FRERES
ENGINEERED WOOD PRODUCTS

Environmental Product Declaration

EPD for Mass Ply Products produced by Freres Engineered Wood in Lyons, Oregon

INNOVATION IS OUR TRADITION

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 Rules. Version: 8.0, Revised 04/29/20	
DECLARATION OWNER	Freres Engineered Wood 40519 S. Cedar Mill Rd Lyons, OR 97358, USA	FRERES ENGINEERED WOOD PRODUCTS
DECLARATION NUMBER	1109	Freres Engineered Wood Mass Ply Products - Lyons, OR
DECLARED PRODUCT	Mass Ply Products - Mass Ply Panels and Mass Ply Lams produced at Freres Engineered Wood, Lyons, Oregon	
DECLARED UNIT	One cubic meter (1 m^3) of Mass Ply Products	
REFERENCE PCR AND VERSION NUMBER	ISO 21930:2017 Sustainability in Building and Civil Engineering works – Core Rules for environmental Product Declaration of Construction Products and Services. [9] 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, v4.0 2022 [15] Part B: Structural and Architectural Wood Products EPD Requirements, v1.1 2020 [16]	
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE	Mass Ply Products are a veneer based engineered wood product that is characterized by large structural elements that use layers of wood for wall, floor, beams, columns, and roof construction.	
MARKETS OF APPLICABILITY	Construction Sector, Mass timber design	
DATE OF ISSUE	January 7, 2026	
PERIOD OF VALIDITY	5 years	
EPD TYPE	Product-Specific	
EPD SCOPE	Cradle to gate	
YEAR OF REPORTED MANUFACTURER PRIMARY DATA	2023	
LCA SOFTWARE	SimaPro v10.1	
LCI DATABASES	USLCI [11], Ecoinvent 3.11 [4], Datasmart 2023 [10]	

LCIA METHODOLOGY	TRACI 2.2 v1.0 [3], CML-IA Baseline V3.11, CED, LHV 1.01
THE SUB-CATEGORY PCR REVIEW WAS CONDUCTED BY:	Dr. Thomas Gloria (chair) t.gloria@industrial-ecology.com
LCA AND EPD DEVELOPER This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	The Consortium for Research on Renewable Industrial Materials (CORRIM) PO Box 2432 Corvallis, OR 97330 541-231-2627 www.corrim.org

This declaration was independently verified in accordance with ISO 14025:2006 [6].
The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v4.0 (2022), in conformance with ISO 21930:2017 with additional considerations from the USGBC/UL Environment Part A Enhancement (2017).

Tim Brooke, ASTM International

☐Internal ☒ External

INDEPENDENT VERIFIER This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Dr. Thomas Gloria (chair) t.gloria@industrial-ecology.com

LIMITATIONS

- Environmental declarations from different programs (ISO 14025) may not be comparable.
- Comparison of the environmental performance of Structural and Architectural Wood Products using EPD information shall be based on the product's use and impacts at the construction works level, and therefore EPDs may not be used for comparability purposes when not considering the construction works energy use phase as instructed under this PCR.
- Full conformance with the PCR for Mass Ply allows EPD comparability only when all stages of a life cycle have been considered, when they comply with all referenced standards (ISO 21930:2017 §5.5), use the same sub-category Part B PCR, and use equivalent scenarios with respect to construction works. However, variations and deviations are possible. It should be noted that different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

Company and Product Description

Freres Engineered Company

Established in 1922, located in the Santiam Canyon of Oregon, Freres is a family-owned and operated wood products manufacturing business headquarters in Lyons, Oregon. Now in its third generation, family management continues to build on the success of past generations.

The company operates six processing plants, including a small log veneer plant, large log veneer plant, veneer drying facility, plywood plant, mass ply plant and stud mill in addition to having their own fleet of log and highway trucks and a cogeneration facility. They are dedicated to reinvesting modern manufacturing facilities, providing high-quality wood products, and providing family wage jobs within the community and have around 425 employees.

Mass Ply Panels

Mass Ply products are a veneer-based engineered wood product that is part of the mass timber product line. Mass timber is a category of timber products typically characterized by large structural elements such as panels or beams that use multiple layers of wood for wall, floor, and roof construction. Products represented in this EPD fall under the products of Mass Ply Panels (MPP) and Mass Ply Lams (MPL), hereafter referred to as Mass Ply (MP). Mass Ply is an innovative veneer-based engineered mass timber product which is manufactured using veneers from small-diameter trees, which minimizes a loss of wood during its production. Mass Ply products are strong and lightweight and have inherent acoustic, insulating, and environmentally friendly properties as well as superior fire, seismic, and thermal properties. Like cross-laminated timber, MP products are used as a substitute for traditional building materials such as steel and concrete. MPP is easy to install at the building site and generates almost no waste onsite.

