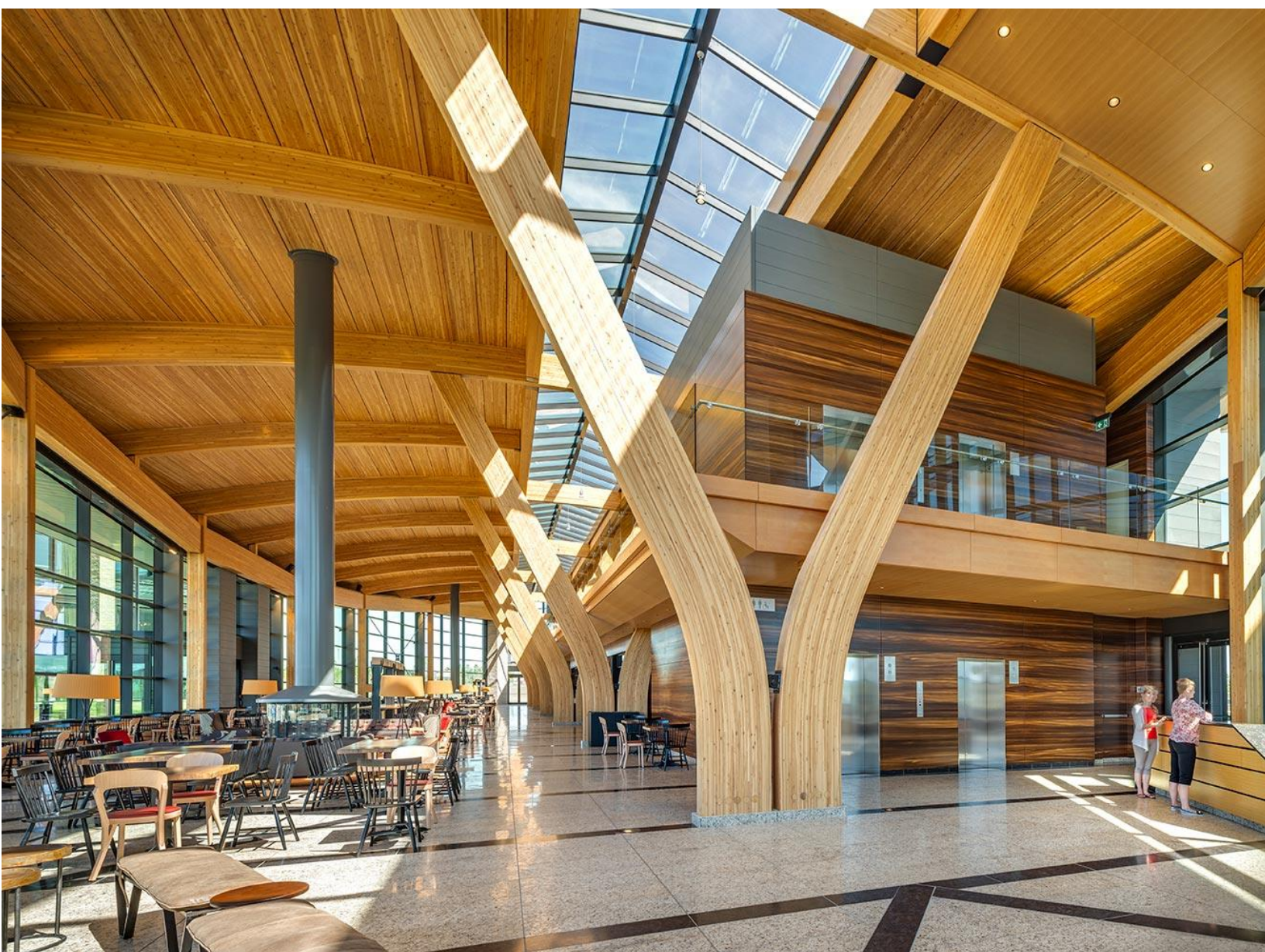


Environmental Product Declaration

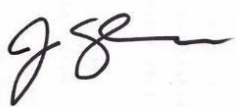


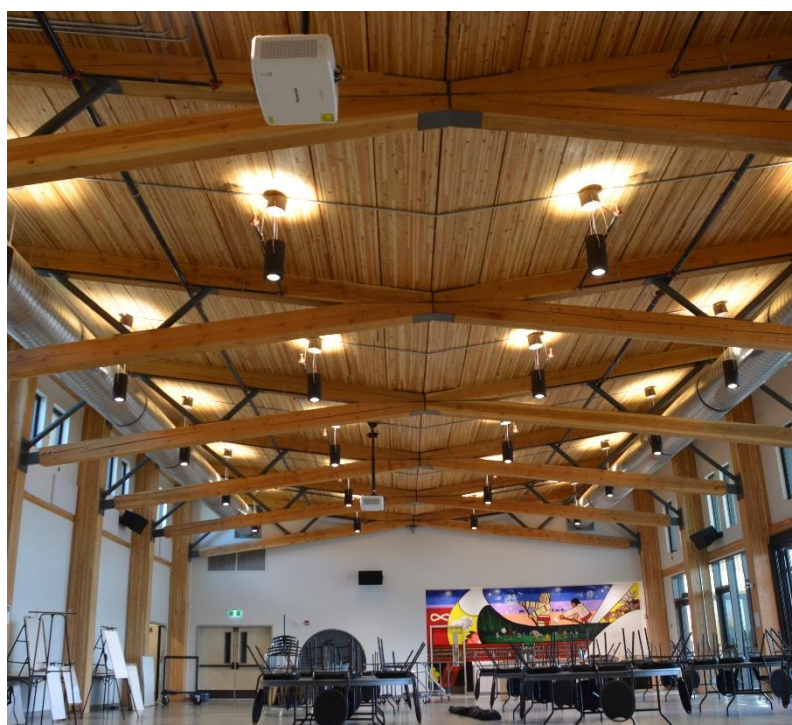
EPD for Glued Laminated Timber produced by Western Archrib in Edmonton, Alberta



ASTM Certified Environmental Product Declaration

Program Operator	ASTM International 100 Barr Harbor Drive PO Box C700 West Conshohocken, PA, 19428-2959 USA www.astm.org  ASTM INTERNATIONAL Helping our world work better		
General Program Instructions and Version Number	ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs) - General Program Instructions, version: 6.0		
Declaration Owner	WA Enterprises Ltd. 4315 92nd Avenue Edmonton, Alberta T6B 3M7 www.westernarchrib.com 		
Declaration Number	EPD 247		
Declared Product	Glued Laminated Timber (Glulam)		
Declared Unit	1 m ³ of Glulam produced at Western Archrib's facility in Edmonton, Alberta		
Reference PCR and Version Number	ISO 21930:2017 Sustainability in Building Construction — Environmental Declaration of Building Products. [11] UL Environment: Product Category Rules for Building-Related Products and Services Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report, v3.2 [15] Part B: Structural and Architectural Wood Products EPD Requirements, v1.0 [16]		
