Environmental Product Declaration

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

Hardie® Panel and Hardie® Architectural Panel

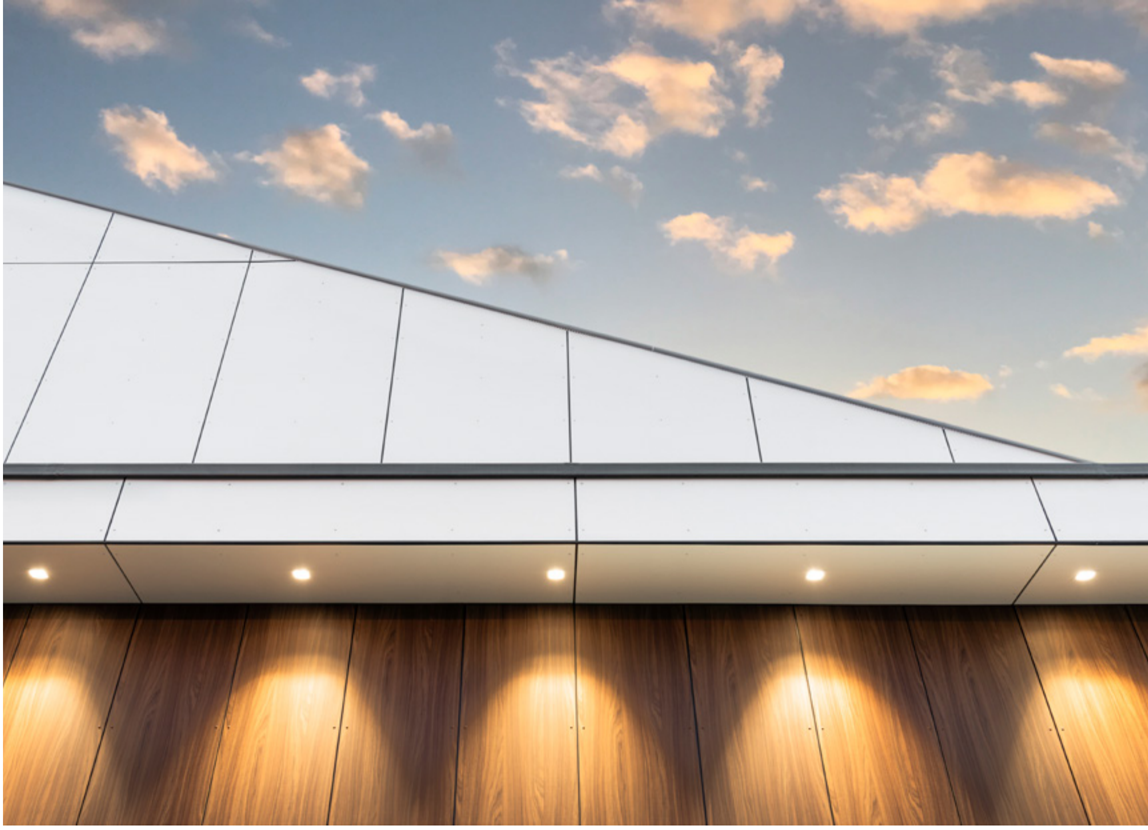
from

James Hardie Europe GmbH

Program: The International EPD® System
www.environdec.com
Program Operator: EPD International AB
EPD Registration Number: S-P-10857
Publication Date: 31 October 2023
Valid Until: 24 October 2028

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



About Us

James Hardie is the world's number one producer and marketer of high-performance fiber cement products. As a trusted industry leader, we are committed to offering innovative, durable and sustainable solutions across an extensive range of exteriors and interiors.

James Hardie applies a continuous improvement mindset to research and development, manufacturing and sales.

Our innovative and durable solutions combine lasting beauty and endless design possibilities with trusted protection and low maintenance. We are driven to develop quality solutions that are built to last, improving the livability and street-scape for homeowners and communities alike.

Integrated Approach to Sustainability

James Hardie is committed to delivering greater value for our consumers and the community. Our global strategy for value creation embeds the sustainability principles and practices that inform our environmental, social and governance (ESG) strategy.

Sustainability is integrated into our day-to-day operations demonstrating our leadership in sustainability performance and reporting.

Our high quality products are responsibly produced, built to last, and deliver long-term value.

Our product design and innovation consider sustainability-related impacts, and are constantly evolving to improve environmental performance.

We prioritize Lean Manufacturing to promote resource conservation and waste reduction.

Our people are central to all that we do. We create a culture in which people can thrive to promote shared success.

The Zero Harm foundation prioritises the safety of our products and employees, partners, customers and communities.

In the coming years, we will continue to develop our sustainability strategy and define the next steps in our ESG journey.

Our Fiber Cement Products

James Hardie understands building professionals and homeowners alike, providing them with innovative building products and solutions. Hardie® fiber cement products are deemed non-combustible and are resistant to damage from moisture, termites, rotting and warping when installed and maintained correctly. They are damage-resistant, low maintenance and highly durable.

Comparing Life Cycle Assessments

Life Cycle Assessments are one of the best tools for helping building professionals and homeowners understand the environmental impacts of their building products. LCA calculations are used to develop Environmental Product Declarations (EPDs); third-party verified documents that outline the environmental impact of a product and are a useful tool for building professionals to compare the environmental impacts between different products.

As EPDs do not certify whether products are environmentally superior to alternatives, it's crucial to understand the differences between the LCAs used when making comparisons between products, to confirm you're comparing like for like.

There are a few things to look out for when comparing LCAs within Environmental Product Declarations (EPDs):

1. They must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs.
2. The two EPDs have equivalent content declarations (e.g., identical declared/functional units) and are valid at the time of comparison.
3. The two EPDs have equivalent system boundaries (e.g., cradle-to-gate, cradle-to-grave or other) and descriptions of data.
4. Products have identical functions, technical performance and use.
5. The LCA behind the EPDs applies equivalent data quality requirements, methods of data collection, and allocation methods.
6. The LCA behind the EPDs applies identical cut-off rules and impact assessment methods (including the same version of characterization factors).
7. When evaluating a product's climate impact (i.e., emissions), use the total Global Warming Potential (GWP-total) measure.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For further information about comparability, see EN 15804 and ISO 14025.

Our Commitment to Innovative, Durable and Sustainable Solutions

The inherent properties of our fiber cement technology allow our Hardie® facade products to capture carbon dioxide (CO_2) from the atmosphere during its use phase.

During the life of a built asset, carbon emissions are released at every phase, including during manufacturing and transportation of materials, construction, and end of life. This is commonly referred to as embodied carbon.

