CITY CIRCLE
DEMOLITION - EXCAVATION - RECYCLING

Environmental product declaration

RECYCLED AGGREGATE PRODUCTS

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EPD INTERNATIONAL EPD SYSTEM

AUSTRALASIA EPD® INTERNATIONAL EPD SYSTEM

ECO PLATFORM EPD VERIFIED

EPD of multiple products, based on the average results of the product group.

Details of products covered by this EPD are presented within this document on page 5. In accordance with ISO 14025:2006 and EN 15804:2012 + A2:2019/AC:2021 for City Circle Recycling recycled aggregate products.

Products included are: 20 mm Class 2 Wet/Dry Rock, 20 mm Class 3 Wet/Dry Rock, 20 mm Class 4 Wet/Dry Rock, 20 mm Pavement Base Wet/Dry, 40 mm Brick Aggregate with Clay, 75 mm Minus Rock Rubble, Concrete Aggregate 20 mm Down Class 2, Concrete Aggregate 20 mm Down Class 3, Concrete Aggregate 20 mm Down Class 4.

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com.

CONTENTS

What is an Environmental Product Declaration?

An Environmental Product Declaration (EPD) tells the environmental story of a product over its life cycle in a format that is clear and transparent. It is science-based, independently verified and publicly available.

EPDs help manufacturers translate complex sustainability information about their product's environmental footprint into simpler information that governments, companies, industry associations and end consumers can trust to make decisions.

An EPD communicates the environmental impacts at different stages in a product's life cycle. This may include the carbon emitted when it's made, and any emissions that pollute the air, land or waterways during its use.

This EPD covers the environmental impacts of City Circle Recycling's coarse aggregate products. The product is processed and manufactured at their yards around Melbourne, Australia.

This EPD is based on a 'cradle-to-gate' Life Cycle Assessment (LCA), with end-of-life and resource recovery stages included (modules A1–A3, C1–C4 and D). 'Cradle' refers to the raw material extraction and 'gate' are the City Circle Recycling facilities as the products leave and go out to customers.

As the EPD owner, City Circle Recycling has the sole ownership, liability and responsibility for the EPD.

LOCAL FACILITIES, LASTING IMPACT

The City Circle Group was proudly founded in 1981 by the Skidmore family. We set out with a clear vision to collect waste materials through our demolition business, transform this demolition waste into high-quality aggregate, and resell it to the very industry that originally disposed of it.

Today, City Circle Group transforms waste into valuable resources that are building the city of Melbourne.

In 1999, we established our first City Circle Recycling site to complement our demolition operations and advance our zero-waste ambitions. Since then, we have grown to three recycling facilities across Melbourne, processing over 1.4 million tonnes, or 9% of Victoria's total waste[1].

With this continued growth and the ever-changing challenges of the industry, we have never lost sight of our core values. The introduction of best practice initiatives, with a focus on sustainability, has been extremely important to us, with both demolition and recycling businesses being accredited to ISO 9001:2015 Quality Management Systems, ISO 45001:2018 Occupational Health & Safety Management Systems and ISO 14001:2015 Environment Managements Systems.

Our aggregate is accredited by the Department of Transport and Planning and our recycling facilities are Green Star accredited. The facilities are strategically located in Brooklyn, Dandenong South and Melton South to ensure freight movement is kept to a minimum, further reducing their impact.

Our sites

Kew East (HQ)
714-716 High Street
Kew East VIC 3102

Brooklyn
166-156 Jones Road
Brooklyn VIC 3012

Dandenong
128-142 Ordish Road
Dandenong South VIC 3175

Melton
17/31 Ferris Road
Melton South VIC 3338

"City Circle Group has been a lifetime passion for our family. We began as a small rubbish removal company over 44 years ago and our goals were to push boundaries, push ourselves and our business to the forefront of the industry.

We now find ourselves as a leader in the demolition industry and a major factor in the state's recycling of waste."

Peter Skidmore, Founder and Director

1 https://www.ces.vic.gov.au/soe2023/key-topics/waste#:~:text=The%20amount%20of%20waste%20produced,than%20in%20any%20other%20year

DEMOLITION, EXCAVATION, RECYCLING – FULL CIRCLE

Our unique approach to demolition enables accurate separation of waste for recycling. Notably, as we move towards our 100% recycling goal, 96% of demolition waste from the City Circle Group's demolition division is taken to one of our recycling sites to be processed for reuse. The recycling that we perform directly negates the need to mine aggregate from quarries.

Our three Victorian recycling sites also receive large quantities of construction and demolition waste from collaborators, demolition competitors and third parties.

We strive for excellence and reliability in our goals and practices in the waste, recycling and resource recovery sectors. This has led to us being identified by the Victorian Government as an essential service provider significant to progress towards circular economy[1].

In 2023, the waste materials recovered and processed for reuse by City Circle represented 9% of Victoria's waste[2]. A key corporate indicator being pursued is to increase City Circle Group's management of Victoria's waste to above 10% in 2026.

The future of our business is based on our circular economy framework and we will expand our pool of resources and abilities to efficiently produce premium-grade aggregate from waste streams, thus furthering the benefits to Victoria's economy.

1 https://www.vic.gov.au/guidelines-responsible-entity-risk-consequence-and-contingency-rercc-plan

2 https://www.ces.vic.gov.au/soe2023/key-topics/waste#:~:text=The%20amount%20of%20waste%20produced,than%20in%20any%20other%20year

What we value

Our values centre around culture, people and sustainability. We seek to build an environment centred around inclusiveness and continuous improvement that is focused on the company's resilience and longevity.

We achieve this through an attitude of empowering the individual and investing in a skill set that is centred on delivering sustainable solutions for our company and the communities in which we work. A commitment to our people creates loyalty within the business that underpins what we collectively deliver to our customers and collaborators.

We strive to make an impact and provide solutions to help the communities in which we work to achieve outcomes that align with progress, sustainability, and growth. All of this is laced with a mindset of ensuring the long-term viability of the business over any potential short-term, unsustainable gains.

OUR RECYCLED AGGREGATES

City Circle Recycling (CCR) produce recycled aggregate products by recycling construction and demolition waste (C&D waste), such as concrete rubble, brick and rock waste. These recycled aggregate products are coarse aggregate to be used as road materials and engineered fills for civil construction.

CCR recycled aggregate products are manufactured at the three recycling sites across Victoria, Australia listed on page 3.

This EPD covers the following recycled aggregate products and adopts the option of 'EPD of multiple products, based on the average results of the product group' (EPD International, 2024). The results were calculated for individual products and weighted based on the sales data for 2023/24.

Table 1: Product information and application

Product type	Coarse aggregate (all)								
Image									
Product	20 mm Class 2 Wet/Dry Rock	20 mm Class 3 Wet/Dry Rock	20 mm Class 4 Wet/Dry Rock	20 mm Pavement Base Wet/Dry	40 mm Brick Aggregate with Clay	75 mm Minus Rock Rubble	Concrete Aggregate 20 mm Down Class 2	Concrete Aggregate 20 mm Down Class 3	Concrete Aggregate 20 mm Down Class 4
Size	20 mm	20 mm	20 mm	20 mm	40 mm	75 mm	20 mm	20 mm	20 mm
Manufacturing site	• Melton South	• Melton South	• Melton South	• Brooklyn • Dandenong • Melton South	• Melton South	• Brooklyn	• Brooklyn • Dandenong	• Brooklyn • Dandenong • Melton South	• Brooklyn • Dandenong
Application	Road materials and engineered fills for civil construction (all)								

