BRICKWORKS

# UrbanStone Concrete Pavers

## Jandakot, Western Australia

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


**Programme:** The International EPD® System www.environdec.com
**Programme operator:** EPD International AB
**Regional Programme:** EPD Australasia www.epd-australasia.com
**EPD Registration no.** EPD-IES-0024486:001 | **Version 1.0**
**Date of issue** 2025-06-19 **| Valid until** 2030-06-19
**Geographical scope:** Australia

EPD of multiple concrete paver products from a single manufacturing facility, based on a representative product.
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

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# Program Information and Verification

An Environmental Product Declaration (EPD) is a standardised way of quantifying the potential environmental impacts of a product or system. EPDs are produced according to a consistent set of rules – Product Category Rules (PCR) – that define the requirements within a given product category. These rules are a key part of ISO 14025 as they enable transparency and comparability between EPDs.

This EPD is a "cradle-to-gate plus modules C1-C4, D" declaration covering production and end-of-life life cycle stages.

Brickworks Ltd, as the EPD owner, has the sole ownership, liability, and responsibility for the EPD.

| | | |
|---|---|---|
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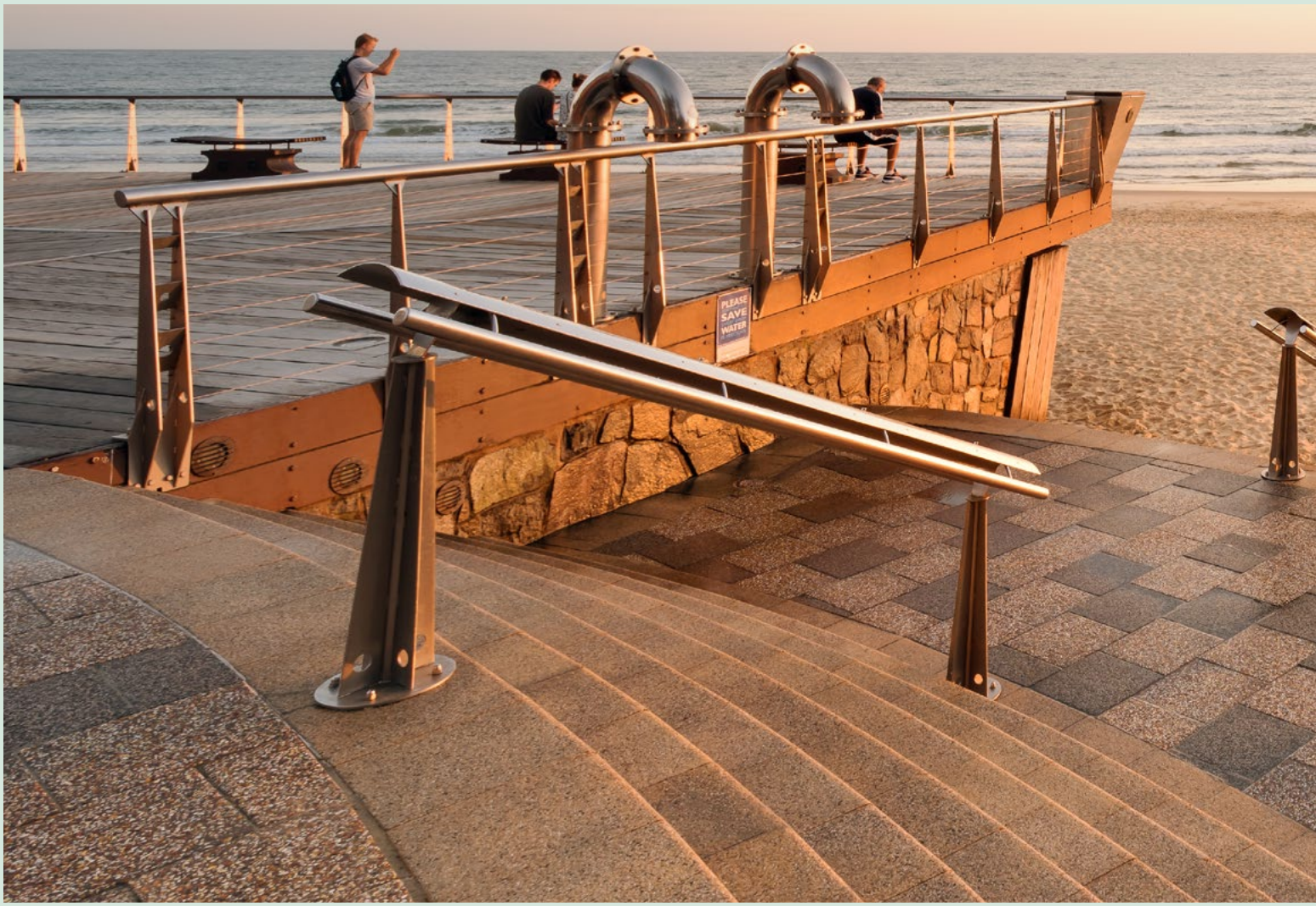
| **Reference year for data** | 2021-07-01 – 2022-06-30 | |

CEN standard EN 15804 serves as the Core Product Category Rules (PCR)

| | |
|---|---|
| **PCR** | PCR 2019:14 Construction Products, Version 1.3.4, 2024-04-30 (valid until 2025-06-20) |
| **PCR review was conducted by:** | The Technical Committee of the International EPD® System.<br>See www.environdec.com for a list of members.<br><br>Most recent review chair: Claudia A. Peña, University of Concepción, Chile.<br>The review panel may be contacted via the Secretariat www.environdec.com/contact. |
| **Independent verification of the declaration and data, according to ISO 14025:** | ■ EPD verification by individual verifier |
| **Third party verifier: Approved by EPD Australasia Ltd** | Sazal Kundu, Edge Impact<br>Address: Greenhouse, Level 3, 180 George Street<br>Sydney NSW 2000, Australia<br>Web: https://www.edgeimpact.global/<br>Phone: +61 2 9438 0100<br>Email: sazal.kundu@edgeimpact.global |
| **Procedure for follow-up of data during EPD validity involves third party verifier** | ☐ Yes<br>■ No |




# About Us

Brickworks is one of Australia's largest and most diverse building material manufacturers.

Brickworks has been transformed from originally a NSW state-based operation to an International organisation with manufacturing operations in New South Wales, Victoria, Tasmania, South Australia, Queensland and North America.

