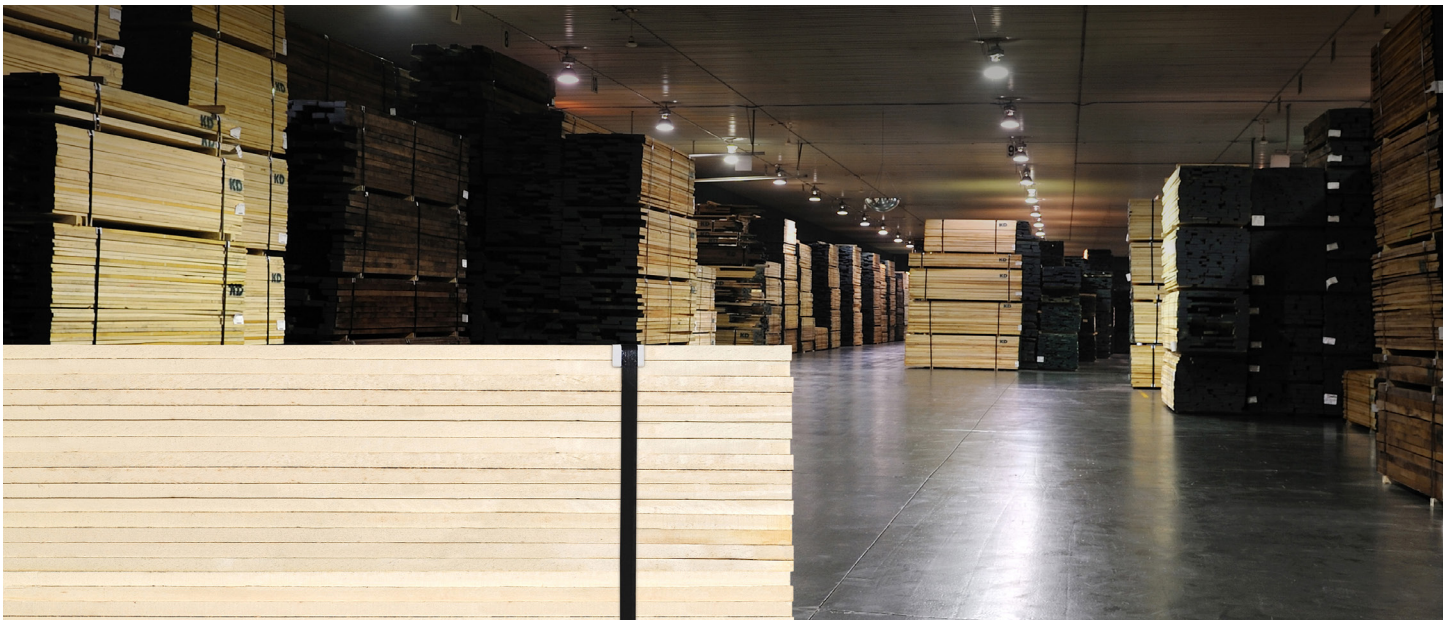
Environmental Product Declaration

Eastern Canadian Hardwood Lumber

Type III environmental declaration for eastern Canadian hardwood lumber developed according to ISO 21930 and 14025 represents average green and kiln-dried hardwood lumber manufactured in eastern Canada. This environmental product declaration (EPD) reports environmental impacts based on established life cycle impact assessment (LCIA) methods. The reported environmental impacts are estimates, and their level of accuracy may differ for a particular product line and reported impact. Life Cycle Assessments (LCAs) do not generally address site-specific environmental issues related to resource extraction or toxic effects on human health of product systems. 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: government regulations in eastern Canada and forest certification schemes (Canadian Standard Association, and Forest Stewardship Council (FSC)). EPDs do not report product environmental performance against any benchmark.



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Manufacturer Information

Hardwood lumber manufacturers operating in eastern Canada. The sample data represents 10% of hardwood lumber production in the year 2007.