Description of Product's intended application and use	Glued Laminated Timber (Glulam) is a structural engineered product created by laying dimensional lumber together and bonding them with structural adhesives. Western Archrib's Glulam products have proven longevity across a wide variety of projects.		
Markets of Applicability	Construction Sector, Mass timber design		
Date of Issue	August 19, 2021		
Period of Validity	August 19, 2026		
EPD Type	Product-specific EPD		
EPD Scope	Cradle to Gate		
Year of reported manufacturer primary data	2020		
LCA Software	SimaPro v8.6		
LCI Databases	USLCI [13], Ecoinvent 3.5 [17], Datasmart [12]		
LCIA Methodology	TRACI 2.1 [6]		
The sub-category PCR review was conducted by:	Dr. Thomas Gloria (chair) Industrial Ecology Consultants	Dr. Indro Ganguly University of Washington	Dr. Sahoo University of Georgia

LCA and EPD Developer This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Athena Sustainable Materials Institute 119 Ross Ave. #100 Ottawa, ON K1Y 0N6 613-729-9996 www.athenasmi.org  James Salazar 
This declaration was independently verified in accordance with ISO 14025:2006. The UL Environment "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, v1.0, in conformance with ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017). ☐ INTERNAL ☒ EXTERNAL	
Independent Verifier This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Dr. Thomas Gloria Industrial Ecology Consultants 
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.	



