Land use related impacts / soil quality

** 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.*

Use of Resources, waste production and output flows

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**GS202AP2 - 20MPa**	**GS252AP2 - 25MPa**	**GS322AP2 - 32MPa**	**GS402AP2 - 40MPa**	**GS502AP2 - 50MPa**
PERE	MJ	2.27E+01	2.30E+01	2.47E+01	2.72E+01	3.09E+01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.27E+01	2.30E+01	2.47E+01	2.72E+01	3.09E+01
PENRE	MJ	1.83E+03	1.86E+03	1.96E+03	2.12E+03	2.32E+03
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.83E+03	1.86E+03	1.96E+03	2.12E+03	2.32E+03
SM	kg	1.45E+02	1.48E+02	1.69E+02	1.90E+02	2.24E+02
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.62E+00	2.50E+00	2.53E+00	2.61E+00	2.85E+00
HWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	1.17E-01	1.19E-01	1.24E-01	1.30E-01	1.42E-01
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	3.95E+01	3.95E+01	3.95E+01	3.95E+01	3.95E+01
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acronyms	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal					

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

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**GS202AP2 - 20MPa**	**GS252AP2 - 25MPa**	**GS322AP2 - 32MPa**	**GS402AP2 - 40MPa**	**GS502AP2 - 50MPa**
GWP	kg CO_2 eq	221	224	239	264	291
ODP	kg CFC11 eq	7.97E-06	8.08E-06	8.25E-06	8.50E-06	8.79E-06
AP	kg SO_2 eq	8.70E-01	8.83E-01	9.40E-01	1.03E+00	1.13E+00
EP	kg PO_4^{3-} eq	1.35E-01	1.37E-01	1.45E-01	1.57E-01	1.70E-01
POCP	kg C_2H_4 eq	7.74E-02	7.86E-02	8.11E-02	8.49E-02	8.89E-02
ADPE	kg Sb eq	2.00E-06	2.09E-06	2.20E-06	2.44E-06	2.98E-06
ADPF	MJ_{NCV}	1730	1760	1860	2010	2200
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for elements; ADPF = Abiotic depletion potential for fossil resources					

Carbon footprint in line with Australian climate change reporting frameworks

Results per declared unit (A1-A3 total)						
Indicator	**Unit**	**GS202AP2 - 20MPa**	**GS252AP2 - 25MPa**	**GS322AP2 - 32MPa**	**GS402AP2 - 40MPa**	**GS502AP2 - 50MPa**
GWP-GHG	kg CO_2 eq	221	224	240	264	291

End-of-life Stages

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

Results per declared unit (C1 – C4, D)						
Indicator	**Unit**	**Module C1**	**Module C2**	**Module C3**	**Module C4**	**Module D**
GWP-total	kg CO_2 eq.	1.22E+01	1.53E+01	8.92E+00	5.84E-01	-1.47E+01
GWP-fossil	*kg CO_2 eq.*	*1.22E+01*	*1.53E+01*	*8.91E+00*	*5.84E-01*	*-1.47E+01*
GWP-biogenic	*kg CO_2 eq.*	*1.27E-03*	*1.41E-03*	*1.15E-02*	*7.26E-05*	*-2.65E-02*
GWP-luluc	*kg CO_2 eq.*	*6.01E-06*	*7.10E-06*	*4.00E-06*	*2.81E-07*	*-4.17E-06*
ODP	kg CFC 11 eq.	2.01E-06	2.37E-06	1.09E-06	9.47E-08	-1.14E-06
AP	mol H^+ eq.	1.39E-01	1.33E-01	3.21E-02	1.45E-03	-1.23E-01
EP-freshwater	kg P eq.	1.81E-06	1.06E-06	7.49E-06	8.77E-08	-1.59E-05
EP-marine	kg N eq.	6.02E-02	4.18E-02	5.31E-03	2.58E-04	-3.87E-02
EP-terrestrial	mol N eq.	6.60E-01	4.58E-01	5.77E-02	2.82E-03	-4.41E-01
POCP	kg NMVOC eq.	1.59E-01	1.12E-01	1.54E-02	7.58E-04	-1.02E-01
ADP-minerals&metals*	kg Sb eq.	1.48E-08	1.74E-08	2.14E-06	6.79E-10	-9.91E-07
ADP-fossil*	MJ	1.73E+02	2.04E+02	1.04E+02	8.10E+00	-1.65E+02
WDP*	m^3	1.02E+01	1.12E+01	1.18E+02	5.92E-01	-3.99E+01
Additional indicators						
PM	disease incidence	3.66E-06	7.54E-07	2.31E-07	7.90E-09	-2.25E-06
IRP**	kBq U235 eq.	2.56E-04	3.02E-04	1.74E-03	1.20E-05	-2.25E-04
ETP-fw*	CTUe	5.04E+01	5.93E+01	3.20E+01	2.34E+00	-4.04E+01
HTP-c*	CTUh	6.28E-10	2.50E-10	1.45E-09	2.15E-11	-9.66E-10
HTP-nc*	CTUh	5.79E-08	2.01E-08	4.84E-08	2.11E-09	-4.89E-08
SQP*	-	8.31E-01	9.17E-01	2.34E+04	1.36E+01	-8.92E+01