Product Description

Hardwood lumber is used to manufacture flooring, moldings, furniture etc. in residential and commercial applications. Eastern Canadian hardwood lumber is sourced from a variety of hardwood species grown in eastern Canada, mainly maple, birch and oak.

Product composition of one thousand board feet (Mfbm) of lumber at the mill gate:

- Green lumber
  - Wood fibre: 1413 kg on oven dry basis
- Kiln-dried lumber
  - Wood fibre: 1573 kg on oven dry basis

Scope: Cradle-to-gate.

Declared unit: 1Mbfm of lumber at mill gate.

System boundary: Life cycle activities from resource extraction, transportation and processing through product (lumber) manufacture.

Geographic coverage: 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 relied on the report titled "A Cradle-to-Gate Life Cycle Assessment of Canadian Hardwood Lumber" compiled by FPInnovations. This report was updated in June, 2016 to include kiln-dried hardwood lumber and was third-party peer-reviewed by James Salazar at Coldstream Consulting.

The system boundary includes all the production steps from extraction of raw materials from the earth (the cradle) through to final product at the mill gate (the gate). See Figure 1. The boundary includes the transportation of major inputs to, and within, each activity stage.

Ancillary materials such as hydraulic fluids, lubricants and packaging are included in the boundary. 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, capital equipment and land use are excluded.

Mahalle L. 2016. A cradle-to-gate life cycle assessment of Canadian Hardwood Lumber. FPInnovations, Vancouver. http://www.fpinnovations.ca

