# Environmental Product Declaration

# Typical Western Red Cedar Bevel Siding

## "½ x 6" Clear Grade, Stained

This Type III environmental declaration is developed according to ISO 21930 and 14025 for average cedar siding products manufactured by the members of the Western Red Cedar Lumber Association. This environmental product declaration (EPD) reports environmental impacts based on established life cycle impact assessment (LCA) methods. The reported environmental impacts are estimates, and their level of accuracy may differ for a particular product line and reported impact. LCAs do not generally address site-specific environmental issues related to resource extraction or toxic effects of products on human health. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change and habitat destruction. Forest certification systems and government regulations address some of these issues. The products in this EPD conform to: timber harvesting and silvicultural practices regulation of British Columbia (BC) and forest certification schemes (Forest Stewardship Council (FSC), Sustainable Forestry initiative (SFI)). EPDs do not report product environmental performance against any benchmark.

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WESTERN RED CEDAR LUMBER ASSOCIATION
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# Manufacturer Information

This EPD addresses products from multiple manufacturers and represents an average for the membership of the Western Red Cedar Lumber Association (WRCLA), a non-profit trade association representing manufacturers of western red cedar products. This average is based on a sample that included three remanufacturing mills (two in BC and one in Washington, US), which represented 13% of industry production in 2014. These data are combined with Athena Sustainable Materials Institute western red cedar resource extraction inventory updated using recent in-house coastal harvesting data, a survey of cedar nursery production in BC, and CORRIM (The Consortium for Research on Renewable Industrial Materials) forest management data.

# Product Description

Wood siding is a board-type weatherproof product applied to a building as a final surfacing for exterior walls. Western red cedar siding is produced in various dimensions and different profiles (shapes) including bevel, board and batten, tongue and groove, and channel. This EPD addresses the following product:

- Cedar siding type: Bevel siding
- Board size: "½ x 6" (12.7 mm x 152.4 mm)
- Grade: Clear
- Product composition (on the basis of 1 m$^2$ installed siding with a 50-year service life):
  - Western red cedar lumber: 4.65 kg (oven-dry basis) (0.0141m$^3$)
  - Coatings
    - Alkyd primer (solvent-based): 0.20 litres
    - Acrylic paint (water-based): 0.93 litres
  - Fasteners (6D 2" galvanized nails): 0.05 kg
- Installed and used according to Western Red Cedar Lumber Association specifications *(See http://www.realcedar.com/siding/installation/bevel/)*. Information reported here is for a product that is painted on installation and then repainted every 15 years.

Scope: Cradle-to-grave.

Functional unit: 1m$^2$ of siding assumed installed over a wood-frame wall.

Service life: 50 years.

System boundary: Life cycle activities from resource extraction through product use for a 50-year life span inclusive of maintenance, replacement and end-of-life effects. Wood-framed wall substructure is excluded as it is common to other siding types.

Geographic boundary: North America.