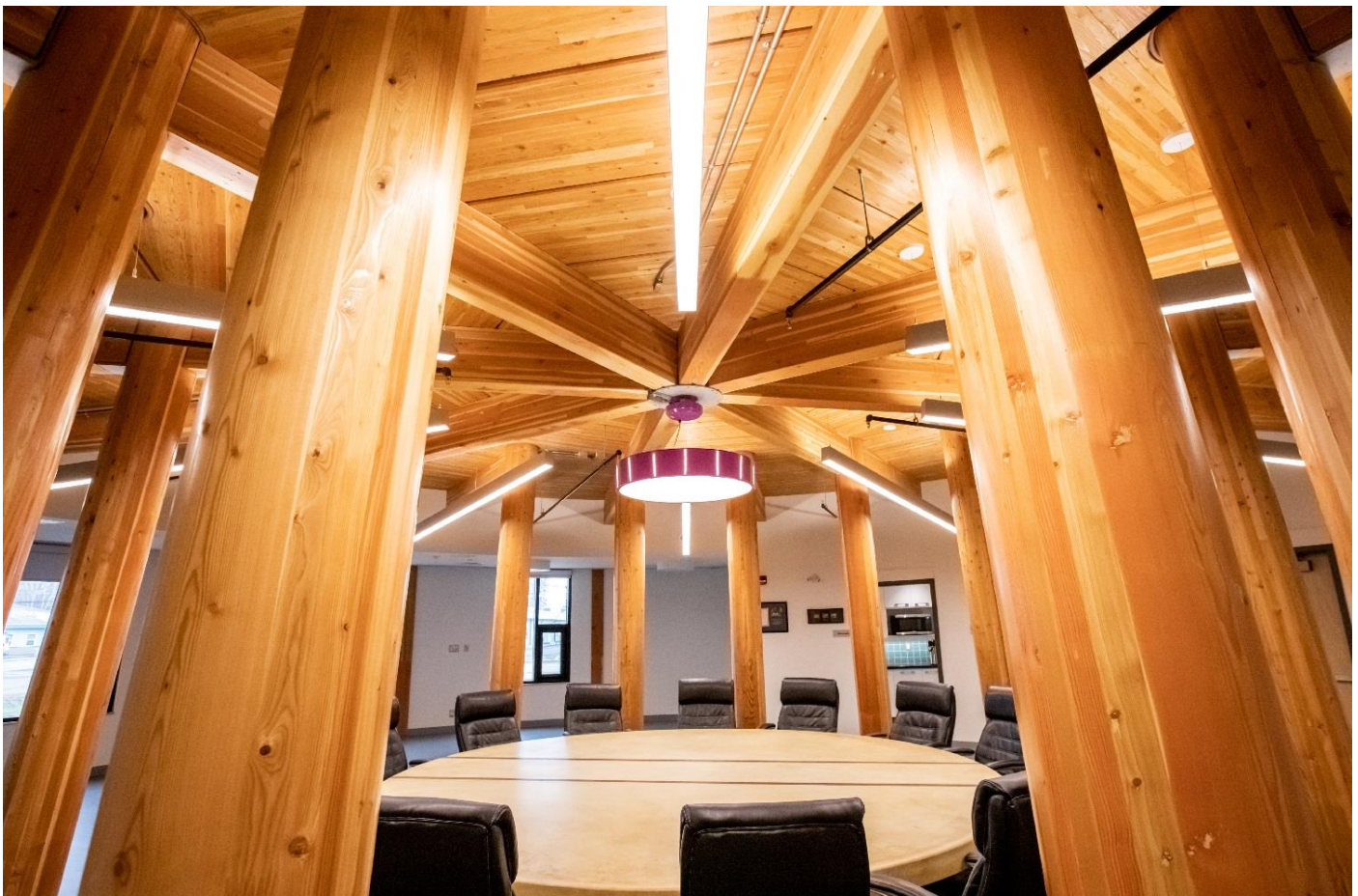
PRODUCT DESCRIPTION

Western Archrib Structural Wood Systems Glulam

Glued Laminated Timber (Glulam) is a structural engineered product created by laying dimensional lumber together and bonding them with structural adhesives. This allows for the manufacture of an endless variety of creative shapes and sizes that will always maintain structural integrity. The Construction Specification Institute (CSI) MasterFormat codes for glulam are as follows:

- **Glued-Laminated Construction: 06 18 00**
- Glued-Laminated Beams Glued-Laminated Columns: 06 18 13
- Glued-Laminated Beams Glued-Laminated Beams: 06 18 16

The main product components of Western Archrib glulam are dimensional softwood lumber (97%) and various resins (3%). The softwood lumber used for glulam production is derived from sustainable managed forests in Canada (See below 'Treatment of biogenic carbon and sustainable forest management certification').



METHODOLOGICAL FRAMEWORK

Type of EPD and Life Cycle Stages

The underlying LCA [5] aligns with a previous industry study on Canadian glulam [4] investigates the glulam product system from cradle to gate. This comprises the production stage including the information modules 'A1 Extraction and upstream production', 'A2 Transport to factory' and 'A3 Manufacturing' (Figure 1).

Building Life Cycle Information Modules															
Production stage			Construction Stage		Use stage							End-of-life stage			
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport to waste processing or disposal	Waste processing	Disposal
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Figure 1 Life Cycle Stages and Information Modules per ISO 21930:2017. (MND: module not declared)



System Boundaries and Product Flow Diagram

The product system described in Figure 2 includes the following information modules and unit processes:

A1 Extraction and upstream production

A1 includes the cradle-to-gate production of softwood lumber and resins that are used in glulam manufacture. The upstream resource extraction includes removal of raw materials and processing, processing of secondary material input (e.g., recycling processes) after crossing the system boundary of the previous product system. A1 also includes reforestation processes that include nursery operations (which include fertilizer, irrigation, energy for greenhouses if applicable etc.), site preparation, as well as planting, fertilization, thinning and other management operations.

A2 Transport to facility

Average or specific transportation of raw materials (including secondary materials and fuels) from extraction site or source to manufacturing site (including any recovered materials from source to be recycled in the process).

A3 Manufacturing

Manufacturing of the glulam product, including packaging (lumber wrap).