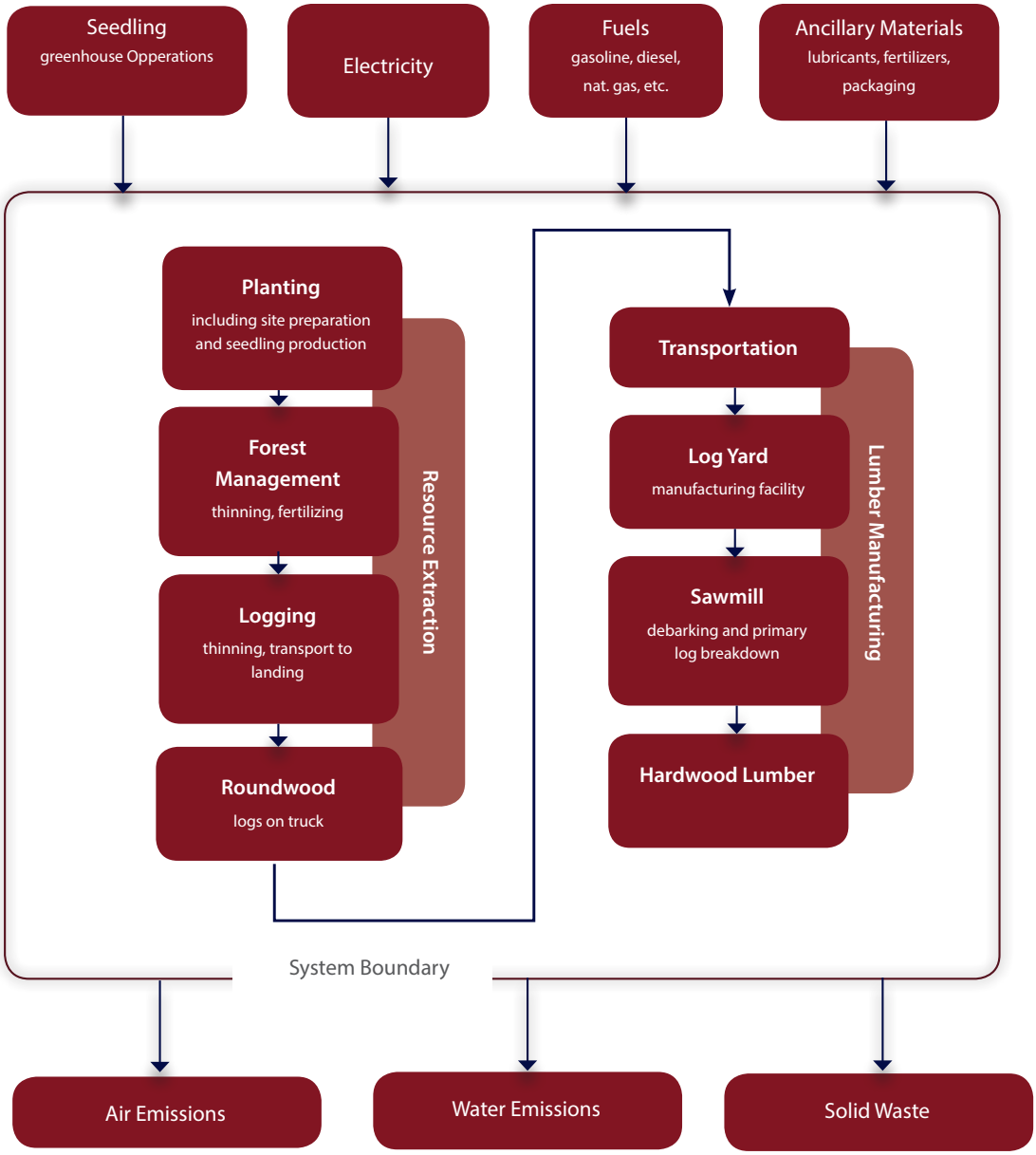

Figure 1: System Boundary and Process Flows

Environmental Performance

Environmental impacts were calculated using TRACI (Tool for the Reduction and Assessment of Chemical and other Environmental Impacts) version 2.1 – the life cycle impact assessment methodology developed by the U.S. Environmental Protection Agency. Per declared unit energy and material resource consumption, waste and impact indicator results are presented in Table 1 and 2. Impact indicators used are global warming potential (GWP), acidification potential, eutrophication potential, smog potential, and ozone depletion potential. The LCA model is designed to track all carbon fluxes in the GWP measure: the carbon stored in lumber and all carbon emissions, including those from biomass combustion throughout the cradle-to-gate life cycle. A summary of the carbon balance at each life cycle stage is depicted in Table 5.

Hardwood lumber manufacturing generates multiple products that provide revenue: the main product (lumber) and co-products (bark, sawdust and pulp chips). The PCR requires economic allocation for multi-product systems if the difference in revenues between the main product and co-products from a multi-output process is more than 10%. This is the case with the lumber, so the environmental burden of hardwood lumber manufacturing is allocated based on the revenues of lumber and co-products produced from the milling process.