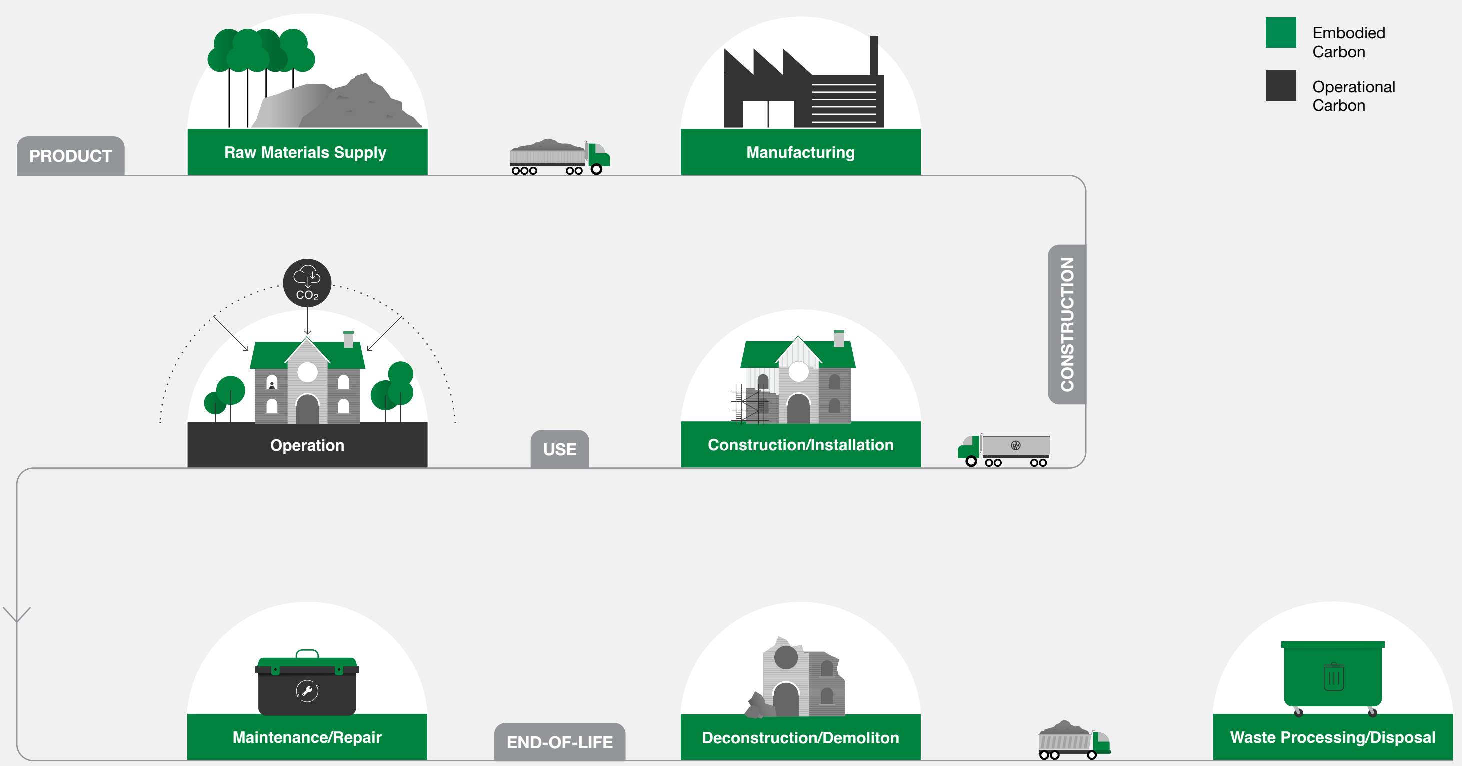
According to the World Green Building Council, embodied carbon in buildings contributes around 11 percent of all global carbon emissions.

Figure 1 below highlights the phases where embodied and operational carbon are released. Differing from other materials, fiber cement products capture CO_2 from the atmosphere during their operational use.

James Hardie's Lean Manufacturing helps us deliver quality products with less, promoting resource conservation and waste reduction to further our sustainability efforts.

Our line of responsibly produced products are high quality and built to last, delivering long-term value for building professionals and homeowners, whilst helping builders to reduce the environmental impact of their builds.

FIGURE 1 PRODUCT LIFE CYCLE



Product Range & Descriptions

Hardie® Panel

Nominal thickness: 8 mm
Product weight: 11,2 kg/m^2

Hardie® Architectural Panel

Nominal thickness: 8 mm
Product weight: 11,2 kg/m^2

General Information

Programme information

Programme: The International EPD® System
EPD International AB
Box 210 60
SE-100 31 Stockholm, Sweden
w: www.environdec.com
e: info@environdec.com

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

Product category rules (PCR): PCR 2019:14 Construction products (EN 15804+A2) (1.3.1)
c-PCR-001 Cement and building limes (EN 16908)
c-PCR-003 Concrete and concrete elements (EN 16757)
UN CPC Code: 37570, 2021-02-05

PCR review was conducted by:
The Technical Committee of the International EPD® System.
See www.environdec.com for a list of members.
Review chair: Claudia A. Peña, University of Concepción, Chile.
The review panel may be contacted via the Secretariat www.environdec.com/contact-us.

Independent third-party verification of the declaration and data, according to ISO 14025:2006:
☐ EPD process certification ☑ EPD verification

Third party verifier:
Chris Foster, EuGeos SRL
e: info@eugeos.eu
Approved by: The International EPD® System

Procedure for follow-up of data during EPD validity involves third party verifier:
☐ Yes ☑ No

EPD type: Manufacturer-specific EPD

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

Please note, the EPD uses "," comma as the decimal separator.

Company information

Owner of the EPD:
James Hardie Europe GmbH
Bennigsen-Platz 1
40474 Düsseldorf
Contact Person:
Isabelle Régnier - Product Manager
t: +31 6 46 37 23 76
e: fermacell@jameshardie.de
w: https://www.jameshardie.eu/en
Manufacturing locations:
Pulaski
1000 James Hardie Way, Pulaski, VA 24301, United States

EPD Produced by:
Edge Environment Sustainability Consulting Inc.
Ronnie Fang, Xinyue Zhang
269 Cordaville Road
Southborough, MA 01772, USA
t: +1 774 206 9172
e: bryan.sheehan@edgeimpact.global
w: edgeimpact.global

Product information

TABLE 2 PRODUCT INFORMATION

Product	Product use	Panel nominal thickness (mm)	Product weight (kg/m²)*
Hardie® Panel	Facade cladding	8	11,2
Hardie® Architectural Panel	Facade cladding	8	11,2

Detailed product information and supporting evidence is available on https://www.jameshardie.eu/en.