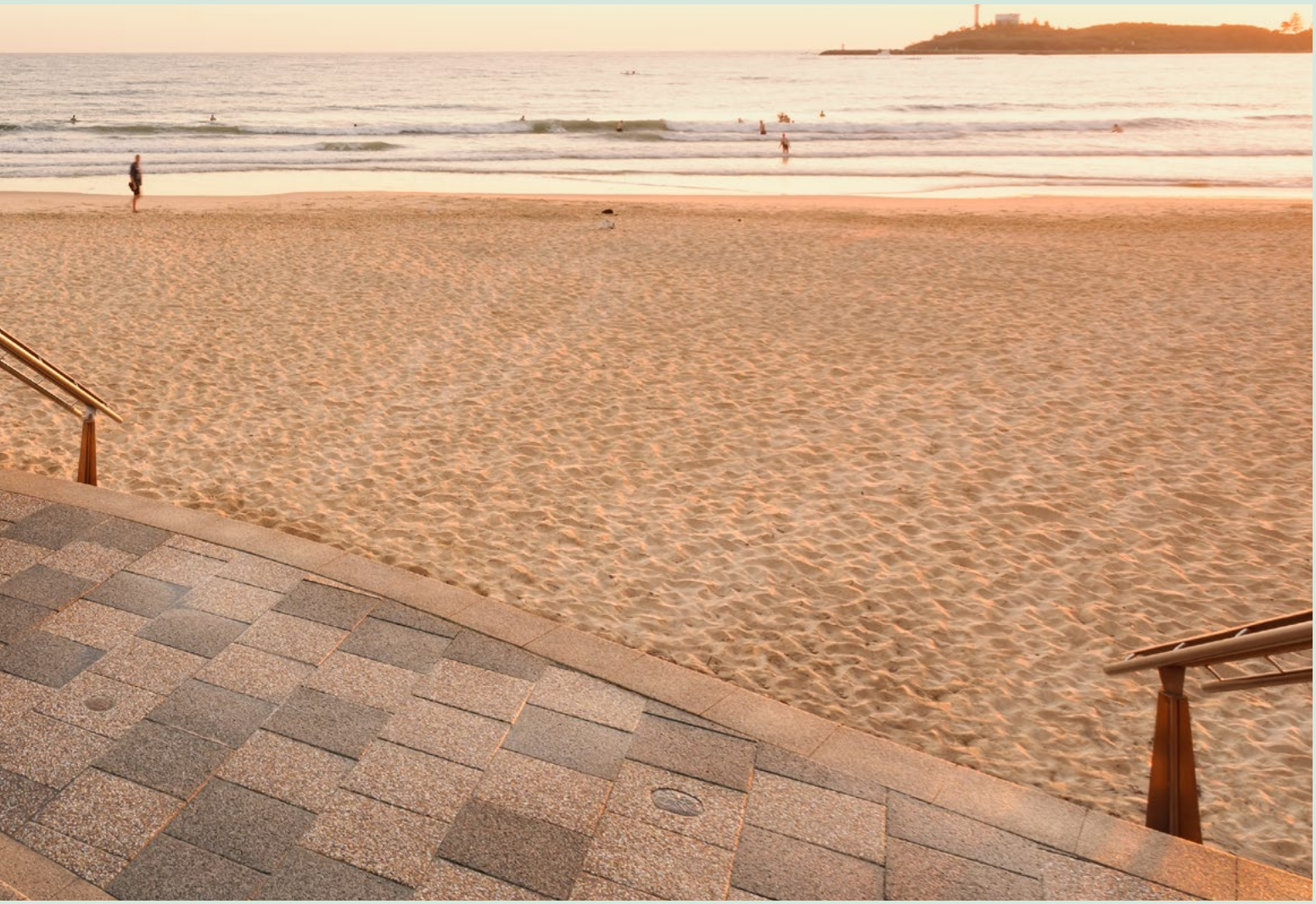
UrbanStone is a brand of Austral Masonry, a subsidiary of Brickworks that manufactures and sells Australian made wet cast pavers, concrete pavers, concrete blocks, retaining wall blocks, natural stone.

UrbanStone also sells a collection of bricks, advanced brick systems, wall cladding, natural stone pavers and cladding, limestone blocks, roofing materials and other custom made products.

These products are used in a range of residential and commercial projects.

This EPD covers all wet cast pavers produced at our Jandakot Western Australia location which manufactures under the UrbanStone brand.

Owner of the EPD: Brickworks Limited
Contact: info@brickworks.com.au



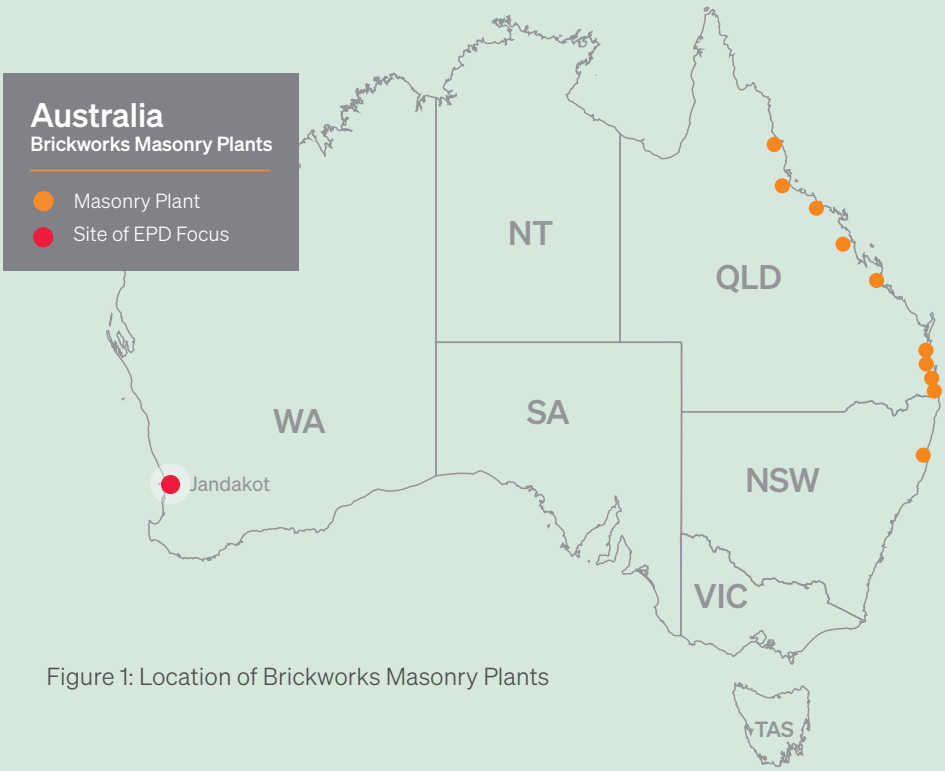



Figure 1: Location of Brickworks Masonry Plants

# Our Products

The life cycle of wet cast pavers starts with extraction of sand, gravel and cement from quarries and mines.