MPP and MPL Certifications

- ASTM D5456 – Certification/standard for Structural Composite Lumber (SCL), which underlies their veneer / lamellae / LVL products used in MPP
- ICC-ESR 4760 – Structural Wood Based Products APPROVED LISTING: FRERES MASS PLY PANEL (MPP) AND MASS PLY LAMS (MPL) BEAMS AND COLUMNS
- ANSI/APA PRG 320-2025 – Standard for Performance Rated Cross-Laminated Timber
- ICC-ES A C 455 – Cross Laminated Timber Panels for use as Components in Floor and Decks
- APA PR L325 2025 (APA 2025).
- SWRI – Passed Standard Test Method for Surface Burning Characteristics Performed in Accordance with ASTM E84-18 [14].
- PATENTS - MPP is patented in multiple countries including U.S., Canada, Australia and New Zealand

Mass Ply can be used for floors, walls, columns, beams and roof systems and is categorized by United Nations Standard Products and Services Code (UNSPSC) 111220 and Construction Specifications Institute (CSI) codes for Engineered Wood Products 06 11 13 and Heavy Timber construction 06 13 00. Mass Ply falls into the North American Industry Classification System (NAICS) Code 321231 for Engineered Wood Member (except Truss) Manufacturing. Mass Ply is made of Douglas-fir (Pseudotsuga menziesii) from westside forests in Oregon. MPP product density was 577 kg/m^3 at, 8 percent moisture content, dry basis or 534 kg/m^3 oven dry.

Mass Ply Production

Mass Ply production begins with the manufacturing of Structural Composite Lumber (SCL) lamellas, which form the core material for all Mass Ply products. The SCL product is made from structural graded veneers that are bonded together with adhesive using a cross-ply layering technique. These layers are sanded, scarfed together using a tongue-and-groove method to create extended lamellas, which are then assembled and placed in a press to form a large Mass Ply Panel, otherwise known as a billet.

Freres Mass Ply Panels (MPP) are produced from nominal 1-inch thick SCL lamellas that are parallel-laminated, bonded with melamine formaldehyde adhesive, and pressed to create a solid, structural panel. MPP billets are available in nominal thicknesses ranging from 2-1/16 inches to 12-1/4 inches, standard widths of 4, 8, 10, and 12 feet, and lengths up to 48 feet, making them ideal for use in floors, walls, and roofs.

From these billets, **Mass Ply Lams (MPL)** are vertically rip-cut to produce beams and columns. MPL billets are manufactured in nominal thicknesses from 2-1/16 inches to 24-1/2 inches, widths from 1 inch to 48 inches, and lengths up to 48 feet, potential for 60 feet lengths in development, providing flexible structural solutions for a wide range of building applications.

The Mass Ply products are custom-fabricated at the Freres facility using advanced Computer Numerical Controlled (CNC) routers, allowing for precision cutting of complex shapes, openings, and penetrations—streamlining installation and minimizing on-site labor.

Packing materials represent only 0.18 percent of the mass of the main product. Lumber Wrap represents 91 percent, strapping represents 3.6 percent, and cardboard represents 5.3 percent of the total packaging mass.

Methodological Framework

The underlying LCA [13] was performed in conformance with ISO 14040/44 [7,8], ISO 21930 [9] and EN15804 [5], as well as the PCR.

Type of EPD and Life Cycle Stages

This EPD is intended to represent a product specific life cycle assessment (LCA) for MP products produced in Lyons, Oregon. The manufacturer provided production data, resource use, energy and fuel use, transportation distances, and onsite processing emissions. The underlying LCA [13] investigates MP production from cradle-to-gate. Information modules included in the LCA are shown in Table 1. This EPD includes mandatory modules A1-A3 for a cradle-to-gate analysis.

Table 1. Life Cycle Stages & Information Modules per ISO 21930.

PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE							END-OF-LIFE STAGE				OPTIONAL BENEFITS
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Extraction and up-stream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use	Building Operational Water Use	Deconstruction	Transport	Waste	Disposal	Reuse, Recycle, & Recovery benefits
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

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 SCL and resins that are used in MPP manufacture. Also included is the cradle to gate forestry operation that may 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 MP including packaging

