Environmental Product Declaration

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

Firth Masonry Group I products with a GWP-GHG intensity of 17.7 kg CO_2e/m^2 to 21.5 kg CO_2e/m^2

EPD of multiple products, based on a representative product, includes: 20 Series Open Bond Beam, 15 Series Open Bond Beam, Flagstone 50mm Paver, 25 Series Half Lintel, Keystone Sedona Stone Retaining Wall, 20 Series Knock-in Bond Beam, Forum 50mm Paver, Gobi Block, Piazza 50mm Paver, 10 Series Standard, Porous Pave 80mm, Chancery 50mm Paver, Grass Paver, Holland 50mm Paver, 15 Series Half Lintel and 10 Series Half in specific colours and finishes. Refer pages 5 for full detailed list.

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Firth

Firth Industries Ltd (Firth) is New Zealand's largest manufacturer of concrete and concrete masonry products. The history of Firth is part of the history of New Zealand. We've been developing, manufacturing, and delivering concrete and concrete masonry products to New Zealanders for almost a century. Firth has four masonry manufacturing sites across New Zealand.

From day one, innovation has been at the core of the Firth Brand, but not at the expense of long-lasting durability. In 1925, the 'original' Firth family with their entrepreneurial spirit created innovative concrete products that made life easier. Today's wider Firth family still carries that same can-do spirit into today's market challenges. Our designers work alongside our engineers to ensure new designs will stand up to the rigors of time.

All of Firth Industries' products are formulated to meet strict NZ standards. Our engineers ensure Firth customers consistently receive delivery of the highest quality product that they can rely on.

For more information, see: www.firth.co.nz

WHAT IS AN EPD?

An Environmental Product Declaration, or EPD, is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as a PCR (Product Category Rules). EPDs report the measured lifecycle environmental impact of a product so designers and builders can make more informed decisions.

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

The results for EN15804+A1 compliant EPDs are not comparable with EN15804+A2 compliant studies as the methodologies are different. Results that are EN15804+A1 compliant are given in this document to assist comparability with older EPDs.

Declaration Owner:	Firth Industries Ltd
	web: www.firth.co.nz email: info@firth.co.nz Post: PO Box 14534, Panmure, Auckland 1741, New Zealand
EPD Programme	The International EPD® System, www.environdec.com
EPD Programme operator:	EPD International AB Email: info@environdec.com Post: Box 210 60, SE-100 31 Stockholm, Sweden,
EPD Regional programme	EPD Australasia Ltd Web: www.epd-australasia.com Email: info@epd-australasia.com Post: EPD Australasia Ltd, 315a Hardy St, Nelson 7010, New Zealand

Product Category Rules (PCR)

CEN standard EN 15804 served as the core Product Category Rules (PCR)

Product Category Rules (PCR):	PCR 2019.14 Construction Products, version 1.3.3 C-PCR-003 (to 2019:14) Concrete and concrete elements, version 2024-04-30
PCR review was conducted by:	The Technical Committee of the International EPD® System. See www.environdec.com for a list of members.
Review Chair:	Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact.

Life cycle assessment (LCA)

LCA Accountability:	thinkstep Ltd Barbara Nebel, thinkstep-anz ltd. Noa Meron, thinkstep-anz ltd. Kimberly Robertson, thinkstep-anz ltd. Web: http://www.thinkstep-anz.com Email: anz@thinkstep-anz.com Post: 11 Rawhiti Road, Pukerua Bay, Wellington 5026, New Zealand

Third-party verification

Independent verification of the declaration and data, according to ISO 14025:2006, via:

✔ EPD verification by individual verifier

Third party verifier:	Rob Rouwette (Start2see) Rob.rouwette@start2see.com.au
Verifier approved by:	EPD Australasia

Procedure for follow-up of data during EPD validity involved third-party verifier Yes ✔ No

FIRTH'S SUSTAINABILITY COMMITMENT

As NZ's largest concrete company and a leader in concrete design and innovation, Firth are committed to understanding and mitigating any adverse impact our operation has on the environment and integrating the core principles of sustainability throughout our operation.

Implementing sustainable practices throughout the manufacturing process is only the beginning of the contribution Firth makes to long-term sustainable building. Firth recognises that the integration of sustainability goals into business operations is key to the longevity of the concrete industry and its impact on the ecological, social and economic environment.

EPD (Environmental Product Declaration)

The EPD has been produced according to ISO 14040 (ISO, 2006a), ISO 14044 (ISO, 2006b), ISO 14025 (ISO, 2006c), EN 15804+A2 (CEN, 2019), PCR 2019:14 V1.3.3: Construction products and construction services of the International EPD® System (published 2024-03-01), the primary PCR for this EPD, (EPD International, 2024) and C-PCR-003 (to 2019:14) Concrete and Concrete Elements, version 2024-04-30.

The results of this study are not intended to support environmental claims or comparative assertions of competitor products which are intended to be disclosed to the public.

PRODUCT INFORMATION

The EPD is of the 'cradle-to-gate with modules C1-C4 and module D' type (i.e., EN 15804 modules A1, A2, A3, C1, C2, C3, C4 and module D).

Firth masonry (bricks, blocks, paving and segmental retaining walls) are manufactured at four sites across New Zealand and four of them are included in the LCA. All life cycle inventory and impact assessment data have been reported per square meter (m^2) of bricks, blocks, paving and segmental retaining walls, at the manufacturing plant gate. Firth's manufacturing plants use cement exclusively from Golden Bay.

Products covered by EPD

Firth masonry products are produced at 4 manufacturing plants around New Zealand (Whangarei, Hunua/ Auckland, Belmont/Wellington, and Broughs Rd/Christchurch). The products manufactured at each plant are listed in Table 1. There are three finished options for the masonry:

- Fair faced – as the bricks, blocks and paving are removed from the curing kiln.
- Honed – the outside of the bricks, blocks and paving is ground to produce a matt exposed aggregate finish. They are intended to be used as either used as masonry wall systems for residential and commercial buildings, as well as use as internal feature and inter-tenancy walls.
- Bush- hammered – the outside of the brick and paving is hit by a high impact machine to pit the surface and creates a rough surface slip resistant for pavers.