# Life Cycle Assessment

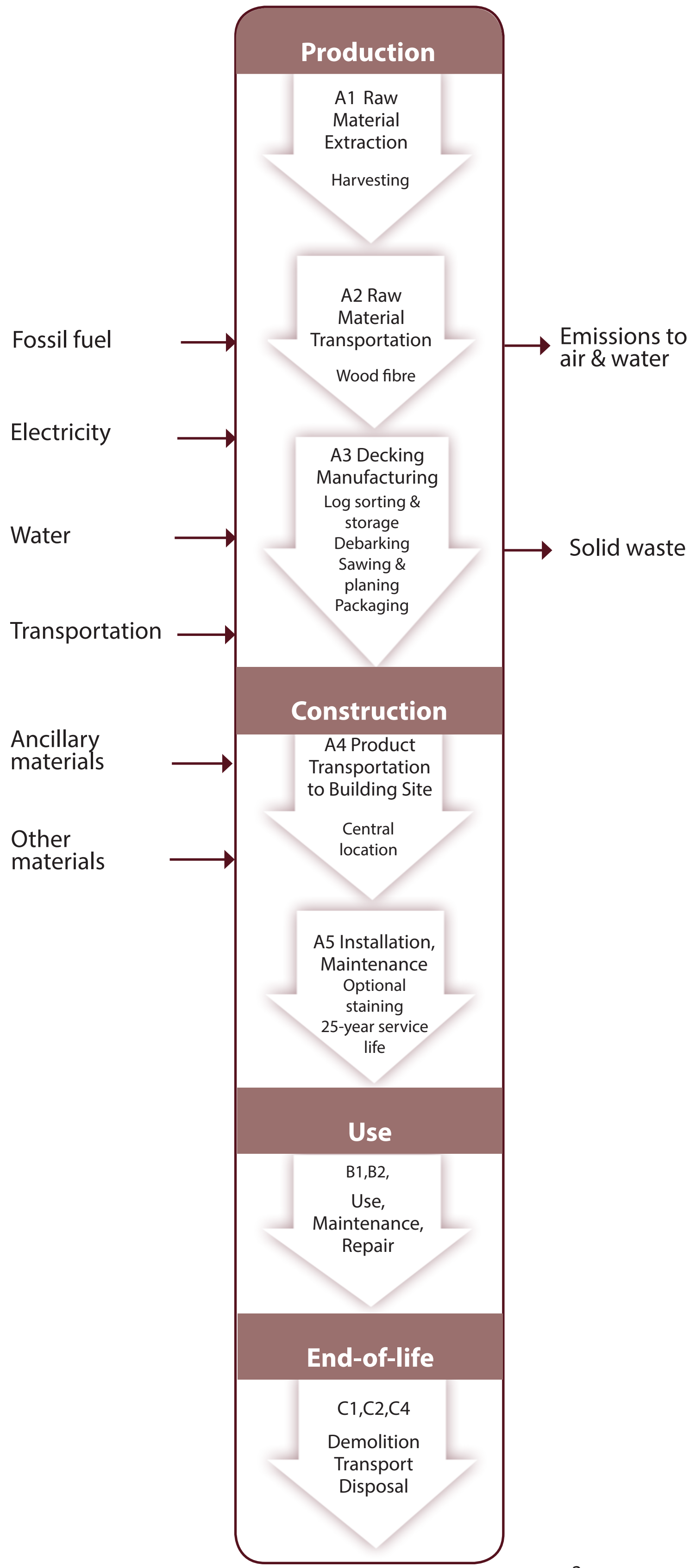
Life cycle assessment (LCA) is a rigorous study of inputs and outputs over the entire life of a product or process and the associated environmental impact of those flows to and from nature. The underlying LCA supporting this EPD was performed by FPInnovations for WRCLA in 2017 and was third-party peer-reviewed by three member panel comprised of Dr. Tom Gloria from Industrial Ecology Consultants (chair), Dr. Lindita Bushi from Athena Sustainable Materials Institute and James Salazar from Coldstream Consulting.. The LCA study collected primary data from western red cedar lumber and siding manufacturing operations in 2015 for the production year 2014.

The system boundary includes all the production steps from extraction of raw materials from the earth (the cradle) through to final fate of the product at the end of its service life (the grave). See Figure 1. The boundary includes the transportation of major inputs to, and within, each activity stage including the shipment of products to a hypothetical building site location in North America and eventual transportation to landfill. The city of Minneapolis, MN was chosen as the typical building location, as a central location in North America.

This study followed the information modules defined in the wood products PCR:

- A1 – extraction (removal) of raw materials and processing;
- A2 – transportation of raw materials from an extraction site to a manufacturing site;
- A3 – manufacturing of the wood construction product, including packaging;
- A4 – construction stage (building product transport to construction site)
- A5 – installation,
- the use-phase (B1 use and B2 maintenance);
- end-of-life processes (C1, deconstruction, dismantling/demolition, C2, transport from building site to waste processing, and C4, disposal).

Figure 1. System boundary and process flows



Ancillary materials and other materials such as coatings, fasteners and packaging are included in the boundary unless below the cut-off criteria. Mass or energy flows are excluded if they account for less than 1% of model flows and less than 2% of life cycle impacts in all categories. Human activity and capital equipment are excluded. For the use phase, the consumption of water and cleaning solutions is common to all siding types and is excluded.