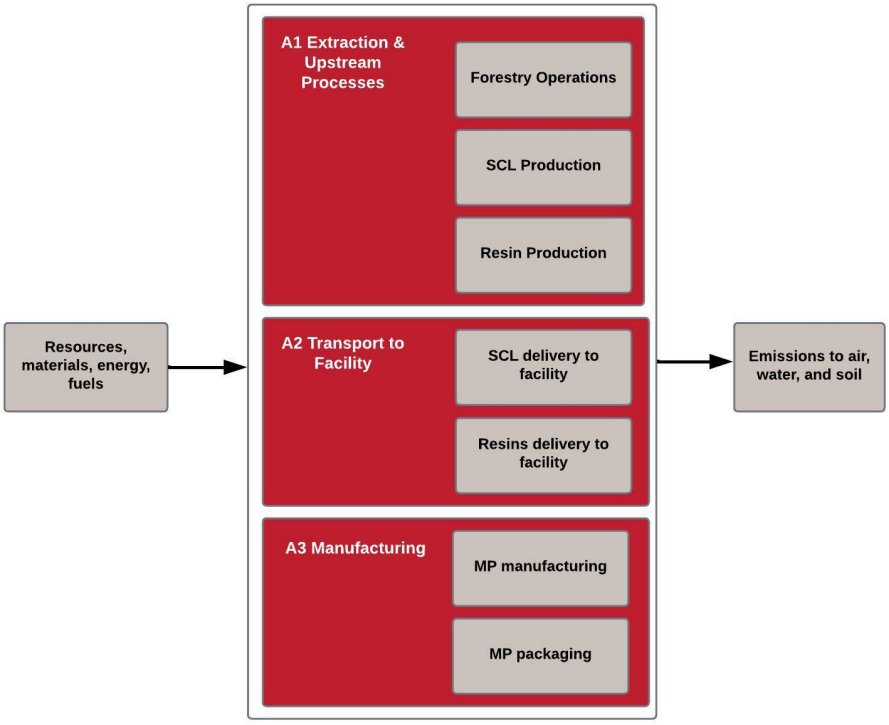


Figure 1. Cradle-to-Gate (A1-A3) System Boundary for Mass Ply Product Production.

Declared Unit

The declared unit is the production of one cubic meter (1 m^3) of MP produced at Freres facility in Lyons, Oregon. Table 2 shows the declared unit and additional product information.

Table 2. Declared Unit and Product Information

Property	Unit	Value
Mass, oven dry	kg	534.00
Moisture Content	%	8.00%
Product Composition		
Structural Composite Lumber	%	97.44%
Resins	%	2.56%

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 input material for producing MP is a billet of SCL. Following the PCR (UL 2022, 2020) and ISO 21930:2017, allocation is based on physical properties (e.g., mass or volume). For this study, a mass allocation was achieved for the primary product and subsequent by-products. Some by-products used internally were used for on-site energy generation. Packaging inputs are not related to the by-products and are allocated 100% to the final product.

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 to 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 PCR (US 2020).
Third party verified ISO [6,7,8] secondary LCI data sets contribute <1-41% of total impact to any of the required impact categories identified by the applicable PCR [15,16].

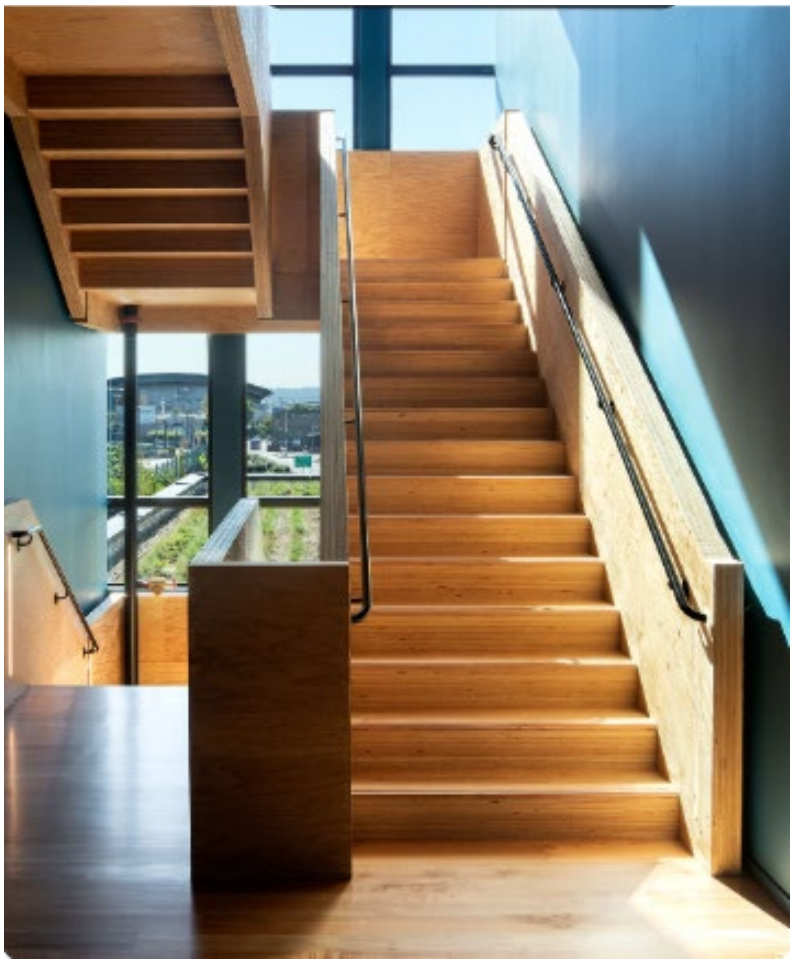
Treatment of Biogenic Carbon

Biogenic carbon emissions and removals are reported in accordance with ISO 21930 7.2.7. and 7.2.12. ISO 21930 requires a demonstration of forest sustainability to characterize carbon removals with a factor of -1 kg CO_2eq/kg CO_2. ISO 21930 Section 7.2.11 Note 2 states the following regarding demonstrating forest sustainability: "Other evidence 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." The United States UNFCCC annual report Table 6-1 provides annual NET GHG Flux Estimates for different land use categories. This report indicates non-decreasing forest carbon stocks and thus the source forests meet the conditions for characterization of removals with a factor of -1 kg CO_2eq/kg CO_2.