The study and associated EPD present results for a product group, using representative products. The grouping is done based on GWP-GHG, keeping products in all groups within ±11% of the representative products impact.

As New Zealand's largest manufacturer of concrete masonry products, Firth products are made for local conditions to meet or exceed New Zealand Building Code compliance.

- Firth manufacture its concrete segmental pavers to NZS3116 in association with AS/NZS 4455 and AS/NZS 4456

- Firth manufacture its concrete segmental retaining wall blocks to AS/NZS 4455 and AS/NZS 4456.
- Firth manufacture its structural masonry blocks and concrete brick veneers to NZS4210 and tested to New Zealand Standard AS/NZS4455.
- Firth manufacture its structural masonry blocks, concrete brick veneers and segmental retaining wall products to New Zealand Standard NZS4210 in conjunction with the combined standard AS/NZS 4455 and test methods as per AS/NZS 4456.

Table 1: Products included in the EPD and location of manufacture.

Plant	Product	Colour	Finish	Grade
Belmont	20 Series Open Bond Beam	Natural	Fair Face	Standard
Belmont	15 Series Open Bond Beam	Natural	Fair Face	Municipal
Belmont	Flagstone 50mm	Terracotta	Fair Face	Municipal
Belmont	Flagstone 50mm	Black Sand	Fair Face	Municipal
Belmont	Flagstone 50mm	Volcanic Ash	Fair Face	Municipal
Belmont	15 Series Open Bond Beam	Natural	Fair Face	Standard
Belmont	25 Series Half Lintel	Natural	Fair Face	Municipal
Belmont	Flagstone 50mm	Terracotta	Fair Face	Standard
Broughs Road	Keystone Sedona Stone	Rockface	Honed	Municipal
Broughs Road	Keystone Sedona Stone	Rockface	Bush Hammered	Municipal
Broughs Road	20 Series Knock-in Bond Beam	Natural	Fair Face	Municipal
Broughs Road	20 Series Open Bond Beam	Natural	Fair Face	Municipal
Broughs Road	Keystone Sedona Stone	Rockface	Fair Face	Municipal
Broughs Road	Forum 50mm	Avon	Honed	Municipal
Broughs Road	Forum 50mm	Avon	Bush Hammered	Municipal
Broughs Road	Forum 50mm	Avon	Fair Face	Municipal
Broughs Road	Gobi Block	Natural	Honed	Municipal
Broughs Road	Gobi Block	Natural	Bush Hammered	Municipal
Broughs Road	Piazza 50mm	Avon	Honed	Municipal
Broughs Road	Piazza 50mm	Avon	Bush Hammered	Municipal
Broughs Road	Piazza 50mm	Avon	Fair Face	Municipal
Broughs Road	Gobi Block	Natural	Fair Face	Municipal
Broughs Road	Keystone Sedona Stone	Rockface	Honed	Standard
Broughs Road	Keystone Sedona Stone	Rockface	Bush Hammered	Standard
Hunua	20 Series Open Bond Beam	Natural	Fair Face	Standard
Hunua	10 Series Standard	Natural	Fair Face	Municipal
Hunua	Porous Pave 80mm	Black Sand	Fair Face	Standard
Hunua	Gobi Block	Natural	Fair Face	Standard
Hunua	Chancery 50mm	Black Sand	Honed	Municipal
Hunua	Chancery 50mm	Black Sand	Bush Hammered	Municipal
Hunua	10 Series Standard	Natural	Fair Face	Standard
Hunua	Grass Paver	Natural	Fair Face	Municipal
Hunua	Chancery 50mm	Black Sand	Fair Face	Municipal
Hunua	Holland 50mm	Black Sand	Honed	Municipal
Hunua	Holland 50mm	Black Sand	Bush Hammered	Municipal
Whangarei	Keystone Sedona Stone	Rockface	Fair Face	Standard
Whangarei	15 Series Half Lintel	Natural	Fair Face	Standard
Whangarei	10 Series Half	Natural	Fair Face	Municipal
Whangarei	10 Series Half	Natural	Fair Face	Standard

Declared Unit

The declared unit for the EPD is 1 m^2 of packaged concrete blocks or paving stones at the manufacturing plant gate, used for buildings and infrastructure in a range of structural and decorative applications. The UN CPC and ANZSIC codes applicable to Firth Masonry products in this EPD are shown in Table 2.

Table 2: Industry Classification

Product	Classification	Code	Category
Masonry blocks and paving stones	UN CPC Ver.2	37510	Non-refractory mortars and concretes
	ANZSIC 2006	2034	Concrete Product Manufacturing

Grouping of Products

This EPD covers 39 combinations of product, product finish and manufacturing location. To simplify the communication of environmental profiles, it is necessary to group products. Products were grouped based on their GWP-GHG results, complying with the PCR 2019:14 v1.3.3 requirements (EPD International, 2024).

The impacts for a representative product are declared for each group. The GWP-GHG impacts for all products in the group fall within ±10.3% of the representative product impact. The representative product for this EPD is the product with a GWP-GHG impact value higher than the group's average and closest to it. Gobi Block, Nautral, Fair Face, Standard, Manufactured at Hunua.

Content Declaration

The composition of Firth Masonry products is given in Table 3, and its packaging in Table 4.

Due to the confidential nature of the composition, upper and lower limits are given per ingredient.

The masonry products included in this EPD are non-hazardous. They do not contain - or release during use - any of the hazardous materials identified in the 'Candidate List of Substances of Very High Concern' (SVHC) (European Chemical Agency, 2023) at a concentration of greater than 0.1% of the mass. However, health effects may result due to release of dust when cutting, sawing, drilling, sanding and grinding hardened concrete. Exposure through inhalation should be avoided.

