Environmental Product Declaration

Typical Eastern Canadian Pre-finished Solid Strip Hardwood Flooring

Type III environmental declaration developed according to ISO 21930 and 14025 for average hardwood flooring manufactured by Eastern Canadian flooring manufacturers.

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Quebec Wood Export Bureau

FPInnovations

Manufacturers

This EPD encompasses products from multiple manufacturers and represents an average of pre-finished hardwood strip flooring produced in Eastern Canada. This average is based on a sample that included five Eastern Canadian flooring mills and three finishing plants. This data represents about 10% of total Canadian hardwood flooring production in the year 2004.

Although not certified to ISO, the flooring companies operating in eastern Canada effectively apply quality management systems in their facilities. The facilities also have worker safety management systems in place in accordance with the relevant provincial occupational health and safety regulations applicable to the facility locations. The Quebec occupational health and safety statute applies to the facilities located in Quebec while the facilities in Ontario follow Ontario worker health and safety legislation.

Product Description

Pre-finished solid hardwood strip flooring is a stained and varnished or prefinished floor covering product used for interior flooring. Planks come in various widths. The hardwood flooring evaluated in this EPD was based on a common hardwood strip size of 3¼" (83 mm) wide, ¾" (19 mm) thick. The National Wood Flooring Association's NOFMA International Standards for Factory Finished Solid Wood Flooring applies. The material composition for 1 m^2 of installed floor covering with a 25-year service life is as follows:

- Floor
  - Hardwood planks: 11.02 kg (oven dry basis)
    A cellulosic material based resourced from forests located in eastern Canada.
  - Stain: 0.01 litres
  - Polyurethane Sealer: 0.07 litres
- Underlay:
  Material amounts were calculated in line with the widely used "Condo Method", which can be applied for installation over any type of subfloors (i.e., concrete, wood and radiant subfloors)
  - Polyethylene vapour barrier (6mil or 0.15mm): 0.14 kg
  - Plywood underlay (16mm): 10.80 kg
  - Carpenters' glue: 0.07 kg
  - Fasteners (galvanized/stainless steel nails): 4 nails (2" (50.8 mm) long, 18 gauge (1.207 mm))

Scope: Cradle-to-grave.

Functional unit: 1m^2 of installed flooring using "Condo Method".

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.

Geographic boundary: North America.

Flooring Manufacturing

Flooring manufacturing is a three step process: drying, milling, and finishing. Drying starts with rough green lumber received at the flooring manufacturing plant gate. Dried lumber then undergoes planing, ripping, trimming, and moulding during milling to produce unfinished flooring boards. Finishing adds value to the flooring through application of a stain or protective coating to the wood.

Pre-finished flooring in delivery condition at mill gate contains 99.16%, 0.1% and 0.74% of hardwood, stain, and polyurethane on a mass basis respectively. Stain materials used and their CAS numbers are:

Stain	CAS number
1, 6-hexanedoil diacrylate	13048-33-4
Acrylated resin	-
Acrylates of dipentaerythritol	60506-81-2
Acrylic ester	-
Carbon black	1333-86-4
Dipentaerythritol acrylates	60506-81-2
Epoxy acrylate	55818-57-0
Glycerol propoxylate acrylate	52408-84-1
Glycol diacrylate Tripropyleneglycol	42978-66-5
Polyester acrylate	-
Titanium dioxide	13463-67-7

Pre-finished flooring planks are packed and delivered in closed cardboard boxes. Kind and material of packaging used are:

- Cardboard – boxes
- Plastics – strapping and shrink wrap
- Steel – strapping

Flooring Installation

The manufacturer's installation instructions should be followed. Commonly applied "Condo Method" can be used to install hardwood flooring.

Personal protective equipment (dust masks or respirators, ear plugs and safety glasses) should be worn during installation to protect respiratory system, ear and eye from excess exposure to sawdust. In addition, knee pads and rubber gloves may also be used.