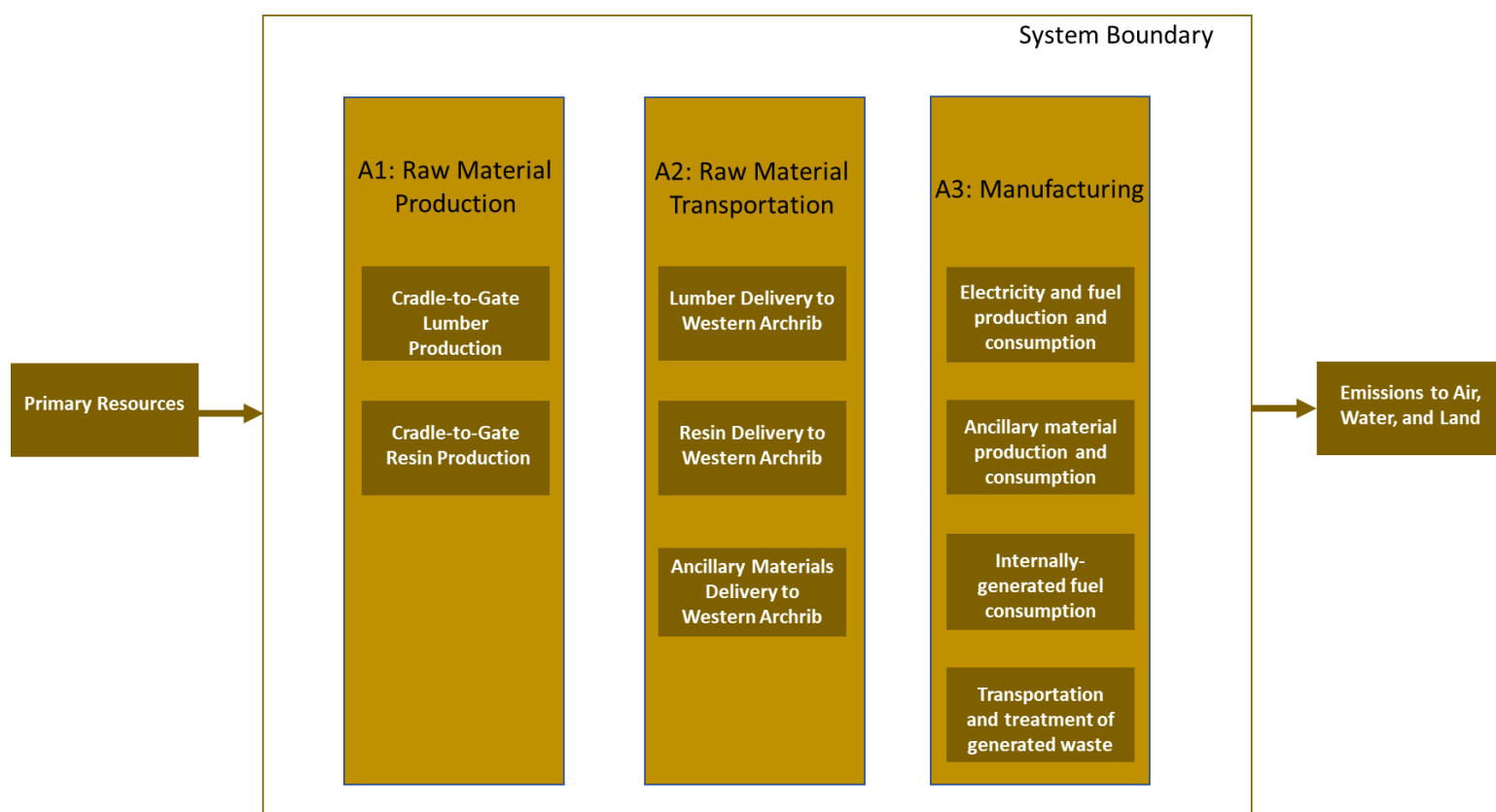


Figure 2: Cradle-to-Gate glulam Product System

Declared Unit

Table 1 shows the declared unit and additional product information.

Table 1: Declared Unit and Product Information

Declared Unit		
The declared unit is “the production of one cubic meter (1 m3) of glulam produced at Western Archrib’s facilities in Edmonton AB”.		
Property	Unit	Value
Mass	kg	± 489 (SPF)
Moisture Content	%	12% (± 3%)
Product Composition		
Softwood Lumber	%	97
Resins	%	3

Western Archrib glulam is available in a variety of dimensions:

- Widths: 80mm, 130mm, 175mm, 215mm, 265mm, 315mm, 365mm, 400mm, 440mm, 490mm, 540mm, 590mm and 640mm
- Depths: 114mm to 2128mm (38mm increments)

Allocation Methods

Allocation is the method used to partition the environmental load of a process when several products or functions share the same process. The Western Archrib facility at Edmonton Alberta produces Glulam (main products) and several valuable coproducts. In accordance with UL PCR 2019, the environmental load among these products is allocated according to its mass. Furthermore, the manufacturing process does produce wood waste that is transferred for free to downstream users. No environmental burden has been allocated to these wastes. A detailed explanation of the allocation methodology of upstream lumber production is provided in the lumber LCA project report.

Cut-off Criteria

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.

No material or energy input or output was knowingly excluded from the system boundary.

Data Sources

Primary and secondary data sources, as well as the respective data quality assessment are documented in the underlying LCA project report in accordance with UL PCR 2019.

This EPD estimates the impacts of forest management by the weighted industry average EPD of Canadian softwood lumber.

Third party verified ISO 14040/44 secondary LCI data sets contribute more than 67% of total impact to any of the required impact categories identified by the applicable PCR.

Treatment of Biogenic Carbon and Sustainable Forest Management Certification

Biogenic carbon emissions and removals are reported in accordance with ISO 21930 7.2.7. and 7.2.12. Detailed information is provided in the underlying LCA in Section 2.5.