Freres *Salvage Timber following the* ***2020 fires*** *from private timberland.*

Environmental Parameters Derived from the LCA

The impact categories and characterization factors for the LCIA were derived from the U.S. EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts - TRACI 2.2 v1.00 [3]. The total primary energy consumption is tabulated from the LCI results based on the Cumulative Energy Demand Method (CED, LHV, v1.01) published by Ecoinvent [4]. 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 10.1 [12] was used to organize and accumulate the LCI data, and to calculate the LCIA results (Table 3).



*The image shows the interior **staircase** of the **Meyer Memorial Trust** headquarters in Portland, Oregon.*

- *The building was designed by LEVER Architecture and completed in 2020.*
- *It is located in the city's historic Albina neighborhood.*
- *The headquarters is a three-story, 20,000-square-foot building constructed with locally harvested mass timber.*
- *The design emphasizes sustainability and community, featuring a library, educational garden, and event spaces.*

Table 3. Selected Impact Category Indicators and Inventory Parameters.

Impact Indicators per ISO 21930	Abbreviation	Units	Method
Core Mandatory Impact Indicator			
Global warming potential, Total	GWP_{TOTAL}	kg CO_2 eq	$GWP_{BIOGENIC}$ + GWP_{FOSSIL}
Global warming potential, Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	TRACI 2.2+ LCI Indicator
Global warming potential, Fossil	GWP_{FOSSIL}	kg CO_2 eq	TRACI 2.2
Depletion potential of the stratospheric ozone layer	ODP	kg CF-11 eq	TRACI 2.2
Acidification potential of soil and water sources	AP	kg SO_2 eq	TRACI 2.2
Eutrophication potential, Freshwater	EP, Freshwater	kg P eq	TRACI 2.2
Eutrophication potential, Marine	EP, Marine	kg N eq	TRACI 2.2
Formation potential of tropospheric ozone	SFP	kg O_3 eq	TRACI 2.2
Abiotic depletion potential (ADP fossil) for fossil resources;	ADPf	MJ, LHV	CML-IA Baseline V3.11/EU25
Use of Primary Resources			
Renewable primary energy carrier used as energy	RPRE	MJ, LHV	CED (LHV) V1.01
Renewable primary energy carrier used as material	RPRM	MJ, LHV	LCI Indicator
Non-renewable primary energy carrier used as energy	NRPRE	MJ, LHV	CED (LHV) V1.01
Renewable primary energy carrier used as material	NRPRM	MJ, LHV	LCI Indicator
Secondary material, secondary fuel and recovered energy			
Secondary material	SM	kg	LCI Indicator
Renewable secondary fuel	RSF	MJ, LHV	LCI Indicator
Non-renewable secondary fuel	NRSF	MJ, LHV	LCI Indicator
Recovered energy	RE	MJ, LHV	LCI Indicator
Mandatory Inventory Parameters			
Consumption of freshwater resources;	FW	m^3	LCI Indicator
Indicators Describing Waste			
Hazardous waste disposed	HWD	kg	LCI Indicator
Non-hazardous waste disposed	NHWD	kg	LCI Indicator
High-level radioactive waste, conditioned, to final repository	HLRW	m^3	LCI Indicator
Intermediate- and low-level radioactive waste, conditioned, to final repository	ILLRW	m^3	LCI Indicator
Components for re-use	CRU	kg	LCI Indicator
Materials for recycling	MR	kg	LCI Indicator
Materials for energy recovery	MER	kg	LCI Indicator
Recovered energy exported from the product system	EE	MJ, NCV	LCI Indicator
Additional Inventory Parameters for Transparency			
Biogenic Carbon Removal from Product	BCRP	kg CO2e	Manual
Biogenic Carbon Emission from Product	BCEP	kg CO2e	Manual
Biogenic Carbon Removal from Packaging	BCRK	kg CO2e	Manual
Biogenic Carbon Emission from Packaging	BCEK	kg CO2e	Manual
Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	BCEW	kg CO2e	Manual
Biogenic Carbon Removal from Product	BCRP	kg CO2e	Manual

Life Cycle Impact Assessment Results

Tables 4-6 present the cradle-to-gate (A1-A3) LCIA and LCI parameter results for the declared unit of one m^3 of MP. No permanent carbon storage is included in the cradle-to-gate (A1-A3) results. As a result, the biogenic carbon balance for the cradle-to-gate portion of the life cycle is net neutral. Cradle-to-gate results for MP on a relative basis are presented in Tables 7-9 and Figure 2.