Fifty years is the expected life span for cedar siding based on suggested manufacturer care procedures according to WRCLA. This figure is supported by expert opinion, anecdotal evidence and product warranty claims. A 15-year repainting schedule is used based on manufacturer warranties. According to cedar siding industry standards, an initial flood-coat primer and paint finish is applied with a 15 to 20 year service life. The final painting at year forty-five is fully allocated to the siding as a conservative approach, rather than pro-rated to reflect the remaining life span of the final paint coat at year fifty.

### End-of-life assumptions

It is common for construction and demolition (C&D) debris to end up in landfill – the US EPA estimates that 50% of construction and demolition debris is directed to landfills and 50% is recovered (US EPA, 2009). A review conducted by Bratkovich et.al., (2014) estimates the same landfilling and recovery rates for C&D wood waste generated in 2010. While considering the reported C&D waste estimates in these two studies, it is assumed that 50% of siding ends up in a nearby landfill and the remaining 48% is used for energy recovery at the end-of-life.

Based on the data available in the USEPA Landfill Methane Outreach Program database , it was estimated that about 58% of landfills are equipped with landfill gas (LFG) collection systems. Collection systems operate at an average well density of 1 well/ 4000 m2 and result in the capture of 75% of emitted LFG while 25% enters the atmosphere (Themelis and Ulloa, 2007). After capture, landfill gas is either openly flared or combusted with energy recovery and thus avoiding the combustion of fossil fuels by providing heat for direct use or electricity generation. The study estimated that about 16% landfill gas captured was flared and the remainder used for energy recovery.

## Environmental Performance

The U.S. Environmental Protection Agency's TRACI (Tool for the Reduction and Assessment of Chemical and other Environmental Impacts) life cycle impact assessment methodology is used to characterize the flows to and from the environment. Energy and material resource consumption, waste and impacts per functional unit of cedar siding are shown in Table 1. Impact measures shown are global warming potential (GWP), acidification potential, eutrophication potential, smog potential, and ozone depletion potential. Water consumed for maintenance (periodic washing) during use, as it is difficult to estimate and common to all siding types.

Allocation of environmental burdens to cedar siding and its co-products is done according to economic allocation principles.

Table 1. Environmental performance, 100 ft$^2$ of installed WRC siding with a 50 year service life by life cycle stage – absolute values

| Impact Category | Unit | Total | Production: Cradle-to-gate Product Manufacturing | Construction: Transport to Customer | Construction: Installation | Use: Use , Maintainance, Repair | End-of-life: Dismantling | End-of-life: Waste Transport | End-of-life: Disposal |
|---|---|---|---|---|---|---|---|---|---|
| | | | A1, A2, A3 | A4 | A5 | B1, B2 | C1 | C2 | C4 |
| **Global Warming** | kg $CO_2$ eq | 55.05 | 19.84 | 1.88 | 17.31 | 6.51 | 0.00 | 1.23 | 8.28 |
| **Ozone depletion** | kg CFC-11 eq | 4.87E-06 | 1.33E-06 | 4.35E-10 | 2.69E-06 | 8.32E-07 | 0.00 | 2.81E-10 | 1.75E-08 |
| **Acidification** | kg $SO_2$ eq | 0.34 | 0.15 | 0.03 | 0.10 | 0.03 | 0.00 | 0.01 | 0.02 |
| **Eutrophication** | kg N eq | 0.16 | 0.06 | 2.05E-03 | 0.07 | 0.01 | 0.00 | 5.40E-04 | 0.02 |
| **Smog** | kg $O_3$ eq | 5.81 | 2.63 | 1.00 | 0.98 | 0.38 | 0.00 | 0.21 | 0.62 |
| **Total Energy** | MJ eq | 1066.73 | 424.62 | 25.64 | 432.96 | 163.46 | 0.00 | 16.53 | 3.51 |
| **Fossil** | MJ eq | 852.83 | 294.98 | 25.60 | 372.99 | 139.45 | 0.00 | 16.51 | 3.31 |
| **Nuclear** | MJ eq | 71.49 | 18.64 | 0.01 | 37.10 | 15.57 | 0.00 | 0.01 | 0.16 |
| **Biomass** | MJ eq | 275.41 | 18.05 | 0.00 | 16.44 | 5.55 | 0.00 | 1.90E-03 | 235.37 |
| **Other renewable*** | MJ eq | 102.36 | 92.96 | 0.03 | 6.44 | 2.89 | 0.00 | 0.02 | 0.03 |
| **Material resource consumption** | | | | | | | | | |
| **-Non-renewable materials** | kg | 3.42 | 2.74 | 1.86E-03 | 0.56 | 0.04 | 0.00 | 1.21E-03 | 0.08 |
| **-Renewable materials** | kg | 43.24 | 43.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **-Fresh water** | l | 241.19 | 138.68 | 0.01 | 36.76 | 20.83 | 0.00 | 0.01 | 44.90 |
| **Waste generated** | | | | | | | | | |
| **-Hazardous waste** | kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **-Non-hazardous waste** | kg | 47.49 | 4.25 | 0 | 4.32 | 0 | 0.00 | 0 | 38.92 |
| **Feedstock energy** | MJ | 975.49 | | | 975.49 | | | | |