ISO 21930 requires a demonstration of forest sustainability to characterize carbon removals with a factor of -1 kg CO₂e/kg CO₂. ISO 21930 Section 7.2.11 Note 2 states the following regarding demonstrating forest sustainability: “Other evidences such as national reporting under the United Nations Framework Convention on Climate Change (UNFCCC) can be used to identify forests with stable or increasing forest carbon stocks.” Canada’s UNFCCC annual report Table 6-1 provides annual NET GHG Flux Estimates for different land use categories. This reporting indicates non-decreasing forest carbon stocks and thus the source forests meet the conditions for characterization of removals with a factor of -1 kg CO₂e/kg CO₂.

Table 3 provides additional inventory parameters related to biogenic carbon removal and emissions.

ENVIRONMENTAL PARAMETERS DERIVED FROM LCA

Table 2 presents the LCIA and LCI parameter results for the declared unit of 1 m³ of glulam. The impact categories and characterization factors (CF) for the LCIA were derived from the U.S. EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts -TRACI 2.1 [6].

The total primary energy consumption is tabulated from the LCI results based on the Cumulative Energy Demand Method published by ecoinvent [18]. Lower heating value of primary energy carriers is used to calculate the primary energy values reported in the study.

Other inventory parameters concerning material use, waste, water use and biogenic carbon were drawn from the LCI results. We followed the ACLCA's Guidance to Calculating non-LCIA Inventory Metrics in accordance with ISO 21930:2017 [1].

SimaPro v8.5 [14] was used to organize and accumulate the LCI data, and to calculate the LCIA results.