Table 4. Cradle-to-Gate LCIA Results for 1 m^3 of Mass Ply Product – Absolute Basis

Core Mandatory Impact Indicator	Total	A1	A2	A3
GWP_{TOTAL} [kg CO_2 eq]	235.19	(1,070.89)	0.1058	1,305.98
$GWP_{BIOGENIC}$ [kg CO_2 eq]	-	(1,278.00)	-	1,278.00
GWP_{FOSSIL} [kg CO_2 eq]	235.19	207.11	0.1058	27.98
ODP [kg CF-11 eq]	2.17E-06	2.16E-06	9.68E-11	1.37E-08
AP [kg SO_2 eq]	0.9459	0.893	0.001	0.053
$EP_{FRESHWATER}$ [kg P eq]	0.0132	0.013	0.000	0.000
EP_{MARINE} [kg N eq]	0.1971	0.188	0.000	0.009
SFP [kg O_3 eq]	25.80	20.883	0.017	4.905
ADP_{FOSSIL} [MJ, LHV]	3,824.34	3,405.05	1.33	417.97

Table 5. Cradle-to-Gate Resource Use for 1 m^3 of Mass Ply Product – Absolute Basis

Use of Primary Resources	Total	A1	A2	A3
RPRE [MJ, LHV]	2,310.58	2,293.12	0.00	17.46
RPRM [MJ, LHV]	14,365.41	14,365.41	0.00	0.00
NRPRE [MJ, LHV]	3,920.58	3,493.33	1.35	425.91
NRPRM [MJ, LHV]	905.44	905.44	0.00	0.00
SM [kg]	0.00	0.00	0.00	0.00
RSF [MJ, LHV]	0.00	0.00	0.00	0.00
NRSF [MJ, LHV]	0.00	0.00	0.00	0.00
RE [MJ, LHV]	0.00	0.00	0.00	0.00
FW [m^3]	0.4827	0.4687	0.0000	0.0141

Table 6. Cradle-to-Gate Output Flows for 1 m^3 of Mass Ply Product – Absolute Basis

Indicators Describing Waste	Total	A1	A2	A3
HWD [kg]	8.91E-04	5.46E-04	1.01E-07	3.46E-04
NHWD [kg]	3.97E+00	3.71E+00	8.98E-03	2.51E-01
HLRW [m^3]	1.55E-08	1.51E-08	1.04E-11	3.69E-10
ILLRW [m^3]	3.37E-07	2.75E-07	8.97E-11	6.15E-08
CRU [kg]	0.00	0.00	0.00	0.00
MR [kg]	0.00	0.00	0.00	0.00
MER [kg]	0.00	0.00	0.00	0.00
EE [MJ, LHV]	0.00	0.00	0.00	0.00

Table 7. Cradle-to-Gate LCIA Results for 1 m^3 of Mass Ply Product – Relative Basis

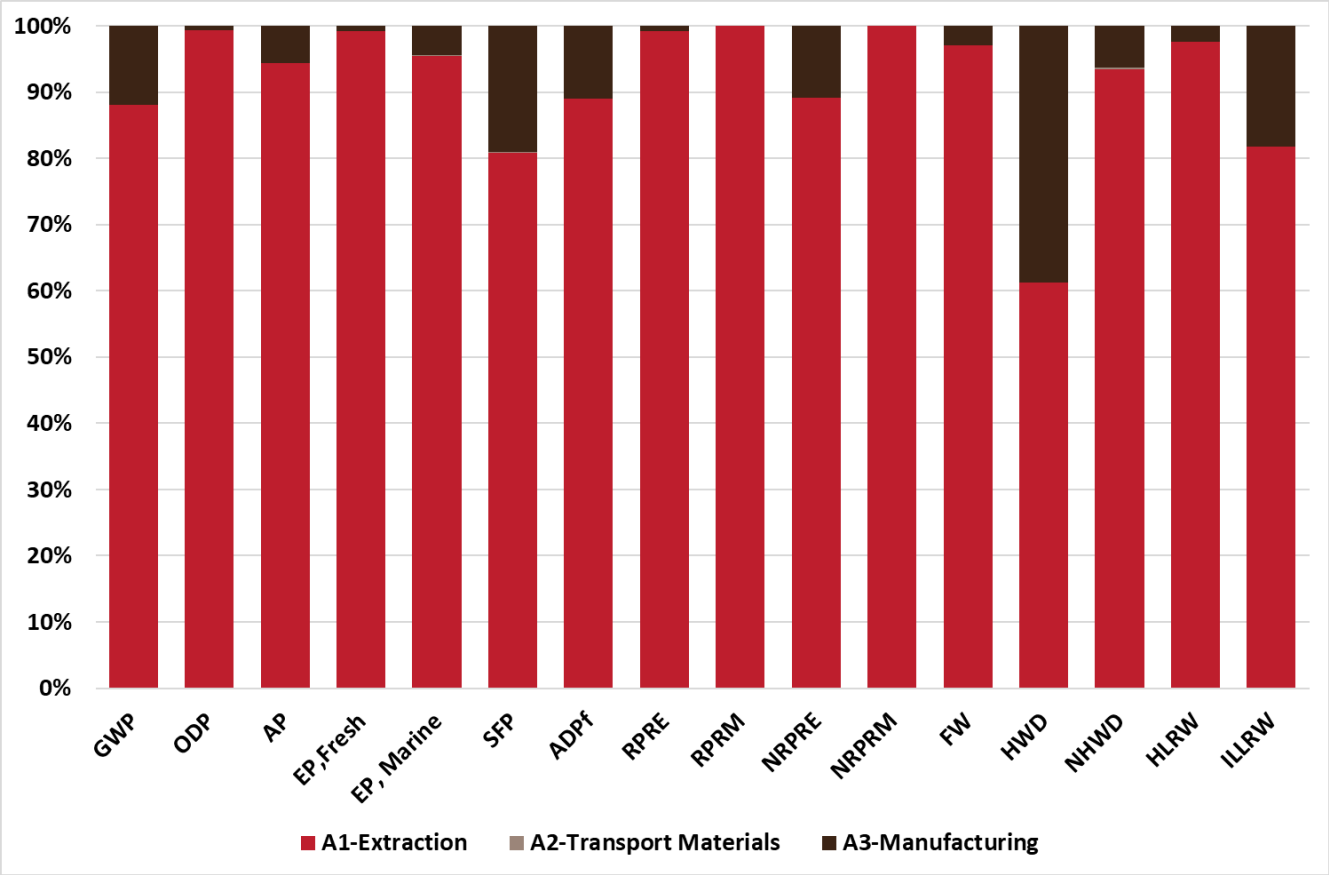
Core Mandatory Impact Indicator	Total	A1	A2	A3
GWP_{FOSSIL} [kg CO_2 eq]	100%	88.1%	0.0%	11.9%
ODP [kg CF-11 eq]	100%	99.4%	0.0%	0.6%
AP [kg SO_2 eq]	100%	94.4%	0.1%	5.6%
$EP_{FRESHWATER}$ [kg P eq]	100%	99.1%	0.0%	0.9%
EP_{MARINE} [kg N eq]	100%	95.5%	0.1%	4.5%
SFP [kg O_3 eq]	100%	80.9%	0.1%	19.0%
ADP_{FOSSIL} [MJ, LHV]	100%	89.0%	0.0%	10.9%