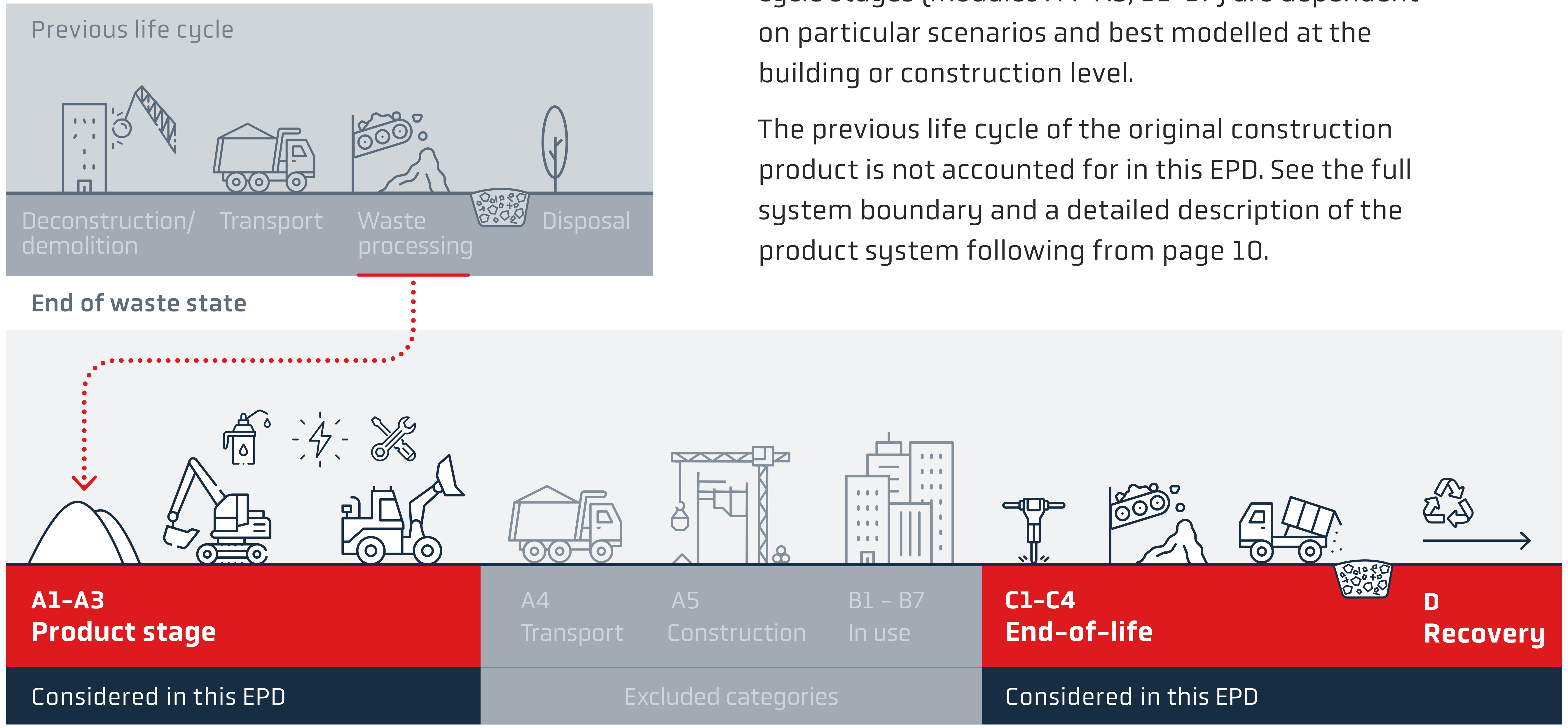
THE ORIGIN STORY

Our operations start with the drop-off of processed construction waste, including concrete, bricks and rocks. In an EPD, the system boundary divides the processes which are included from those which are excluded. Our system boundary includes a product stage, end-of-life and recovery stages.

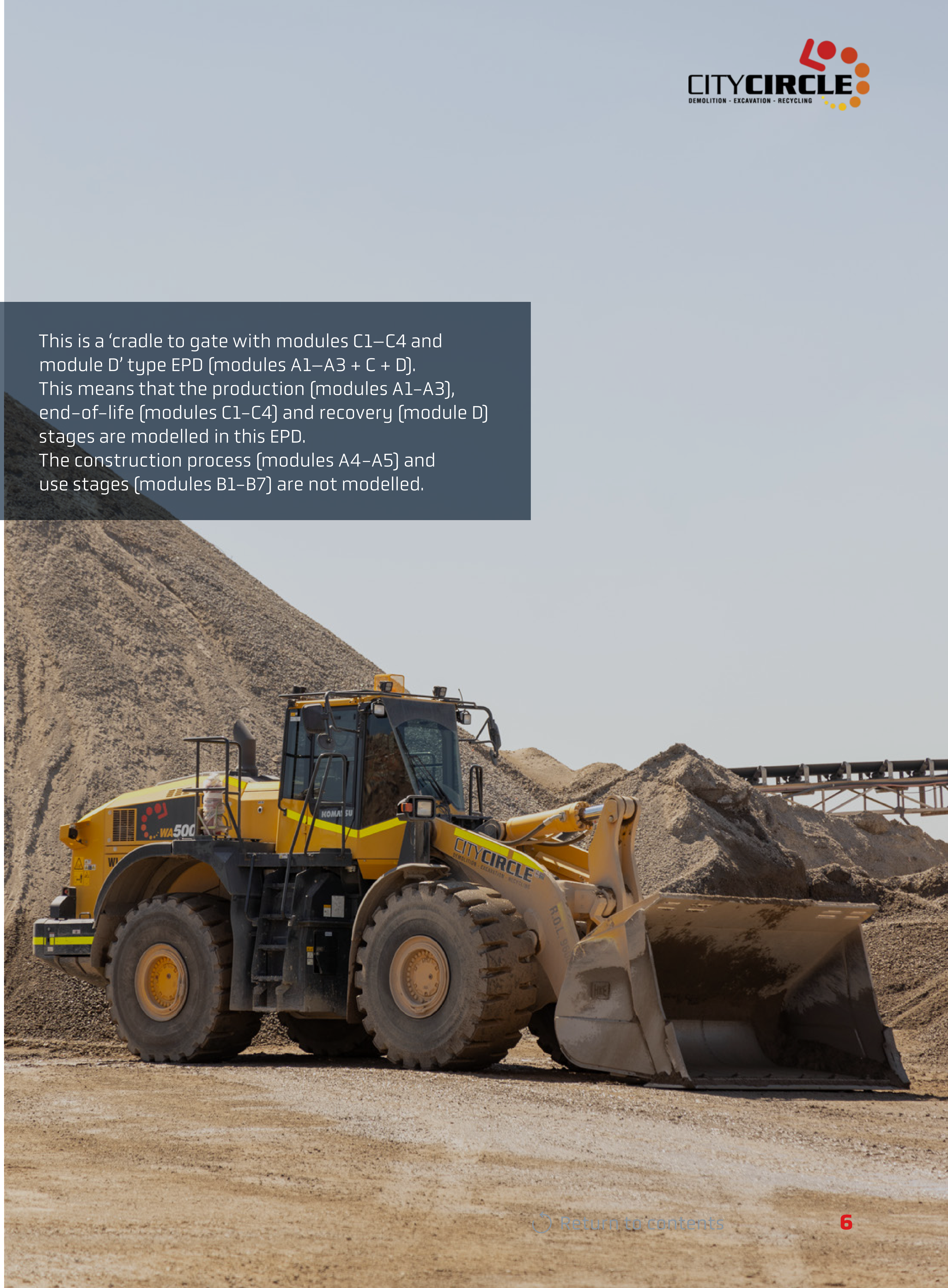
The product stage involves running and maintaining our equipment to make coarse aggregate ready to be distributed to customers. The materials' end-of-life stage includes deconstruction, transportation to landfill and landfilling of the materials. Other life cycle stages (modules A4-A5, B1-B7) are dependent on particular scenarios and best modelled at the building or construction level.

The previous life cycle of the original construction product is not accounted for in this EPD. See the full system boundary and a detailed description of the product system following from page 10.

Figure 1. System boundary



This is a 'cradle to gate with modules C1–C4 and module D' type EPD (modules A1–A3 + C + D). This means that the production (modules A1–A3), end-of-life (modules C1–C4) and recovery (module D) stages are modelled in this EPD. The construction process (modules A4–A5) and use stages (modules B1–B7) are not modelled.