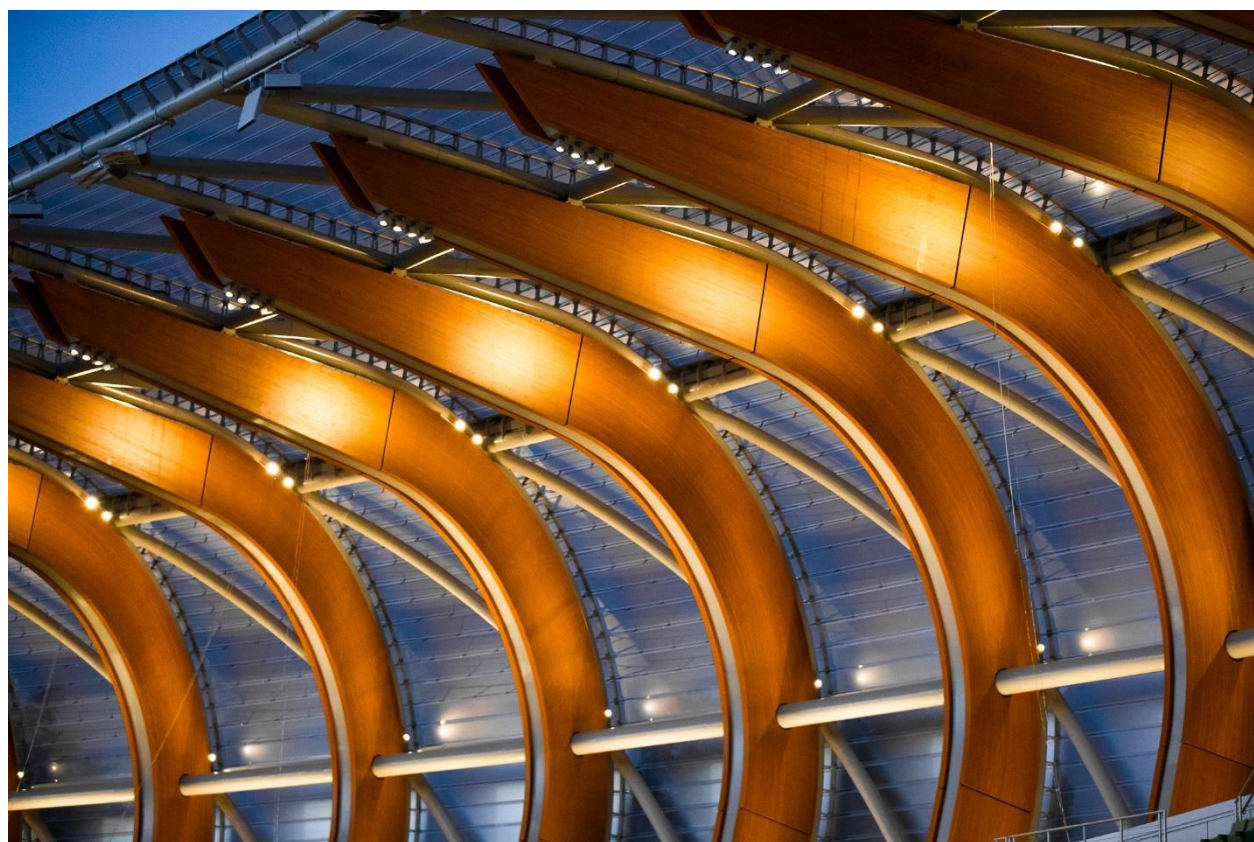


Table 2: LCIA Results Summary for Cradle-to-Gate production of 1 m3 of glulam

Core Mandatory Impact Indicator			Total	A1	A2	A3
Global warming potential – Total Fossil & Biogenic	GWP _{TOTAL}	kg CO2e	267.42	-798.92	22.48	1,043.86
Global warming potential - Fossil	GWP _{FOSSIL}	kg CO2e	267.42	64.21	22.48	180.72
Global warming potential - Biogenic	GWP _{BIO}	kg CO2e	0.00	-863.13	0.00	863.13
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	9.10E-06	2.57E-06	9.48E-10	6.53E-06
Acidification potential of soil and water sources	AP	kg SO2e	2.07	0.64	0.30	1.13
Eutrophication potential	EP	kg Ne	1.51	0.10	0.02	1.40
Formation potential of tropospheric ozone	SFP	kg O3e	28.69	12.35	7.61	8.73
Abiotic depletion potential (ADP _{fossil}) for fossil resources;	ADP _f	MJ, NCV	3,874.12	1191.61	322.21	2360.30
Fossil fuel depletion	FFD	MJ Surplus	484.14	163.28	47.62	273.24
Use of Primary Resources						
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	1,666.33	1,601.93	0.00	64.40
Renewable primary energy carrier used as material	RPRM	MJ, NCV	8,945.20	8,945.20	0.00	0.00
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	7,451.44	4,482.31	341.55	2,627.58
Non-renewable primary energy carrier used as material	NRPRM	MJ, NCV	0.00	0.00	0.00	0.00
Secondary Material, Secondary Fuel and Recovered Energy						
Secondary material	SM	kg	0.00	0.00	0.00	0.00
Renewable secondary fuel	RSF	MJ, NCV	0.00	0.00	0.00	0.00
Non-renewable secondary fuel	NRSF	MJ, NCV	0.00	0.00	0.00	0.00
Recovered energy	RE	MJ, NCV	0.00	0.00	0.00	0.00
Mandatory Inventory Parameters						
Consumption of freshwater resources	FW	m3	1.20	0.22	0.00	0.98
Indicators Describing Waste						
Hazardous waste disposed	HWD	kg	0.00	0.00	0.00	0.00
Non-hazardous waste disposed	NHWD	kg	2.52	0.00	0.00	2.52
High-level radioactive waste, conditioned, to final repository	HLRW	m3	0.00	3.66E-07	0.00E+00	1.02E-08
Intermediate- and low-level radioactive waste, conditioned, to final repository	ILLRW	m3	0.00	2.95E-07	0.00E+00	1.28E-07
Components for re-use	CRU	kg	0.00	0.00	0.00	0.00
Materials for recycling	MR	kg	0.00	0.00	0.00	0.00
Materials for energy recovery	MER	kg	0.00	0.00	0.00	0.00
Recovered energy exported from the product system	EE	MJ, NCV	0.00	0.00	0.00	0.00

To ensure transparency Table 3 shows additional inventory parameters related to biogenic carbon removal and emissions. The carbon dioxide flows are presented unallocated to consider co-products leaving the product system in information module A3. Even though, the system boundary of this study included only the information modules A1-A3, in accordance with ISO 21930, BCEK was reported in A5 and BCEP of the main product in C3/C4.

The net carbon emission across the entire life cycle is zero. It is assumed that all carbon removed from the atmosphere is eventually emitted to the atmosphere as CO₂. Total GWP_{BIO} includes biogenic carbon emissions and removals from the information modules A1-A3, A5 and C3/C4, leading to a net zero contribution of biogenic carbon to GWP_{BIO}. Therefore, in Table 2, results for total GWP_{TRACI} and total GWP_{BIO} are equal.