LCA information

James Hardie's LCA calculates the environmental footprint at each of the following stages: product, transportation, manufacturing, use, and end-of-life. All the significant environmental impacts associated with the product, including the impact on water, air, land, and climate change are reported based on international ISO LCA standards.

This product declaration is based on the report for James Hardie Europe GmbH "Life Cycle Assessment and Environmental Product Declaration of Fiber Cement Cladding" background report by Edge Environment Sustainability Consulting Inc. and verified by Chris Foster in October 2023.

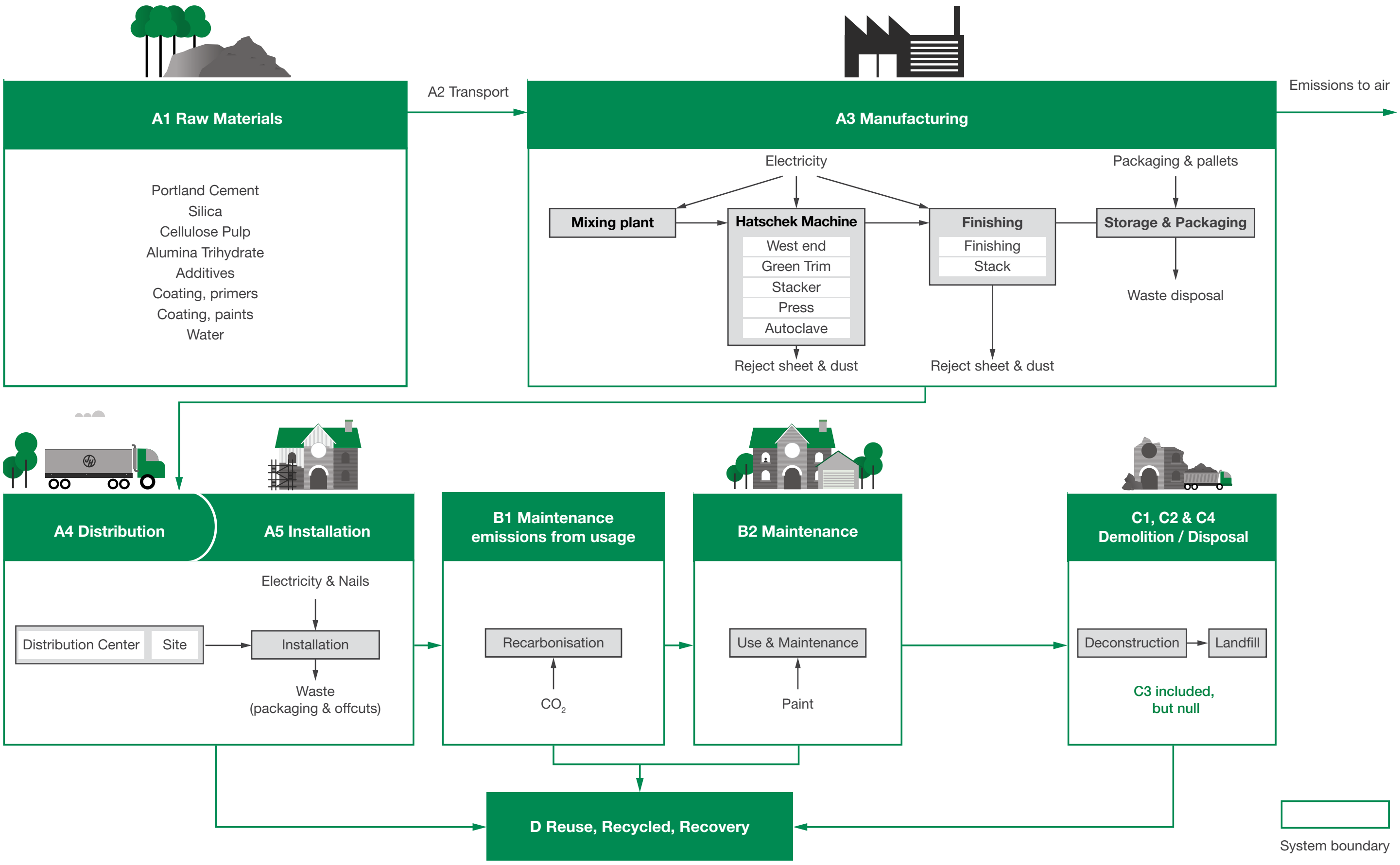
TABLE 3 PRODUCT CHARACTERISTICS

Product Characteristics	
Declared Unit	1 square meter of installed product over its reference service life (RSL).
System Boundary	Cradle to gate with options, modules C1–C4, and module D with additional modules (A1-A3 + C + D and additional modules). The additional modules are A4-A5 and B1-B2.
Reference Service Life (RSL)	The fiber cement product life is assumed to be 50 years.
Geographical Coverage	Europe
Time Period	Foreground was provided first-hand by James Hardie for CY20 (2020-01-01 to 2020-12-31)
Databases used	Ecoinvent v3.9.1 (all background data is less than 10 years old)
Software	SimaPro (v9.5.0.0)

*No post-consumer recycled material is used in the production of products and packaging.

System Diagram:

FIGURE 1. SYSTEM BOUNDARY



Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation:

The life cycle of a building product is divided into three process modules according to the General Program Instructions (GPI) and four information modules according to ISO 21930 and EN 15804 and supplemented by an optional information module on potential loads and benefits beyond the building life cycle, as given in following table.

Scope

TABLE 4 THE LIFE CYCLE OF A BUILDING PRODUCT

	Product stage		Construction process stage			Use stage							End of life stage				Resource Recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potantial
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	x	x	x	x	x	x	x	ND	ND	ND	ND	ND	x	x	x	x	x
Geography	US	US	US	EU	EU	EU	EU						EU	EU	EU	EU	EU
Specific data used			>90%			-	-	-	-	-	-	-	-	-	-	-	-
Variation - Product			Not relevant			-	-	-	-	-	-	-	-	-	-	-	-
Variation - location			Not relevant			-	-	-	-	-	-	-	-	-	-	-	-

ND = Not Declared
The following life cycle stages are deemed not applicable for James Hardie: Repair (B3); Replacement (B4); Refurbishment (B5); Operational energy use (B6); and Operational water use (B7).
The scenarios included are currently in use and are representative for one of the most likely scenario alternatives.