Table 1: Environmental performance of green lumber, by life cycle stage

Indicator	Unit	Per one thousand board feet of lumber				Per one cubic meter of lumber			
		Total	Resource extraction	Transport	Production	Total	Resource extraction	Transport	Production
Energy consumption									
Total primary energy:	MJ eq	1724.59	444.04	543.27	737.29	730.76	188.15	230.20	312.41
Non-renewable, fossil	MJ eq	1060.24	442.44	541.97	75.83	449.26	187.47	229.65	32.13
Non-renewable, nuclear	MJ eq	1.54	0.37	0.07	1.10	0.65	0.16	0.03	0.47
Renewable, biomass	MJ eq	186.24	0.10	0.01	186.13	78.92	0.04	0.01	78.87
Renewable, (SWHG)	MJ eq	476.57	1.13	1.22	474.22	201.94	0.48	0.52	200.94
Feedstock energy, renewable*	MJ eq	25312.74			25312.74	10725.74			10725.74
Environmental impacts									
Global warming potential (GWP)	kg CO_2 eq	129.07	67.30	40.61	21.16	54.69	28.52	17.21	8.97
Ozone depletion potential	kg CFC-11 eq	2.53E-07	9.02E-08	1.14E-07	4.91E-08	1.07E-07	3.82E-08	4.81E-08	2.08E-08
Acidification potential	kg SO_2 eq	1.39	0.69	0.24	0.45	0.59	0.29	0.10	0.19
Eutrophication potential	kg N eq	0.07	0.04	0.01	0.02	0.03	0.02	0.01	0.01
Smog potential	kg O_3 eq	38.84	20.48	6.63	11.73	16.46	8.68	2.81	4.97
Material resources and fresh water consumption									
Renewable material consumption (wood)	kg	27.53	11.59	0.00	15.94	11.67	4.91	0.00	6.75
Non- renewable material consumption (clay and shale, coal, coarse aggregate, crude oil, gypsum, iron ore, limestone, natural gas, sand, metal, uranium, etc.)	kg	1405.00	1405.00	0.00	0.00	595.34	595.34	0.00	0.00
Freshwater use	l	1.22	0.36	0.06	0.80	0.52	0.15	0.03	0.34
Waste									
Hazardous	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-hazardous (wood waste, wood ash and other solid waste)	kg	2740.67	2740.13	0	0.54	1161.30	1161.07	0.00	0.23

Note: **SWHG: Solar, wind, hydroelectric and geothermal**
***Higher heating value (HHV) basis**

Table 2: : Environmental performance of kiln-dried lumber, by life cycle stage

Indicator	Unit	Per one thousand board feet of lumber				Per one cubic meter of lumber			
		Total	Resource extraction	Transport	Production	Total	Resource extraction	Transport	Production
Energy consumption									
Total primary energy:	MJ eq	2565.34	494.17	604.60	1466.57	1087.01	209.39	256.19	621.43
Non-renewable, fossil	MJ eq	1308.29	492.39	603.16	212.74	554.36	208.64	255.58	90.15
Non-renewable, nuclear	MJ eq	1.77	0.41	0.08	1.28	0.75	0.17	0.03	0.54
Renewable, biomass	MJ eq	474.71	0.11	0.01	474.59	201.15	0.05	0.01	201.10
Renewable, (SWHG)	MJ eq	780.58	1.26	1.36	777.96	330.75	0.53	0.57	329.65
Feedstock energy, renewable*	MJ eq	28169.47			28169.47	11936.22			11936.22
Environmental impacts									
Global warming potential (GWP)	kg CO_2 eq	160.85	74.90	45.19	40.76	68.16	31.74	19.15	17.27
Ozone depletion potential	kg CFC-11 eq	2.88E-07	1.00E-07	1.26E-07	6.09E-08	1.22E-07	4.25E-08	5.35E-08	2.58E-08
Acidification potential	kg SO_2 eq	1.71	0.77	0.27	0.67	0.73	0.33	0.11	0.28
Eutrophication potential	kg N eq	0.09	0.04	0.02	0.03	0.04	0.02	0.01	0.01
Smog potential	kg O_3 eq	47.68	22.79	7.38	17.51	20.20	9.66	3.13	7.42
Material resources and fresh water consumption									
Renewable material consumption (wood)	kg	49.25	22.98	13.14	13.12	20.87	9.74	5.57	5.56
Non- renewable material consumption (clay and shale, coal, coarse aggregate, crude oil, gypsum, iron ore, limestone, natural gas, sand, metal, uranium, etc.)	kg	1579.34	1563.56	0.00	15.78	669.21	662.53	0.00	6.69
Freshwater use	l	1.41	0.40	0.06	0.95	0.60	0.17	0.03	0.40
Waste									
Hazardous	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-hazardous (wood waste, wood ash and other solid waste)	kg	3049.97	3049.37	0.00	0.60	1292.36	1292.11	0.00	0.25

Note: **SWHG: Solar, wind, hydroelectric and geothermal**
***Higher heating value (HHV) basis**

Glossary

Source: *Primewood Lumber*

Glossary

Acidification Potentia*l*

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 two key substances contributing to acidification potential. Acidification potential is reported in kg of SO_2 equivalents.