HOW TO USE THIS EPD

We developed this EPD to help showcase the environmental credentials of our recycled aggregate products.

This independently verified EPD provides environmental performance information from cradle-to-gate (modules A1-A3), plus end-of-life (modules C1-C4) and reuse-recovery-recycling potential (module D). The results are presented for the declared unit of 1 000 kg of recycled aggregates. The results may be used by specifiers and developers to calculate and present the environmental impacts of particular construction projects.

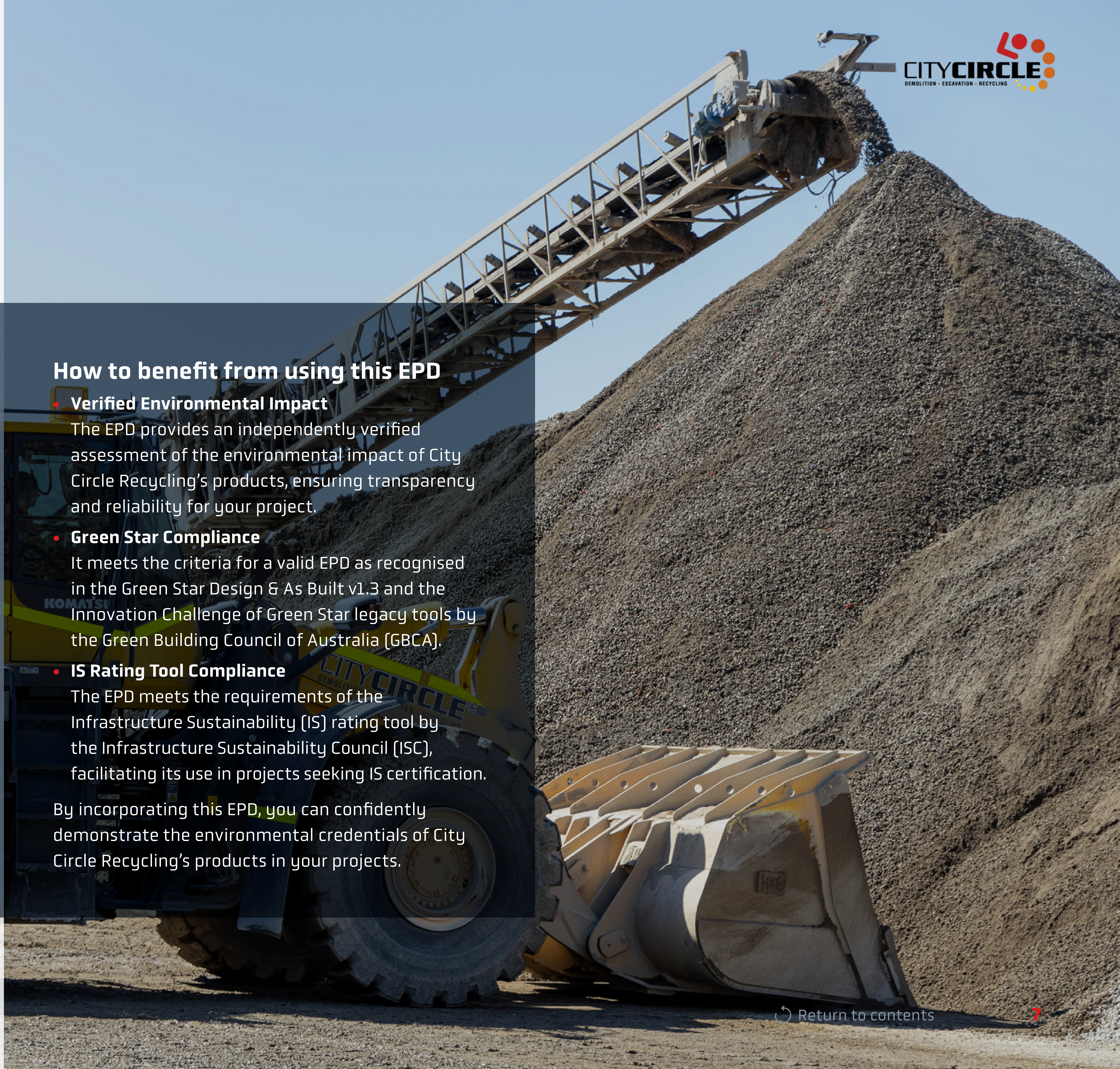
EPDs are not always comparable

An 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).

It's important to note that EPDs within the same product category but from different programs may not be directly comparable. Construction products can only be compared if the EPDs comply with the EN 15804 standard. EPDs of construction products from a group of manufacturers may not be comparable to an EPD of a similar construction product that a single manufacturer has generated.

Understanding the detail is important in comparisons. Expert analysis is required to ensure data is truly comparable to avoid unintended misrepresentations.

Furthermore, this EPD conforms to EN 15804+A2. EPDs conforming to EN 15804+A1 are not directly comparable with those conforming to EN 15804+A2 due to differences in methodologies.



How to benefit from using this EPD

- **Verified Environmental Impact**
  The EPD provides an independently verified assessment of the environmental impact of City Circle Recycling's products, ensuring transparency and reliability for your project.
- **Green Star Compliance**
  It meets the criteria for a valid EPD as recognised in the Green Star Design & As Built v1.3 and the Innovation Challenge of Green Star legacy tools by the Green Building Council of Australia (GBCA).
- **IS Rating Tool Compliance**
  The EPD meets the requirements of the Infrastructure Sustainability (IS) rating tool by the Infrastructure Sustainability Council (ISC), facilitating its use in projects seeking IS certification.

By incorporating this EPD, you can confidently demonstrate the environmental credentials of City Circle Recycling's products in your projects.

DECLARED UNIT

This EPD is based on a declared unit. ISO 14040 defines a functional unit as 'quantified performance of a product system for use as a reference unit'. EPDs that do not cover the full product life cycle from raw material extraction through to end-of-life use the term 'declared unit' instead.

> The declared unit and reference flow is **1 000 kg (1 tonne) of recycled aggregate.**

Content declaration

According to the General Programme Instructions, the EPD shall include a content declaration with a list of materials and chemical substances including information on their hazardous properties. Content declaration of packaging is not applicable.

Table 2: Content declaration for one tonne of recycled aggregate

Product components	Weight, kg	Post-consumer recycled material, weight-% of product	Biogenic material, weight-% of product	Biogenic material, kg C/product
Construction and demolition waste (rubble of concrete, bricks, rocks)	1 000	100	0	0
Sum	1 000	100	0	0

Classification

Table 3 shows the relevant classification and Table 4 presents the relevant Australian standards and applications for the products in this EPD.

Table 3: Industry classification

Product	Classification	Code	Category
CCR recycled aggregate products	UN CPC Ver.2.1	89420	Non-metal waste and scrap recovery (recycling) services, on a fee or contract basis
	ANZSIC 2006	29220	Recycling of other non-metal waste and scrap

Table 4: Technical specifications applying to the products in this EPD

Product group	Relevant Standards
CCR recycled aggregate products	AS 1141.19:2018 Methods for sampling and testing aggregates, Method 19: Fine particle size distribution in road materials by sieving and decantation
	AS 1289.0:2014 Methods of testing soils for engineering purposes, Part 0: Definitions and general requirements
	AS 2758.1:2014 Uniformity Requirements for Graded Coarse Aggregate

Dangerous substances from the candidate list of SVHC for Authorisation

Hazardous properties for Hazardous Substances and New Organisms (HSNO classifications) and Globally Harmonized System (GHS) classifications are reproduced from vendor SDS or OECD's global portal to information on chemical substances available at: https://www.echemportal.org/echemportal/substance-search. No products declared within this EPD contain substances exceeding the limits for registration according to the European Chemicals Agency's 'Candidate List of Substances of Very High Concern for authorisation' (European Union, 2024).

