Environmental Product Declaration

Typical Western Red Cedar Decking

Type III environmental declaration developed according to ISO 21930 and 14025 for average cedar decking products manufactured by the members of the Western Red Cedar Lumber Association.

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WESTERN RED CEDAR LUMBER ASSOCIATION
REAL CEDAR
WRCLA

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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 two lumber mills in British Columbia (BC), combined with recent secondary data on western red cedar resource extraction from the Athena Institute. The total data represents 20% of western red cedar decking production in the year 2007.

Product Description

Wood decking is a board-type product horizontally applied in a load-carrying capacity and as the final surfacing for an outdoor flat surface attached to a house and typically elevated above the ground. A decking product in the most common size is modeled for this EPD.

- Typical board size: 5/4" x 6" (31.75 mm x 152.4 mm)
- Grade: Average
- Product composition (on the basis of 1 m^2 installed decking with a 25-year service life):
  - Western red cedar lumber: 8.14 kg (oven-dry basis) (0.0247m^3)
  - Optional coating
    - Stain: 1.25 litres
  - Fasteners (2½" galvanized nails, N° 8 or 10): 0.1 kg per 1 m^2 installed decking
- Installed and used according to Western Red Cedar Lumber Association specifications *(See http://www.wrcla.org/installation_and_finishing/finishing_cedar_decks/default.htm)*. Base case is an uncoated deck. An alternate scenario has regular applications of a stain coating.

Scope: Cradle-to-grave.

Functional unit: 1m^2 of decking assumed installed over a wood substructure.

Service life: 25 years.

System boundary: Life cycle activities from resource extraction through product use for a 25-year life span inclusive of maintenance, replacement and end-of-life effects. Wood-framed deck substitute is excluded as it is common to other decking types.

Geographic boundary: North America.