Content information

TABLE 5 MATERIAL CONTENT

Material Input	Percent composition for 1m² of product
Cement (100% portland)	30–35%
Silica (sand)	40–45%
Cellulose Pulp	5–10%
Hydrated Alumina	2–4%
Additive	0–1%
Coatings – primer & paint*	Confidential
Water	10–15%
Packaging for 1m² of product	
Pallet	0–0,0082 kg
Pallet bag	0–0,005 kg
Silage wrap	0–0,0011 kg
Strapping	0–0,0025 kg
Edge protectors	0–0,0583 kg

Table 5 lists materials used to produce fiber cement. None of the products contain one or more substances that are listed in the "Candidate List of Substances of Very High Concern for authorisation". Safety data sheets are available request. Cellulose pulp is the main source of biogenic carbon content of the product(s), while pallet is the source of biogenic carbon content of packaging. Default biogenic carbon from Ecoinvent datasets is used here. For example, the biogenic carbon content is 0,14 kg per kg of sulfate pulp, and 495 kg per m³ of sawnwood, which is used as the raw material of pallet. No recycled materials included in packaging.

*Coatings are included in the model. Due to the data confidentiality, details are not reported here.

Raw Materials, Packaging, and Transportation from Supplier (Module A1 and A2)

The inventory data collected from James Hardie for production year 2020 is available below. In summary, the panels are produced from:

- Cement, cellulose pulp, silica, hydrated alumina, additive, and water.
- Both products also use primers and paints.
- Water listed in Table 5 reflects the amount of water in each product by the time it is packaged.
- Material transportation to manufacturing sites was assumed to be 130km. The additive material also includes a transportation distance of 5708 nautical miles by ship.
- For modelling purposes, it was assumed a typical product load had 50% utilisation of a typical heavy truck (i.e., 15t product on 30t capacity truck) for local distribution.
- Typical production process includes the use of energy (electricity, gasoline, diesel, natural gas, and propane), and water. Energy and water consumption were allocated to each product based on its portion of the overall yearly production (in STDM, 1STDM is 4,5mm*1000mm*1000mm worth of material) for each production site.
- Co-products of cladding production (i.e., reject sheets for cement production and dust for road base applications) do not currently have economic value for James Hardie (other than avoided landfill charges). With no economic value, the co-products do not share any of the production.
- The cellulose pulp is assumed to have 12,2 MJ/kg as renewable energy resource used as raw material, based on the energy density quoted for biomass municipal and industrial materials in the National Greenhouse Accounts Factors (Department of the Environment, 2021).
- Additional materials, including primers and paints, are based on Bill of Material (BOM) in CY 2020 and STDM.
- Typical packaging, including wood, polyethylene, polyester, and polystyrene.
- Electricity is modelled with the regional grid of each plant location. Hardie® Panel and Hardie® Architectural Panel are manufactured at Pulaski, VA, United States.

Panel Manufacturing (Module A3)

Typical production process includes the use of energy (electricity, gas, diesel, etc.). Energy consumption was allocated to each product based on its portion of the overall yearly production (in STDM) for each production site. Electricity is modeled with the regional grid of each plant location.

TABLE 6 ELECTRICITY GRID MIX FOR MANUFACTURING LOCATION AND GLOBAL WARMING POTENTIAL (GWP)

Electricity mix, Pulaski	Grid mix (%)	Emission factor (EF) (kg CO_2-e/kWh)
Electricity, high voltage {RoW}| heat and power co-generation, hard coal | Cut-off, U	0,8%	1,21
Electricity, high voltage {RoW}| heat and power co-generation, lignite | Cut-off, U	0,1%	1,25
Electricity, high voltage {RoW}| treatment of coal gas, in power plant | Cut-off, U	0,03%	1,26
Electricity, high voltage {SERC}| electricity production, hard coal | Cut-off, U	14,2%	1,23
Electricity, high voltage {SERC}| electricity production, hydro, pumped storage | Cut-off, U	0,03%	0,72
Electricity, high voltage {SERC}| electricity production, hydro, reservoir, alpine region | Cut-off, U	0,8%	0,001
Electricity, high voltage {SERC}| electricity production, hydro, run-of-river | Cut-off, U	3,4%	0,00003
Electricity, high voltage {SERC}| electricity production, lignite | Cut-off, U	3,7%	1,29
Electricity, high voltage {SERC}| electricity production, natural gas, combined cycle power plant | Cut-off, U	39,3%	0,48
Electricity, high voltage {SERC}| electricity production, natural gas, conventional power plant | Cut-off, U	4,6%	0,76
Electricity, high voltage {SERC}| electricity production, nuclear, boiling water reactor | Cut-off, U	8,1%	0,005
Electricity, high voltage {SERC}| electricity production, nuclear, pressure water reactor | Cut-off, U	17,2%	0,004
Electricity, high voltage {SERC}| electricity production, oil | Cut-off, U	0,03%	1,11
Electricity, high voltage {SERC}| electricity production, wind, <1MW turbine, onshore | Cut-off, U	0,04%	0,0001
Electricity, high voltage {SERC}| electricity production, wind, >3MW turbine, onshore | Cut-off, U	0,004%	0,0001
Electricity, high voltage {SERC}| electricity production, wind, 1-3MW turbine, onshore | Cut-off, U	0,5%	0,0001
Electricity, high voltage {SERC}| heat and power co-generation, biogas, gas engine | Cut-off, U	0,2%	0,93
Electricity, high voltage {SERC}| heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical | Cut-off, U	3,1%	0,53
Electricity, high voltage {SERC}| heat and power co-generation, natural gas, conventional power plant, 100MW electrical | Cut-off, U	1,8%	0,61
Electricity, high voltage {SERC}| heat and power co-generation, oil | Cut-off, U	0,001%	0,96
Electricity, high voltage {SERC}| heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014 | Cut-off, U	2,0%	0,06
Total	**100%**	**0,50***

Transport (Module A4)

Transport distances and loads from James Hardie gate were calculated based on primary data from James Hardie in the production year 2020.

For modelling purposes, it was assumed a typical product load had 100% utilisation of a typical heavy truck (i.e., 30t product on 30t capacity truck) for national distribution, and 50% utilisation of a typical heavy truck (i.e., 15t product on 30t capacity truck) for local distribution.

Impact from energy consumption at warehouse when products are stored in the Europe warehouse is also included.

Installation (Module A5)

The following assumptions have been used in this study to model product construction:

- Energy (electricity) consumption for construction and deconstruction has been calculated based on the consumption of 0,2 kWh of electricity per m² of panel installed, which is assumed to be a conservative estimate based on up to 6 minutes of power tool usage (average 2kW power rating).
- Galvanised Rivets/ screws is included.
- Installation waste is 5%. All waste goes to landfill 100%.
- Product packaging is assumed to be disposed in landfill after delivery to site.