Table 3: Composition of Firth Masonry products (per 1m^2 of product)

Product components	% (m/m input)	Weight, kg/m^2	Post-consumer recycled material, weight-%	Biogenic material, weight-%	Biogenic material, kg C/m^2
Cement	**4%-34%**	5.11-56.8	0%	0%	0
Premium All Passing (PAP) Aggregate	**0%-69%**	0-304	0%	0%	0
Sand	**0%-91%**	0-440	0%	0%	0
Limestone	**0%-86%**	0-120	0%	0%	0
Pumice	**0%-32%**	0-70.8	0%	0%	0
Admixtures	**0%-1%**	0-1.09	0%	0%	0
Oxides	**0%-1%**	0-1.33	0%	0%	0
Water	**1%-4%**	0.511-13.0	0%	0%	0
Total	**100%**	**17.5-525 kg/m^2 (1,2)**	**0%**	**0%**	**0**

Table 4: Composition of Firth Masonry packaging (per 1m^2 of product)

Packaging materials	Weight, kg/m^2	Weight-% (versus the product)	Biogenic material, weight-% (versus the product)	Weight biogenic carbon, kg C/m^2
Wooden Pallet	0.0564-1.69	0.323%	0.126%	0.102-0.661
LDPE shrink wrap	0.0137-0.0395	0.0146%	0	0
Total	**0.0701-1.73**	**0.3376%**	**0.126%**	**0.102-0.661**

1) The composition table above covers our range of masonry products. The range in weight of the products covered by this EPD varies between 94 - 242 kg/m^2
2) The weight of the representative product is 136 kg/m^2

Software and Database

The LCA model was created using the Life Cycle Assessment for Experts (LCA FE): version 10.8.0.14 (formerly known as GaBi Software) system for life cycle engineering, developed by Sphera Solutions, Inc. The Managed LCA Content (MLC) database v 2023.2 (Sphera, 2023) provides the life cycle inventory data for several of the raw and process materials obtained from the background system. Background data used is less than 10 years old.

System Boundaries

This study, and the EPD based on it, has a scope of 'cradle-to-gate with modules C1-C4 and module D', as shown in Table 5. The production stage (modules A1-A3) includes all aspects of masonry brick and paving stone production from cradle to gate, utilising elementary and product flows.

Other life cycle stages concerning transport to customer (A4), construction (A5), the use stage (B1-B7), are not included in this EPD. These life cycle stages vary by end use and are best considered according to application. CO_2 uptake (carbonation) has not been included at end-of-life. Impacts and indicators related to waste are considered in the module in which the waste occurs in line with the polluter pays principle specified in EN 15804.

Table 5: Modules of the production life cycle included in the EPD

	Product stage			Construction process stage		Use stage							End-of-life stage				Recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport	Waste processing	Disposal	Future reuse, recycling or energy recovery 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	X	X	X	X	X
Geography	GLO	GLO	NZ										NZ	NZ	NZ	NZ	NZ
Specific data	>83%																
Variation: products	<10.3%																
Variation: sites	0%*																

X = included in the EPD; ND = Module not declared

*Most products are unique to each manufacturing site. Products from different manufacturing sites are reported separately and are not reported as the same products.

The processes below are included in the product system to be studied. For modules beyond A3, the scenarios included are currently in use and are representative for one of the most probable alternatives.

Product stage (Modules A1-A3)

The production stage includes the environmental impacts associated with raw materials extraction and processing of inputs, transport to, between and within the manufacturing site, and manufacturing of average product at the exit gate of the manufacturing site. The impacts include the production and use of fuels and electricity, production of auxiliary materials and packaging materials, and waste treatment of production wastes. A1-A3 results include the 'balancing-out reporting' of the biogenic CO_2, PERM and PENRM of packaging released in module A5. This was done according to Annex 3 of PCR 2019:14 v1.3.3 (EPD International, 2024).