Table 8. Cradle-to-Gate Resource Use for 1 m^3 of Mass Ply Product – Relative Basis

Use of Primary Resources	Total	A1	A2	A3
RPRE [MJ, LHV]	100%	99.2%	0.0%	0.8%
RPRM [MJ, LHV]	100%	100.0%	0.0%	0.0%
NRPRE [MJ, LHV]	100%	89.1%	0.0%	10.9%
NRPRM [MJ, LHV]	100%	100.0%	0.0%	0.0%
SM [kg]	0.00	0.00	0.00	0.00
RSF [MJ, LHV]	0.00	0.00	0.00	0.00
NRSF [MJ, LHV]	0.00	0.00	0.00	0.00
RE [MJ, LHV]	0.00	0.00	0.00	0.00
FW [m^3]	100%	97.1%	0.0%	2.9%

Table 9. Cradle-to-Gate Output Flows for 1 m^3 of Mass Ply Product – Relative Basis

Indicators Describing Waste	Total	A1	A2	A3
HWD [kg]	100%	61.2%	0.0%	38.8%
NHWD [kg]	100%	93.5%	0.2%	6.3%
HLRW [m^3]	100%	97.5%	0.1%	2.4%
ILLRW [m^3]	100%	81.7%	0.0%	18.3%
CRU [kg]	0.00	0.00	0.00	0.00
MR [kg]	0.00	0.00	0.00	0.00
MER [kg]	0.00	0.00	0.00	0.00
EE [MJ, LHV]	0.00	0.00	0.00	0.00



GWP	Global Warming Potential	**RPRM**	Renewable Primary Energy Carrier Used as Material
ODP	Depletion Potential of the Stratospheric Ozone Layer	**NRPE**	Non-Renewable Primary Energy Carrier Used as Energy
AP	Acidification Potential (soil and water sources)	**NRPRM**	Renewable Primary Energy Carrier Used as Material
$EP_{FRESHWATER}$	Eutrophication potential, Freshwater	**FW**	Consumption of Freshwater Resources
EP_{MARINE}	Eutrophication potential, Marine	**HWD**	Hazardous waste disposed
SFP	Formation Potential of Tropospheric Ozone	**NHWD**	Non-hazardous waste disposed
ADPf	Abiotic Depletion Potential (ADP fossil) for fossil resource	**HLRW**	High-Level Radioactive Waste, conditioned, to Final Repository
FFD	Fossil Fuel Depletion	**ILLRW**	Intermediate-and Low-Level Radioactive Waste, Conditioned to Final Repository
RPRM	Renewable Primary Energy Carrier Used as Energy		

Figure 2. Cradle-to-Gate LCIA Results for the Production of Mass Ply Products– Relative Basis.