TABLE 7 PRODUCT INSTALLATION INPUTS FOR 1M² OF PRODUCT

Life Cycle Stage	Input	Unit	Quantity
Installation	Panel Installed	m²	1
	Electricity[1]	kWh	0,20
	Galvanised Rivet/ screws[2]	kg	0,08

TABLE 8 PRODUCT INSTALLATION OUTPUTS FOR 1M² OF PRODUCT

Installation (A5)	Waste product	Packaging waste-wood (pallet)	Packaging waste-inert (pallet bag, strapping, etc.)
Unit	**%**	**kg**	**kg**
Hardie® Panel	5%	0,067	0,071
Hardie® Architectural Panel	5%	0,067	0,071

Recarbonation (Module B1)

Carbonation is a natural process whereby concrete absorbs carbon dioxide (CO_2) from the atmosphere through a chemical reaction between the CO_2 in the ambient air and hydration products within the concrete ($Ca(OH)_2$). Concrete products can be subject to carbonation from the use stage onward (i.e., after construction and curing). From a life cycle impact accounting perspective, this process can also be referred to as 'reabsorption', since the CO_2 emitted during the cement manufacturing process can be partly offset by the lifetime absorption of CO_2, therefore reducing the net CO_2 emissions associated with the concrete over its lifetime.

This EPD has used the Global Cement and Concrete Association's (GCCA) tool for quantifying carbon reabsorption. This tool was developed with Quantis and is available at https://gccassociation.org/sustainability-innovation/environmental-product-declarations/. The results are included in the GWP-fossil, GWP-T, and GWP-GHG indicators.

*The electricity emission factor accounts for the direct emission, losses, and transmission, not a simple accumulative emission from the listed electricity inventory in the table.

[1]Assumptions from previous EPD.
[2]Assumptions from previous EPD.

Assumptions:

- Outside and inside areas are exposed to air*.
- Both products are assumed exposed to rain.
- The fiber cement product life is assumed to be 50 years.
- 100% has been assumed for Degree of Carbonation (Dc %) from EN16757 and GCCA tool. James Hardie has done lab test to show this is not an overestimation.

TABLE 9 PANEL USE INPUT TO GCCA TOOL FOR 1M² OF PRODUCT

Use Phase (B1)	Service life	Average exposed surface during service life, per declared unit	Exposure conditions	Density
Unit	**yrs**	**m²/m³ of ready-mix concrete**		**kg/m³**
Hardie® Panel	50	254,78	Exterior	1332
Hardie® Architectural Panel	50	254,78	Exterior	1332

Maintenance (Module B2)

The exterior facing panel side is assumed to be re-painted (two coats) every 15 years, over the assumed 50 year life of the building. Acrylic varnish is assumed to be the paint. 2 layers on the coated side are required for each re-painting. It is assumed that fiber cement panels have a lifespan of 50 years and no replacements will be required during the life of the building. It is recommended to clean the products once a year.

Deconstruction and End of Life (Module C1, C2, C3, C4)

The end-of-life environmental profile is based on the assumed most conservative scenario, which is that all the products are dismantled and disposed at inert waste landfill. It is assumed that there is a 50km delivery distance to landfill based on the distance from likely construction sites within major cities to main landfill sites for the area. Transport to landfill is modelled based on 50% loaded rigid trucks (no empty return trips). There is no activity under C3, therefore C3 result is 0 for all impact categories.

Recyclability potentials (Module D)

100% of the product goes to landfill, therefore no activities are included in Module D. Module D result is 0.

Cut-off rules

All inputs and outputs to a unit process are included in the calculation. Data gaps are filled by conservative assumptions with average or generic data, such as module A5, C. Detailed assumptions are listed in the relevant section. According to the PCR 2019:14 and EN 15804+A2, the cut-off criteria shall be 1 % of renewable and non-renewable primary energy usage and 1 % of the total mass input of that unit process. The total of neglected input flows per module shall be a maximum of 5 % of energy usage and mass. Conservative assumptions in combination with plausibility considerations and expert judgement are used in this exercise.

In accordance with the PCR 2019:14, the following system boundaries on manufacturing equipment and employees are excluded:

- Environmental impact from infrastructure, construction, production equipment, and tools that are not directly consumed in the production process are not accounted for in the LCI. Capital equipment and buildings typically account for less than a few percent of nearly all LCIs and this is usually smaller than the error in the inventory data itself. For this project, it is assumed that capital equipment makes a negligible contribution to the impacts as per Frischknecht et al. (Frischknecht, 2007) with no further investigation.
- Personnel-related impacts, such as transportation to and from work, are also not accounted for in the LCI. The impacts of employees are also excluded from inventory impacts on the basis that if they were not employed for this production or service function, they would be employed for another. It is very hard to decide what proportion of the impacts from their whole lives should count towards their employment. For this project, the impacts of employees are excluded.

*There is enough area behind the board that allows water to drain after installed and dry out behind the boards, so there is air on the exposed and building-side sides.

Allocation

According to EN15804+A2:2019, in a process step where more than one type of product is generated, it is necessary to allocate the environmental stressors (inputs and outputs) from the process to the different products (functional outputs) in order to get product-based inventory data instead of process-based data. An allocation problem also occurs for multi-input processes. In an allocation procedure, the sum of the allocated inputs and outputs to the products shall be equal to the unallocated inputs and outputs of the unit process.

The following stepwise allocation principles shall be applied for multi-input/output allocations:

- The initial allocation step includes dividing up the system sub-processes and collecting the input and output data related to these sub-processes.
- The first (preferably) allocation procedure step for each sub-process is to partition the inputs and outputs of the system into their different products in a way that reflects the underlying physical relationships between them.
- The second (worst case) allocation procedure step is needed when physical relationship alone cannot be established or used as the basis for allocation. In this case, the remaining environmental inputs and outputs from a sub-process must be allocated between the products in a way that reflects other relationships between them, such as the economic value of the products.

Annual manufacturing data, including energy consumption, water consumption, and waste at manufacturing stage, are allocated by production volume in standard meter, which takes the product thickness into account.

Manufacturing wastes that get disposed or recycled has negligible economic value, therefore no impact has been allocated to manufacturing wastes.

Data Quality and Validation

The primary data used for the study (core module) is based on direct utility bills or feedstock quantities from James Hardie's procurement records. Edge used contribution analysis to focus on the key pieces of data contributing to the environmental impact categories. Edge considers the data to be of high quality for the core module. Data quality level and criteria from the Product Environmental Footprint Category Rules listed in EN 15804+A2 Annex E is used to perform this data quality assessment activity.

