Independent Cement

Environmental Product Declaration

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for:

Ground Granulated Blast-furnace Slag Environmental Product Declaration

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021
Programme: The International EPD® System, www.environdec.com
Programme operator: EPD Australasia Limited
EPD Registration Number: S-P-10955
Publication date: 2023-12-12
Issued: 2023-11-30
Valid until: 2028-11-30
Version 1.0

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Contents

Programme information

EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804:2012. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804:2012 and ISO 14025:2006. The EPD owner has the sole ownership, liability, and responsibility for the EPD.

Declaration Owner		
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Product category rules (PCR)	PCR 2019:14 Construction Products, Version 1.2.5 2022-11-01 (valid until 2024-12-20) c-PCR-001: Complementary Product Category Rules (c-PCR) for Cement and building lime (EN 16908:2017+A1:2022) Version 2022-05-18 (valid until 2024-12-20)	
PCR review conducted by	The Technical Committee of the International EPD® System. Chair: Claudia A. Peña Contact: info@environdec.com	
Independent third-party verification of the declaration and data, according to ISO 14025:2006:		
☐ EPD process certification	☑ EPD verification	
Procedure for follow-up of data during EPD validity involves third party verifier:		
☐ Yes ☑ No		

About Independent Cement and Lime

Independent Cement and Lime Pty Ltd (ICL) was established in 1987. We are a specialist supplier of cement and cement-blended products as well as Supplementary Cement Materials SCM's such as Slag and Fly-ash, focused on blended cements.

ICL is a marketing and distribution operation with an integrated, purpose built supply chain specifically designed to cater for our core markets. ICL is a specialist supplier of cement and cement-blended products supplying to a wide variety of industries throughout Victoria and NSW including:

— Concrete manufacturing

— Concrete product and precast concrete manufacturers

— The mining sector

— Road construction and rehabilitation

— Cementitious building products

— Packaged cement products to the retail and hardware sectors

ICL is also a specialist supplier of Supplementary Cement Materials SCM's such as Slag and Fly-ash, focused on blended cements and their many benefits to our markets and customers.

Product information

Ground Granulated Blast-furnace Slag (GGBFS) powder is a fine white powder used in concrete. Slag is produced in iron and steel manufacturing process as a by-product. Molten slag is extracted from iron ore at elevated temperature (approximately around 1 500ºC) and rapidly water quenched to obtain reactive granular slag particles. The granular blast furnace slag is then dried and milled with optimized quantities of gypsum in Vertical Roller Miller (VRM) to cement fineness.

Currently slag is most widely used in concrete as a separate supplementary cementitious material or as part of a blended cement. Ground Granulated Blast Furnace Slag complies with Australian Standard AS 3582.2-2001 Supplementary cementitious materials for use with Portland cement.

Typical characteristics of slag

Property Requirements of AS3582.2 Typical result (%) Loss on ignition NA ≤1 Sulfide Sulphur Max 1.5% ≤1 Magnesia Max 15% 4-7 Alumina Max 18% 12-15 Total Iron NA ≤1 45µm residue NA ≤5

Appearance

Concrete containing slag will lighten the colour of fully hardened, cured concrete. Lighter colour in concrete is generally considered as a positive benefit as it improves the aesthetic look and reflectivity of concrete.

Production site

This EPD covers GGBFS from the ICL facility in Yarraville, Victoria (Australia).

Industry classification

UN CPC 374: Plaster, lime and cement

LCA information

This EPD is for one specific product (ground granulated blast-furnace slag). The results are declared for one production site; there is no averaging of products.

Declared unit

1 000 kg of GGBFS from Independent Cement and Lime (ICL).

Background data

Primary data for the LCA was collected and provided by ICL for the year: 1 January 2022 – 31 December 2022.

SimaPro® LCA software v9.5 was used for the LCA modelling. All global background data are taken from Ecoinvent v3.9.1 allocation recycling cut-off model (Weidema, Bauer et al. 2021). Background data for Australian material inputs, energy use, waste treatment and trucks are all sourced from the AusLCI database v1.42 (ALCAS 2023), which are then updated to Ecoinvent 3.9.1 for consistency with other data. Additional EN 15804:2012+A4:2019+AC:2021 indicators for resource use, waste categories, and output flows were manually added in relevant processes using data from the allocation, recycling, cut-off, EN 15804:2012, Ecoinvent database. Background data is less than 10 years old or have been updated within this timeframe.