Biogenic Carbon Results

Cradle-to-Gate Results

Wood is a biobased material and thus contains biogenic carbon. The accounting of biogenic carbon follows the requirements set out in ISO 21930:2017 where biogenic carbon enters the product system (removal) as primary or secondary material. Carbon removal is considered a negative emission. The biogenic carbon leaves the system (emission) as a product, by-products, or directly to the atmosphere when combusted for heat energy. These mass flows of biogenic carbon from and to nature are listed in the LCI and are expressed in kg CO_2.

Table 10 shows the biogenic carbon removal and emissions. All carbon dioxide flows (kg CO_2) presented in Table 10 are unallocated to include by-products leaving the system boundary in module A3. Even though the system boundary for this LCA only includes module A1-A3, in accordance with ISO 21930, emission from packaging (BCEK) is reported in A5-Construction and emission from the main product (BCEP) is reported in C3/C4-End-of-Life[1]. The net carbon emission across the cradle-to-gate life cycle is zero. It is assumed that all carbon removed from the atmosphere is eventually emitted to the atmosphere as CO_2.

Table 10. Biogenic Carbon Inventory Parameters for 1 m^3 of Mass Ply Products, Unallocated. (Resin mass has been removed)

	A1	A2	A3	A5	C3/C4	Total
BCRP [kg CO_2]	(1,278.00)	0.00	0.00	0.00	0.00	(1,278.00)
BCEP [kg CO_2]	0.00	0.00	317.06	0.00	960.94	1,278.00
BCRK [kg CO_2]	0.00	0.00	(0.8699)	0.00	0.00	(0.8699)
BCEK [kg CO_2]	0.00	0.00	0.00	0.8699	0.00	0.8699
BCEW [kg CO2]	0.00	0.00	0.00	0.00	0.00	0.00

Cradle-to-Grave Results

The product system represented in this EPD includes the information modules 'A1 Extraction and upstream production', 'A2 Transport to factory' and 'A3 Manufacturing'. As per ISO 21930, the net biogenic carbon emissions across the reported modules are zero (carbon neutral). This conservative assumption excludes the permanent sequestration of biogenic carbon if the LCA were to consider the typical end-of-life treatment for wood products, landfilling.

UL Environment published an addendum to the reference PCR that estimates the emissions from landfilling of wood products (UL 2020 Appendix A). The carbon sequestration addendum is based on the United States EPA WARM model and aligns with the biogenic accounting rules in ISO 21930 Section 7.2.7 and Section 7.2.12. Because the end-of-life fate of this material is unknown, we have applied the default disposal pathway from the PCR Part A (UL 2022) Section 2.8.5, 100% landfill.

[1] These products are reported in modules outside the scope of this LCA system boundary to provide reference for EoL waste and emissions if a full cradle-to-grave LCA were to be performed.

The following results apply the addendum methodology (UL 2020 Appendix A) to the biogenic carbon present in the primary product as it leaves the manufacturer in Module A3[2].

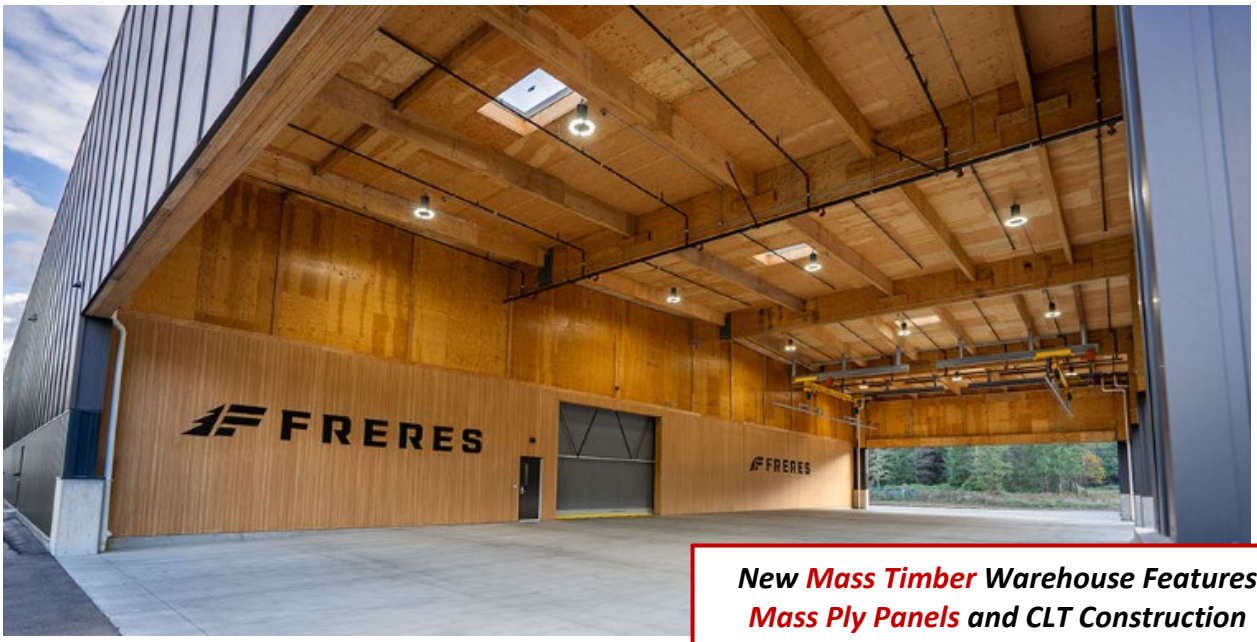
1 m^3 MP = 534 oven dry kg = 267 kg carbon = 979 kg CO_2 eq