Table 3: Biogenic carbon inventory parameters for glulam

Additional Inventory Parameters			Total	A1	A2	A3	A5	C3/C4
Biogenic Carbon Removal from Product	BCRP	kg CO ₂	-863.13	-863.13	-	-	-	-
Biogenic Carbon Emission from Product	BCEP	kg CO ₂	863.13	-	-	78.47	-	784.67
Biogenic Carbon Removal from Packaging	BCRK	kg CO ₂	-	-	-	-	-	-
Biogenic Carbon Emission from Packaging	BCEK	kg CO ₂	-	-	-	-	-	-
Biogenic Carbon Emission from Combustion of Waste from Ren. Sources Used in Production	BCEW	kg CO ₂	-	-	-	-	-	-
Net biogenic carbon emission		kg CO ₂	0.00					

INTERPRETATION AND LIMITATIONS

Comparability

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. In addition, to be compared EPDs must comply with the same core and sub-category PCRs (Part A and B) and include all relevant information modules. 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.

Forest Management

While this EPD does not address landscape level forest management impacts, potential impacts may be addressed through requirements put forth in regional regulatory frameworks, ASTM 7612-15 guidance, and ISO 21930 Section 7.2.11 including notes therein. These documents, combined with this EPD, may provide a more complete picture of environmental and social performance of wood products.

While this EPD does not address all forest management activities that influence forest carbon, wildlife habitat, endangered species, and soil and water quality, these potential impacts may be addressed through other mechanisms such as regulatory frameworks and/or forest certification systems which, combined with this EPD, will give a more complete picture of environmental and social performance of wood products.

Scope of the EPD

EPDs can complement but cannot replace tools and certifications that are designed to address environmental impacts and/or set performance thresholds – e.g. health assessments and declarations, etc.

Data

National or regional life cycle averaged data for raw material extraction does not distinguish between extraction practices at specific sites and can greatly affect the resulting impacts.

Accuracy of Results

EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact when averaging data.

REFERENCES

1. American Center for Life Cycle Assessment (2019) ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017
2. ANSI/APA (2018) PRG 320-2018: Standard for Performance-Rated Cross-Laminated Timber
3. Athena Sustainable Materials Institute (2019) A Cradle-to-Gate Life Cycle Assessment of Canadian Surfaced Dry Softwood Lumber. Prepared for the Canadian Wood Council.
4. Athena Sustainable Materials Institute (2019) A Cradle-to-Gate Life Cycle Assessment of Canadian Glulam. Prepared for the Canadian Wood Council.
5. Athena Sustainable Materials Institute (2021) A Cradle-to-Gate Life Cycle Assessment of Glued-laminated Timber Manufactured by Western Archrib, v1.0,
6. Bare, J. (2012) Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) - Version 2.1.
7. Canadian Wood Council <https://cwc.ca/how-to-build-with-wood/wood-products/mass-timber/glulam/>
8. International Organization for Standardization (2006) ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and procedures
9. International Organization for Standardization ISO 14040:2006/AMD 1:2020, Environmental management – Life cycle assessment – Principles and framework
10. International Organization for Standardization ISO 14044:2006/AMD 1:2017/AMD 2:2020, Environmental management – Life cycle assessment – Requirements and guidelines
11. International Organization for Standardization (2017) International Standard ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
12. LTS (2019) DataSmart: <http://ltsexperts.com/services/software/datasmart-life-cycle-inventory/>
13. National Renewable Energy Laboratory (2019) U.S. Life Cycle Inventory Database <http://www.nrel.gov/lci/>
14. PRé Consultants BV (2018) SimaPro v8.5 LCA Software
15. UL Environment (2018) Product Category Rule (PCR) Guidance for Building-Related Products and Services, Part A Life Cycle Assessment Calculation Rules and Report Requirements; UL 10010, Version 3.2.
16. UL Environment (2019) Product Category Rule (PCR) Guidance for Building-Related Products and Services, Part B: Structural and Architectural Wood Products EPD Requirements; UL 10010-9, Version 1.0.
17. Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., & Weidema, B. (2016) The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, 21, 1218–1230.