The processed materials are then mixed with oxide and poured into moulds where the mix is vibrated to release air bubbles in the mix and allowed to cure into the mould which creates the desired paver size and finish.

The process of pouring wet concrete into moulds where they are allowed to cure is called 'wet casting'.

Wet cast pavers are used in residential and commercial landscape applications.

This EPD covers the wet cast pavers produced at our Jandakot Western Australia plant under the UrbanStone brand.

UrbanStone produces a significant number of product variations based on a limited number of concrete mix designs. To present the results in a meaningful manner, we have used a representative product. The representative wetcast mix was determined using a mix with a higher cement content compared to the (weighted) average cement content. This ensures the representative product is likely more conservative than the weighted average would be.

# UrbanStone Range

| Range | Series | Finishes Available | Size L x W x H (mm) | Weight |
|---|---|---|---|---|
| **Commercial Paving** | 200 Series | Shot Blast \| Milled \| Honed \| Honed Shot | 200L × 200W × 40H<br>200L × 200W × 60H | 3.8kg<br>5.7kg |
| **Commercial Paving** | 300 Series | Shot Blast \| Milled \| Honed \| Honed Shot | 300L × 150W × 40H<br>300L × 150W × 60H | 4.32kg<br>6.5kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 300L × 200W × 40H<br>300L × 200W × 60H<br>300L × 200W × 70H | 5.7kg<br>8.6kg<br>10kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 300L × 300W × 40H<br>300L × 300W × 60H | 12.9kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 400L × 300W × 40H<br>400L × 300W × 60H | 11.5kg<br>17.2kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 600L × 300W × 40H<br>600L × 300W × 50H<br>600L × 300W × 60H | 17.28kg<br>17.2kg<br>25.8kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 600L x 400W x 40H<br>600L x 400W x 50H<br>600L x 400W x 60H | 23kg<br>28.8kg<br>34.5kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 600L x 600W x 40H<br>600L x 600W x 50H<br>600L x 600W x 60H | 34.4kg<br>43.2kg<br>51.8kg |
| **Commercial Paving** | 400 Series | Shot Blast \| Milled \| Honed \| Honed Shot | 400L x 200W x 40H<br>400L x 200W x 60H | 7.6kg<br>11.5kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 400L x 400W x 40H<br>400L x 400W x 50H<br>400L x 400W x 60H | 15.3kg<br>19.2kg<br>23kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 400L x 500W x 40H<br>400L x 500W x 60H | 19.2kg<br>28.8kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 800L x 400W x 50H<br>800L x 400W x 60H | 38.4kg<br>46kg |
| **Commercial Paving** | 500 Series | Shot Blast \| Milled \| Honed \| Honed Shot | 490L x 245W x 40H<br>490L x 245W x 50H<br>490L x 245W x 60H | 11.5kg<br>14.4kg<br>17.2kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 490L x 490W x 40H<br>490L x 490W x 50H<br>490L x 490W x 60H | 23kg<br>28.8kg<br>34.4kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 745L x 495W x 50H<br>745L x 495W x 60H | 44.25kg<br>53.1kg |

# UrbanStone Range

| Range | Series | Finishes Available | Size L x W x H (mm) | Weight |
|---|---|---|---|---|
| **Commercial Paving** | Step Tread | Shot Blast \| Milled \| Honed \| Honed Shot | 400L x 300W x 50H<br>400L x 300W x 60H | 11.5kg<br>17.2kg |
| | | Shot Blast \| Milled \| Honed \| Honed Shot | 600L x 400W x 50H<br>600L x 400W x 60H | 23kg<br>34.5kg |
| **Tactile Paving** | 400 Series | Hazard or Directional | 400L x 300W x 40H<br>400L x 300W x 60H | 11.5kg<br>17.2kg |
| | | Hazard or Directional | 400L x 400W x 40H<br>400L x 400W x 60H | 15.3kg<br>23.0kg |
| | | Hazard or Directional | 300L x 300W x 40H<br>300L x 300W x 60H | 12.9kg<br>13.2kg |

This EPD applies to all colours UrbanStone make including: Albany Grey, Batavia Grey, Black Pearl, Brisbane Grey, Casino Grey, Castro, Convention Grey, Estuary Grey, Exhibition Black, Flint, Galaxy, Granite Bronze, Gunmetal, Karratha, Kumar, Large, Maroochydore, Mooloolaba Rock, Murdock, Noir, Obsidian, PCC, Ronaldo, RSGC, Safety Red, Shadow, Smoke, Swinbourne Back, Western Cream, West, Gambier, Golden Fleece, Milligan, Newington Grey, Newport, Nightingale, River Topaz, Spinafex, Stanley, Subiaco, Summer, Tusk, Anne, Ash, RES Ash, Babbage, Ficonnaci, Graphite, RES Graphite, Hale, Ivory Grey, Parry, Place, River Grey, Rocky Road, Silver Grey, Albany Beige, New Amber, Beach, Buchanan, Capricorn, Fleece, Ivory, Macquarie, Maya, Muap, Olympic Gold, RES Pearl, Pyrmont, River bank, White Ash, Western Cream, Wheat, French Limestone, Pearl, and Sand.

# Content Declaration

The concrete pavers may have unique characteristics such as shape, colour and dimensions, but in essence, all paver products are made with the same set of ingredients. The concrete constituents that are used (in various combinations) are shown in the table below:

The products included in this EPD do not contain any substances that are listed in the "Candidate List of Substances of Very High Concern (SVHC) for authorisation" (ECHA 2024) in concentrations exceeding 0.1% of the weight of the product.

**Table 1: Product content declaration for Pioneer concrete sleepers produced at Yatala**

| Product component | Weight (kg/t of pavers) | Post-consumer recycled material, weight % of product | Biogenic material, weight % of product | Biogenic material (kgC/t of pavers) |
|---|---|---|---|---|
| CEMENT | 150-185 | 0% | 0% | 0 |
| COARSE AGGREGATES | 0-485 | 0% | 0% | 0 |
| NATURAL SAND | 270-730 | 0% | 0% | 0 |
| WATER | 75-90 | 0% | 0% | 0 |
| ADMIXTURES | 0-2 | 0% | 0% | 0 |
| OXIDES | 0-7 | 0% | 0% | 0 |
| TOTAL | 1000 | 0% | 0% | 0 |
| TOTAL | 1000 | 1.5-9.0% | 0% | 0 |

Our products contain recycled content, however, in line with reporting requirements outlined in the PCR, the above table will indicate 0% post-consumer recycled material where we cannot guarantee whether the origin of recycled material is pre-consumer or post-consumer.