Note: *Other renewables include solar, wind, geothermal and hydro

**Table 2.** Environmental performance, 1 m$^2$ of installed WRC siding with a 50 year service life by life cycle stage – absolute values

| Impact Category | Unit | Total | Production | Construction | | Use | End-of-life | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cradle-to-gate Product Manufacturing | Transport to Customer | Installation | Use , Maintainance, Repair | Dismantling | Waste Transport | Disposal |
| | | | A1, A2, A3 | A4 | A5 | B1, B2 | C1 | C2 | C4 |
| **Global Warming** | kg $CO_2$ eq | 5.93 | 2.14 | 0.20 | 1.86 | 0.70 | 0.00 | 0.13 | 0.89 |
| **Ozone depletion** | kg CFC-11 eq | 5.24E-07 | 1.44E-07 | 4.68E-11 | 2.89E-07 | 8.95E-08 | 0.00 | 3.02E-11 | 1.89E-09 |
| **Acidification** | kg $SO_2$ eq | 0.04 | 0.02 | 3.33E-03 | 0.01 | 3.55E-03 | 0.00 | 8.14E-04 | 2.11E-03 |
| **Eutrophication** | kg N eq | 0.02 | 0.01 | 2.21E-04 | 0.01 | 1.24E-03 | 0.00 | 5.81E-05 | 1.72E-03 |
| **Smog** | kg $O_3$ eq | 0.63 | 0.28 | 0.11 | 0.11 | 0.04 | 0.00 | 0.02 | 0.07 |
| **Total Energy** | MJ eq | 114.83 | 45.71 | 2.76 | 46.61 | 17.60 | 0.00 | 1.78 | 0.38 |
| **Fossil** | MJ eq | 91.80 | 31.75 | 2.76 | 40.15 | 15.01 | 0.00 | 1.78 | 0.36 |
| **Nuclear** | MJ eq | 7.70 | 2.01 | 0.00 | 3.99 | 1.68 | 0.00 | 7.46E-04 | 0.02 |
| **Biomass** | MJ eq | 4.31 | 1.94 | 0.00 | 1.77 | 0.60 | 0.00 | 2.05E-04 | 1.11E-03 |
| **Other renewable*** | MJ eq | 11.02 | 10.01 | 0.00 | 0.69 | 0.31 | 0.00 | 2.00E-03 | 2.98E-03 |
| **Material resource consumption** | | | | | | | | | |
| **-Non-renewable materials** | kg | 0.37 | 0.29 | 2.00E-04 | 0.06 | 3.84E-03 | 0.00 | 1.30E-04 | 0.01 |
| **-Renewable materials** | kg | 4.65 | 4.65 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **-Fresh water** | l | 25.96 | 14.93 | 0.00 | 3.96 | 2.24 | 0.00 | 0.00 | 4.83 |
| **Waste generated** | | | | | | | | | |
| **-Hazardous waste** | kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **-Non-hazardous waste** | kg | 5.11 | 0.46 | 0.00 | 0.47 | 0.00 | 0.00 | 0.00 | 4.19 |
| **Feedstock energy** | MJ | 105.00 | | | 105.00 | | - | | |