Cut-off criteria

The cut-off threshold for the LCA study was flows contributing less than 1% for any impact category included in the LCA. No flows were deliberately excluded due to this threshold, however particularly minor inputs expected to be well below this threshold were not considered. Packaging for the grinding aid is assumed to be particularly minor and well below this cut-off threshold and therefore excluded. Personnel related activities are non-attributable and excluded from the system boundary.

Allocation

Some of the key processes requiring allocation in the LCA were the products and co-products from the GGBFS production line. As EN 15804:2012 postulates, the allocation of these products was based on economic values, as the difference in revenue from the co-products relevant to this LCA (GGBFS and iron oxide) is high. As iron oxide is a zero value co-product, the allocation of all impacts is placed on the GGBFS.

Slag is a by-product of steel production; hence the proportion of impacts from pig iron production allocated to blast furnace slag production were included.

Content declaration

The composition of the GGBFS is >95% slag (CAS no. 65996-69-2). The product may contain smaller amounts of gypsum (3-8%) and crystalline silica (quartz).

As ICL GGBFS is delivered in bulk, there is no packaging for the product included in this EPD. There is also no biogenic carbon or recycled material in the GGBFS.

GGBFS from ICL does not contain substances in the Candidate List of Substances of Very High Concern in the European Chemicals Agency in concentrations >0.1% of the weight of the product. For further information, the safety data sheet for ICL GGBFS can be found on the Independent Cement website (direct link here).

System boundary

The system boundary describes the process steps included in the LCA and EPD. The cradle-to-gate life cycle stages (modules A1-A3) are included. As GGBFS is typically used as an additive to cement and concrete mixes, it cannot be physically separated at the end of life and is no longer identifiable at this stage. There is also no biogenic carbon in GGBFS. As such, modules C1-C4 and D are not declared. Modules A4-B7 are also excluded from this study as a typical scenario for this product cannot be defined, and these modules are best modelled at the final product/construction/building project level. End-of-life scenarios may be found in EPDs for concrete, which can include GGBFS as a supplementary cementitious material.

Table 1 System boundary table according to EN 15804:2012+A2 life cycle stages

	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	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Geography	AU, JP	AU	AU	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Specific data used	>90%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = module declared in this study. ND = module not declared in this study.