MANUFACTURING PROCESS

CCR's processes to recycle C&D waste include the separation and crushing of the concrete, brick and rock waste to produce recycled aggregates, followed by maintenance of the recycled aggregates stockpiles, and internal transport and load out of aggregate products into trucks to send to clients. Considering that the end-of-waste state is achieved only after crushing stage, impacts for the manufacturing stage only include the stockpile maintenance and load out activities. The detailed manufacturing process is explained here.

Most of CCR's operations start with the drop-off of waste streams by the construction industry, including waste concrete, bricks and rocks. Non-recyclable inert materials within the construction waste are sent to landfill directly. Each waste stream is maintained as a separate stockpile by an excavator. CCR's management of waste is a paid activity, with customers charged for each load they drop off.

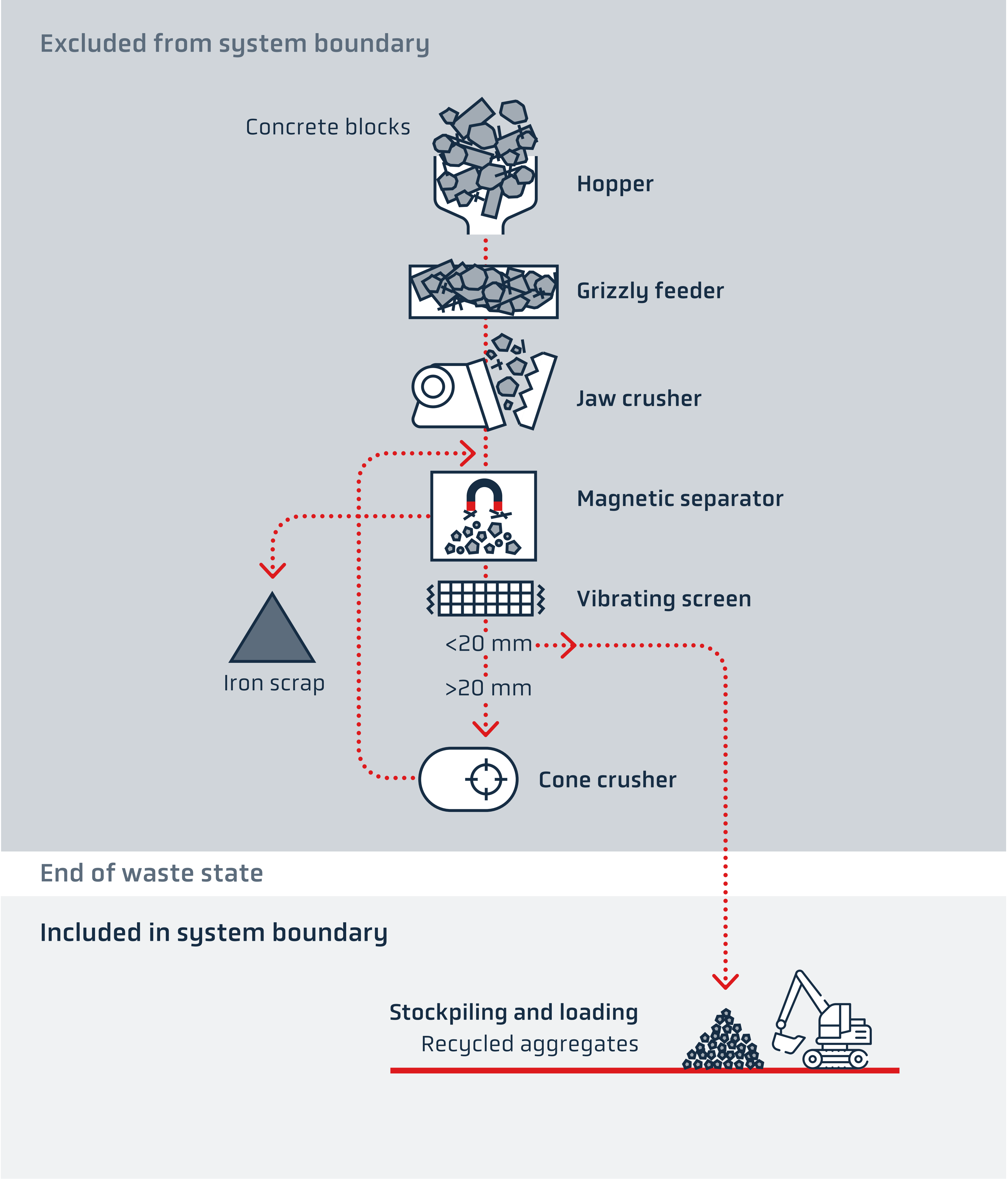
The collected construction and demolition waste are processed into smaller pieces by excavator with a pulveriser attachment. Wheel loaders and a grizzly feeder are used to transport the feedstock to a jaw crusher, where it is further crushed to the required size. A magnetic separator and manual picking are then involved to separate the steel components from the recycled aggregates. Following this, the recycled aggregates undergo grading and sorting based on their size to conform to specific size and quality standards suitable for their intended use in construction projects. Oversized recycled aggregates are fed back to the cone crusher and crushed again to the required size. Then different sizes of recycled aggregate products are maintained in separate stockpiles or loaded into trucks by loaders.

The criteria for end-of-waste state are determined in-line with the 'Polluter Pays' principle within EN 15804. Since the waste does not have a value at drop-off and CCR is paid to receive them, these materials transported and delivered to CCR's site have not yet reached the end-of-waste state. The collection and transport of the waste streams are therefore part of the waste processing in the previous product system, in line with the polluter pays principle.

Specific to this EPD, the C&D waste does not have a value, and has not reached end-of-waste state, until it has been crushed to produce recycled aggregate products. As such, all processing up to and including the crushing process is considered as part of the end-of-life of the original products. Thus, the end-of-waste state is reached after the crushing and screening process that makes C&D waste become useful. Considering the provisions of Allocation of Waste in PCR 2019:14 v1.3.4 (section 4.5.2), CCR should bear the impacts after crushing and screening stage.

Therefore, the stockpiling and loading processes form the production stage (modules A1-A3) for CCR's recycled aggregate products, with additional overheads for site operation.

Figure 2. Manufacturing process



SYSTEM BOUNDARIES

As shown here, this EPD is of the type (a) – cradle-to-gate with modules C1–C4 and module D (A1–A3 + C + D). Other life cycle stages (modules A4–A5, B1–B7) are dependent on particular scenarios and best modelled at the building or construction level.

For modules beyond A3, the scenarios included are currently in use and are representative for one of the most probable alternatives.

Table 5: Modules included in the scope of the EPD
X = declared module | ND = module not declared (such a declaration shall not be regarded as an indicator result of zero)

	Product stage			Construction process stage		Use stage							End-of-life				Recovery
	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	AU	AU	AU	–	–	–	–	–	–	–	–	–	AU	AU	AU	AU	AU
Share of specific data	93%–95%[1]			–	–	–	–	–	–	–	–	–	–	–	–	–	–
Variation – products	+29%/-9%[2]			–	–	–	–	–	–	–	–	–	–	–	–	–	–
Variation – sites	+29%/-9%[3]			–	–	–	–	–	–	–	–	–	–	–	–	–	–

1 Specific data includes material and fuel transport (such as lubricant and diesel), and energy use for manufacturing. Share of specific data was calculated based on the share of the GWP-GHG results in A1-A3 coming from specific data.
2 This is the variation across similar CCR recycled aggregates products.
3 This is the variation across identical CCR recycled aggregates products manufactured in different sites.

Product stage (modules A1–A3)

Raw material supply (module A1)

The following upstream processes are **included**:

- Production of lubricants used in the manufacturing process.
- Generation of fuels and electricity from primary energy resources, including their extraction, refining and transport.

The following upstream processes are **excluded**:

- Production of raw materials for C&D waste, e.g. production of concrete, bricks and rocks.
- Demolition and excavation processes to generate waste streams. These processes are part of the end-of-life of the previous product system and are excluded in line with the polluter pays principle.

Transportation (module A2)

The following upstream processes are **included**:

- Transport of lubricants and fuels used in the manufacturing process.