Compliance with Standards

The methodology and report format are compliant with:

- ISO 14040:2006 and ISO14044:2006+A1:2018 which describe the principles, framework, requirements and provides guidelines for life cycle assessment (LCA) (ISO, ISO 14040:2006. Environmental management – Life cycle assessment – Principles and framework., 2006) (ISO, ISO 14044:2006. Environmental management – Life cycle assessment – Requirements and guidelines, 2006).
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and procedures, which establishes the principles and specifies the procedures for developing Type III environmental declaration programmes and Type III environmental declarations (ISO, ISO 14025:2006 - Environmental labels and declarations - Type III environmental declarations - Principles and procedures, 2006).
- ISO 14020:2022 Environmental statements and programmes for products – Principles and general requirements (ISO, ISO 14020:2022 - Environmental statements and programmes for products — Principles and general requirements, 2022).
- EN 15804+A2:2019: Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products (here after referred to as EN15804+A2) (European Standard, 2019).
- Product Category Rules (PCR) 2019:14, v1.3.1 – Construction products – Hereafter referred to as PCR 2019:14 (EPD International, 2023).
- c-PCR-001 Cement and building limes (EN 16908) (EPD International, 2019).
- c-PCR-003 Concrete and concrete elements (EN 16757) (EPD International, 2019).

Key Assumptions and Considerations

TABLE 10 ASSUMPTIONS, CHOICES, AND LIMITATIONS

Module	Assumption or limitation	Impact on LCA results	Discussion
General	Indicators SM, RSF, NRSF values	Minor	These values are only calculated for foreground processes, not the whole product system.
A1	Raw material packaging	Minor	For simplicity and lacking comprehensive data, all raw material packaging is excluded in this study.
A1	Most product packaging data are given by unit or piece. Assumptions have been made to convert data into mass.	Minor	Given the material and quantities of product packaging data (including pallet, pallet bag, strapping, and edge protectors), we converted to mass data by using secondary source data.
A2	Transport distance from raw material supplier to James Hardie production plants	Minor	The distance is assumed to be 130km. This assumption comes from the Product Environmental Footprint method (Zampori & Pant, 2019) which assumes 130km truck transportation. Since most materials are sourced locally, this assumption is reasonable.
A3	Energy allocation	Significant	The energy consumptions and other manufacturing data at manufacturing stage are allocated by production volume in standard meter, which takes the product thickness into account, by James Hardie.
A4	Energy consumption for storage in the EU warehouse	Minor	The electricity consumption comes from the Product Environmental Footprint method (Zampori & Pant, 2019), which assumes 1 m^2 space in the warehouse consumes 30kWh electricity (for lighting) in a year. Assumptions are also provided by James Hardie regarding the occupation area and storage length for 1m^2 of Fiber Cement products.
A5	Installation	Minor	Installation process is assumed to be the same for both products.
B2	Maintenance	Minor	The potential impact associated with cleaning is minimal and there is limited data related to this activity. Thus, it's omitted from this LCA. However, the impact of this activity should not consider to be zero.
C1	Transport to landfill	Minor	It is assumed 50km delivery distance to landfill based on the distance from likely construction sites within major cities to main landfill sites for the area.
C4	End of life scenario	Minor	For simplicity and lacking comprehensive data and statistics on the fate of used panels, all products are assumed to be disposed in landfill after use.
A5 & C4	GWP-biogenic impact	Minor	Based on the guidance provided in PCR 2019:14 annex 2, the biogenic carbon of product raw material and packaging should be balanced across product life cycle. Compared to the relatively small emission from the artefact of the background LCA processes, the emission from pulp and pallet is significantly larger. Thus, the GWP-biogenic value for these processes in A5 and C omit the other materials impact and only consider the impacts from pulp and pallets.

Environmental Performance

The potential environmental impacts, use of resources and waste categories included in this EPD were calculated using the SimaPro v9.5.0.0 tool and are listed in the table below. All tables from this point will contain abbreviations only. The potential environmental performance is calculated based on the input data and the emission factors from Ecoinvent v3.9.1. The LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds and safety margins or risks.

A1-A3 impact results are better used and interpreted when the impact from module C (end-of-life) is also considered. Sole interpretation of impacts from A1-A3 without considering the end-of-life impact is not recommended.

TABLE 11 LIFE CYCLE IMPACT, RESOURCE AND WASTE ASSESSMENT CATEGORIES, MEASUREMENTS AND METHODS

Impact Category	Indicator/Abbreviation	Measurement Unit	Assessment Method and Implementation
Potential environmental impacts			
Global warming potential (fossil)	GWP-fossil	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2013
Global warming potential (biogenic)	GWP-biogenic	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2013
Land use/ land transformation	GWP-luluc	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2013
Total global warming potential	GWP-total	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2013
Acidification potential	AP	mol H^+ eq.	Accumulated Exceedance, Seppälä et al. 2006, Posch et al., 2008
Eutrophication – aquatic freshwater	EP – freshwater	kg P equivalent	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
Eutrophication – aquatic marine	EP – marine	kg N equivalent	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
Eutrophication – terrestrial	EP – terrestrial	mol N equivalent	Accumulated Exceedance, Seppälä et al. 2006, Posch et al.
Photochemical ozone creation potential	POCP	kg NMVOC equivalents	LOTOS-EUROS, Van Zelm et al., 2008, as applied in ReCiPe
Abiotic depletion potential (elements)*	ADPE	kg Sb equivalents	CML (v4.1)
Abiotic depletion potential (fossil fuels)*	ADPF	MJ net calorific value	CML (v4.1)
Ozone depletion potential	ODP	kg CFC 11 equivalents	Steady-state ODPs, WMO 2014
Water Depletion Potential*	WDP	m^3 equivalent deprived	Available Water Remaining (AWARE) Boulay et al., 2016