Carbon sequestered in product at manufacturing gate:
979 kg CO_2 eq = -979 kg CO_2 eq

Methane emitted from fugitive landfill gas:
1.89 kg CH_4 = 47.22 kg CO_2 eq emission[3]

Carbon dioxide emitted from fugitive landfill gas and the combustion captured landfill gas:
110.00 kg CO_2 eq emission[4]

Permanent carbon sequestration, net of biogenic carbon emissions:
821.77 kg CO_2 eq = -821.77 kg CO_2 eq emission[5]



New Mass Timber Warehouse Features Mass Ply Panels and CLT Construction

Photo provided by CD Redding Construction

[2] Background assumptions for EoL and 100% Landfill: methane emission = 3.53E-03 kg CH4/kg dry wood; carbon dioxide emission = 2.06E-01 kg CO2/kg dry wood (UL 2020).
[3] Methane emissions= 3.53E-03 kg CH4/kg of dry wood X 534 kg of dry wood = 1.89 kg CH4; kg CO2 eq = 1.89kg CH4 X 25.05 kg CH4/kg CO2 eq = 47.22 kg CO2 eq
[4] Carbon dioxide emissions= 2.06E-01 kg CO2/kg of dry wood X 534 = 110.00 kg CO2
[5] Final sequestration, net of biogenic emissions = CO2 eq in product at gate = 97900 – (47.22 + 110.00) = 821.77 kg CO2 eq

LCA Interpretation

Comparability

Environmental declarations from different programs [6] 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 different results for upstream or downstream of the life cycle stages declared.

Limitations

This LCA was created using manufacturer average data for upstream materials. Variation can result from differences in supplier locations, manufacturing processes, manufacturing efficiency and fuel type used. This LCA does not report all of the environmental impacts due to manufacturing of the product but rather reports the environmental impacts for those categories with established LCA-based methods to track and report. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change, and habitat destruction. In order to assess the local impacts of product manufacturing, additional analysis is required.

Additional Environmental Information

According to ISO 21930 section 9.6, a manufacturer is required to report hazardous and/or dangerous substances. Drying and pressing processes contribute to the production of emissions during MP manufacturing. Mills classed as major sources under EPA rules are required to report methanol, formaldehyde, phenol, acetaldehyde, propionaldehyde, and acrolein which are on the US Environmental Agency (EPA) Toxics Release Inventory. These emissions are reported in this EPD.

Freres Engineered Wood obtain their wood fiber from sources that are legally and sustainably sourced. Participating facilities reported Fiber Sourcing data for the three sourcing categories established in ASTM-D7612-21: Standard Practice for Categorizing Wood and Wood-Based Products According to Their Fiber Sources [2]. The standard provides criteria for differentiating wood products into three categories:

1. Non-controversial Sources of Forest Products,
2. Responsible Sources of Forest Products, and
3. Certified Sources of Forest Products.

Fiber from non-controversial, or legal, sources are from geographic areas with a low risk of illegal activity and are compliant with legal or other proprietary standards. Products from responsible sources are produced with wood fiber acquired according to an independently certified procurement standard or are from jurisdictions with regulatory or quasi-regulatory programs to implement best management

practices. Independently certified procurement standards include FSC Controlled Wood and SFI Fiber Sourcing. To qualify for either standard, a facility must have a system in place that verifies their logs are coming from areas in compliance with forestry best management practices to protect air and water quality and ensure all fiber comes from known and legal sources. Products from certified sources are independently certified to an internationally recognized forest management certification standard, such as those from the Sustainable Forestry Initiative (SFI), Forest Stewardship Council (FSC), Programme for the Endorsement of Forest Certification (PEFC), American Tree Farm System (ATFS), or the Canadian Standards Association (CSA).

The facility in Lyons, Oregon represented in this LCA reported on average,100% of the fiber entering their mills to be non-controversial (legal), 100% to be responsible (following a certified procurement standard), and 37% originates from independently certified forests, with compliance verified annually under the Responsibly Sourced ASTM D7612 classification and confirmed through third-party audits. The remaining 63% comes from federal lands which do not participate in certification programs.

Forest Management

While this EPD does not address landscape level forest management impacts that influence forest carbon, wildlife habitat, endangered species, and soil and water quality, these potential impacts may be addressed through requirements put forth in regional regulatory frameworks, ASTM 7612-21 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.

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., Type 1 certifications, 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 product line and reported impact when averaging data.

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