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.

Global Warming Potential

This impact category refers to the potential change in the earth's energy balance due to the accumulation of greenhouse gases which block long wave radiation that would otherwise have passed out of the earth's atmosphere. Greenhouse gas refers to several different gases including carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). For global warming potential, greenhouse gases are tracked and their impact is reported in units of CO2 equivalents (eq).

Ozone Depletion Potential

This impact category addresses the reduction of protective ozone within the upper 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 CFC-11 equivalent.

Primary Energy Consumption

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

Smog Potential

Photochemical smog is the chemical reaction of sunlight, nitrogen oxides (NO_X) and volatile organic compounds (VOCs) in the lower atmosphere. Ground-level ozone is an indicator, and NOx emissions are a key driver in the creation of ground-level ozone. This impact indicator is reported in units of O_3 equivalent.

Source: Bare et al, 2003

Freshwater Consumption

Use of freshwater when release into the original watershed does not occur because of evaporation, product integration, or discharge into different watersheds, or the sea.

Environmental Performance Calculated using CML 1A Method

Table 3: LCIA results of cradle-to-gate rough green lumber production – absolute values per cubic meter basis

Impact category	Unit	Total	Resource Extraction	Transport	Production
Abiotic depletion	kg Sb eq.	1.80E-06	3.96E-07	1.97E-08	1.38E-06
Abiotic depletion (fossil fuels)*	MJ	411.80	171.66	210.22	29.91
	kg Sb eq.	0.20	0.08	0.10	0.01
Global warming (GWP100a)	kg CO_2 eq.	54.69	28.52	17.21	8.97
Ozone layer depletion (ODP)	kg CFC-11 eq.	8.94E-08	3.11E-08	4.08E-08	1.74E-08
Human toxicity	kg 1,4-DB eq.	26.96	11.34	13.59	2.03
Fresh water aquatic ecotoxicity	kg 1,4-DB eq.	9.50	3.96	4.91	0.63
Marine aquatic ecotoxicity	kg 1,4-DB eq.	35678.03	14913.77	18327.98	2436.28
Terrestrial ecotoxicity	kg 1,4-DB eq.	0.01	3.95E-03	1.17E-04	2.34E-03
Photochemical oxidation	kg C_2H4 eq.	0.03	0.02	3.65E-03	0.01
Acidification	kg SO_2 eq.	0.48	0.24	0.08	0.16
Eutrophication	kg PO_4--- eq.	0.09	0.05	0.02	0.03
Total renewable energy	MJ	280.85	0.52	0.52	279.81
Total non-renewable energy	MJ	449.91	187.63	229.68	32.60
Total energy	MJ	730.76	188.15	230.20	312.41

Note: *Abiotic fuel conversion 4.81E-04 kg Sb/MJ

Table 4: LCIA results of cradle-to-gate rough kiln-dried lumber production – absolute values per cubic meter basis

Impact category	Unit	Total	Resource Extraction	Transport	Production
Abiotic depletion	kg Sb eq.	2.00E-06	4.41E-07	2.19E-08	1.54E-06
Abiotic depletion (fossil fuels)*	MJ	508.21	191.04	233.96	83.21
	kg Sb eq.	0.24	0.09	0.11	0.04
Global warming (GWP100a)	kg CO_2 eq.	68.16	31.74	19.15	17.27
Ozone layer depletion (ODP)	kg CFC-11 eq.	1.02E-07	3.47E-08	4.54E-08	2.18E-08
Human toxicity	kg 1,4-DB eq.	33.26	12.62	15.12	5.52
Fresh water aquatic ecotoxicity	kg 1,4-DB eq.	11.80	4.41	5.46	1.93
Marine aquatic ecotoxicity	kg 1,4-DB eq.	44017.85	16597.53	20397.21	7023.12
Terrestrial ecotoxicity	kg 1,4-DB eq.	0.01	4.39E-03	1.30E-04	3.72E-03
Photochemical oxidation	kg C_2H4 eq.	0.04	0.02	4.06E-03	0.02
Acidification	kg SO_2 eq.	0.59	0.26	0.09	0.24
Eutrophication	kg PO_4--- eq.	0.11	0.05	0.02	0.04
Total renewable energy	MJ	531.90	0.58	0.58	530.74
Total non-renewable energy	MJ	555.11	208.81	255.61	90.69
Total energy	MJ	1087.01	209.39	256.19	621.43