Acronyms

GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption
PM = Particulate matter emissions; IRP = Ionising radiation, human health; ETP-fw = Ecotoxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects; SQP = Land use related impacts / soil quality

** 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.*

Use of Resources, waste production and output flows

Results per declared unit (C1 – C4, D)						
Indicator	**Unit**	**Module C1**	**Module C2**	**Module C3**	**Module C4**	**Module D**
PERE	MJ	2.39E-01	2.62E-01	1.89E+00	1.42E-02	-3.63E+00
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	2.39E-01	2.62E-01	1.89E+00	1.42E-02	-3.63E+00
PENRE	MJ	1.85E+02	2.19E+02	1.25E+02	8.71E+00	-1.76E+02
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.85E+02	2.19E+02	1.25E+02	8.71E+00	-1.76E+02
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	2.54E-02	3.00E-02	4.44E-02	1.20E-03	-2.15E-01
HWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	1.78E-03	1.95E-03	1.34E-02	1.06E-04	-5.60E-02
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acronyms	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Material for recycling; MER = Materials for energy recovery; EE = Exported energy, electricity and thermal					

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

Results per declared unit (C1 – C4, D)						
Indicator	**Unit**	**Module C1**	**Module C2**	**Module C3**	**Module C4**	**Module D**
GWP	kg CO_2 eq	1.21E+01	1.50E+01	8.83E+00	5.80E-01	-1.45E+01
ODP	kg CFC11 eq	1.58E-06	1.87E-06	8.61E-07	7.48E-08	-9.01E-07
AP	kg SO_2 eq	9.82E-02	7.34E-02	1.62E-02	1.12E-03	-6.60E-02
EP	kg PO_4^{3-} eq	2.02E-02	1.41E-02	1.84E-03	8.87E-05	-1.50E-02
POCP	kg C_2H_4 eq	1.15E-02	1.60E-02	1.91E-03	1.49E-04	-6.46E-03
ADPE	kg Sb eq	1.48E-08	1.75E-08	2.15E-06	6.83E-10	-9.95E-07
ADPF	MJ_{NCV}	1.70E+02	2.01E+02	1.17E+02	8.01E+00	-1.68E+02
Acronyms	GWP = Global Warming Potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone; ADPE = Abiotic depletion potential for elements; ADPF = Abiotic depletion potential for fossil resources					

Carbon footprint in line with Australian climate change reporting frameworks

Results per declared unit (C1 – C4, D)						
Indicator	**Unit**	**Module C1**	**Module C2**	**Module C3**	**Module C4**	**Module D**
GWP-GHG	kg CO_2 eq	12.1	15.1	8.85	0.58	-14.4

Additional Information

Waste and Recycling

Throughout Gunlake's operations some materials are re-used into our production processes, including concrete washout, which beneficially reuses materials that would otherwise require disposal.

Biodiversity Management

Gunlake has established over 200 hectares of biodiversity offset land at its Marulan Quarry. These areas are managed in accordance with both NSW and Commonwealth requirements and have been established to provide long term protection and enhancement of habitat and ecological communities.

Community Investment

Gunlake participates in numerous local community programs and events, including ongoing annual funding/grant commitments, community initiatives and memberships. Gunlake will continue to provide such community support and investment within the local and regional areas in which it operates.

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