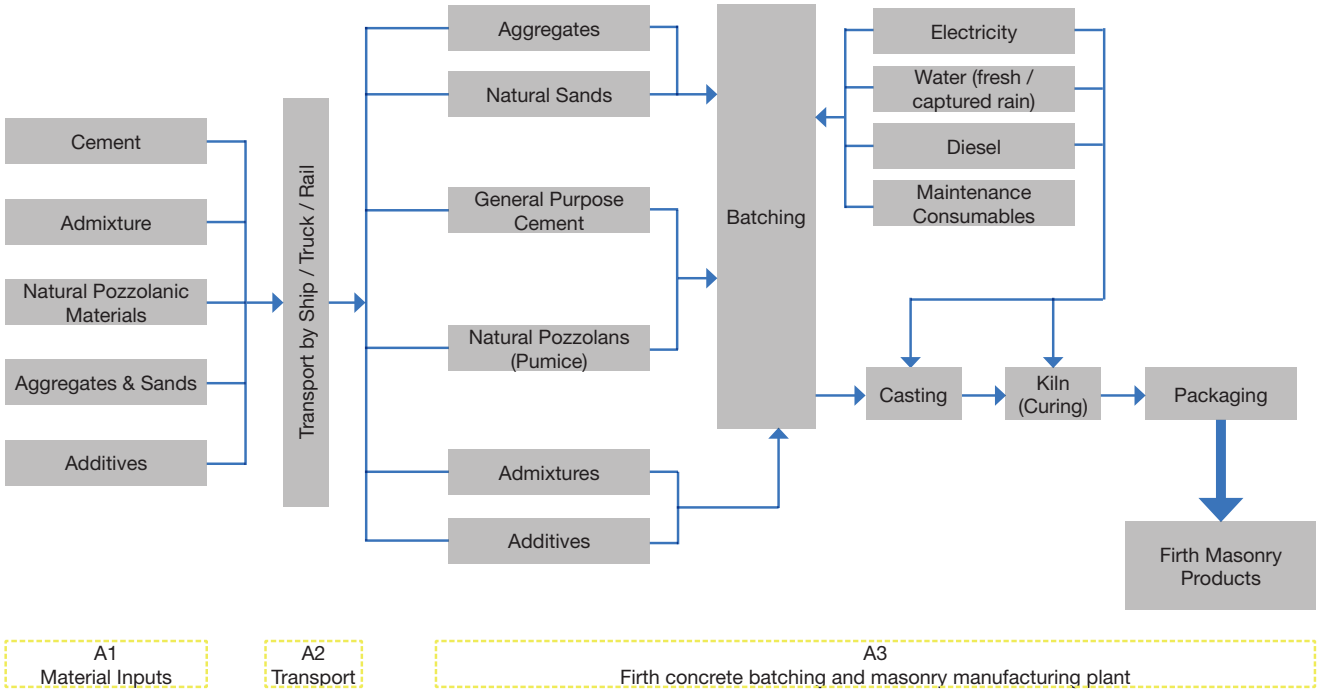
Manufacturing Process

This study focuses on the production technologies in use at four of Firth's masonry brick and paving stone manufacturing plants as listed below. The high-level processes for modules A1-A3 are given in Figure 1. Producer specific data have been collected for a twelve month period ending in 2019.

- Whangarei
- Auckland (Hunua)
- Wellington (Belmont)
- Christchurch (Broughs Rd)

Masonry concrete products are manufactured by mixing the concrete constituents in specific quantities to achieve the desired engineering properties. The concrete is then cast, once cast if required the concrete is kilned. Typically, between 20%-80% of our products are kilned. The energy that is used for kilning averaged across the kilned products using mass allocation.

Figure 1: Life cycle stages of Firth Masonry products concrete manufacture (A1-A3)



The composition of the 1kV-60kV electricity grid mix is modelled in LCA FE. It is based on published data for the year 1st April 2021 – 31st March 2022 (BraveTrace, 2023). The New Zealand residual electricity mix is made up of hydro (56.6%), geothermal (19.7%) natural gas (12.5%), wind (6.55%), coal (4.25%), biomass (0.266%) and biogas (0.160%). The emission factor for the New Zealand residual grid mix for the GWP-GHG indicator is 0.146 kg CO_2e/kWh (based on EF3.0).

Transport

Primary transport data was used for transport of production inputs (A2). Any wastes from the production process (A3) are assumed to be transported over a 30 km distance to a treatment or disposal site. Transport modes:

- Transport, freight, lorry 16-32 metric ton, EURO4.
- Transport, freight, sea, container ship.

End of Life (Module C)

When a building reaches its end-of-life, Firth Masonry products are disposed of. In New Zealand, brick waste materials are typically disposed of in a landfill or recycled. Module C includes waste processing followed by recycling/landfill of the product. The scenarios included are currently in use and are representative for one of the most probable alternatives. The end-of-life stage (Modules C1-C4) and resource recovery stage (Module D) are modelled using a scenario reflecting end-of-life recycling/ landfilling rates for concrete products in the construction sector, based on the estimated share of bricks going to landfilling and recycling from BRANZ (Dowdell, 2022). When a building reaches its end-of-life it is demolished (C1) and the demolition waste is transported to a processing facility (C2). The waste processing (C3) includes the separation and crushing of masonry waste from other building materials. The point at which the concrete is crushed is considered as the end-of-waste point for the recycled concrete blocks. The end-of-life stage (Modules C1-C4) and resource recovery

stage (Module D) are modelled using a scenario reflecting end-of-life recycling/ landfilling rates for concrete products in the construction sector.

There is a large variation of products' mass within the group. If end-of-life impacts are important to the user of the EPD, the effect of the mass of the product on module C and module D results should be considered, as the current values are valid for the representative product.

Module D

50% of masonry is assumed to be recycled at end-of-life (in module C3). The recycling process generates recycled concrete aggregate, which can replace virgin aggregates. Module D considers the net amount of recycled materials over the life cycle of a product. Since no recycled aggregates are used in the production of our masonry, the net amount of recycled material entering module D is 0.50 tonnes per tonne of product. (This equals 0.068 tonnes per m^2 for product group I.) It is assumed that the recycled concrete aggregate replaces an equal amount of virgin aggregates.

Table 6: Assumptions for end-of-Life scenario development

Process	Unit (expressed per declared unit of products by type of material)
Excavator	Demolishing with an Excavator equivalent of 1m^2 of product
Collection process	1 m^2 collected separately
	0 m^2 collected with mixed construction waste
Recovery system specified by type	50% for recycling
	50% for landfill
Disposal specified by type	50% modelled as inert material in landfill
Assumptions for scenario development	C1 - Demolishing with an Excavator (100kW). Fuel consumption is calculated based on 0.172 kg diesel input per tonne of material. Equivalent to 0.02 L/m^2. Conversion: 136 kg/m^2.
	C2 - 50 km of transport by truck
	C3 – based on 0.52 L of diesel per tonne of recycled masonry material produced. Equivalent to 0.025 L/m^2. Equivalent to 0.068 tonne/m^2.
	C4 – landfilled material modelled as inert material. Equivalent to 0.068 tonne/m^2.
	D – 50% product as avoided virgin aggregate (RER: Crushed stone grain 2-15 mm (undried) (EN15804 A1-A3)). Equivalent to 0.068 tonne/m^2.

Geographical coverage

The foreground data for masonry production were collected from four masonry manufacturing plants around New Zealand. Geographical coverage is as follows:

- Input materials: relevant to locations identified (New Zealand cement (S-P-01170 Version 1.1, Golden Bay Cement, 2023), aggregates, water, Chinese microsilica, and European admixtures (EPD-EFC-20210198-IBG2-EN for +A2 indicators (EFCA, 2023) and EPD-EFC-20150091-IAG1-EN for +A1 indicators (EFCA, 2015))).
- Transport of materials and inputs from suppliers (Australian fuel datasets used as a proxy for New Zealand).
- Energy: specific situations modelled for the relevant geographic location with primary data reflecting specific or regional conditions, e.g. regional energy provisions (electricity and thermal energy).