### Packaging materials

Concrete pavers are stacked and held together using plastic (polyester or polypropylene) strapping bands. The amount of strapping is estimated to be less than 0.05% of total product mass and have been excluded from the results of this EPD.

# Technical Compliance

Urbanstone residential and commercial paver collections are manufactured to Australian Standard AS/NZS 4455.2: 2010 Masonry units, pavers, flags and segmental retaining wall units (Reconfirmed 2020).

Product quality testing is performed in accordance with AS/NZS 4456:2003 Masonry Units and Segmental Pavers – Methods of Test.

Further details on product use and design for different applications can be found on UrbanStone's website and more specifically their concrete pavers product page and product information page.[1]

Concrete paver products are classified under:

- UN CPC 3754 - Tiles, flagstones, bricks and similar articles, of cement, concrete or artificial stone
- ANZSIC 2034 - Concrete product manufacturing.

**Declared Unit**

Concrete pavers are available in various shapes and sizes that are specifically designed for different styles and applications. The declared unit that covers all the permutations within the scope of the products included in this EPD is:

1 tonne (1,000 kg) of concrete paver products.

A reference service life (RSL) is not declared, as the EPD does not cover the full life cycle.

[1] https://www.urbanstone.com.au/

# Product Life Cycle

## Overview

The EPD covers the cradle-to-gate with modules C1–C4 and module D (A1–A3, C and D) life cycle stages. Intermediate life cycle stages (Modules A4, A5 and B1-B7) have not been included as these are better defined at building or structure level.

**Table 2: Scope of the EPD**

| Stages | Product stage | | | Construction stage | | Use stage | | | | | | | End-of-life stage | | | | Benefits beyond system boundary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw Materials | Transport | Production | Transport | Installation | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstruction/Demolition | Transport | Waste Processing | Disposal | Reuse, recovery, recycling potential |
| **Modules** | **A1** | **A2** | **A3** | **A4** | **A5** | **B1** | **B2** | **B3** | **B4** | **B5** | **B6** | **B7** | **C1** | **C2** | **C3** | **C4** | **D** |
| | | | | SCENARIO | | | | | SCENARIO | | | | | SCENARIO | | | SCENARIO |
| Modules Declared | A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| | ✓ | ✓ | ✓ | ND | ND | ND | ND | ND | ND | ND | ND | ND | ✓ | ✓ | ✓ | ✓ | ✓ |
| Geography | AU | AU | AU | | | | | | | | | | AU | AU | AU | AU | AU |
| Share of specific data | | 97% | | | | | | | | | | | | | | | |
| Variation products | | <10% | | | | | | | | | | | | | | | |
| Variation sites | | 0% | | | | | | | | | | | | | | | |

✓ = module is included in this study

ND = module is not declared. When a module is not accounted for, the stage is marked with “ND” (Not Declared). ND is used when we cannot define a typical scenario.

# Product Stages (A1-A3)

**Stage A1 – raw material extraction**

Concrete paver products are typically made using cement, fine and coarse aggregates and water. Admixtures and oxides may be used to achieve desired material properties and colours.

**Stage A2 – transportation**

Raw materials are typically transported to UrbanStone facilities via articulated trucks (with distances varying for each facility). Cement is sourced from Munster, WA.

The impact of transportation is determined from the specific supply sources to UrbanStone's plants. It is noted that for admixtures, the supplier location which is known is the location that is used in the analysis.

Internal transport occurring within UrbanStone's core process is included in stage A3, as fuel use cannot always be separated from other core processes.

**Stage A3 – manufacturing**

The manufacturing process of UrbanStone's concrete pavers starts by dosing and mixing the concrete constituents in exact formulations (concrete mix designs). The mix is fed into paver moulds and vibrated. Our facilities use electricity, diesel and LPG in this process. When the concrete has developed enough strength, the mould is removed, cleaned and reused. Finally, the products are tested and stockpiled.

# End-of-life stage (C1-C4)

generic scenario. The scenario included is currently in use and is representative for one of the most probable alternatives.

Module C1 covers demolition of the concrete pavers at the end of its service life. We have used the Australian average end-of-life scenario representative for building & demolition materials products based on the National Waste Report 2022 (NWR 2022). This scenario implies that 79.8% of the concrete is recycled and the remaining 20.2% of the concrete is sent to landfill.

Module C2 comprises the transport from the demolition site to a recycling centre or landfill site (50km). Module C3 encompasses the recycling process (i.e. crushing of concrete), while Module C4 represents disposal of concrete in a landfill site.

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

Details for the end-of-life scenario have been captured in table 3 below.

Due to high uncertainty in the parameters and lack of data, $CO_2$-uptake (carbonation) has not been included in end-of-life.

