Environmental Product Declaration (EPD)

NORDIC X-LAM™

NORDIC STRUCTURES

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The development of this product-specific environmental product declaration (EPD) for Nordic X-Lam™ was commissioned by Nordic Structures. This EPD was developed in compliance with CAN/CSA-ISO 14025, ISO 14040, ISO 14044, ISO 21930 and has been verified by Jean-François Menard from the International Reference Center for Life Cycle Assessment and Sustainable Transition (CIRAIG).

The EPD includes life cycle assessment (LCA) results for raw material supply, transport and manufacturing modules (cradle-to-gate). The LCA was performed by FPInnovations.

For more information about Nordic Structures, please go to www.nordic.ca.

Environmental Product Declaration

CSA Group Registered Based on ISO 14025 and Other Requirements

For more information visit csaregistries.ca/epd

5960-4998

November 2023-November 2028

This environmental product declaration (EPD) is in accordance with CAN/CSA-ISO 14025 and ISO 21930 the PCR noted below. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	CSA Group 178 Rexdale Blvd, Toronto, ON, Canada M9W 1R3
PRODUCT	Nordic X-Lam™
MANUFACTURER NAME AND ADDRESS	Nordic Structures 100-1100, avenue des Canadiens-de-Montréal, Montréal (Québec), H3B 2S2
EPD REGISTRATION NUMBER	5960-4998
EPD RECIPIENT ORGANIZATION	Nordic Structures
DECLARATION PRODUCT & DECLARED UNIT	One cubic meter (1 m3) of Nordic X-LamTM
REFERENCE PCR AND VERSION NUMBER	UL Environment: Product Category Rules (PCR) for Building-Related Products and Products and Services; Part B: Structural and Architectural Wood Products EPD Requirements, v1.1 Valid until October 2024
MARKET OF APPLICABILITY	North America
DATE OF ISSUE	November 10, 2023
PERIOD OF VALIDITY	November 10, 2023 – November 8, 2028
EPD TYPE	Product-specific
EPD SCOPE	Cradle-to-gate (A1-A3)

YEAR(S) OF REPORTED MANUFACTURER PRIMARY	2018 - 2019
LCA SOFTWARE & VERSION NUMBER	SimaPro 9.0003
LCI DATABASE(S) & VERSION NUMBER	US-EI 2.2 (i.e., DATASMART)
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1
The PCR review was conducted by:	Dr. Thomas Gloria (chair, Industrial Ecology Consultants), Dr. Indro Ganguly (University of Washington), Dr. Sahoo (University of Georgia) Contact information: 35 Bracebridge Road, Newton, Massachusetts, USA, 02459-1728 t.gloria@industrial-ecology.com
This EPD and related data were independently verified by an external verifier, CIRAIG/Jean-François Ménard, according to CAN/CSA-ISO 14025:2006	__ Internal _x_ External
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	FPINNOVATIONS 570, boul. Saint-Jean, Pointe-Claire (Qc), Canada, H9R 3J9 https://web.fpinnovations.ca
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Jean-François Ménard Jean-François Ménard

LIMITATIONS

Environmental declarations from different programs (ISO 14025) may not be comparable.

Comparison of the environmental performance using EPD information shall consider all relevant information modules over the full life cycle of the products within the building.

This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. It should be noted that different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

1. DESCRIPTION OF NORDIC STRUCTURES

Nordic Structures is a company dedicated to engineered wood products for the construction industry. Nordic solutions are tailor-made for tomorrow's school, commercial, industrial, infrastructure, institutional, multi-residential, recreational, and residential projects. With Chantiers Chibougamau, Nordic Structures has over 60 years of experience and expertise as wood processing innovators. From product distribution to turnkey wood structures, Nordic is known for its technical expertise and product quality. Nordic sustainable solutions are appreciated by customers seeking the right product at the right price, backed by first-rate service.

2. MANUFACTURER INFORMATION

This EPD represents glued-laminated timber produced at Nordic Structures located in Chibougamau, Quebec, Canada. This EPD is based on a life cycle assessment study compiled in 2023 with manufacturing data gathered for the 2018-2019 fiscal year.

3. DESCRIPTION OF PRODUCT

3.1. Definition and product classification

Nordic X-Lam™ is a structural panel product (cross-laminated timber) composed of crosswise glued wood (black spruce) boards. Cross-laminated timber (CLT) is used for wall, floor/ ceiling, and roof applications in commercial, multi-residential, and residential buildings. Nordic X-Lam is produced by bonding multiple lumber boards layered crosswise (at 90° angles) with structural adhesives. Nordic X-Lam possesses superior strength and stability and thus offers new applications opportunities in wood construction, such as floor slabs, roof slabs, and wall panels, and use in light framing to provide lateral stability for greater building heights, or mixed structures. The manufacturing process involves lumber selection, lumber grouping, lumber planning, lumber cutting, adhesive application, panel lay-up, and assembly pressing. Nordic kiln dries its components to 12% moisture content.