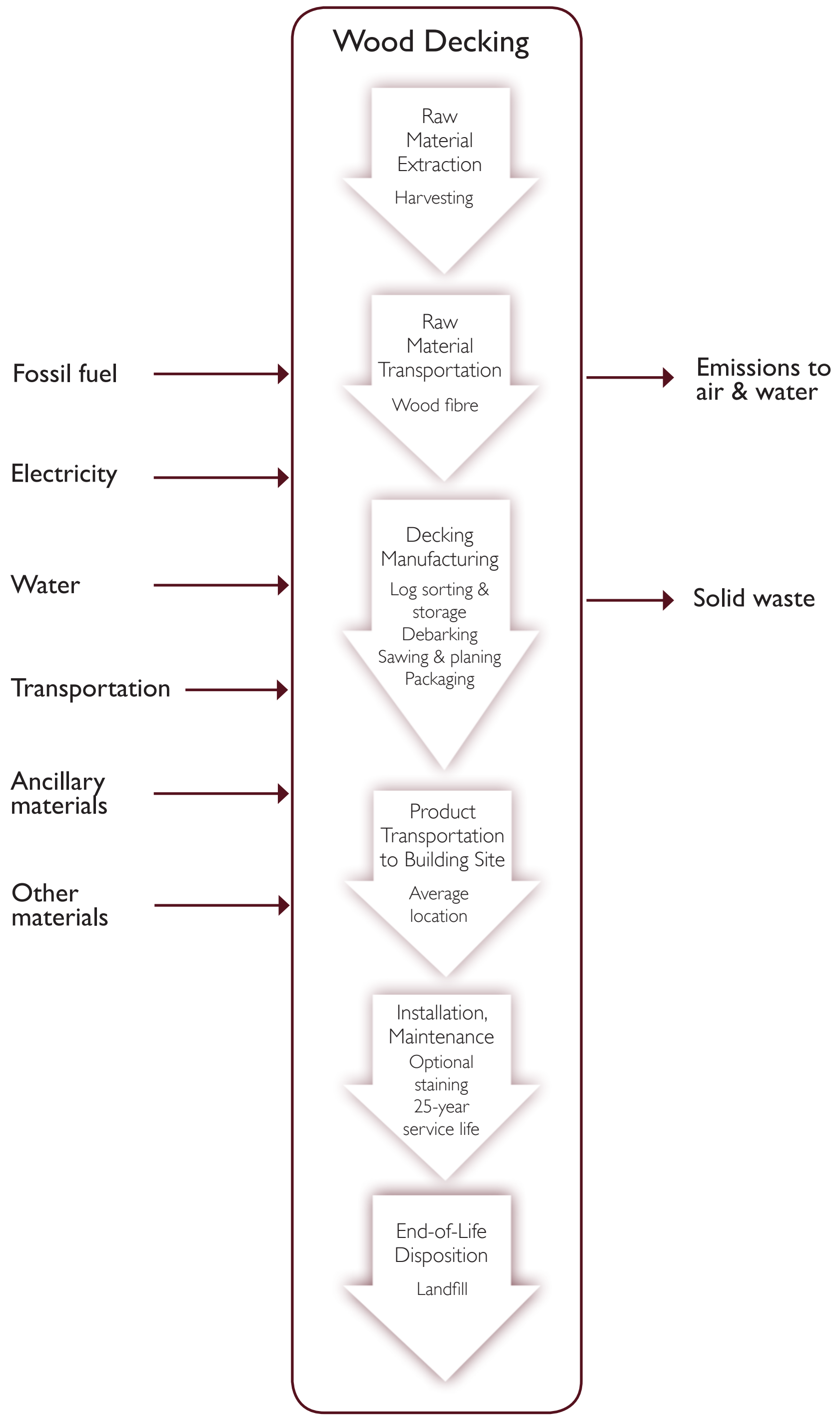
Life Cycle Assessment

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 2009 and was third-party peer-reviewed by two organizations. The LCA study collected primary data from western red cedar lumber operations in 2008 for the production year 2007, which was combined with recently developed secondary data on red cedar resource extraction available from the Athena Institute.

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, USA was chosen as the typical building location, as a central location in North America.

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

Figure 1. System boundary and process flows



capital equipment are excluded. For the use phase, the use of water and cleaning solutions is common to all decking types and is excluded.

Twenty-five years is the expected life span for cedar decking according to WRCLA. This figure is supported by expert opinion, anecdotal evidence and product warranty claims. The base case deck is uncoated (no stain is applied and the deck is allowed to take on a natural weathered appearance). An alternate scenario is modeled that includes a stain application at installation and a re-application every three years thereafter.

End-of-life assumptions

In the LCA used for this EPD, materials at the end of their service life are assumed to be transported through municipal solid waste collection to inert material landfills, as is estimated by Franklin Associates to be the fate for 70 to 80% of construction and demolition debris (USEPA, 1998). Organic materials in landfills decompose into the greenhouse gases methane and carbon dioxide; the methane portion of which may be captured for heat recovery or flaring. The USEPA (2006) estimates that 59% of landfills are equipped with gas collection systems and 75% of emitted gases are captured; of that, 53% is burned for energy recovery and 47% is flared. The handling of municipal solid waste is modeled with representative process data provided in the ecoinvent database (Doka, 2007), with electricity-fuel breakdown, energy supply chain, and combustion processes substituted with USLCI data. Wood products are known to not completely decompose in landfill (leaving some or most of the carbon essentially in permanent storage); estimates for the proportion of wood that will decompose vary from very low to the most recent estimate of 23% (Skog, 2008). The figures discussed in this paragraph are directly applied in the LCA, along with the assumption that landfill gas is equal parts carbon dioxide and methane.

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 decking are shown in Table 1. Impact measures shown are global warming potential (GWP), acidification potential, eutrophication potential, smog potential, and ozone depletion potential. The LCA model tracks overall life cycle carbon emissions, including those from biomass combustion. Carbon emissions are addressed in the GWP measure, which reports all carbon fluxes, including the carbon stored in the product and all carbon emissions throughout the product life cycle. A carbon balance at each life cycle stage is also shown on page 7. Landfilling is the assumed end-of-life fate. Landfill gas emissions and management are modeled per a USA average (see page 3). Water consumption does not include the amount of water consumed for maintenance (periodic washing) during use, as it is difficult to estimate and common to all decking types.

Allocation of environmental burdens to cedar decking and its co-products is done according to economic allocation principles. Environmental burdens are allocated entirely to cedar decking due to the low value of co-products relative to cedar decking (95% of the revenue flows are associated with the main product).

Table 1. Environmental performance, base case

Impact category	Unit	Per 1 m^2 of decking	Per 100 ft^2 of decking
Total primary energy:	MJ	275.86	2562.71
Non-renewable, fossil	MJ	74.13	688.64
Non-renewable, nuclear	MJ	0.60	5.62
Renewable (SWHG)	MJ	14.08	130.79
Renewable, biomass	MJ	3.46	32.12
Feedstock, non-renewable fossil	MJ	0.00	0.00
Feedstock, renewable biomass	MJ	183.59	1705.54
Renewable material consumption (wood)	kg	8.14	75.60
Non-renewable material consumption (nails)	kg	0.10	0.91
Fresh water use	L	0.03	0.30
Total waste	kg	8.24	76.51
Hazardous	kg	0.00	0.00
Non-hazardous	kg	8.24	76.51
Global warming potential (GWP)	kg CO_2eq	-1.45	-13.39
Acidification potential	H+ moles eq	2.72	25.31
Eutrophication potential	kg N eq	2.62E-03	2.43E-02
Smog potential	kg NO_x eq	5.91E-02	5.49E-01
Ozone depletion potential	kg CFC-11 eq	2.55E-09	2.37E-08

SWHG: Solar, wind, hydroelectric and geothermal
Note: GWP includes all biogenic carbon sinks and sources throughout the product system boundary.