The following upstream processes are **excluded**:

- Transport of raw materials, i.e. waste streams including concrete, bricks and rocks to CCR plants. These raw materials are delivered to the manufacturing site by the raw material producer. These processes are part of the end-of-life of the previous product system and are excluded in line with the polluter pays principle.

Internal transport that occurs within the stockpiling and loading process is included in module A3.

Manufacturing (module A3)

The following processes are **included**:

- Maintenance of CCR aggregates stockpiles using a wheeled loader.
- Load out of CCR aggregates into trucks using a wheeled loader.
- Internal transport: movement of products on-site.
- Overall maintenance of the site, including water used for dust suppression and cleaning equipment, electricity consumption in site office, and disposal of general waste.

The following processes are **excluded**:

- Processing of waste to end-of-waste state, including maintenance of waste stream stockpiles and loading of waste into crusher by excavator, wheel loader and grizzly feeder. The following crushing and screening processes are also excluded, such as crushing process by using jaw crusher and cone crusher and screening process by using magnetic separator. These processes are part of the end-of-life of the previous product system and are excluded in line with the polluter pays principle.
- Production of processing equipment.

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

End-of-life (modules C1-C4)

When a building reaches its end-of-life it will be demolished (C1) and the demolition waste transported to a processing facility (C2). The waste processing (C3) includes the separation of concrete, brick and rock waste from other building materials, and processing of these wastes until end-of-waste state. Materials that cannot be recycled will be disposed (C4). The benefits and loads of recycling waste are calculated in module D. 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, brick and rock waste in the construction sector. See Table 6 for assumptions for end-of-life and resource recovery stages.

According to the latest report, about 80% of Australia's C&D waste is recycled, while the remaining 20% goes to landfill (DCCEEW, 2022). The R2 value, i.e. recycling rate, for aggregate recycling is not available in the European Union Guidance on PEF (European Commission, 2020). In addition, the R2 value, i.e. 80%, is provided in DCCEEW's report by excluding recycling residuals that are sent to landfill or otherwise disposed of and materials received at a recycling facility but not yet processed (DCCEEW, 2022). Therefore, the processing of 80% of CCR aggregates to end-of-life state is included in C3. The landfill of 20% of CCR aggregates is included in C4. It was assumed that the transport distance to recycler and landfill sites are the same, which is 50 km. This is based on the experience from similar projects which shows that this assumption is reasonable (and probably conservative) for the product type.

Table 6: End-of-life scenarios for products

Process	Unit (expressed per declared unit of products or materials and by type of material)
Excavator	Equivalent of 1 tonne of CCR aggregates
Recovery system specified by type	80% for recycling[1]
Disposal specified by type	20% modelled as inert materials in landfill[1]
Assumptions for scenario development	• C1 – Demolishing with hydraulic diggers (Safe Work Australia, 2018). The process is modelled based on 'excavation, hydraulic digger' dataset from ecoinvent database. • C2 – 50 km of transport by truck[2]. • C3 – Recycling process model with 'treatment of waste concrete gravel, recycling' dataset from ecoinvent database. • C4 – Landfill process model with 'treatment of inert waste, inert material landfill' dataset from ecoinvent database. • D – Production of virgin aggregates to make up the loss of secondary materials. Burdens of transport of recycled and virgin aggregates to the site to produce aggregates.

1 The European Union Guidance on PEF does not provide an R2, i.e. recycling rate, value for aggregate recycling (European Commission, 2020). The R2 value for construction and demolition waste is 80% according to DCCEEW (2022). Therefore, it is more accurate to use the Australian value.
2 DCCEEW (2009).

Recovery and recycling potential (module D)

Since the produced secondary materials outputs (i.e. only 80% of CCR aggregates are recycled) are less than the secondary materials inputs (i.e. production of CCR aggregates use 100% secondary materials), burdens are calculated in the module D to consider the loss of secondary materials. This includes the transport of CCR aggregates after end-of-waste state and the production and transport of virgin aggregate to make up the loss of secondary materials. The transport distance of recycled and virgin aggregates is assumed as 10 km. This assumption is based on the average waste collection distance provided by clients in VIC. This scenario is currently in use and is representative for one of the most likely scenario alternatives.

LIFE CYCLE INVENTORY

Primary data were collected for recycled aggregate products manufactured by CCR for the 12-month period from 2023-02-21 to 2024-02-21.

Upstream data

With the exception of electricity, diesel and water (which correctly reflect Australian conditions), minor upstream (supply chain) data used were rest of the world due to a lack of consistent LCI data for Australasia at the time this study was conducted.

LCA software and database

Background data for raw materials, energy, and transportation are all from the ecoinvent v3.10 database (Wernet, 2016) and AusLCI v2.45 database (ALCAS, 2025) with reference years between 2023-2025. Both primary and background data fall within the EN 15804 and PCR requirements of 10 years for generic data and 5 years for producer specific data.

The LCA was conducted in Microsoft Excel. The LCA utilises life cycle inventory data from ecoinvent, Allocation, cut-off, EN15804, ecoinvent database version 3.10 (Wernet, 2016) for several of the raw and process materials obtained from the background system. The ecoinvent datasets have not been adapted as they are provided in Excel and have not been used in conjunction with an LCA software. This includes capital goods and infrastructure as they are included in the background datasets provided by ecoinvent database for Excel and it is not possible to subtract them in Excel. Regional averages for fuel inputs and electricity grid mixes were obtained from the AusLCI database version 2.45 (ALCAS, 2025). The emission factors of regionalised fuels and electricity inputs are calculated in SimaPro. Then, these emission factors are imported into Excel to finish the calculation.

Electricity

The residual electricity grid mix of VIC is modelled based on SimaPro and AusLCI Database version 2.45 (ALCAS, 2025). The emission factor for the VIC residual grid mix for the GWP-GHG indicator is 1.03 kg CO_2eq./kWh (based on EF3.1).

Recycling and recycled inputs

CCR use construction and demolition waste as a main input material for recycled aggregate production. According to the polluter pays principle, cut-off allocation is applied. Therefore, all unit processes before the point of end-of-waste (i.e. processing of concrete, brick and rock waste until the end-of-waste state) are assigned to the product system generating the waste (i.e. the previous life cycle of concrete, brick and rock waste). All unit processes after the point of end-of-waste are assigned to the subsequent product system (i.e. the system boundary used in this study). This assumption is also aligned with the statement '...flows leaving the product system as outputs from the building, shall at first be considered to be waste, and leave the product system when reaching the end-of-waste state' in section 4.5.2 of PCR 2019:14 v1.3.4 (EPD International, 2024).

For waste generated within the system boundary of this study, waste processing and disposal are assigned to the CCR aggregates until the end-of-waste criteria are fulfilled. Therefore, a consistent allocation method is adopted in this study. Regionally-specific statistical data is used to inform end-of-life recycling values where available to secure high geographical representativeness. According to DCCEEW (2022), recycling rate of CCR products is assumed to be 80%, with 20% sent to landfill.

Based on the end-of-life scenario, the net scrap generated is about -0.2 tonnes per tonne of product. This means the generated aggregate waste is not enough to meet the needs of aggregate production. Therefore, a burden with positive results is calculated in module D. This includes the 10 km transport of CCR aggregates after end-of-waste state and the production and transport of virgin aggregate to make up the loss of secondary materials. This assumption is based on the average waste collection distance provided by clients in VIC, Australia. This scenario is currently in use and is representative for one of the most likely scenario alternatives.

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 6 km distance to a treatment or disposal site. This is due to all CCR sites are located near to disposal sites.

Transport modes:

- Truck – transport, freight, lorry, all sizes, EURO4 to generic market for transport, freight, lorry, unspecified

Explanation of average products and variation

The EPD presents weighted average recycled aggregate results from three sites across VIC, Australia. The declared average GWP-GHG results for modules A1-A3 may differ by more than 10% compared to the GWP-GHG results of specific products included in the group. This is due to the differences in production efficiency of different aggregate products. In addition, variation between specific products manufactured across three sites is between -9% to 29%, for modules A1-A3 GWP-GHG indicator results.