Note: *Abiotic fuel conversion 4.81E-04 kg Sb/MJ

Additional Environmental Information

Sustainable Forestry

Eastern Canadian forestry companies are committed to sustainable forestry. All hardwood timber comes from responsible sources, i.e., sustainably managed forests such as certified procurement systems or forests managed using responsible practices. Most of the timber produced in eastern Canada is either FSC or ISO 14000 certified.

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. See Table 5 for cradle-to-gate carbon balance at each of the life cycle stage, i.e., the net carbon footprint per 1Mfbm or 1 m^3 of lumber, calculated considering the carbon contained in the wood (a negative number as carbon sequestering is a removal of atmospheric carbon dioxide) and the life cycle carbon emissions and removals from bioenergy (net zero), and carbon emissions from fossil fuel combustion (a positive number). Carbon dioxide sequestered in lumber is used as the starting point, and after accounting for carbon emissions at each of the stage, the final product, hardwood lumber leaving the mill gate still caries negative carbon balance, meaning that lumber has sequestered more carbon than cradle-to-gate carbon dioxide emissions. In other words, stored carbon in hardwood lumber at the manufacturing gate is still available to mitigate carbon footprint of buildings.

Table 5: Carbon balance

	kg of CO_2 eq			
	Green lumber		Kiln-dried lumber	
	Per 1 Mfbm	Per 1 m^3	Per 1 Mfbm	Per 1 m^3
Forest carbon uptake	-2491.44	-1055.70	-2772.62	-1174.84
GWP harvesting from forests	67.3	28.52	74.9	31.74
Net carbon balance cradle-to-round wood	-2424.14	-1027.18	-2697.72	-1143.10
GWP transporting to sawmill	40.61	17.21	45.19	19.15
Net carbon balance cradle-to-round wood at sawmill	-2383.53	-1009.97	-2652.53	-1123.95
GWP lumber manufacture	21.16	8.97	40.76	17.27
Net carbon balance cradle-to-lumber	-2362.37	-1001.00	-2611.77	-1106.68

GWP: Global warming potential

References

Mahalle L. 2016. A Cradle-to-Gate Life Cycle Assessment of Canadian Hardwood Lumber. FPInnovations, Vancouver. http://www.fpinnovations.ca.

Bare, Jane C., Gregory A. Norris, David W. Pennington and Thomas McKone. 2003. TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts. Journal of Industrial Ecology, Vol.6 No.3-4.

ISO 14025:2006. Environmental labels and declarations – Type III environmental declarations. International Standards Organization.

ISO 21930:2007. Environmental labels and declarations – Sustainability in building construction. Environmental declaration of building products. International Standards Organization.

About this EPD

The EPD represents average performance of hardwood lumber produced in eastern Canada.

PCR: North American Structural and Architectural Wood Products. version 2.0 June 2015. Prepared by FPInnovations and available at www.fpinnovations.ca.

Explanatory information can be obtained from:

Program Operator:

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EPDs based on cradle-to-gate information modules using a declared unit shall not be used for comparisons. EPDs from different programs may not be comparable.

PCR Review was conducted by:

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EPD Review:

Independent verification of the declaration and data, according to ISO 14025 :

Internal External ✓

Third party verifier:

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