New Zealand-specific data were used where possible. For some materials, background data represent Australian or European conditions as no geographically relevant matching New Zealand LCI dataset was available within the MLC databases (Sphera, 2023). These are not expected to materially impact the overall results.

Cut off criteria

Personnel-related processes are excluded as per section 4.3.2 in the PCR (EPD International, 2024).

thinkstep-anz consistently excludes environmental impacts from infrastructure, construction, production equipment, and tools that are not directly consumed in the foreground production process, ('capital goods')

regardless of potential significance. High-quality infrastructure-related data isn't always available and there is no clear cut-off for what to include. For this reason, capital goods data are applied to LCA studies inconsistently. This is expected to lead to reduced consistency and comparability of EPDs. Capital goods were previously excluded from EPDs, thus including capital goods in current EPDs would further reduce their comparability. Infrastructure used in electricity generation is included as standard in the LCAFE datasets, as this is important for renewable generation.

Allocation

Where subdivision of processes was not possible, allocation rules listed in PCR chapter 4.5 have been applied. Impacts associated with concrete manufacturing have been allocated on a linear production volume basis.

End-of-life allocation follows the requirements of EN 15804:2017+A2:2019 § 6.4.3.3 and generally follows the polluter pays principle. At the end of life of product, brick waste is collected for recycling and is thus available to produce a recycling credit within Module D. The point at which the concrete is crushed is considered as the end-of-waste point for the recycled concrete blocks.

Life Cycle Impact Assessment

The results tables describe the different environmental indicators for each product per declared unit, for each declared module. The EN 15804 reference package based on EF 3.0 is used.

- Table 7 contains the core environmental impact indicators in accordance with EN 15804:2012+A2:2019, describing the potential environmental impacts of the product.
- Table 8 shows the life cycle inventory indicators for resource use.
- Table 9 displays the life cycle inventory indicators for waste and other outputs.
- Table 10 provides additional environmental impact indicators in accordance with EN 15804:2012+A2:2019.
- Table 11 displays biogenic carbon content indicators.
- Table 12 contains results for environmental impact indicators in accordance with EN 15804:2012+A1:2013 to aid backward comparability.

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

Energy indicators (MJ) are always given as net calorific value.

Table 7: EN15804+A2 Core Environmental Impact Indicators

Impact category	Abbreviation	Unit
Climate change – total	GWP-total	kg CO_2-eq.
Climate change – fossil	GWP-fossil	kg CO_2-eq.
Climate change – biogenic	GWP-biogenic	kg CO_2-eq.
Climate change – land use and land use change	GWP-luluc	kg CO_2-eq.
Ozone depletion	ODP	kg CFC11-eq.
Acidification	AP	Mole of H^+ eq.
Eutrophication aquatic freshwater	EP-freshwater	kg P eq.
Eutrophication aquatic marine	EP-marine	kg N eq.
Eutrophication terrestrial	EP-terrestrial	Mole of N eq.
Photochemical ozone formation	POFP	kg NMVOC eq.
Depletion of abiotic resources – minerals and metals[1]	ADP-m&m	kg Sb-eq.
Depletion of abiotic resources – fossil fuels[1]	ADP-fossil	MJ
Water use[1]	WDP	m^3 world equiv.

Table 8: Life cycle inventory indicators on use of resources

Indicator	Abbreviation	Unit
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	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 energy resources used as raw materials	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
Total use of net fresh water	FW	m^3

Table 9: Life cycle inventory indicators on waste categories and output flows

Indicator	Abbreviation	Unit
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed	RWD	kg
Components for reuse	CRU	kg
Materials for energy recovery	MER	kg
Materials for recycling	MFR	kg
Exported electrical energy	EEE	MJ
Exported thermal energy	EET	MJ

Table 10: EN15804+A2 Additional Environmental Impact Indicators

Indicator	Abbreviation	Unit
Climate Change[2]	GWP-GHG	kg CO_2-eq
Climate Change[3]	GWP-GHG (IPCC AR5)	kg CO_2-eq
Particulate Matter emissions	PM	Disease incidences
Ionising Radiation – human health[4]	IRP	kBq U235 eq.
Eco-toxicity (freshwater)[1]	ETP-fw	CTUe
Human Toxicity, cancer[1]	HTP-c	CTUh
Human Toxicity, non-cancer[1]	HTP-nc	CTUh
Land use related impacts / soil quality[1]	SQP	Dimensionless

Table 11: Biogenic carbon content indicators

Indicator	Abbreviation	Unit
Biogenic carbon content - product	BCC-prod	kg C
Biogenic carbon content - packaging	BCC-pack	kg C

Table 12: EN15804+A1 Environmental Impact Indicators

Indicator	Abbreviation	Unit
Global warming potential	GWP (EN15804+A1)	kg CO_2-eq.
Ozone depletion potential	ODP (EN15804+A1)	kg CFC11-eq.
Acidification potential	AP (EN15804+A1)	kg SO_2-eq.
Eutrophication potential	EP (EN15804+A1)	kg PO_4^3-- eq.
Photochemical ozone creation potential	POCP (EN15804+A1)	kg C_2H_4-eq.
Abiotic depletion potential for non-fossil resources	ADPE (EN15804+A1)	kg Sb-eq.
Abiotic depletion potential for fossil resources	ADPF (EN15804+A1)	MJ

Disclaimers

[1]The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

[2]This indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero. It has been included in the EPD following the PCR.

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

[4]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 some construction materials, is also not measured by this indicator.

For Firth, the following indicators are not relevant, hence result in zero values:

- Materials for energy recovery (MER) is zero as there are none produced.
- Exported electrical and thermal energy (EEE and EET) are zero as none is produced.

Results

Since Module C is included in the EPD, the use of Module A1-A3 results without considering the results of Module C is discouraged.

Table 13: EN15804+A2 core environmental impact indicators for 1 m^2 of representative product.