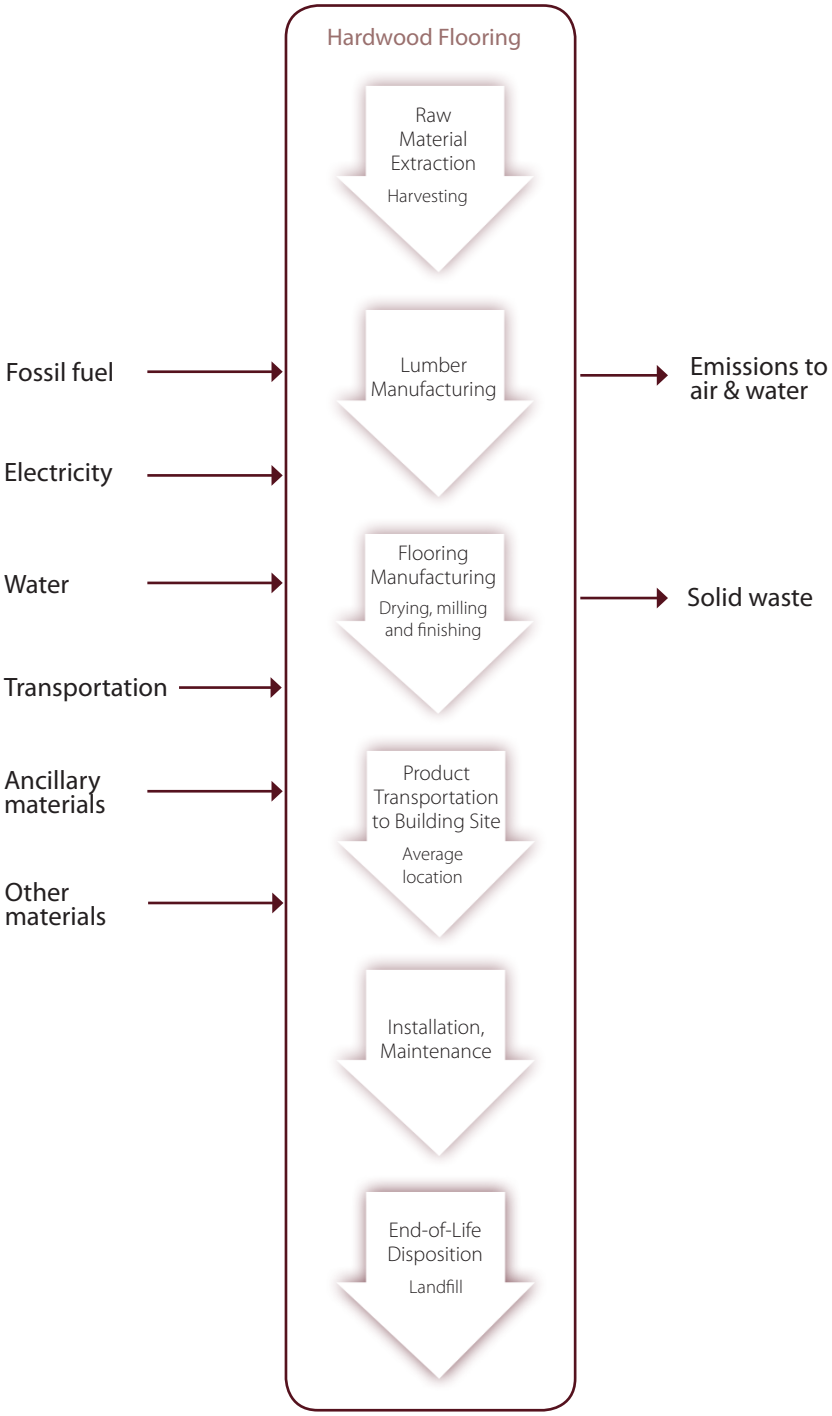
Life Cycle Assessment

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 and was third-party peer-reviewed by two organizations. The LCA study relied on two LCA data sources: primary data gathered from hardwood harvesting and lumber manufacturing operations occurring in eastern Canada for the production years 2008 and 2007 respectively and the gate-to-gate flooring manufacturing study compiled by Athena Institute, using 2008 production year data.

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 New York, USA was chosen as the typical building location as a major portion of the flooring shipments moved to that region during 2000 - 2009.

Ancillary materials such as fasteners 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 1% of life cycle impacts in all categories. Human activity and

Figure 1. System Boundary and Process Flows



capital equipment are excluded.

The expected life span is considered to be 25 years as hardwood flooring comes with a 25 year structure and finish warranty.