About 70% of energy use associated with cedar decking over its lifetime is attributed to harvesting and manufacturing of the product. Another 29% of the lifetime energy consumption occurs during transportation to the building site. Less than 1% is attributed to end-of-life and less than 0.1% to the installation and use phase (see Figure 2).

The types of energy used in the life cycle of cedar decking are shown in Figure 3. Fossil fuels are the predominant source at 80%. Biomass (wood fuels, typically from recovered waste within the facility itself) comprises only 4% of the energy.

The application of a coating (a stain) to cedar decking increases the environmental impacts of decking. See Table 2 for results with a scenario where the deck is initially stained at installation and then recoated with stain every three years over the life of the deck.

Figure 2. Proportional consumption of primary energy by life cycle stage

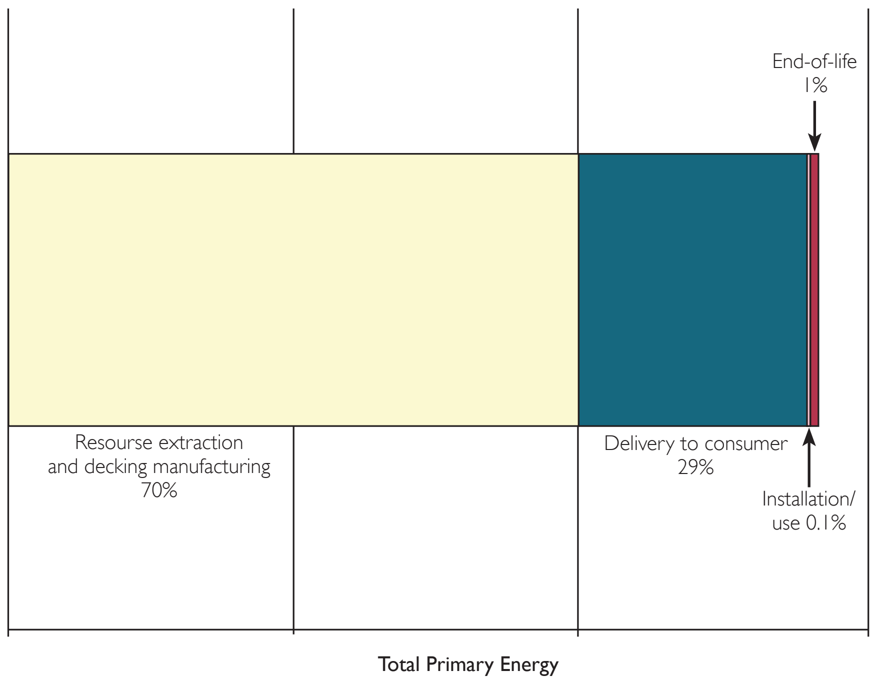


Figure 3. Total primary energy, proportional by source

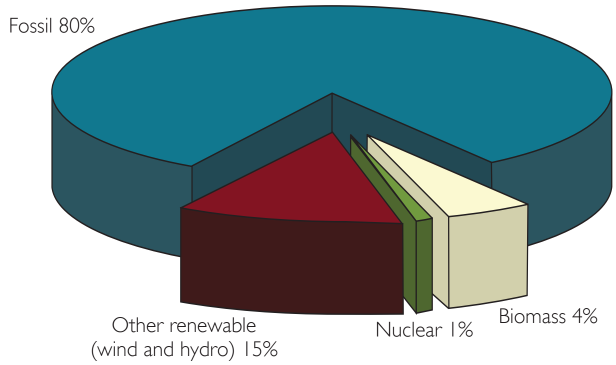


Table 2. Environmental performance, decking with regular applications of stain

Impact category:	Unit	Per 1 m^2 of decking	Per 100 ft^2 of decking
Total primary energy:	MJ	308.89	2869.56
Non-renewable, fossil	MJ	102.35	950.80
Non-renewable, nuclear	MJ	5.07	47.10
Renewable (SWHG)	MJ	14.37	133.48
Renewable, biomass	MJ	3.51	32.64
Feedstock, non-renewable fossil	MJ	0.00	0.00
Feedstock, renewable biomass	MJ	183.59	1705.54
Renewable material consumption (wood)	kg	8.14	75.60
Non-renewable material consumption (nails, stain)	kg	0.90	8.33
Fresh water use	L	3.16	29.31
Total waste	kg	9.03	83.93
Hazardous	kg	0.00	0.00
Non-hazardous	kg	9.03	83.93
Global warming potential (GWP)	kg CO_2eq	-0.02	-0.15
Acidification potential	H+ moles eq	3.02	28.06
Eutrophication potential	kg N eq	5.38E-03	5.00E-02
Smog potential	kg NO_x eq	6.10E-02	5.67E-01
Ozone depletion potential	kg CFC-11 eq	1.95E-07	1.81E-06

SWHG: Solar, wind, hydroelectric and geothermal
Note: GWP includes all biogenic carbon sinks and sources throughout the product system boundary.