Impact Category	Indicator/Abbreviation	Measurement Unit	Assessment Method and Implementation
Resource use			
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ, net calorific value	Manual for direct inputs[3]
Use of renewable primary energy resources used as raw materials	PERM	MJ, net calorific value	Manual for direct inputs[4]
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PERT	MJ, net calorific value	Sum of “Non-renewable, biomass”, “Renewable, biomass”, “Renewable, wind, solar, geothe”, and “Renewable, water” indicators from calculating Cumulative Energy Demand based on fuels’ lower heating values
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ, net calorific value	Manual for direct inputs[5]
Use of non- renewable primary energy resources used as raw materials	PENRM	MJ, net calorific value	Manual for direct inputs[6]
Total use of non- renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PENRT	MJ, net calorific value	Sum of “Non-renewable fossil” and “Non-renewable, nuclear” indicators from calculating Cumulative Energy Demand based on fuels’ lower heating values
Use of secondary material	SM	kg	Manual for direct inputs
Use of renewable secondary fuels	RSF	MJ, net calorific value	Manual for direct inputs
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value	Manual for direct inputs
Use of net fresh water	FW	m^3	ReCiPe 2016
Waste categories			
Hazardous waste disposed	HWD	kg	EDIP 2003 (v1.05)
Non-hazardous waste disposed	NHWD	kg	EDIP 2003 (v1.05)[7]
Radioactive waste disposed/stored	RWD	kg	EDIP 2003 (v1.05)
Additional environmental impact indicators			
Global warming potential, excluding biogenic uptake, emissions and storage	GWP-GHG	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2013[8]
Particulate matter	Potential incidence of disease due to PM emissions (PM)	Disease incidence	SETAC-UNEP, Fantke et al. 2016
Ionising radiation – human health**	Potential Human exposure efficiency relative to U235 (IRP)	kBq U-235 eq	Human Health Effect model
Eco-toxicity (freshwater)*	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	CTUe	USEtox
Human toxicity potential – cancer effects*	Potential Comparative Toxic Unit for humans (HTP-c)	CTUh	USEtox
Human toxicity potential – non cancer effects*	Potential Comparative Toxic Unit for humans (HTP-nc)	CTUh	USEtox
Soil quality*	Potential soil quality index (SQP)	dimensionless	Soil quality index (LANCA®)
Output flows			
Components for re-use		kg	Manual for direct inputs
Materials for recycling		kg	Manual for direct inputs
Materials for energy recovery		kg	Manual for direct inputs
Exported energy		MJ per energy carrier	Manual for direct inputs

[3]PERE = PERT - PERM
[4]Calculated based on the lower heating value (LHV) of renewable raw materials. LHV is taken from https://phyllis.nl/, as recommended by SimaPro in compliance with EN15804+A2: https://support.simapro.com/s/article/How-to-calculate-EN-15804-A2-indicators-in-desktop-SimaPro
[5]PENRE = PENRT - PENRM
[6]Calculated based on the lower heating value (LHV) of non-renewable raw materials. LHV is taken from https://phyllis.nl/, as recommended by SimaPro in compliance with EN15804+A2: https://support.simapro.com/s/article/How-to-calculate-EN-15804-A2-indicators-in-desktop-SimaPro
[7]Calculated as sum of Bulk waste and Slags/ash.
[8]This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO2 is set to zero.
*Disclaimer – 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.
**Disclaimer – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground.

Environmental Information for Hardie® Panel and Hardie® Architectural Panel

Potential environmental impact – mandatory indicators according to EN 15804+A2											
Indicator	**Unit**	**Tot.A1-A3**	**A4**	**A5**	**B1**	**B2**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-fossil	kg CO_2 eq.	7.17E+00	3.56E+00	6.43E-01	-1.46E+00	3.17E+00	6.71E-02	8.18E-02	0.00E+00	6.00E-02	0.00E+00
GWP-biogenic	kg CO_2 eq.	-1.85E+00	1.58E-03	4.12E-01	0.00E+00	3.92E-02	2.64E-03	2.55E-05	0.00E+00	1.54E+00	0.00E+00
GWP-luluc	kg CO_2 eq.	2.65E-03	1.35E-04	7.45E-04	0.00E+00	2.43E-03	1.67E-04	1.56E-06	0.00E+00	2.32E-05	0.00E+00
GWP-total	kg CO_2 eq.	5.32E+00	3.56E+00	1.06E+00	-1.46E+00	3.22E+00	6.99E-02	8.18E-02	0.00E+00	1.60E+00	0.00E+00
ODP	kg CFC 11 eq.	9.14E-08	6.38E-08	7.87E-09	0.00E+00	7.88E-08	1.08E-09	1.72E-09	0.00E+00	7.84E-10	0.00E+00
AP	mol H^+ eq.	2.14E-02	2.91E-02	3.17E-03	0.00E+00	4.23E-02	3.25E-04	2.08E-04	0.00E+00	4.96E-04	0.00E+00
EP-freshwater	kg P eq.	1.10E-03	5.07E-05	2.57E-04	0.00E+00	1.02E-03	6.10E-05	5.45E-07	0.00E+00	2.23E-05	0.00E+00
EP-marine	kg N eq.	5.68E-03	8.28E-03	6.37E-04	0.00E+00	2.95E-03	5.73E-05	8.15E-05	0.00E+00	2.16E-04	0.00E+00
EP-terrestrial	mol N eq.	6.01E-02	9.02E-02	6.00E-03	0.00E+00	2.75E-02	4.94E-04	8.61E-04	0.00E+00	2.34E-03	0.00E+00
POCP	kg NMVOC eq.	1.95E-02	2.74E-02	2.10E-03	0.00E+00	1.27E-02	1.58E-04	3.36E-04	0.00E+00	6.95E-04	0.00E+00
ADP-minerals & metals*	kg Sb eq.	1.60E-05	1.26E-07	1.07E-05	0.00E+00	2.16E-06	4.12E-09	2.74E-09	0.00E+00	2.22E-09	0.00E+00
ADP-fossil*	MJ	7.22E+01	4.59E+01	8.22E+00	0.00E+00	5.68E+01	1.55E+00	1.06E+00	0.00E+00	7.51E-01	0.00E+00
WDP*	m^3	1.35E+00	5.15E-02	1.77E-01	0.00E+00	3.21E+00	1.56E-02	9.76E-04	0.00E+00	2.59E-03	0.00E+00

Potential environmental impact – additional mandatory and voluntary indicators											
Indicator	**Unit**	**Tot.A1-A3**	**A4**	**A5**	**B1**	**B2**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-GHG	kg CO_2 eq.	7.17E+00	3.56E+00	6.44E-01	0.00E+00	3.18E+00	6.73E-02	8.18E-02	0.00E+00	6.00E-02	0.00E+00