Environmental Indicator	Unit	A1-A3	A1-A3 Max variation	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq.	19.6	10%	0.0954	0.768	0.0151	1.11	-0.224
GWP-fossil	kg CO_2 eq.	19.5	10%	0.0913	0.734	0.0151	1.11	-0.223
GWP-biogenic	kg CO_2 eq.	0.111	77%	0.00415	0.0341	0	0	0
GWP-luluc	kg CO_2 eq.	0.00385	102%	5.65E-06	9.07E-06	1.51E-06	0.00344	-9.49E-04
ODP	kg CFC-11 eq.	8.43E-12	90%	1.06E-14	1.72E-14	9.83E-15	2.82E-12	-2.06E-12
AP	Mole H+ eq.	0.0452	27%	4.52E-04	0.00457	9.53E-05	0.00786	-6.76E-04
EP-freshwater	kg P eq.	5.68E-06	161%	2.18E-08	1.36E-07	1.89E-08	2.23E-06	-7.90E-07
EP-marine	kg N eq.	0.0188	31%	2.14E-04	0.00232	3.09E-05	0.00203	-2.46E-04
EP-terrestrial	Mole N eq.	0.215	30%	0.00235	0.0255	3.40E-04	0.0224	-0.00283
POCP	kg NMVOC kg.	0.0497	26%	6.06E-04	0.00443	9.75E-05	0.00613	-5.97E-04
ADPE[1]	kg Sb eq.	2.10E-07	92%	1.11E-09	2.49E-09	4.21E-10	5.11E-08	-2.50E-08
ADPF[1]	MJ	107	651%	1.29	10.6	1.58	14.8	-3.83
WDP[1]	m^3 world eq.	2.11	350%	2.16E-04	0.00129	4.65E-04	0.122	-0.106

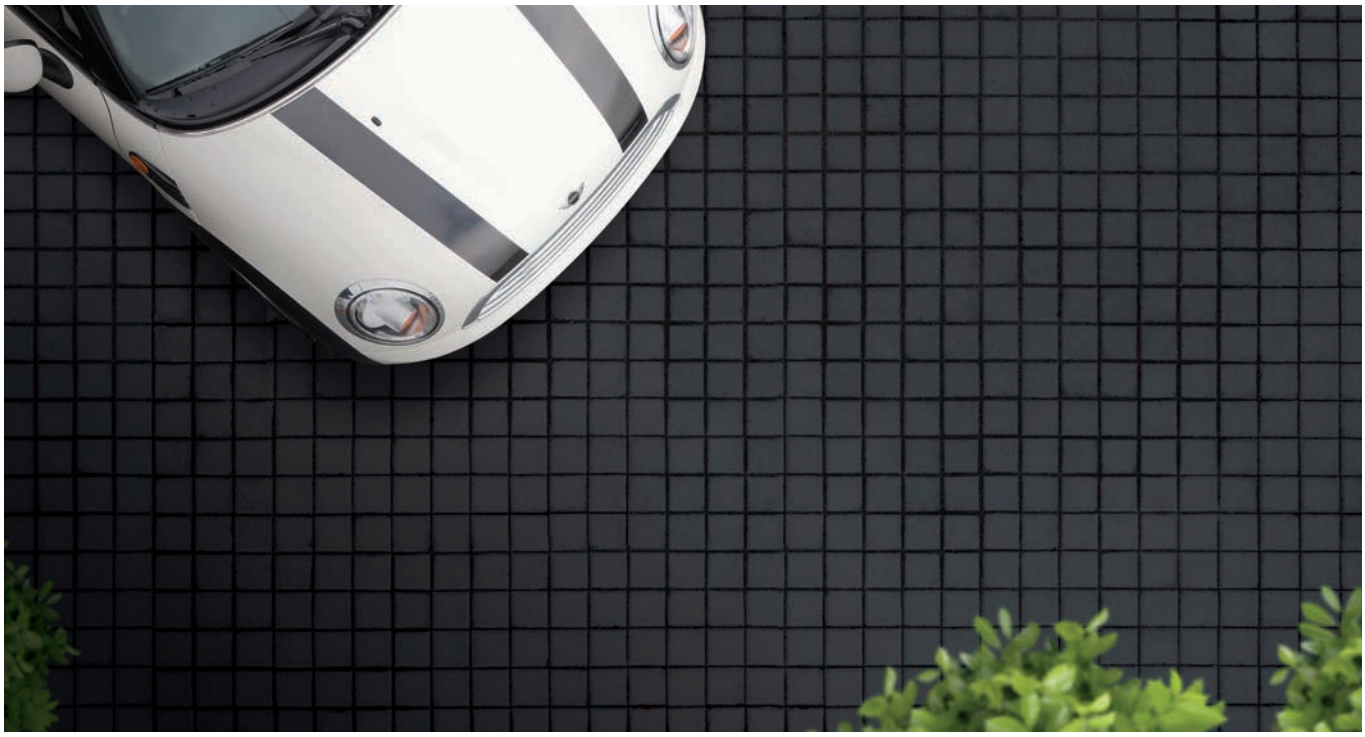


Table 14: EN15804+A2 parameters for 1 m^2 of representative product

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
PERE	MJ	64.5	0.00833	0.0166	0.00572	2.41	-1.50
PERM	MJ	0	0	0	0	0	0
PERT	MJ	64.5	0.00833	0.0166	0.00572	2.41	-1.50
PENRE	MJ	107	1.30	10.6	1.58	14.8	-3.83
PENRM	MJ	0	0	0	0	0	0
PENRT	MJ	107	1.30	10.6	1.58	14.8	-3.83
SM	kg	0.172	0	0	0	0	0
RSF	MJ	15.3	0	0	0	0	0
NRSF	MJ	0.0137	0	0	0	0	0
FW	m^3	0.126	9.69E-06	2.42E-05	9.23E-06	0.00373	-0.00310
HWD	kg	2.34E-10	2.39E-12	6.55E-12	1.14E-12	3.21E-10	1.63E-10
NHWD	kg	15.0	1.29E-04	1.19E-04	3.40E-05	73.9	-0.00202
RWD	kg	0.00112	2.16E-06	3.26E-07	2.30E-07	1.68E-04	-3.74E-04
CRU	kg	5.06E-04	0	0	0	0	0
MFR	kg	0	0	0	73.8	0	0
MER	kg	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0