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.

Source: Bare et al, 2003.

Additional Environmental Information

Carbon balance

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. At the manufacturing gate, wood products are typically carbon-negative; that is, more carbon is stored in the product than was emitted during harvesting and manufacturing. Emissions from transportation to a building site, product maintenance such as repainting, transportation to landfill, and decomposition in landfill can render wood products into net carbon emitters at the end of the full life cycle. See Tables 3 and 4 for the carbon balance at each life cycle stage, that is, the net carbon footprint per functional unit considering the carbon contained in the wood (a negative number) and the life cycle carbon emissions (a positive number). A negative number indicates a net climate change benefit (a greenhouse gas removal); a positive number is a net greenhouse gas emission. One square metre of decking stores the equivalent of 15.41 kilograms of CO_2. The sum of the greenhouse gas emissions during harvesting, manufacturing, transportation, installation, maintenance, transportation to landfill and decomposition in landfill is less than 15.41 kg CO_2eq, meaning at the complete end-of-life cycle, cedar decking remains carbon negative. The addition of a triennial regime of staining adds greenhouse gas emissions but not enough to outweigh the embodied carbon.

Table 3. Carbon balance per 1m^2 of cedar decking

	kg CO_2eq	
	Base case No stain	Alternate scenario Regular applications of stain
Forest carbon uptake	-15.41	-15.41
GWP harvesting and manufacturing	2.74	2.74
Net carbon balance cradle-to-gate	-12.67	-12.67
GWP transportation to customer	1.96	1.96
Net carbon balance cradle-to-site	-10.71	-10.71
GWP installation and use	0.00	1.42
Net carbon balance cradle-to-end-of-use	-10.71	-9.29
GWP end-of-life processes	9.26	9.27
Net carbon balance cradle-to-grave	-1.45	-0.02

GWP: Global Warming Potential
Note: GWP includes all biogenic carbon sinks and sources throughout the product system boundary.

Table 4. Carbon balance per 100 ft^2 of cedar decking

	kg CO_2eq	
	Base case No stain	Alternate scenario Regular applications of stain
Forest carbon uptake	-143.17	-143.17
GWP harvesting and manufacturing	25.49	25.49
Net carbon balance cradle-to-gate	-117.68	-117.68
GWP transportation to customer	18.25	18.25
Net carbon balance cradle-to-site	-99.43	-99.43
GWP installation and use	0.03	13.18
Net carbon balance cradle-to-end-of-use	-99.40	-86.25
GWP end-of-life processes	86.01	86.10
Net carbon balance cradle-to-grave	-13.39	-0.15

GWP: Global Warming Potential
Note: GWP includes all biogenic carbon sinks and sources throughout the product system boundary.

Alternate allocation method

In a production process where more than one product is generated, it is necessary to allocate the environmental impacts from manufacturing in some proportional manner to the various products. This is most typically done based on mass of the co-products. However, if a co-product has far less economic value than the main product, it may be more appropriate to allocate proportionally by value. In such cases, a conservative approach is to allocate 100% of the environmental burdens to the main product. For many wood products, a co-product (or by-product) is wood chips, which typically have market value as feedstock for other forest products, as mulch, or as fuel. In the LCA study underlying this EPD, the value of this by-product was found to be very low, hence 100% allocation to the main product was used. Had that study reported LCA results using allocation by mass, the numbers shown in Tables 1 and 2 would be reduced by two-thirds.

Sustainable forestry

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

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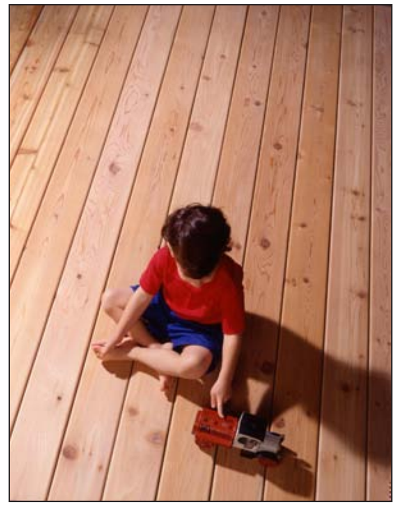

About this EPD

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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.

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