3.2. Material content

The product composition is based on 1 m³ of Nordic X-Lam™ output at the mill gate (see Table 2).

- Wood portion: 1 m³ (456 kg on oven-dry basis)
- Adhesive: 4.73 kg (Polyurethane and isocyanate)
- Lumber wrap: 0.08 kg of LDPE (Low-Density Polyethylene).

Table 1. Nordic X-Lam™ composition on dry-basis

Product component	Percentage (%)
Wood	98.97%
Adhesive	1.03%

3.3. Production of Nordic X-Lam

Nordic X-Lam is made with softwood lumber and adhesive. Figure 1 shows the detailed cradle-to-gate process flow diagram (PFD) for manufacturing Nordic X-Lam products included in this EPD. Figure 1 illustrates process flow for all life cycle stages considered in the study as well as the system boundary.

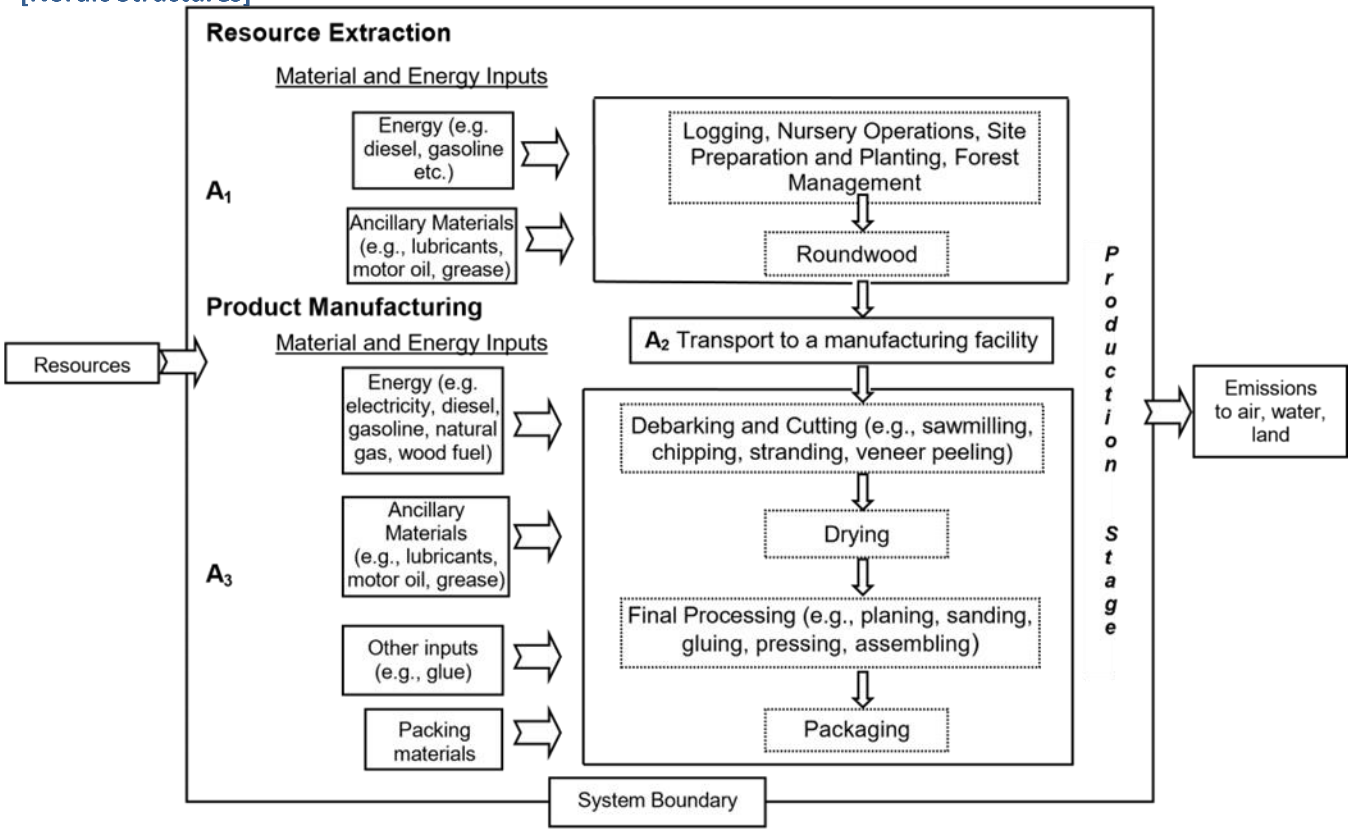

Figure 1: Process flow and system boundary

4. SCOPE OF EPD

4.1. Declared unit

In LCA, a reference unit is defined based on the quantified performance (functions) of the product system for the analysis, called as "functional unit" (FU). Environmental inputs and outputs within the system boundary are then normalized to this FU to allow for comparisons with the products fulfilling the same functions. One of the primary purposes of FU is to provide reference flows (i.e. the outputs from a product system required to fulfill the defined function) to provide a similar basis for the comparison. This LCA, however, is a cradle-to-facility gate assessment; it did not include the installation and use, and product disposal at the end of service life. The concept of declared unit (DU) was applied as the unit of analysis to normalize the cradle-to-gate environmental input and output flows. The DU was defined as 1 m3 of the kiln-dried final product ready for shipping at the facility gate (see Table 3).

Table 2. Declared unit for Nordic X-Lam, its density, and its moisture content

Parameter	Value	Unit
Declared unit	1	m³
Thickness to achieve Declared Unit	0.175	m
Density	456	Oven-dry (kg/m³)
Moisture content	12	%
Product density (@ 12% moisture)	523	kg/m³

4.2. System boundary

The system boundary of this study is depicted in Figure 1. It includes all the production steps from the extraction of raw materials from the earth (the cradle) through to the final Nordic X-Lam product at the mill gate (See Table 4). The product stage is included in the cradle-to-gate system boundary. All downstream stages are excluded from this study, and the reference service life is not specified as the study is cradle-to-gate and does not cover life cycle stages for product use.

Table 4. Life cycle stages considered in the study

Production stage			Construc-tion stage		Use stage							End-of-life stage				
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport to manufacturing plant	Manufacturing of X-Lam products	Transport	Construction – installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

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

- A1 – Extraction (removal) of raw materials and processing. A1 includes stump to the roadside (logging, delimbing, moving to a roadside) and subsequent reforestation processes that include nursery, site preparation, as well as planting, and thinning operations;

- A2 – Transportation of raw materials from their extraction site to the manufacturing site; and

- A3 – Manufacturing of the wood construction product, including packaging