# Resource recovery stage (D)

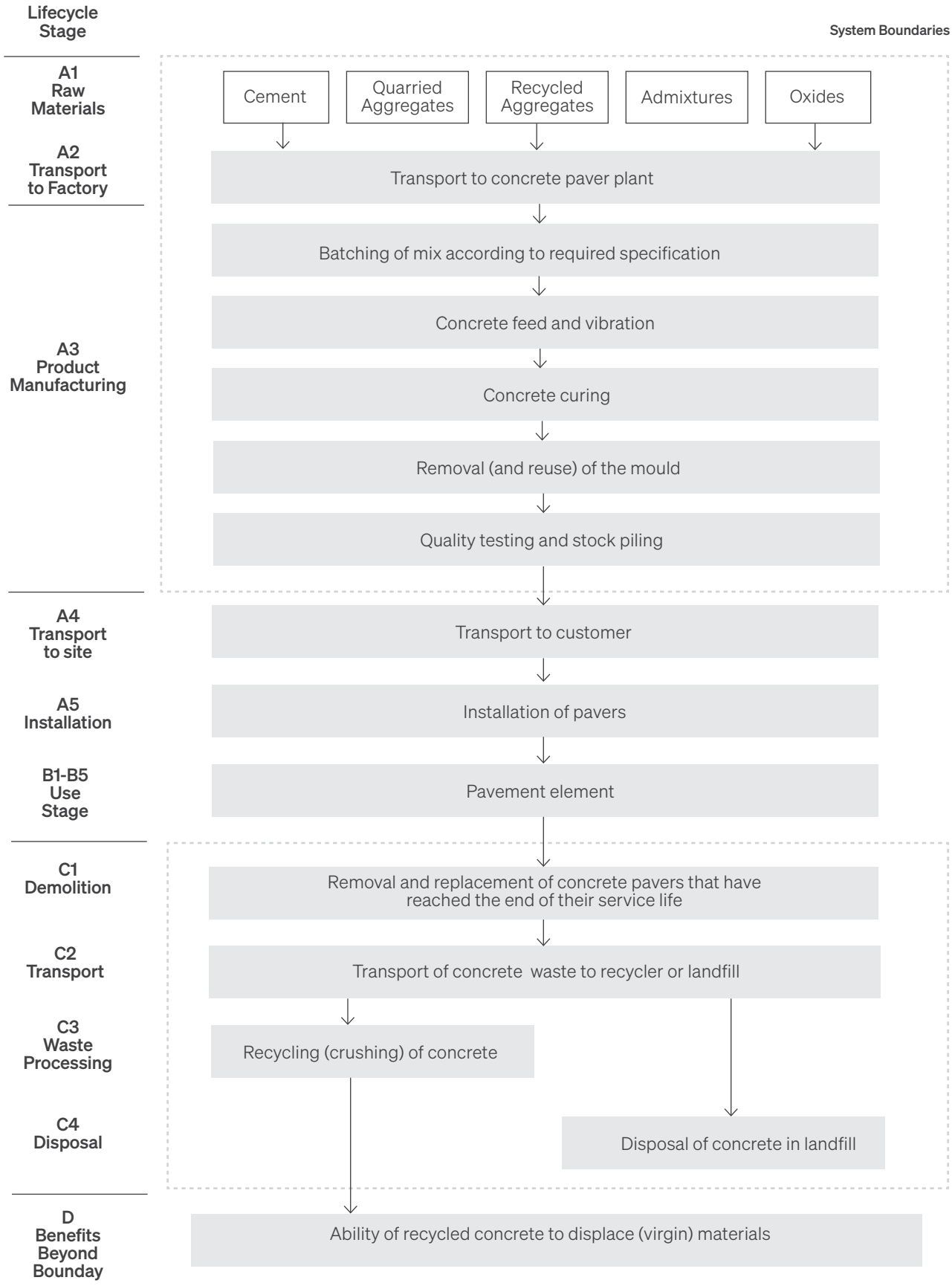
Net benefits and loads from net flows leaving the product system beyond the system boundary that have passed the end-of-waste state (except those which have been allocated as co-products). This stage is modelled based on assumptions to represent the most likely scenario for unreinforced concrete paver products.

Benefits associated with the recycled concrete aggregates that have come out of module C for unreinforced concrete pavers:

- It is assumed that for every kg of concrete that is recycled, 1 kg of crushed rock production is avoided.
- Recycled aggregates: When products contain recycled aggregates (bottom ash, glass), these materials reduce the net flow of recycled materials going to module D.

[2] based on the National Waste Report 2022 (NWR 2022); table 37 building & demolition materials, Australian average

Figure 2: Life cycle stages of UrbanStone concrete pavers



### Table 3: End-of-life scenario of concrete pavers, per tonne

| Processes | Quantity | Unit |
|---|---|---|
| Collection process specified by type | 1,000 | kg collected separately |
| | 0 | kg collected with mixed construction waste |
| Transport from demolition site to recovery/ disposal sites | 50 | km transport (transport, truck, 16-28t, fleet average/AU U) |
| Recovery system specified by type | 0 | kg for re-use |
| | 798 | kg for recycling (recycling brick rubble and concrete, at plant/AU U) |
| | 0 | kg for energy recovery |
| Disposal to landfill | 202 | kg product or material for final deposition (disposal, concrete, 5% to inert material landfill/CH U/ AusSD U) |
| Assumptions for scenario development | 61.7 | MJ for demolition (diesel, burned in building machine/GLO U/AusSD U) |
| | | The end-of-life scenario is based on the National Waste Report 2022 (NWR 2022); table 37 building & demolition materials, Australian average |

### Table 4: Assumptions relating to Module D of unreinforced concrete paver products

| Parameter | Unit / effect |
|---|---|
| $M_{MR\ out}$ = 79.8% | Amount of concrete exiting the system that will be recycled in a subsequent system |
| $M_{MR\ in}$ = 0% | Amount of recycled input material (aggregates) in the concrete |
| Y = 100% | The material yield, between point of end-of-waste (M-EoW) in modules A4-C4 and point of substitution (M-DoS) in module D (when the material has been upgraded). |
| $E_{MR\ after\ EoW\ out}$ = 0 (n/a) | Specific emissions and resources consumed per unit of analysis arising from material recovery processes of a subsequent system after the end-of-waste state. |
| $E_{VMSub\ out}$ = virgin materials | Specific emissions and resources consumed per unit of analysis arising from acquisition and pre-processing of the primary material, or average input material if primary material is not used, from the cradle to the point of functional equivalence where it would substitute secondary material that would be used in a subsequent system<br>Virgin materials (concrete): coarse aggregates |
| $Q_{R\ out}$ / $Q_{Sub}$ = 1 | Quality ratio between outgoing recovered material and the substituted material is assumed to be 1 (equal quality) |

# Life Cycle Assessment Methodology

**LCA methodology**

A background LCA for UrbanStone's concrete paver products was conducted by Energetics and serves as the foundation for this EPD. The methodology for the LCA is detailed below.

**Primary and Background Data**

UrbanStone supplied primary data for the FY22 (1 July 2021 – 30 June 2022) period. Primary data include production volumes at the Jandakot plant, product compositions for all concrete mixes, type and quantity of concrete used for each product group, energy and water consumption and waste data. UrbanStone also provided information regarding its upstream value chain (raw materials and supply chain logistics data). Data sets used for calculations have been reviewed and where relevant updated within the last 10 years for generic data and within the last 5 years for producer-specific data.

Background data have predominantly been sourced from AusLCI (v1.42) and the AusLCI shadow database (based on ecoinvent v2):

- Cement is known to be the key contributor to environmental impacts of most concrete products. The GP cement used in Jandakot has been adjusted to reflect EPD data published by their supplier for GP cement manufactured in Cockburn (WA).
- Aggregate data are based on natural sand production or crushed rock production (for manufactured sand). Some of the sands we use are double-washed or triple-washed. Energetics doubled or tripled electricity use in the sand production process to account for the additional handling of the material. The effect on the LCA results is minimal.
- Data for admixtures have been sourced from EPDs published by EFCA in 2021 and 2023 (European Federation of Concrete Admixtures Associations Ltd.)
- We use various types of iron oxides to colour our products. AusLCI data for iron ore production have been used to model the impacts of the oxides.