Resource use											
Indicator	**Unit**	**Tot.A1-A3**	**A4**	**A5**	**B1**	**B2**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	3.80E+01	1.93E-01	3.13E+00	0.00E+00	3.86E+00	3.52E-01	2.79E-03	0.00E+00	1.06E+01	0.00E+00
PERM	MJ	1.19E+01	0.00E+00	-1.37E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.05E+01	0.00E+00
PERT	MJ	4.99E+01	1.93E-01	1.76E+00	0.00E+00	3.86E+00	3.52E-01	2.79E-03	0.00E+00	1.84E-02	0.00E+00
PENRE	MJ	6.64E+01	4.59E+01	1.12E+01	0.00E+00	5.68E+01	1.55E+00	1.06E+00	0.00E+00	3.60E+00	0.00E+00
PENRM	MJ	5.84E+00	0.00E+00	-3.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.84E+00	0.00E+00
PENRT	MJ	7.22E+01	4.59E+01	8.22E+00	0.00E+00	5.68E+01	1.55E+00	1.06E+00	0.00E+00	7.51E-01	0.00E+00
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	5.01E-02	1.10E-03	6.03E-03	0.00E+00	7.95E-02	1.20E-03	2.72E-05	0.00E+00	7.25E-05	0.00E+00

Waste categories											
Indicator	**Unit**	**Tot.A1-A3**	**A4**	**A5**	**B1**	**B2**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	2.05E-04	2.86E-04	1.63E-05	0.00E+00	1.19E-04	1.74E-06	7.01E-06	0.00E+00	4.22E-06	0.00E+00
Non-hazardous waste disposed	kg	1.45E+00	5.29E-03	1.23E+00	0.00E+00	1.34E+00	1.84E-03	5.24E-05	0.00E+00	1.05E+01	0.00E+00
Radioactive waste disposed	kg	1.28E-04	6.07E-06	2.56E-05	0.00E+00	1.00E-04	1.15E-05	9.10E-08	0.00E+00	4.22E-07	0.00E+00

Output flows											
Indicator	**Unit**	**Tot.A1-A3**	**A4**	**A5**	**B1**	**B2**	**C1**	**C2**	**C3**	**C4**	**D**
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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

Environmental Information for Hardie® Panel and Hardie® Architectural Panel (cont)

Additional environmental impact indicators											
Indicator	**Unit**	**Tot.A1-A3**	**A4**	**A5**	**B1**	**B2**	**C1**	**C2**	**C3**	**C4**	**D**
Particulate matter	disease incidence	2.11E-07	2.03E-07	4.08E-08	0.00E+00	1.99E-07	9.17E-10	5.34E-09	0.00E+00	1.29E-08	0.00E+00
Ionising radiation - human health**	kBq U-235 eq.	5.66E-01	2.57E-02	1.01E-01	0.00E+00	3.93E-01	4.50E-02	4.03E-04	0.00E+00	1.74E-03	0.00E+00
Eco-toxicity (fresh-water)*	CTUe	1.42E+01	1.80E+01	1.99E+00	0.00E+00	2.05E+01	5.33E-02	3.96E-01	0.00E+00	2.58E-01	0.00E+00
Human toxicity potential - cancer effects*	CTUh	7.87E-10	1.21E-10	4.75E-10	0.00E+00	2.13E-10	4.49E-12	3.09E-12	0.00E+00	3.11E-12	0.00E+00
Human toxicity potential - non cancer effects*	CTUh	1.81E-08	9.59E-09	3.71E-09	0.00E+00	4.09E-08	6.56E-11	2.24E-10	0.00E+00	3.67E-10	0.00E+00
Soil quality*	dimensionless	2.19E+02	1.57E-01	1.77E+00	0.00E+00	9.75E+00	1.94E-01	2.02E-03	0.00E+00	1.83E+00	0.00E+00

Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

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

**Disclaimer – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground

Differences versus previous versions

James Hardie has previously completed an EPD for Hardie® Panel with the geographic scope in Europe. It was completed in 2019 with data from 2016. It's set to expire on December 31, 2023 (S-P-01432). This current EPD is built based on 2020 data, which is more up-to-date, especially on raw materials, packaging, and manufacturing. Also, the database used for this report is updated to Ecoinvent v3.9.1.

Differences from the previous version can be seen in raw material inputs (A1), energy inputs (A3), and transportation to customers (A4). In this EPD, A5, B1, B2, and C are added with reasonable conservative assumptions, to provide a more comprehensive potential environmental impact. This EPD is also developed following EN15804+A2, while the previous version followed EN15804+A1.

References

British Standards Institution. (2014). *Sustainability of construction works. - Environmental product declarations - Product Category Rules for concrete and concrete elements, BS EN16757:2017*. British Standards Institution.

Cooke, A. M. (2000). *Durability of Autoclaved Cellulose Fiber Cement Composites*. Retrieved from http://fibrecementconsulting.com/publications/990925.DurabilityPaper.pdf

Dauriat, A., Coulon, A., Bitar, J., Liao, X., & Delerce-Mauris, C. (2021). *GCCA Industry EPD Tool for Cement and Concrete*. Global Cement and Concrete Association. Switzerland: Quantis.

Department of the Environment. (2014). *National Greenhouse Accounts Factors - Australian National Greenhouse Accounts*. Australian Government. Retrieved from www.environment.gov.au

Department of the Environment. (2021). *National Greenhouse Accounts Factors - Australian National Greenhouse Accounts*. Australian Government. Retrieved from www.environment.gov.au

ecoinvent Centre. (2022). *The ecoinvent Database*. Retrieved from https://ecoinvent.org/the-ecoinvent-database/

Edge Environment Sustainability Consulting Inc. (2023). *Life Cycle Assessment and Environmental Product Declaration of Fiber Cement Cladding.*

EPD International. (2019). *c-PCR-001 Cement and building limes (EN 16908)*.

EPD International. (2019). *c-PCR-003 Concrete and concrete elements (EN 16757)*.

EPD International. (2023). *Product Category Rules (PCR) 2019:14, v1.3.1*. EPD International.

European Standard. (2019). *EN 15804:2012+A2:2019*. BSI Standards Limited 2020.

Frischknecht, R. (2007). *The Environmental Relevance of Capital Goods in Life Cycle Assessments of Products and Services*. Int. J LCA.

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

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

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

ISO. (2022). *ISO 14020:2022 - Environmental statements and programmes for products — Principles and general requirements*. Geneva: International Organization for Standardization (ISO).

The British Standards Institution. (2012). *EN 15804:2012+A2:2019*. BSI Standards Limited 2020.

Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., & & Weidema, B. (2019). The ecoinvent database version 3.6.

Zampori, L., & Pant, R. (2019). *Suggestions for updating the Product Environmental Footprint (PEF) method*. Luxembourg: Publications Office of the European Union.

Environmental Product Declaration

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

Hardie® Panel and Hardie® Architectural Panel

from

James Hardie Europe GmbH

Program: The International EPD® System
www.environdec.com
Program Operator: EPD International AB

EPD Registration Number: S-P-10857
Publication Date: 31 October 2023
Valid Until: 24 October 2028

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

THE INTERNATIONAL EPD® SYSTEM