The geographic boundary for the study was set as North America as all the flows to and from the environment of this system occur within this region.

5. ENVIRONMENTAL IMPACTS

Life cycle assessment (LCA) is a rigorous study of inputs and outputs over the entire life of a product or process and the associated potential environmental impacts of those flow to and from nature. A cradle-to-gate life cycle assessment has been conducted according to ISO 14040 and 14044 standards and the Product Category Rules (PCR) for Building-Related Products and Products and Services; Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report, v3.2; and Part B: Structural and Architectural Wood Products EPD Requirements, v1.1.

5.1. Data sources

The underlying LCA supporting this EPD relied on two LCA data sources: primary data gathered from Nordic's lumber and engineered wood product manufacturing facility located in Chibougamau, Quebec for the 2018-2019 fiscal year, and in-house resource extraction data gathered from harvesting operations occurring in Quebec in 2015 and 2016. The study also relied on generic energy, ancillary materials, and transport LCI data available in the US-EI 2.2 (i.e., DATASMART).

5.2. Cut-off rules

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 impact results for all categories. Human activity and capital equipment are excluded. No known material, energy input, or output was deliberately excluded from this EPD.

5.3. Allocation

Nordic X-Lam™ is produced from Lumber. The multiproduct allocation guidance provided in the PCR was applied to split the environmental burden between the co-products of Lumber. The revenue-based allocation was applied since the difference in revenue from the co-products is greater than 10% (UL Environment Inc., 2019).

5.4. Data quality

Data quality has been assessed in the inventory analysis phase at both technosphere flow levels and processes levels, using the US-EPA pedigree matrices for flow indicators (Flow reliability, Temporal correlation, Geographical correlation, Technological correlation, Data collection methods) and process indicators (Geography, Process review, Completeness) (Edelen, A., &

Ingwersen, W. (2016). A detailed data quality rating for the data used as well as the results of process rating are documented in the underlying LCA project reports. The overall data quality level is "Good" according to the achieved minimum score.

5.5. Life cycle impact assessment - Results

The U.S. Environmental Protection Agency's TRACI (Tool for the Reduction and Assessment of Chemical and other environmental Impacts) was the LCIA methodology applied to characterize the inventory flows because it uses characterization factors specific to North America (see Bare C. Jane, et. al., 2003 and Bare C. Jane, 2011). TRACI Version 2.1 (Bare C. Jane, 2012) was used. Cumulative Energy Demand (v1.11) was used to characterize primary energy consumption by energy sources. The environmental impact categories and life cycle inventory parameters stated in the wood products PCR (UL Environment Inc.,2019) were chosen to report potential environmental impacts per declared unit energy and material resource consumption. Waste and impact indicator results are presented in Table 3. Impact indicators used are global warming potential (GWP), acidification potential, eutrophication potential, smog potential, ozone depletion potential, Abiotic depletion potential for fossil resources, and Fossil fuel depletion.