Methodological choices have been applied in line with EN 15804 and any deviations have been recorded

**Allocation**

The allocation hierarchy outlined in ISO 14044 and joint co-product allocation rules from EN 15804 have been followed.

The materials, products, and processes in the life cycle of concrete paver products that require allocation are:

- Coarse aggregates: coarse aggregates (and manufactured sand) are produced through crushing of rock, which is graded in different sizes. The process cannot be subdivided and energy required for the crushing and screening does not differentiate between products. Therefore, the background data used show aggregates (including manufactured sand) have been allocated based on the mass of product.
- Production of various concrete paver products: UrbanStone manufactures a range of concrete paver products. Energy use for concrete paver production has been allocated to the products based on their share in the total mass of products.
- Landfill: landfill is a multi-input process. Physical causality has been used to allocate emissions in landfill.

**Cut-off Criteria**

All inputs and outputs to a process have been included where possible. The cut-off criteria applied are 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of a process.

The materials and processes that have been excluded are:

- Greases and lubricants, other minor ancillary materials used during precast concrete products production
- Packaging of admixtures and oxides are also well

  below the cut-off:

  - Admixtures make up less than 1% of the mass of the concrete pavers. Packaging of admixtures (IBCs) is estimated to make up less than 0.01% of total mass inputs and can be reused.
  - Oxides make up less than 0.6% of the mass of the concrete pavers. Packaging of oxides (20 kg lined paper bags) is estimated to make up less than 0.01% of total mass inputs.
- Packaging of concrete pavers. Concrete pavers are stacked and held together using plastic (polyester or polypropylene) strapping bands. The amount of strapping is estimated to be less than 0.05% of total product mass

The total (cumulative) of neglected input flows for the cradle-to-gate stages is well below 5% of energy usage and mass (the exact percentage has not been determined).

The environmental impacts incorporated in the infrastructure (buildings, plant, equipment, roads, vehicles, etc.) associated with manufacturing products is excluded from the product system. Other capital goods (e.g. transport equipment, power lines, etc.) are excluded as well. This is technically not a cut-off issue. Capital goods (production equipment and infrastructure) and personnel are non-attributable processes and they contribute less than 10% to GWP-GHG.

Overhead energy use (e.g. for offices) at UrbanStone's manufacturing sites could not be distinguished from process energy use and is therefore included in the LCA. This represents a conservative approach.

**Key assumptions**

The following key assumptions have been made:

- Concrete composition: concrete composition of each product is taken from UrbanStone's internal operating systems and is considered of high quality.
- Production waste: production waste tonnage is measured at the plant and an average production waste percentage has been incorporated across all products into the environmental profiles.
- Transport of raw materials to the plant: transport modes for raw materials where data was not provided has been estimated. This has no material impact on the LCA results.
- Cement data: the cement data have been taken from our supplier's EPD (S-P-07448, EPD International). A minor discrepancy between ADPF and PENRT results in Jandakot is due to this discrepancy coming through the cement data.
- Admixtures: UrbanStone has provided information on which admixtures they use for their concrete paver products. Due to lack of detail regarding admixture constituents and production data, European EPDs for admixtures (EFCA 2021, EFCA 2023) have been used.
- Oxides: UrbanStone uses various iron oxides to colour concrete pavers. We have modelled these using iron ore production.
- Washed sand: Some of the sand supplied to UrbanStone is double washed or triple washed sand. AusLCI data for natural sand production has been used and it has been assumed that the electricity used in the sand production process doubles or triples for double washed sand and triple washed sand, respectively. We assumed that washing water is recycled and have not adjusted water use data.

### Electricity

Electricity in core processes has been modelled using adjusted AusLCI data to represent the estimated residual electricity grid mix in Western Australia.

The GWP-GHG of the electricity is 0.71 kg $CO_2e$/ kWh. The residual grid mix is made up of Black coal (28.1%), natural gas (41.1%), solar (13.5%), wind (16%) other (1.3%), based on Brown & Grant 2025.

Electricity used in upstream and downstream processes is typically modelled following a location-based approach.

### LCA Indicators

An LCA serves as the foundation for this EPD. An LCA analyses the production systems of a product. It provides comprehensive evaluations of all upstream and downstream energy inputs and outputs. The results are provided in a form which covers a range of environmental impact categories.

**Table 5: Environmental indicators legend (EN 15804+A2)**

| Core indicators | Acronym | Unit |
|---|---|---|
| Climate change – total | GWP-total | kg $CO_2$ equivalent |
| Climate change – fossil | GWP-fossil | kg $CO_2$ equivalent |
| Climate change – biogenic | GWP-biogenic | kg $CO_2$ equivalent |
| Climate change – land use and land use change | GWP-luluc | kg $CO_2$ equivalent |
| Ozone layer depletion | ODP | kg CFC-11 equivalent |
| Acidification | AP | mol $H^+$ equivalent |
| Eutrophication aquatic freshwater | EP-freshwater | kg P equivalent |
| Eutrophication aquatic marine | EP-marine | kg N equivalent |
| Eutrophication terrestrial | EP-terrestrial | mol N equivalent |
| Photochemical ozone formation | POCP | kg NMVOC equivalent |
| Abiotic depletion potential – minerals and metals[2] | ADP minerals & metals | kg Sb equivalent |
| Abiotic depletion potential – fossil fuels[2] | ADP fossil | MJ, net calorific value |
| Water use[2] | WDP | $m^3$ world equivalent deprived |

## Table 5: Environmental indicators legend (EN 15804+A2) - continued

| Additional indicators | Acronym | Unit |
|---|---|---|
| Global Warming Potential – Greenhouse gases | GWP-GHG | kg $CO_2$ equivalent |
| Particulate matter emissions | PM | disease incidence |
| Ionising radiation, human health[1] | IRP | kBq U235 equivalent |
| Ecotoxicity (freshwater)[2] | ETP-fw | CTUe |
| Human toxicity, cancer effects[2] | HTP-c | CTUh |
| Human toxicity, non-cancer effects[2] | HTP-nc | CTUh |
| Land use related impacts / soil quality[2] | SQP | - (dimensionless) |
| **Additional GHG indicator** | **Acronym** | **Unit** |
| Carbon footprint in line with IPCC AR5 | GWP-GHG (IPCC AR5) | kg $CO_2$ equivalent |

1 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.