Note: *Other renewables include solar, wind, geothermal and hydro

**Table 3.** Environmental impacts are calculated per 1 $m^2$ of installed WRC siding calculated using CML 2 Baseline 2000 method

| Impact Category | Unit | Total | Production | Construction | | Use | End-of Life | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cradle-to-gate Product Manufacturing | Transport to Customer | Installation | Use | Dismantling, maintenance, repair | Waste Transport | Disposal |
| | | | A1, A2, A3 | A4 | A5 | B1, B2 | C1 | C2 | C4 |
| **Abiotic depletion** | kg Sb eq | 6.75E-06 | 4.70E-07 | 2.08E-10 | 4.59E-06 | 1.66E-06 | 0.00 | 1.34E-10 | 2.58E-08 |
| **Abiotic depletion (fossil fuels)** | kg Sb eq | 0.04 | 0.02 | 1.22E-03 | 0.02 | 0.01 | 0.00 | 7.84E-04 | 1.73E-04 |
| **Global warming (GWP100a)** | kg $CO_2$ eq | 6.21 | 2.16 | 0.20 | 1.89 | 0.71 | | 0.13 | 1.11 |
| **Ozone layer depletion (ODP)** | kg CFC-11 eq | 4.27E-07 | 1.12E-07 | 3.49E-11 | 2.38E-07 | 7.58E-08 | 0.00 | 2.25E-11 | 1.43E-09 |
| **Human toxicity** | kg 1,4-DB eq | 2.06 | 0.87 | 0.16 | 0.61 | 0.20 | 0.00 | 0.10 | 0.11 |
| **Fresh water aquatic ecotoxicity.** | kg 1,4-DB eq | 1.58 | 0.64 | 0.06 | 0.66 | 0.15 | 0.00 | 0.04 | 0.02 |
| **Marine aquatic ecotoxicity** | kg 1,4-DB eq | 4119.28 | 1988.45 | 217.61 | 1323.84 | 415.14 | 0.00 | 140.33 | 33.92 |
| **Terrestrial ecotoxicity** | kg 1,4-DB eq | 0.02 | 2.90E-03 | 1.11E-05 | 0.01 | 0.01 | 0.00 | 7.17E-06 | 3.42E-04 |
| **Photochemical oxidation** | kg $C_2H4$ eq | 0.00 | 6.16E-04 | 5.74E-05 | 7.62E-04 | 2.86E-04 | 0.00 | 2.98E-05 | 7.13E-04 |
| **Acidification** | kg SO2 eq | 0.04 | 0.02 | 2.51E-03 | 0.01 | 3.63E-03 | 0.00 | 6.69E-04 | 1.62E-03 |
| **Eutrophication** | kg PO4--- eq | 0.01 | 3.99E-03 | 5.77E-04 | 3.38E-03 | 6.46E-04 | 0.00 | 1.25E-04 | 8.94E-04 |
| **Total non-renewable energy** | MJ | 91.80 | 31.75 | 2.76 | 40.15 | 15.01 | 0.00 | 1.78 | 0.36 |
| **Total renewable energy** | MJ | 7.70 | 2.01 | 0.00 | 3.99 | 1.68 | 0.00 | 0.00 | 0.02 |
| **Fresh water use** | l | 241.19 | 138.68 | 0.01 | 36.76 | 20.83 | 0.00 | 0.01 | 44.90 |
| **Waste, non-hazardous** | kg | 47.49 | 4.25 | 0 | 4.32 | 0 | 0.00 | 0 | 38.92 |
| **Waste, hazardous** | kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## Glossary

### Primary Energy Consumption

*Primary energy is the total energy consumed by a process including energy production and delivery losses. Energy is reported in megajoules (MJ).*