Cut off criteria

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

In this study capital goods and infrastructure have been included in the background datasets as provided by ecoinvent (Wernet, 2016). It is not possible, within reasonable effort, to subtract the data on infrastructure/capital goods from these datasets[1].

1 The results of the impact categories abiotic depletion of minerals and metals, land use, human toxicity (cancer), human toxicity, noncancer and ecotoxicity (freshwater) may be highly uncertain in LCAs that include capital goods/infrastructure in generic datasets, in case infrastructure/capital goods contribute greatly to the total results. This is because the LCI data of infrastructure/capital goods used to quantify these indicators in currently available generic datasets sometimes lack temporal, technological and geographical representativeness. Caution should be exercised when using the results of these indicators for decision-making purposes.

All other reported data were incorporated and modelled using the best available life cycle inventory data.

Allocation

Post-consumer scrap, i.e. C&D waste, is a main input to the CCR product system. The C&D waste does not have a value at drop-off and CCR is paid to receive them. In addition, these materials collected and delivered to CCR's site has not yet reached the end-of-waste state. The collection and transport of the waste streams is therefore part of the waste processing in C&D waste supplier's system, in line with the polluter pays principle.

In this study, the C&D waste reaches end-of-waste state until it has been crushed to produce recycled aggregate products. As such, all unit processes up to and including the crushing process are allocated to C&D waste supplier's system. All unit processes after the point of end-of-waste, i.e. processes after the crushing and screening process, are allocated to the system boundary used in this study. Therefore, the crushed and screened C&D waste is considered burden free when it enters the system boundary. This is in line with the provisions of Allocation of Waste in PCR 2019:14 v1.3.4 (section 4.5.2).

Multi-output allocation generally follows the requirements of PCR 2019:14 v1.3.4 (EPD International, 2024) section 4.5.1.

CCR produces multiple products, such as recycled concrete, brick and rock aggregates (See Table 1). Marketable products from the same unit process but are not the object of this assessment are considered as co-products in this study. However, allocation of co-products is avoided by dividing the unit process into sub-processes and collecting LCI data for each sub-process. This is because the manufacturing processes of CCR aggregates are not considered as joint co-production processes sub. Each of the co-products can be produced without the other or the ratio of the co-products typically varies in normal production. Therefore, LCI data for each sub-process is obtained and no allocation of co-products is adopted.

End-of-life allocation generally follows the requirements of ISO 14044, section 4.3.4.3 (ISO, 2006b) and the requirements of section 4.5.2 in PCR 2019:14 v1.3.4 (EPD International, 2024). It also generally follows the polluter pays principle.

Material recycling (cut-off approach): Any open scrap inputs into manufacturing remain unconnected. The system boundary at end-of-life is drawn after scrap collection and processing until end-of-waste state, which generates an open scrap output for the product system. The processing and recycling of the scrap associated with the subsequent product system are not considered in this study.

Landfilling (cut-off approach): Any open scrap inputs into manufacturing remain unconnected. The system boundary includes landfilling processes following the polluter pays principle. In cases where materials are sent to landfills, they are linked to an inventory that accounts for waste composition, regional leachate rates, landfill gas capture as well as utilisation rates (flaring vs. power production). No credits for power or heat production are assigned.

Assumptions

- Where specific life cycle inventory data were unavailable, proxy data were used, giving preference to regional data.
- Average utility impact is based on the utility data and total production from 2023-02-21 to 2024-02-21.
- Current utility data is limited per site.
- It was assumed that 80% of CCR products are recycled at the end-of-life stage according to DCCEEW (2022).
- End of waste was defined after the crushing step, therefore CCR only bears the impacts of stockpiling whereas the waste producer bears the impact of processing, which is in line with the polluter pays principle.

Data Quality Assessment

The quality of inventory data is assessed based on four key factors:

- **Precision** – how accurately the data is measured, calculated, or estimated.
- **Completeness** – whether all relevant data is included (e.g. no missing or unreported emissions).
- **Consistency** – how reliably the same methods are applied across the data.
- **Representativeness** – how well the data reflects real-world conditions across different locations, time periods and technologies.

In this study:

- The data has **high** precision and completeness.
- The methodology is applied **consistently** throughout.
- The **representativeness** of data is shown in Table 7.

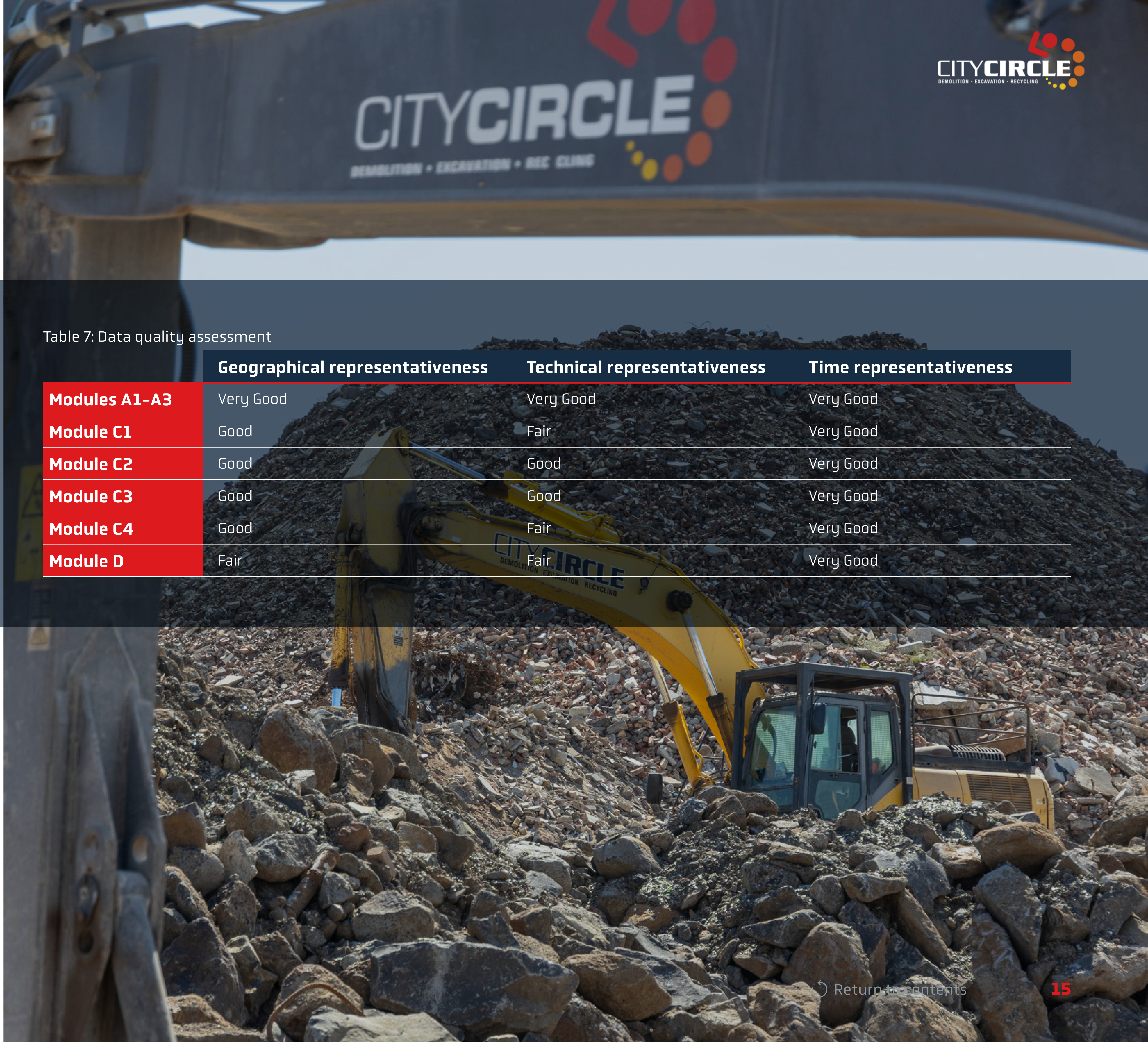


Table 7: Data quality assessment

	Geographical representativeness	Technical representativeness	Time representativeness
Modules A1-A3	Very Good	Very Good	Very Good
Module C1	Good	Fair	Very Good
Module C2	Good	Good	Very Good
Module C3	Good	Good	Very Good
Module C4	Good	Fair	Very Good
Module D	Fair	Fair	Very Good

ASSESSMENT INDICATORS

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 3.1 is used.