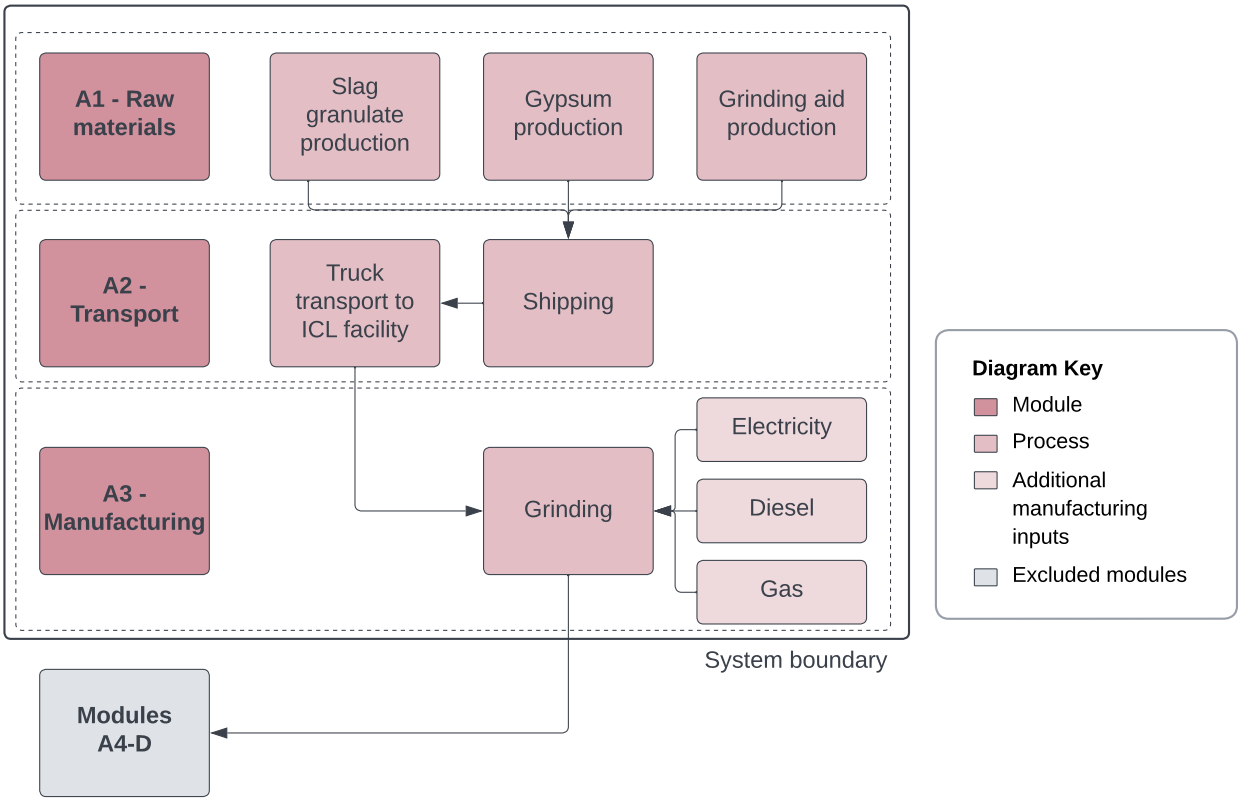

Figure 1 System boundary diagram of ICL GGBFS

Raw material stage (A1)

The key raw materials for ICL GGBFS are slag granulate and raw gypsum. A small quantity of grinding aid is also used.

Transport stage (A2)

The raw materials are shipped via bulk shipping transport to the Port of Melbourne and delivered to the facility via truck.

Manufacturing stage (A3)

This stage involves grinding of the slag granulate into GGBFS. The ICL grinding facility is located in Yarraville, Victoria.

Environmental performance indicators

The environmental indicators for the impact categories described in this EPD are summarised in the tables below. Abbreviations of each indicator will be used in the results tables for simplicity.

Table 2 Mandatory potential environmental impact indicators according to EN 15804:2012+A2:2019/AC:2021

Indicator	Abbreviation	Units
Global warming potential – fossil	GWPF	kg CO2 eq.
Global warming potential – biogenic	GWPB	kg CO2 eq.
Global warming potential - land use/land use change	GWPL	kg CO2 eq.
Global warming potential - total	GWPT	kg CO2 eq.
Ozone depletion potential	ODP	kg CFC 11 eq.
Acidification potential	AP	mol H+ eq.
Eutrophication potential - freshwater	EPF	kg P eq.
Eutrophication potential – marine	EPM	kg N eq.
Eutrophication potential - terrestrial	EPT	mol N eq.
Photochemical ozone creation potential	POCP	kg MNVOC eq.
Abiotic depletion potential – minerals & metals*	ADPE	kg Sb eq.
Abiotic depletion potential – fossil fuels*	ADPF	MJ
Water deprivation potential*	WDP	m^3 H2O eq.

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

Table 3 Additional potential environmental impact indicators according to EN 15804:2012+A2:2019/AC:2021

Indicator	Abbreviation	Units
Particulate Matter emissions	PM	Disease incidence
Ionising Radiation – human health**	IRP	kBq U-235-eq.
Eco-toxicity – freshwater*	ETPF	CTUe
Human toxicity – cancer*	HTPC	CTUh
Human toxicity – non-cancer*	HTPNC	CTUh
Land use related impacts / soil quality*	SQP	Dimensionless
Global warming potential - excluding biogenic uptake, emissions, and storage	GWP-GHG	kg CO_2 eq.

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of the results are high and 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.

Table 4 Use of resources, waste production, and output flows

Indicator		Abbreviation	Units
Primary energy resources - Renewable	Use as energy carrier	PERE	MJ, net calorific value
	Used as raw materials	PERM	
	Total	PERT	
Primary energy resources – Non-renewable	Use as energy carrier	PENRE	
	Used as raw materials	PENRM	
	Total	PENRT	
Use of secondary materials	SM	kg	
Use of renewable secondary fuels	RSF	MJ, net calorific value	
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value	
Net use of fresh water	FW	m^3	
Hazardous waste disposed	HWD	kg	
Non-hazardous waste disposed	NHWD	kg	
Radioactive waste disposed	RWD	kg	
Components for reuse	CRU	kg	
Material for recycling	MFR	kg	
Materials for energy recovery	MER	kg	
Exported energy – electrical and thermal	EE	MJ per energy carrier	

For backwards compatibility, the results according to the EN15804+A1 impact categories are also included in this EPD, shown in Table 5.