2 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.

**Note regarding various GWP indicators:**

GWP-total is calculated using the European Union's Joint Research Centre's characterisation factors (CFs) based on the "EF 3.1 package" for CFs to be used in the EU's Product Environmental Footprint (PEF) framework. CFs listed by JRC include indirect radiative forcing, which results in higher numerical Global Warming Potential (GWP) values than the CFs in the internationally accepted (IPCC 2013).The GWP-GHG indicator is identical to GWP-total except that the CFs for biogenic CO2 are set to zero. The GWP-GHG indicator in PCR 2019:14 v1.3.4 differs from the GWP-GHG in PCR 2019:14 version 1.2.5 and earlier. The "GWP-GHG (IPCC AR 5)" indicator is determined using the IPCC AR5 Global Warming Potentials (GWP) with a 100-year time horizon. This indicator is aligned with Australia's greenhouse gas reporting frameworks.

### Table 6: Legend for parameters describing resource use, waste and output flows

| Parameter | Acronym | Unit |
|---|---|---|
| **Parameters describing resource use** | | |
| Use of renewable primary energy excluding renewable primary energy resources used as raw materials | PERE | $MJ_{NCV}$ |
| Use of renewable primary energy resources used as raw materials | PERM | $MJ_{NCV}$ |
| Total use of renewable primary energy resources | PERT | $MJ_{NCV}$ |
| Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials | PENRE | $MJ_{NCV}$ |
| Use of non-renewable primary energy resources used as raw materials | PENRM | $MJ_{NCV}$ |
| Total use of non-renewable primary energy resources | PENRT | $MJ_{NCV}$ |
| Use of secondary material | SM | kg |
| Use of renewable secondary fuels | RSF | $MJ_{NCV}$ |
| Use of non-renewable secondary fuels | NRSF | $MJ_{NCV}$ |
| Use of net fresh water | FW | $m^3$ |
| **Waste categories** | | |
| Hazardous waste disposed | HWD | kg |
| Non-Hazardous waste disposed | NHWD | kg |
| Radioactive waste disposed | RWD | kg |
| **Output flows** | | |
| Components for re-use | CRU | kg |
| Materials for recycling | MFR | kg |
| Materials for energy recovery | MER | kg |
| Exported energy | EE | MJ |

### Table 7: Legend for EN 15804+A1 indicators

| Indicator | Acronym | Unit |
|---|---|---|
| Global warming potential | GWP | kg $CO_2$ equivalent |
| Ozone layer depletion potential | ODP | kg CFC-11 equivalent |
| Acidification potential | AP | kg $SO_2$ equivalent |
| Eutrophication potential | EP | kg $PO_4^{3-}$ equivalent |
| Photochemical oxidation (Photochemical ozone creation) potential | POCP | kg ethylene equivalent |
| Abiotic depletion potential - elements | ADPE | kg Sb equivalent |
| Abiotic depletion potential – fossil fuels | ADPF | $MJ_{NCV}$ |

# Life Cycle Assessment
## Results

The results in the following tables are provided by life cycle module, per declared unit (one tonne of concrete paver products).

The results have been calculated with SimaPro software v9.6.0.1.

Water flows have been disaggregated using the 36 ALCAS water catchments for which characterisation factors are available for both Pfister WSI and the AWARE method.

To separate the use of primary energy into energy used as raw material and energy used as energy carrier, Option B from Annex 3 of PCR 2019:14 has been applied. In option B, the energy used as raw material is declared as an input to the module where it enters the product system (often in module A1) and as an output from the product system if it exits the product system as useful energy (often from modules A5 or C3).

(Note: As module A5 is not declared, balancing has occurred in modules A1-A3.) Energy content that is wasted (e.g. in landfill), remains as part of the indicator for energy used for raw materials, and is not reported as an input of energy used for energy carriers.

Please consider the following mandatory statements when interpreting the results:

- 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.
- The use of the results of modules A1-A3 (A1-A5 for services) without considering the results of module C is discouraged.

**Table 8: Environmental impact (EN15804+A2) indicators covering modules A1-A3, C1-C4 and D for average brick production, per tonne**

| Environmental Indicator | Unit | Module A1-A3 | Module C1 | Module C2 | Module C3 | Module C4 | Module D |
|---|---|---|---|---|---|---|---|
| | | | Core Indicators | | | | |
| **GWP-total** | kg $CO_2$ eq. | 1.93E+02 | 5.30E+00 | 6.40E+00 | 3.28E+00 | 4.79E-01 | -7.04E+00 |
| **GWP-fossil** | kg $CO_2$ eq. | 1.93E+02 | 5.30E+00 | 6.40E+00 | 3.27E+00 | 4.79E-01 | -7.02E+00 |
| **GWP-BIOGENIC** | kg $CO_2$ eq. | 1.01E-01 | 3.51E-04 | 3.96E-04 | 3.12E-03 | 3.86E-05 | -1.38E-02 |
| **GWP-luluc** | kg $CO_2$ eq. | 6.12E-03 | 2.54E-06 | 3.02E-06 | 1.52E-06 | 2.32E-07 | -1.08E-06 |
| **ODP** | kg CFC-11 eq. | 8.40E-06 | 8.47E-07 | 1.01E-06 | 4.14E-07 | 7.83E-08 | -2.40E-07 |
| **AP** | mol H+ eq. | 8.06E-01 | 5.82E-02 | 5.62E-02 | 9.01E-03 | 1.14E-03 | -2.57E-02 |
| **EP-freshwater** | kg P eq. | 5.86E-04 | 7.05E-07 | 3.85E-07 | 2.43E-06 | 6.53E-08 | -5.06E-06 |
| **EP-marine** | kg N eq. | 2.41E-01 | 2.53E-02 | 1.77E-02 | 1.60E-03 | 2.06E-04 | -4.30E-03 |
| **EP-terrestrial** | mol N eq. | 2.69E+00 | 2.78E-01 | 1.94E-01 | 1.75E-02 | 2.25E-03 | -4.66E-02 |
| **POCP** | kg NMVOC eq. | 6.62E-01 | 7.42E-02 | 4.73E-02 | 4.68E-03 | 6.05E-04 | -1.22E-02 |
| **ADP minerals & metals[2]** | kg Sb eq. | 1.94E-05 | 6.25E-09 | 7.43E-09 | 8.13E-07 | 5.63E-10 | -1.03E-06 |
| **ADP fossil[2]** | $MJ_{NCV}$ | 1.23E+03 | 7.39E+01 | 8.79E+01 | 4.67E+01 | 6.82E+00 | -1.01E+02 |
| **WDP** | $m^3$ world eq. deprived | 1.74E+02 | 4.67E-01 | 5.56E-01 | 4.79E-01 | 4.30E-02 | -4.69E+01 |
| | | | Additional Indicators | | | | |
| **GWP-GHG** | kg $CO_2$ eq. | 1.91E+02 | 5.30E+00 | 6.40E+00 | 3.28E+00 | 4.79E-01 | -7.04E+00 |
| **PM** | Disease incidence | 4.37E-06 | 1.54E-06 | 3.16E-07 | 6.00E-08 | 6.05E-09 | -2.15E-07 |
| **IRP[1]** | kBq U235 eq. | 5.78E-01 | 1.08E-04 | 1.28E-04 | 6.60E-04 | 9.91E-06 | -6.39E-04 |
| **ETP-fw[2]** | CTUe | 8.03E+02 | 1.64E+01 | 1.94E+01 | 8.06E+00 | 1.49E+00 | -4.82E+00 |
| **HTP-c[2]** | CTUh | 1.61E-08 | 2.05E-10 | 2.75E-11 | 6.86E-11 | 3.79E-12 | -3.06E-10 |
| **HTP-nc[2]** | CTUh | 7.15E-07 | 1.09E-09 | 5.24E-10 | 4.47E-10 | 4.58E-11 | -1.93E-09 |
| **SQP[2]** | - | 3.04E+02 | 3.55E-01 | 3.95E-01 | 8.88E+03 | 1.13E+01 | -1.44E+02 |
| | | | Carbon footprint | | | | |
| **GWP-GHG (IPCC AR5)** | **kg $CO_2$ eq.** | **191** | **5.30** | **6.40** | **3.28** | **0.479** | **-7.04** |