End-of-life assumptions

The LCA used for this EPD assumes that flooring disposal at the end of the service life occurs along with the construction and demolition (C&D) waste disposal practice commonly occurring in the US. According to recent estimates, a major portion of C&D waste ends up in specifically designated landfills while the remainder is disposed with municipal solid waste (MSW) in MSW landfills or combusted in incinerators (USEPA 2009a). In landfills, about 23% of solid-wood decomposes (Skog, 2008) and emits landfill gases, mainly methane and carbon dioxide (50:50), into the atmosphere (USEPA, 2006, p. 81). About 59% of modern landfills in the US are equipped with landfill gas collection systems (USEPA, 2006, p.87) that capture 75% of emitted LFG. The remaining 25% enters the atmosphere (USEPA, 1995). USEPA (2009b, p.8-3) provides the amounts of landfill gas (LFG) emitted and recovered in 2007. Approximately 53% of LFG emissions were burned for energy recovery and the remaining 47% was flared. These US averages are directly applied in the LCA, along with the assumption that landfill gas consists of 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 version 2.1 is applied to calculate environmental performance of hardwood strip flooring. Per functional unit energy and material resource consumption, waste and impact indicator results are presented in Tables 1 and 3. Impact indicators used 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 accounts for all carbon fluxes, including the carbon stored in use and the product in the landfill, calculated using the FPInnovations PCR Carbon sequestration calculator, and all carbon emissions throughout the product life cycle calculated using the LCA model. The default end-of-life disposal practice is considered to be landfilling and modeled based on US averages.

Hardwood flooring is a multi-product system that generates more than one product during its lumber and flooring manufacturing processes. Hardwood lumber manufacturing produces the main product (lumber) and co-products (bark, sawdust and pulp chips) while hog fuel is produced during lumber milling into flooring. The PCR requires mass-based allocation for multi-product systems if economic value difference is at least

Table 1. Life cycle environmental performance

Impact category	Unit	Per 1 m^2 of flooring	Per 10 sq. ft. of flooring
Total primary energy:	MJ	734.81	682.66
Non-renewable, fossil	MJ	160.48	149.09
Non-renewable, nuclear	MJ	19.25	17.88
Renewable, biomass	MJ	260.58	242.08
Renewable, other (SWHG)	MJ	40.09	37.25
Feedstock, non-renewable fossil	MJ	37.25	34.60
Feedstock, renewable biomass	MJ	217.16	201.75
Renewable material consumption (wood)	kg	11.02	10.24
Non-renewable material consumption	kg	0.47	0.44
Freshwater withdrawal	Liters	77.19	71.71
Freshwater consumption	Liters	13.50	12.54
Total waste	kg	58.74	54.57
Hazardous	kg	0.00	0.00
Non-hazardous	kg	58.74	54.57
Global warming potential (GWP)	kg CO_2 eq	-2.29	-2.13
Acidification potential	kg SO_2 eq	0.08	0.07
Eutrophication potential	kg N eq	5.27E-03	4.90E-03
Smog creation potential	kg O_3 eq	1.53	1.42
Ozone depletion potential	kg CFC-11 eq	4.67E-08	4.34E-08

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

Note: TRACI is applied to calculate global warming, acidification, eutrophication, smog creation and ozone depletion impact indictor results.

ten times greater between the main product and co-products. The collective value of the co-products generated from lumber production is less than 10 times the difference in value to the main product, lumber. The environmental burden of hardwood lumber manufacturing is allocated based on the mass of lumber and co-products produced during sawmilling for this reason. The environmental burden of hardwood lumber manufacturing is allocated based on the mass of lumber and co-products produced during sawmilling. Flooring milling, on the other hand, produces significantly less valued co-product (hog fuel) which is worth either 5% or less compared to flooring. Therefore, the environmental burden from flooring manufacture is entirely allocated to flooring.

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. The sum of the life cycle greenhouse gas emissions and stored carbon in the product in use and the product in the landfill is a negative number meaning at the complete end-of-life cycle, hardwood flooring remains a net carbon sequester.