Table 15: EN15804+A2 additional environmental indicators for 1 m^2 of representative product

Environmental Indicator	Unit	A1-A3	C1	C2	C3	C4	D
PM	Disease incidences	6.54E-07	5.13E-09	1.52E-08	9.06E-10	9.67E-08	-2.24E-08
IRP[4]	kBq U235 eq.	0.177	3.19E-04	3.33E-05	2.87E-05	0.0195	-0.0622
ETP-fw[1]	CTUe	163	0.920	2.44	0.675	8.05	-2.03
HTP-c[1]	CTUh	1.30E-09	1.71E-11	4.12E-11	1.13E-11	1.24E-09	-6.34E-11
HTP-nc[1]	CTUh	7.44E-08	8.59E-10	2.01E-09	3.48E-10	1.36E-07	-3.28E-09
SQP[1]	Pt	104	0.00807	0.00909	0.00290	3.59	-1.49
GWP-GHG[2]	kg CO_2 eq.	19.5	0.0914	0.734	0.0152	1.12	-0.226
GWP-GHG (IPCC AR5)[3]	kg CO_2 eq.	19.4	0.0902	0.728	0.0143	1.10	-0.221

Table 16: Biogenic Carbon Content for 1 m^2 of representative product

Environmental Indicator	Unit	A1-A3
Biogenic carbon content - product	kg C/m^2	0
Biogenic carbon content - packaging	kg C/m^2	0.167

Table 17 provides results using the indicators and characterisation factors of EN15804+A1 to aid comparison and backwards compatibility with rating tools. While the indicators and characterisation methods are from EN 15804:2012+A1:2013, other LCA rules for the study (system boundaries, allocation, etc.) are according to EN 15804:2012+A2:2019; i.e., this study does not claim that the results of the “A1 indicators” are compliant with EN 15804:2012+A1:2013.

Table 17: EN15804 +A1 core environmental impact indicators for 1 m^2 of representative product

Environmental Indicator	Unit	A1-A3	C1	C2	C3	C4	D
GWP (EN15804+A1)	kg CO_2 eq.	19.3	0.0937	0.455	0.00684	0.524	-0.218
ODP (EN15804+A1)	kg CFC-11 eq	1.69E-11	1.25E-14	1.22E-14	5.79E-15	1.66E-12	-2.43E-12
AP (EN15804+A1)	kg SO_2 eq.	0.0315	3.16E-04	0.00186	3.65E-05	0.00313	-4.87E-04
EP (EN15804+A1)	kg PO_4^{3-} eq.	0.00740	7.21E-05	4.68E-04	5.33E-06	3.55E-04	-9.91E-05
POCP (EN15804+A1)	kg C_2H_4 eq.	0.00180	3.15E-05	-7.65E-04	4.49E-06	2.36E-04	1.72E-05
ADPE (EN15804+A1)	kg Sb eq.	2.05E-07	1.13E-09	1.49E-09	2.11E-10	2.61E-08	-2.75E-08
ADPF (EN15804+A1)	MJ	100	1.27	6.33	0.786	7.08	-2.73

References

Australian/New Zealand Standard (2003) AS/NZS 4456:2003 Masonry units, segmental pavers and flags - Methods of test

Australian/New Zealand Standard (2008) AS/NZS 4455:2008 Masonry units, pavers, flags and segmental retaining wall units - Masonry units

BraveTrace. (2023). NZECS Residual Supply Mix for electricity certification. New Zealand.

CEN. (2019). EN 15804:2012+A2:2019 Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products. Brussels: European Committee for Standardization.

Dowdell, D. (2022). Building end-of-life (module C1). BRANZ. Retrieved from https://www.branz.co.nz/environment-zero-carbon-research/framework/data/

EFCA. (2015). EPD of Concrete admixtures – Plasticisers and Superplasticisers. Declaration number: EPD-EFC-20150091-IAG1-EN. Institut Bauen und Umwelt e.V. (IBU).

EFCA. (2023). EPD of Concrete admixtures – Plasticisers and Superplasticisers. Declaration number: EPD-EFC-20210198-IBG2-EN. Institut Bauen und Umwelt e.V. (IBU). Retrieved from https://www.efca.info/download/plasticisers-and-superplasticisers-epd-2015/

Environdec (2023). c-PCR-003 Concrete and concrete elements (EN 16757:2022), Product category rules for concrete and concrete elements, V 2024-04-30

EPD Australasia. (2023). Instructions of the Australasian EPD Programme V4.1 - A Regional Annex to the General Programme Instructions of the International EPD System. Retrieved from EPD Australasia: https://epd-australasia.com/wp-content/uploads/2023/10/EPD-Australasia-Australasian-Annex-to-GPI_4.1-2023-10-31.pdf

EPD International. (2024). PCR 2019:14 Construction Products version 1.3.3 of 2024-03-01 (valid until 2024-12-20). Stockholm: EPD International.

European Chemicals Association (2023) Candidate List of substances of very high concern for Authorisation, published in accordance with Article 59(10) of the REACH Regulation, Helsinki

Golden Bay Cement. (2023, June 12). EcoSure GP cement and EcoFast HE cement. Declaration number S-P-01170 Version 1.1. Retrieved from EPD Australasia: https://epd-australasia.com

IPCC. (2013). Climate Change 2013: The Physical Science Basis. Geneva, Switzerland: IPCC.

ISO. (2006a). ISO 14040: Environmental management – Life cycle assessment – Principles and framework. Geneva: International Organization for Standardization.