Table 5 EN15804:2012+A1 impact categories

Indicator	Abbreviation	Units	Characterisation model
Global warming potential - total	GWPT	kg CO_2 eq.	IPCC model based on 100-year timeframe based on IPCC 2007
Ozone depletion potential	ODP	kg CFC 11 eq.	CML-IA V4.1
Acidification potential	AP	kg SO_2 eq.	CML-IA V4.1
Eutrophication potential	EP	kg PO_4^{3-} eq.	CML-IA V4.1
Photochemical ozone creation potential	POCP	kg C_2H_4 eq.	CML-IA V4.1
Abiotic depletion potential – minerals & metals	ADPE	kg Sb eq.	CML-IA V4.1
Abiotic depletion potential – fossil fuels	ADPF	MJ (NCV)	CML-IA V4.1

Environmental performance indicator results (A1-A3)

The results produced by this study are relative expressions and therefore do not predict impacts on category endpoints, nor the exceeding of thresholds and safety margins or risks.

Mandatory potential environmental impact indicator results

Table 6 Mandatory potential environmental impact indicator results per declared unit of GGBFS for A1-A3 according to EN 15804:2012+A2:2019/AC:2021

Indicator	Unit	Result
GWPT	kg CO_2 eq.	1.64E+02
GWPF	kg CO_2 eq.	1.64E+02
GWPB	kg CO_2 eq.	1.65E-01
GWPL	kg CO_2 eq.	7.99E-02
ODP	kg CFC 11 eq.	1.84E-06
AP	mol H+ eq.	2.35E+00
EPF	kg P eq.	1.37E-02
EPM	kg N eq.	5.11E-01
EPT	mol N eq.	5.65E+00
POCP	kg MNVOC eq.	1.63E+00
ADPE*	kg Sb eq.	5.38E-04
ADPF*	MJ (NCV)	1.86E+03
WDP*	m^3	8.73E+00

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

Additional environmental impact indicator results (A1-A3)

Table 7 Additional potential environmental impact indicators according to EN 15804:2012+A2:2019AC:2021 results (A1-A3)

Indicator	Unit	Result
GWP-GHG	kg CO_2 eq.	1.64E+02
PM	Disease incidence	9.43E-06
IRP**	kBq U-235 eq.	8.45E-01
ETPF*	CTUe	5.17E+02
HTPC*	CTUh	1.34E-07
HTPNC*	CTUh	8.82E-07
SQP*	Dimensionless	2.69E+02

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of the results are high and 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, waste, and output flows (A1-A3)

Table 8 Resource use and other inventory flow indicator results for A1-A3

Indicator	Unit	Result
Resource use		
PERE	MJ NCV	1.39E+01
PERM	MJ NCV	0.00E+00
PERT	MJ NCV	1.39E+01
PENRE	MJ NCV	2.05E+03
PENRM	MJ NCV	1.03E+01
PENRT	MJ NCV	2.06E+03
SM	kg	9.98E+02
RSF	MJ NCV	1.68E-03
NRSF	MJ NCV	0.00E+00
FW	m^3	1.50E-01
Waste flows		
HWD	kg	2.30E+00
NHWD	kg	5.25E+01
RWD	kg	2.04E-04
Output flows		
CRU	kg	0.00E+00
MFR	kg	1.23E-01
MER	kg	3.17E-05
EE	MJ	1.50E-01

EN15804:2012+A1 indicator results (A1-A3)

Table 9 EN15804:2012+A1 environmental performance results

Indicator	Unit	Result
GWP	kg CO_2 eq.	1.60E+02
ODP	kg CFC 11 eq.	1.81E-06
AP	kg SO_2 eq.	1.72E+00
EP	kg PO_4^{3-} eq.	2.20E-01
POCP	kg C_2H_4 eq.	6.24E-02
ADPE	kg Sb eq.	5.38E-04
ADPF	MJ (NCV)	2.17E+03

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