Table 2. Contribution by material, from cradle to end-of-use phase

Impact Category	Total	Percent contribution by material						
		Flooring boards	Polyethylene underlay	Plywood underlay	Nails	Carpenters' glue	Polyurethane sealer	Stain and solvent
Fossil energy use	100%	51.96	7.14	31.83	0.34	3.73	4.51	0.49
Global warming	100%	52.36	2.16	37.53	0.52	3.28	3.97	0.18
Acidification	100%	55.75	4.75	35.84	0.23	1.48	1.79	0.16
Eutrophication	100%	50.00	0.72	27.00	3.06	8.65	10.48	0.09
Ozone depletion	100%	27.53	0.00	70.58	0.09	0.80	0.97	0.02
Smog creation	100%	72.63	0.46	24.77	0.10	0.88	1.07	0.09

Figure 2. Proportional Primary Energy by Life Cycle Stage

Impact category	Logging	Sawmilling	Flooring manufacturing	Transportation to Consumer	Installation and Use	End-of-life
Primary energy	2.31%	5.47%	75.76%	2.84%	12.37%	1.25%

Figure 3. Total primary energy consumption, proportional by source

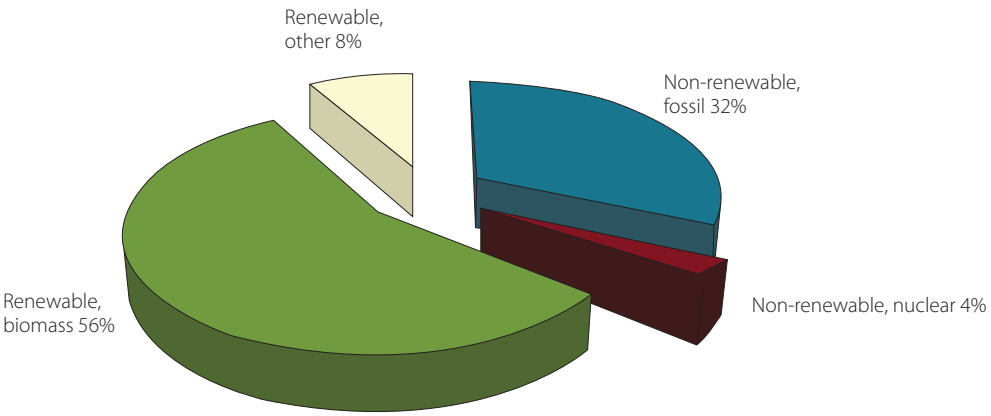


Table 3. Life cycle environmental performance calculated using CML (CML 2 baseline 2000 V2.05 / World, 1990) method

Impact category	Unit	Per 1 m^2 of flooring	Per 10 sq. ft. of flooring
Global warming potential	kg $C0_2$ eq	-1.92	-1.79
Ozone depletion potential	kg CFC-11 eq	4.32E-08	4.02E-08
Smog creation potential	kg C_2H_4	0.01	0.01
Acidification potential	kg SO_2 eq	0.07	0.07
Eutrophication potential	kg Po_4^{-3} eq	0.01	0.01
Abiotic depletion	kg Sb eq	0.07	0.06

End of Life Stage

Hardwood flooring at the end of the service life could be either reused or recycled for energy.

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 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 (CO_2), methane (CH_4) and nitrous oxide (N_2O). For global warming potential, greenhouse gases are tracked and their impact is reported in units of CO_2 equivalents (eq).

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 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.

Smog Creation 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 O_3 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

Glossary cont.

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.

Freshwater Withdrawal

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

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.

Waste Minimization Activities during Production

Wood waste produced during flooring manufacturing is being minimized by recycling internally for energy for drying and selling for hog fuel.

Installation Waste

Wood waste is considered nonhazardous waste and should be disposed of in accordance with local requirements.

Care during Use

Hardwood flooring needs regular cleaning in order to remove grit and sand either by sweeping the floor with a broom or vacuum cleaner. Sweeping with a broom significantly reduces environmental burden compared to vacuuming. Periodic cleaning can be done by washing the floor with a floor cleaner.

Disposal at the End of the Service Life

Using hardwood flooring for energy recovery in bioenergy or waste-to-energy facilities at the end of life has potential environmental benefits when this energy can be used to displace fossil fuels and their associated environmental impacts

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About this EPD

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

PCRs: This EPD is based on the following two PCRs:

1. North American Structural and Architectural Wood Products. Version 1.1 May 2013. Prepared by FPInnovations and available at www.fpinnovations.ca.
2. The Product Category Rule for Environmental Product Declarations: Flooring: Resilient, Laminate, Ceramic, Wood. Prepared by NSF National Center for Sustainability Standards and available at http://www.nsf.org.

Explanatory materials on the background LCA can be obtained from:

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

☐ Internal ☒ External

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EPDs do not address all issues of relevane to sustainability.

Cradle-to-grave LCA results can be used for comparison between different EPDs provided product 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 program may not be comparable.

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