Using the American Center for Life Cycle Assessment (ACLCA) guidance to calculating non-LCA inventory metrics in accordance with ISO 21930:17, additional LCI indicators have been calculated (ACLCA, 2019). The results are summarized in

Table 4.

Table 3: Environmental performance, 1 m^3 of Nordic X-Lam™ by life cycle stage

Impact Category	Unit	Total	Resource Extraction	Resource Transportation	Product Manufacturing
			A1	A2	A3
Global Warming	kg CO_2 eq	69.96	37.41	25.68	6.88
Ozone depletion	kg CFC-11 eq	1.28E-06	4.36E-07	4.52E-08	8.03E-07
Acidification	kg SO_2 eq	0.60	0.37	0.14	0.08
Eutrophication	kg N eq	0.05	0.03	0.01	0.01
Smog	kg O_3 eq	18.45	11.84	4.09	2.52
Abiotic depletion potential for fossil resources	MJ, LVH*	1,029.47	625.80	321.27	82.40
Fossil fuel depletion	MJ, Surplus	152.46	92.39	48.24	11.83

Table 4: Environmental performance, 1 m³ of Nordic X-LamTM by life cycle stage

Impact Category	Unit	Resource Extraction A1	Resource Transportation A2	Product Manufacturing A3
Renewable primary energy used as energy carrier (excluding raw materials)	MJ, LHV	23.68	1.50	1626.78
Renewable primary energy resources used as raw materials	MJ, LHV	15,625.78	N/A	N/A
Non-renewable primary energy used as energy carrier (excluding raw materials)	MJ, LHV	2,328	707.71	51.10
Non-renewable primary energy resources used as raw materials	MJ, LHV	634.6	N/A	N/A
Secondary material				
Use of secondary materials	kg	0	N/A	0
Use of renewable secondary fuels	MJ, LHV	N/A	N/A	N/A
Use of non-renewable secondary fuels	MJ, LHV	N/A	N/A	N/A
Fresh water consumption				
Fresh water	m³	0	0	0
Fresh water consumption				
Hazardous waste generated	kg	N/A	N/A	2.46
Non-hazardous waste generated	kg	N/A	N/A	26.45
Components for reuse	kg	0	0	0
Materials for recycling	kg	0	0	0
Materials for energy recovery	kg	0	0	0
Recovered energy exported from the system	MJ, LHV	0	0	0

The LCA model is designed to track all carbon fluxes in the GWP calculation: the carbon stored in Nordic X-Lam™ 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 presented in Table 5.

6. ADDITIONAL ENVIRONMENTAL INFORMATION

Environmental activities and certifications

Nordic is committed to sustainable forestry and strictly applies government rules and regulations pertaining to forestry to ensure that forestry operations are carried out sustainably. In addition, the cutting strategy of Nordic is based on development plans aimed at minimizing the impact of forestry operations on soils from felling and skidding that, in turn, encourage native regeneration. Overall, these management practices aim to ensure the new stand stocking is at least 10% greater than the former stocking.

According to ASTM D7612, the company's wood fiber sources fall into the following category:

- Certified sources of Nordic wood fiber come from FSC-certified forests. The interested party can find details of the certification program at https://www.nordic.ca/en/sustainable-construction/certifications.

Biogenic carbon balance

The biogenic carbon that is part of the molecular composition of wood, which is removed from the atmosphere as trees grow, is given specific consideration in greenhouse gas calculations and carbon footprints for wood products. As the wood is from sustainably managed sources, characterization factors provided in both ISO 14067 and ISO 21930 for biogenic carbon removals and emissions (+1 and -1, respectively) are applied for the calculation of the global warming potential. Biogenic carbon emissions and removals for 1 m³ of Nordic X-Lam™ (cradle-to-gate) are presented in Table 5.

Table 5: Carbon emissions and removals, 1 m³ of Nordic X-Lam™ by life cycle stage

Biogenic carbon*	kg of CO_2 eq.			
	Total	A1	A2	A3
Carbon removals	(858)	(858)	0	0
Carbon emissions	858	0	0	858**

*Note: * Carbon content in wood 49.8% on oven dry basis (Hunt, et. al., 2010); ** Including biogenic CO_2 contained in the product when living the product system (833 kg of CO2) plus 25 kg of biogenic CO_2 associated with the combustion of planer shavings and export of product, off-specs and end-cuts across system boundaries.*

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 the 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 are reported in terms of equivalent units of CO_2.

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 the 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.

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 SO_2 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 the 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 (NOx), and volatile organic compounds (VOCs) in the 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 NOx equivalent.

Source: Bare et al, 2003

REFERENCES

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