[1] 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.

[2] 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.

Table 9: Parameters covering modules A1-A3, C1-C4 and D, per tonne

| Environmental Indicator | Unit | Module A1-A3 | Module C1 | Module C2 | Module C3 | Module C4 | Module D |
|---|---|---|---|---|---|---|---|
| **PERE** | $MJ_{NCV}$ | 5.46E+01 | 1.14E-01 | 1.26E-01 | 8.08E-01 | 1.33E-02 | -5.74E+00 |
| **PERM** | $MJ_{NCV}$ | 1.25E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **PERT** | $MJ_{NCV}$ | 5.48E+01 | 1.14E-01 | 1.26E-01 | 8.08E-01 | 1.33E-02 | -5.74E+00 |
| **PENRE** | $MJ_{NCV}$ | 1.26E+03 | 7.39E+01 | 8.79E+01 | 4.67E+01 | 6.82E+00 | -1.01E+02 |
| **PENRM** | $MJ_{NCV}$ | 6.17E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **PENRT** | $MJ_{NCV}$ | 1.26E+03 | 7.39E+01 | 8.79E+01 | 4.67E+01 | 6.82E+00 | -1.01E+02 |
| **SM** | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **RSF** | $MJ_{NCV}$ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **NRSF** | $MJ_{NCV}$ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **FW** | $m^3$ | 1.36E+00 | 1.07E-02 | 1.27E-02 | 1.66E-02 | 9.88E-04 | -1.10E+00 |
| **HWD** | kg | 2.44E-04 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **NHWD** | kg | 1.20E+00 | 3.39E-04 | 3.73E-04 | 2.28E-03 | 2.02E+02 | -1.69E-02 |
| **RWD** | kg | 1.34E-03 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **CRU** | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **MFR** | kg | 1.68E+01 | 0.00E+00 | 0.00E+00 | 7.98E+02 | 0.00E+00 | 0.00E+00 |
| **MER** | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **EE** | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

Table 10: Environmental impact (EN 15804+A1) indicators covering modules A1-A3, C1-C4 and D, per tonne*

| Environmental Indicator | Unit | Module A1-A3 | Module C1 | Module C2 | Module C3 | Module C4 | Module D |
|---|---|---|---|---|---|---|---|
| **GWP** | kg $CO_2$ eq | 1.91E+02 | 5.28E+00 | 6.39E+00 | 3.27E+00 | 4.78E-01 | -7.00E+00 |
| **ODP** | kg CFC11 eq | 2.48E-06 | 6.69E-07 | 7.97E-07 | 3.27E-07 | 6.18E-08 | -1.90E-07 |
| **AP** | kg $SO_2$ eq | 3.54E-01 | 4.14E-02 | 3.12E-02 | 5.69E-03 | 9.20E-04 | -8.08E-03 |
| **EP** | kg $PO_4^{3-}$ eq | 7.11E-02 | 8.50E-03 | 5.97E-03 | 5.58E-04 | 7.09E-05 | -1.49E-03 |
| **POCP** | kg $C_2H_4$ eq | 1.10E-02 | 4.06E-03 | 2.01E-03 | 3.18E-04 | 4.58E-05 | -5.57E-04 |
| **ADPE** | kg Sb eq | 2.23E-06 | 6.33E-09 | 7.52E-09 | 8.13E-07 | 5.72E-10 | -1.04E-06 |
| **ADPF** | $MJ_{NCV}$ | 1.26E+03 | 7.39E+01 | 8.79E+01 | 4.67E+01 | 6.82E+00 | -1.01E+02 |

* Note: 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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### Variation (A1-A3) per impact category

The results of this LCA are presented for a representative product. The variation in the GWP-GHG indicator (as well as other core indicators) is typically less than ±10%.

For transparency, we include the variation in core indicators to assist the user of the EPD with the interpretation of the results:

### Table 11: Variation in product group

| Indicator | Jandakot - UrbanStone concrete pavers | |
|---|---|---|
| (Average product = 100%) | Min | Max |
| Climate change | 91% | 103% |
| Ozone depletion | 83% | 93%* |
| Acidification | 90% | 103% |
| Eutrophication, freshwater | 94% | 111% |
| Eutrophication, marine | 90% | 105% |
| Eutrophication, terrestrial | 91% | 107% |
| Photochemical ozone formation | 91% | 106% |
| Resource use, minerals and metals | 94% | 108% |
| Resource use, fossils | 87% | 91%* |
| Water use | 96% | 91%* |

* The maximum is lower than 100% as the mix with highest cement content (which is used to test maximum variation) contains a different aggregate source, less oxides, or has lower transport requirements.


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