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. Long-term emissions (> 100 years) are not taken into consideration in the impact estimate.

Energy indicators (MJ) are always given as net calorific value. The use of primary energy is separated into energy used as raw material and energy used as energy carrier as per option A in Annex 3 in the PCR (EPD International, 2024).

Table 8: Environmental impact indicators described

Climate Change (Global Warming Potential)

(GWP-total, GWP-fossil, GWP-biogenic, GWP-luluc)

A measure of greenhouse gas emissions, such as CO_2 and methane. These emissions are causing an increase in the absorption of radiation emitted by the earth, increasing the natural greenhouse effect. This may in turn have adverse impacts on ecosystem health, human health and material welfare. Global warming potential (GWP) is split into three sub-indicators: fossil, biogenic, and land-use and land-use change.

Ozone Depletion Potential

(ODP)

Depletion of the ozone leads to higher levels of UVB ultraviolet rays reaching the earth's surface with detrimental effects on humans and plants. ODP is a measure of air emissions that contribute to the depletion of the stratospheric ozone layer.

Acidification Potential

(AP)

Acidification potential is a measure of emissions that cause acidifying effects to the environment. A molecule's acidification potential indicates its capacity to increase the hydrogen ion (H+) concentration in the presence of water, thus decreasing the pH value. Potential effects include fish mortality, forest decline, and the deterioration of building materials.

Abiotic Resource Depletion

(ADP-mm, ADP-fossil)

The consumption of non-renewable resources decreases the availability of these resources and their associated functions in the future. Depletion of mineral resources and non-renewable energy resources are reported separately. Depletion of mineral resources is assessed based on total reserves.

Water Use

(WDP)

Water scarcity is a measure of the stress on a region due to water consumption.

Eutrophication Potential

(EP-freshwater, EP-marine, EP-terrestrial)

Eutrophication covers all potential impacts of excessively high levels of macronutrients, the most important of which are nitrogen (N) and phosphorus (P). In aquatic ecosystems where this term is mostly applied, this typically describes a degradation in water quality. Eutrophication can result in an undesirable change in the type of species that flourish and an increase in the production of biomass. As the decomposition of biomass consumes oxygen, eutrophication may decrease the available oxygen level in the water column and threaten fish in their ability to respire.

Photochemical Ozone Formation Potential

(POCP)

Photochemical ozone formation potential gives an indication of the emissions from precursors that contribute to ground level smog formation, mainly ozone (O_3). Ground level ozone may be harmful to human health and ecosystems and may also damage crops. These emissions are produced by the reaction of volatile organic compounds (VOCs) and carbon monoxide in the presence of nitrogen oxides and UV light.

EPD RESULTS

The following tables show the results grouped in six categories, each looking at different types of indicators. The results tables describe the different environmental indicators for **1 000 kg of CCR recycled aggregate product**, for each declared module.

The EN 15804 reference package based on EF 3.1 is used.

The reported impact categories represent impact potentials, i.e. they are approximations of environmental impacts that could occur if the emissions would (a) follow the underlying impact pathway and (b) meet certain conditions in the receiving environment while doing so.

The environmental impact results are therefore relative expressions only and do not predict actual impacts, the exceeding of thresholds, safety margins, or risks. LCIA results are therefore relative expressions only and do not predict actual impacts, the exceeding of thresholds, safety margins, or risks.

Range/variability

According to the assessment results, variations for modules A–C results for core environmental indicators are insignificant.

Environmental impact indicators

Table 9: Environmental impact covering modules A1–A3, C1–C4 and D

			Production	End-of-life				Recovery	A–C variation
Environmental impact	**Abb.**	**Unit**	**A1–A3**	**C1**	**C2**	**C3**	**C4**	**D**	**Absolute (%)**
Climate change (total)	GWP-total	kg CO_2 eq.	9.58E-01	3.88E-01	7.55E+00	3.50E+00	1.25E+00	3.57E+00	2.0%
Climate change (fossil)	GWP-fossil	kg CO_2 eq.	9.57E-01	3.88E-01	7.54E+00	3.50E+00	1.25E+00	3.26E+00	2.0%
Climate change (biogenic)	GWP-biogenic	kg CO_2 eq.	1.17E-03	3.56E-05	3.57E-04	3.78E-04	1.61E-04	4.24E-03	6.7%
Climate change (land use and land use change)	GWP-luluc	kg CO_2 eq.	2.09E-04	4.26E-05	3.10E-03	3.04E-04	6.50E-04	2.40E-03	1.4%
Ozone depletion potential	ODP	kg CFC-11 eq.	1.25E-08	5.55E-09	1.14E-07	5.36E-08	3.62E-08	3.47E-08	1.6%
Acidification potential of land and water	AP	Mole of H+ eq.	2.00E-03	3.43E-03	3.13E-02	3.16E-02	8.86E-03	1.75E-02	0.8%
Eutrophication potential (freshwater)	EP-freshwater	kg P eq.	3.89E-05	1.65E-05	6.03E-04	1.02E-04	1.04E-04	7.50E-04	1.1%
Eutrophication aquatic (marine)	EP-marine	kg N eq.	4.69E-04	1.58E-03	1.13E-02	1.47E-02	3.38E-03	4.75E-03	0.4%
Eutrophication (terrestrial)	EP-terrestrial	Mole of N eq.	4.96E-03	1.73E-02	1.23E-01	1.61E-01	3.69E-02	5.52E-02	0.4%
Photochemical ozone formation	POCP	kg NMVOC eq.	2.91E-03	5.13E-03	4.40E-02	4.79E-02	1.32E-02	1.69E-02	0.7%
Depletion abiotic resources – minerals and metals[1,2]	ADP-mm	kg Sb eq.	1.04E-06	1.74E-07	2.34E-05	1.22E-06	1.94E-06	1.44E-05	0.9%
Depletion abiotic resources – fossil fuels[1]	ADP-fossil	MJ	1.23E+01	5.06E+00	1.08E+02	4.58E+01	3.07E+01	4.24E+01	1.8%
Water user deprivation[1]	WDP	m^3 world eq.	4.69E-02	1.97E-02	6.34E-01	1.34E-01	1.37E+00	3.16E+00	0.5%

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 The results of the impact categories abiotic depletion of minerals and metals, land use, human toxicity (cancer), human toxicity, noncancer and ecotoxicity (freshwater) may be highly uncertain in LCAs that include capital goods/infrastructure in generic datasets, in case infrastructure/capital goods contribute greatly to the total results. This is because the LCI data of infrastructure/capital goods used to quantify these indicators in currently available generic datasets sometimes lack temporal, technological and geographical representativeness. Caution should be exercised when using the results of these indicators for decision-making purposes.

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

Resource use indicators

The resource use indicators describe the use of renewable and non-renewable material resources, renewable and non-renewable primary energy and water.