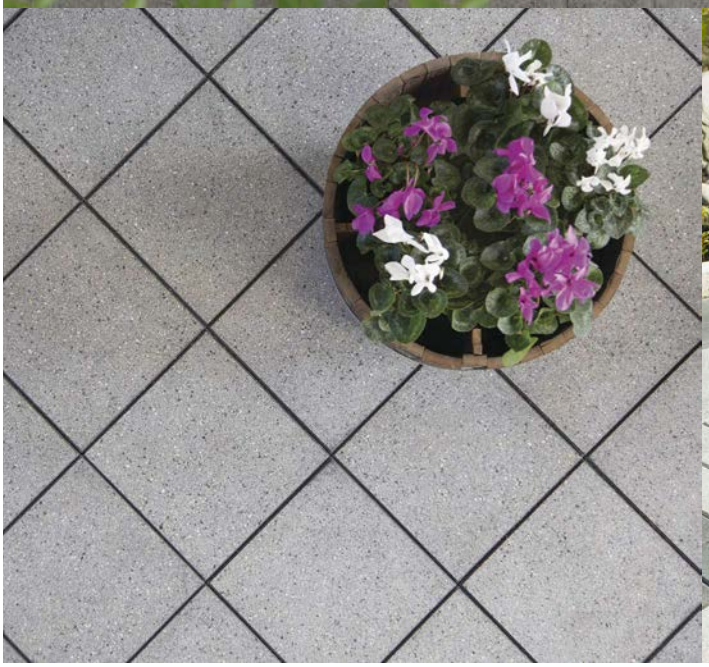
ISO. (2006b). ISO 14044: Environmental management – Life cycle assessment – Requirements and guidelines. Geneva: International Organization for Standardization.

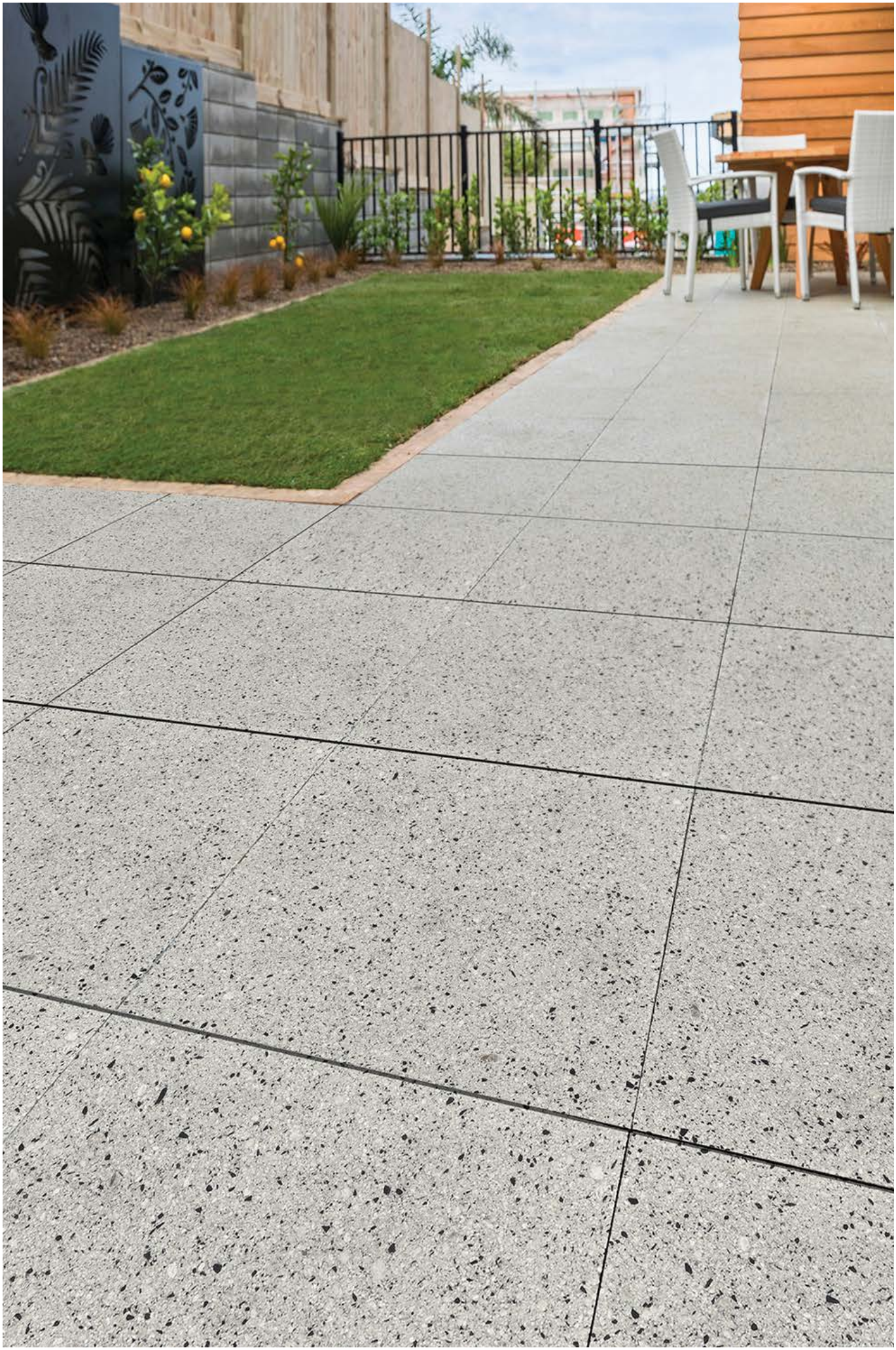
ISO. (2006c). ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures. Geneva: International Organization for Standardization.

New Zealand Standard (2001) NZS 4210:2001 Masonry construction: Materials and workmanship.

New Zealand Standard (2002) NZS 3116:2002 Concrete segmental and flagstone paving.

Sphera. (2023). 2023 Dataset Documentation. Retrieved from https://sphera.com/product-sustainability-gabi-data-search/






Firth