### Global Warming Potential

*This impact category refers to the potential change in the earth's climate due to accumulation of greenhouse gases and subsequent trapping of heat from reflected sunlight that would otherwise have passed out of the earth's atmosphere. Greenhouse gas refers to several different gases including carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$). For global warming potential, these gas emissions are tracked and their potencies reported in terms of equivalent units of $CO_2$.*

### Acidification Potential

*Acidification refers to processes that increase the acidity of water and soil systems as measured by hydrogen ion concentrations (H+) and are often manifested as acid rain. Damage to plant and animal ecosystems can result, as well as corrosive effects on buildings, monuments and historical artifacts. Atmospheric emissions of nitrogen oxides ($NO_x$) and sulphur dioxide ($SO_2$) are the main agents affecting these processes. Acidification potential is reported in terms of $H^+$ mole equivalent per kilogram of emission.*

### Eutrophication Potential

*Eutrophication is the fertilization of surface waters by nutrients that were previously scarce, leading to a proliferation of aquatic photosynthetic plant life which may then lead to further consequences including foul odor or taste, loss of aquatic life, or production of toxins. Eutrophication is caused by excessive emissions to water of phosphorus (P) and nitrogen (N). This impact category is reported in units of N equivalent.*

### Smog Potential

*Photochemical smog is the chemical reaction of sunlight, nitrogen oxides ($NO_x$) and volatile organic compounds (VOCs) in the atmosphere. Ground-level ozone is an indicator, and $NO_x$ emissions are a key driver in the creation of ground-level ozone. This impact indicator is reported in units of $NO_x$ equivalent.*

### Ozone Depletion Potential

*This impact category addresses the reduction of protective ozone within the atmosphere caused by emissions of ozone-depleting substances such as chlorofluorocarbons (CFCs). Reduction in ozone in the stratosphere leads to increased ultraviolet-B radiation reaching earth, which can have human health impacts as well as damage crops, materials and marine life. Ozone depletion potential is reported in units of equivalent CFC-11.*

### Feedstock Energy

*Heat of combustion of a material input that is not used as an energy source to the product system, expressed in terms of higher heating value (HHV).*

### Freshwater use

*Use of freshwater that requires human removal from a natural body of water or groundwater aquifer.*

*Source: Bare et al, 2003.*

# Additional Environmental Information

## Sustainable forestry

Western red cedar products from WRCLA members come from forests that are independently certified as legal and sustainable.

## Carbon Ballance

The carbon that is part of the molecular composition of wood is derived from carbon dioxide removed from the atmosphere by the growing tree that produced the wood; this carbon is often a consideration in greenhouse gas calculations and carbon footprints for wood products. The GWP measure accounts for the carbon stored in the product in use and the product in the landfill, and all carbon emissions throughout the product life cycle. This stored carbon offsets significant amount of life cycle carbon emissions; cedar siding is ultimately a minor source of greenhouse gas emissions.

**Table 4.** Carbon balance

| | kg of $CO_2$ eq. |
|---|---|
| Forest carbon uptake | -81.71 |
| Life cycle GHG emissions | +55.05 |
| Unaccounted biogenic carbon emissions in GWP reporting | +29.49 |
| Net GWP | +2.83 |
| *Note: *Carbon content in cedar 51.54% on oven dry basis (Lamlom and Savidge, 2003)* | |

## References

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## About this EPD

**PCR:** North American Structural and Architectural Wood Products UNCPC 31, NAIC 321,v2. June 2015. Prepared by FPInnovations and available at www.fpinnovations.ca. PCR panel chaired by Thomas P. Gloria.

Explanatory materials on the background LCA can be found at www.realcedar.com/why-real-cedar/sustainability

### Program Operator:

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### Independant verification of the declaration and data, according to ISO 14025

☐ internal ☒ external

### Third Party Verifier:

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Cradle-to-grave LCA results can be used for comparison between different EPDs provided products and systems have been assessed on the basis of the same function, quantified by the same functional unit in the form of their service life reference flows. EPDs from different programs may not be comparable.

EPDs do not address all issues of relevance to sustainability.

Type II environmental product declarations intended for buisness-to-consumer communication shall be available to the consumer at the point of purchase.