Table 10: Resource use indicators covering modules A1–A3, C1–C4 and D

			Production	End-of-life				Recovery
Resource	**Abb.**	**Unit**	**Total A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Renewable primary energy as energy carrier	PERE	MJ	1.45E-01	4.21E-02	1.45E+00	2.80E-01	2.84E-01	2.67E+00
Renewable primary energy resources as material utilisation	PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy resources	PERT	MJ	1.45E-01	4.21E-02	1.45E+00	2.80E-01	2.84E-01	2.67E+00
Non-renewable primary energy as energy carrier	PENRE	MJ	1.22E+01	5.06E+00	1.08E+02	4.58E+01	3.07E+01	4.24E+01
Non-renewable primary energy as material utilisation	PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources	PENRT	MJ	1.22E+01	5.06E+00	1.08E+02	4.58E+01	3.07E+01	4.24E+01
Use of secondary material	SM	kg	1.00E+03	3.62E-03	4.79E-02	1.90E-02	7.70E-03	3.52E-02
Use of renewable secondary fuels	RSF	MJ	2.40E-05	6.01E-06	6.09E-04	4.97E-05	1.59E-04	2.83E-04
Use of non-renewable secondary fuels	NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	FW	m^3	6.63E-02	4.83E-04	1.55E-02	3.28E-03	3.19E-02	7.51E-02

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

Waste material and output flow indicators

Waste indicators describe waste generated within the life cycle of the product. Waste is categorised by hazard class, end-of-life fate and exported energy content.

Table 11: Waste material and output flow indicators covering modules A1–A3, C1–C4 and D

			Production	End-of-life				Recovery
Inventory	**Abb.**	**Unit**	**Total A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	HWD	kg	1.59E-02	9.05E-03	1.89E-01	5.12E-02	3.41E-02	2.21E-01
Non-hazardous waste disposed	NHWD	kg	2.12E-01	1.17E-01	3.54E+00	6.99E-01	2.01E+02	4.13E+00
Radioactive waste disposed	RWD	kg	2.94E-06	1.42E-06	4.55E-05	1.01E-05	9.53E-06	1.05E-04
Components for re-use	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	MFR	kg	0.00E+00	0.00E+00	0.00E+00	8.00E+02	0.00E+00	0.00E+00
Materials for energy recovery	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy	EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy	EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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

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Additional environmental impact indicators

These indicators are voluntarily included to facilitate modularity where an EPD is used as input data for creating another EPD downstream in the value chain.

Table 12: Additional environmental indicators covering modules A1–A3, C1–C4 and D

			Production	End-of-life				Recovery	A-C variation
Indicator	**Abb.**	**Unit**	**Total A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**	**Absolute (%)**
Climate change[3]	GWP-GHG	kg CO_2 eq.	9.58E-01	3.88E-01	7.55E+00	3.50E+00	1.25E+00	3.26E+00	2.0%
IPCC AR5 GWP-GHG[4]	GWP-GHG (IPCC AR5)	kg CO_2 eq.	9.59E-01	3.88E-01	7.56E+00	3.51E+00	1.25E+00	3.27E+00	2.0%
Particulate matter emissions	PM	Disease incidences	1.85E-08	9.68E-08	6.67E-07	6.85E-06	2.02E-07	2.94E-07	0.1%
Ionising radiation – human health[5]	IRP	kBq U235 eq.	6.08E-03	2.89E-03	9.30E-02	2.05E-02	1.95E-02	2.15E-01	1.1%
Ecotoxicity – freshwater[1, 2]	ETP-fw	CTUe	2.03E+00	1.08E+00	2.80E+01	6.49E+00	4.19E+00	1.57E+01	1.4%
Human toxicity, cancer effects[1, 2]	HTP-c	CTUh	3.61E-09	2.58E-09	3.86E-08	1.37E-08	5.65E-09	2.47E-08	1.7%
Human toxicity, non-cancer effects[1, 2]	HTP-nc	CTUh	4.02E-09	8.54E-10	6.96E-08	6.21E-09	5.51E-09	2.83E-08	1.3%
Land use related impacts / soil quality[1, 2]	SQP	Pt	1.09E+01	3.84E-01	8.21E+01	3.21E+00	6.03E+01	3.58E+01	0.2%

3 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 (EPD International, 2024). In this study it is calculated by subtracting the value of Climate change – biogenic (GWP-biogenic) from the value of Climate change – total (GWP-total) since the ecoinvent Excel LCIA results do not include the indicator.
4 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. This indicator was added to improve the comparability of assessment results to previous EPDs.
5 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.

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

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Biogenic carbon content

Biogenic carbon refers to the carbon stored in organic materials. This is sequestered during growth and released at end-of-life. EN15804+A2 requires the declaration of biogenic carbon content of the product and its packaging.

Table 13: Biogenic carbon content for modules A1-3

			Production
Indicator	**Abb.**	**Unit**	**Total A1-A3**
BiogenicC – product	BCC-prod	kg	0.00E+00
BiogenicC – packaging	BCC-pack	kg	0.00E+00

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO_2

EN15804+A1 environmental indicators

EN15804+A1 results are included to aid comparison and backwards compatibility with rating tools.

Table 14: Additional environmental impact indicators EN15804+A1

			Production	End-of-life				Recovery
Indicator	**Abbr**	**Unit**	**Total A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Global warming potential	GWP [EN15804+A1]	kg CO_2-eq.	9.46E-01	3.83E-01	7.44E+00	3.46E+00	1.22E+00	3.21E+00
Depletion potential of the stratospheric ozone layer	ODP [EN15804+A1]	kg CFC11-eq.	8.57E-09	3.88E-09	7.85E-08	3.72E-08	2.50E-08	2.40E-08
Acidification potential of land and water	AP [EN15804+A1]	kg SO_2-eq.	1.19E-03	2.36E-03	2.19E-02	2.17E-02	6.19E-03	1.23E-02
Eutrophication potential	EP [EN15804+A1]	kg PO_4^{3-}-eq.	2.96E-04	5.82E-04	5.70E-03	5.25E-03	1.46E-03	4.03E-03
Photochemical ozone creation potential	POCP [EN15804+A1]	kg C_2H_4-eq.	1.67E-03	1.04E-03	1.46E-02	9.87E-03	4.37E-03	4.64E-03
Abiotic depletion potential – elements	ADPE [EN15804+A1]	kg Sb-eq.	1.04E-06	1.74E-07	2.34E-05	1.22E-06	1.94E-06	1.44E-05
Abiotic depletion potential – fossil fuels	ADPF [EN15804+A1]	MJ	1.23E+01	5.06E+00	1.08E+02	4.58E+01	3.07E+01	4.24E+01

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

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PROGRAMME INFORMATION

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).

The EPD owner 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.

To support backwards comparability and compatibility, environmental performance results have also been provided for the indicators required in EN 15804:2012+A1:2013 (CEN, 2013), although the study does not claim compliance with this standard. The indicators and characterisation methods are from EN 15804:2012+A1:2013, but other LCA rules (system boundaries, allocation, etc.) are according to EN 15804:2012+A2:2019; i.e. the results of the 'A1 indicators' shall not be claimed to be compliant with EN 15804:2012+A1:2013.

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	Post:	PO Box 67, Kew East VIC 3102, Australia		
Geographical scope		Australia		
Reference year		2023-02-21 to 2024-02-21		
LCA accountability		**thinkstep Pty Ltd** Barbara Nebel Kasia Pitman, Joel Edwards, Haoran Lei		
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EPD programme operator		**The International EPD System**		
	Operator:	EPD International AB		
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Regional programme		**EPD Australasia Limited**		
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PCR		CEN standard EN 15804 served as the core Product Category Rules (PCR) PCR 2019.14 Construction Products, version 1.3.4 (published on 2024-04-30, valid until 2025-06-20)		
PCR review conducted by		The Technical Committee of the International EPD System. See www.environdec.com for a list of members. The most recent review chair: Claudia Peña, PINDA LCT SpA. The review panel may be contacted via the Secretariat: www.environdec.com/support		
Independent verification of the declaration and data, according to ISO 14025:2006		☐ EPD process certification (Internal) ☑ EPD verification (External)		
Third party verifier		Claudia A. Peña, Director, PINDA LCT SpA	Email:	pinda.lct@gmail.com
Approved by		EPD Australasia Limited		
Procedure for follow-up of data during EPD validity involved third-party verifier		☐ Yes ☑ No		
Version history		1.0 (2025-06-06) – Original EPD release. 2.0 (2025-08-05) – Editorial updates to product descriptions. No data and results changes to the original EPD.		

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