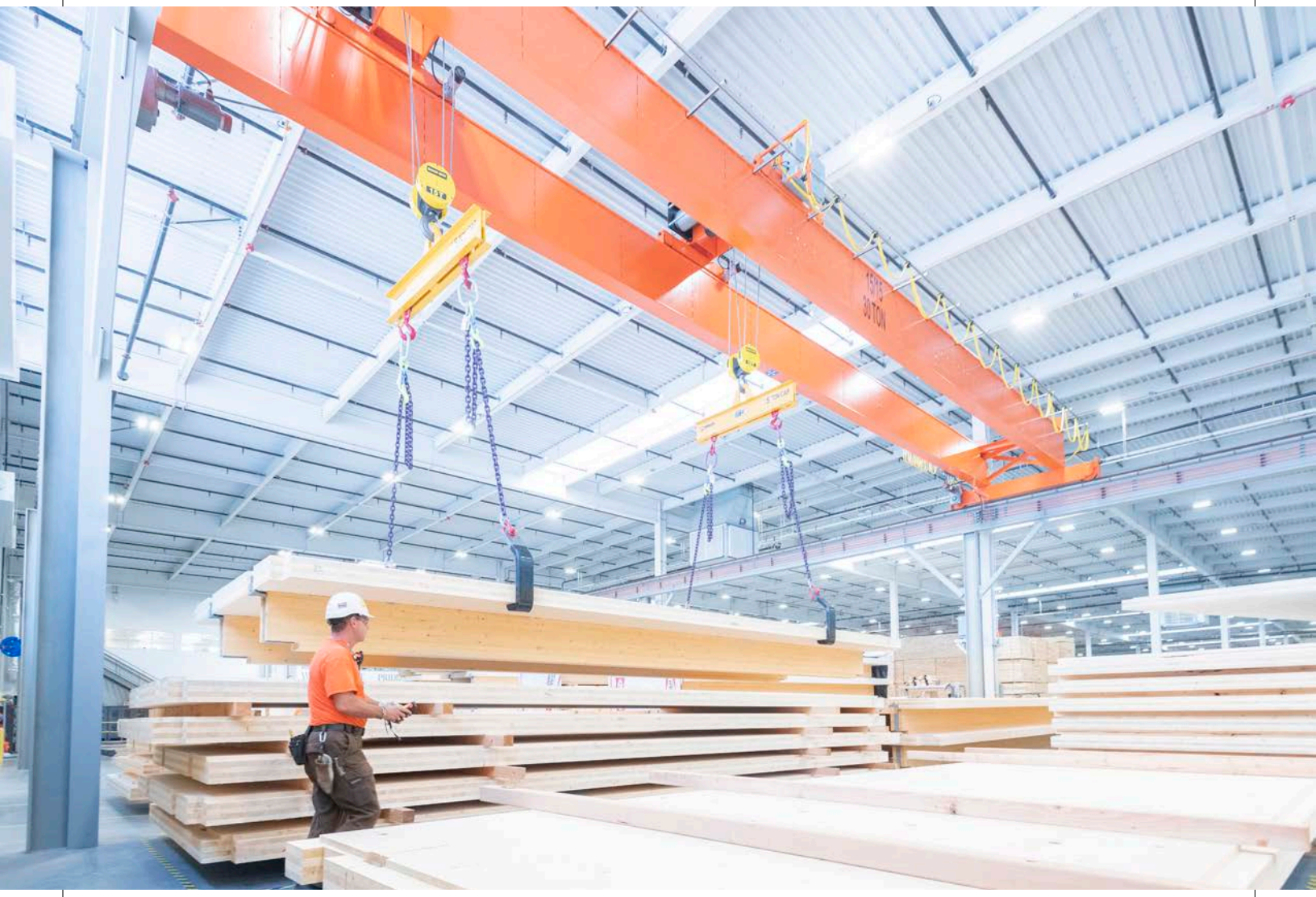
MERCER SPOKANE

ENVIRONMENTAL PRODUCT DECLARATION

CROSS-LAMINATED TIMBER & GLUE-LAMINATED TIMBER

VERSION 1.1

June 2025



MERCER mass timber

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ASTM Certified Environmental Product

PROGRAM OPERATOR	ASTM International 100 Barr Harbor Drive PO Box C700 West Conshohocken, PA, 19428-2959 USA www.astm.org
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	ASTM Program Operator Rules. Version: 8.0, Revised 04/29/20
DECLARATION OWNER	Mercer Mass Timber Spokane, Washington, USA www.mercermasstimber.com
DECLARATION NUMBER	EPD 943 Mercer Mass Timber Cross-laminated Timber & Glue-laminated Timber - Spokane, Washington
DECLARED PRODUCT	Cross-laminated Timber (CLT) / Glue-laminated timber (GLT)
DECLARED UNIT	1 m^3 of CLT / GLT at Spokane, Washington USA
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. [8] UL Environment: Product Category Rule Guidance for Building-Related Products and Services: Part A Life Cycle Assessment Calculation Rules and Report Requirements v3.2 2018 [16] Part B: Structural and Architectural Wood Products, v1.1 2020 [17]
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE	CLT /GLT is an engineered wood product with high structural strength and stability. CLT and GLT can be used as either linear or panelized components in floor, roof, and wall assemblies in building construction.
MARKETS OF APPLICABILITY	Construction Sector, North America
DATE OF ISSUE	March 13, 2025
PERIOD OF VALIDITY	5 years

EPD TYPE	Product Specific EPD
EPD SCOPE	Cradle to gate
YEAR OF REPORTED MANUFACTURER PRIMARY DATA	2023/2024
LCA SOFTWARE	SimaPro v9.5
LCI DATABASES	USLCI [11], Ecoinvent 3.9.1 [18], Datasmart 2023 [10]
LCIA METHODOLOGY	TRACI 2.1 v1.08 [3], CML-IA Baseline V3.09, CED, LHV 1.0
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

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," v3.2 (December 2018), 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:	Thomas Gloria, Ph.D., Industrial Ecology Consultants

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 Mercer CLT/GLT, Spokane WA 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.

1. Description of Industry and Product

Mercer Mass Timber in Spokane, Washington (WA) is a manufacturer of engineered wood products (EWP). The facility in Spokane produces Cross-laminated timber (CLT) and glue-laminated timber (GLT) on the same production line. The CLT/GLT industry is a subset of the EWP industry which also produces, mass ply-panels, and laminated veneer lumber and other EWP products derived from trees. A distinction is often made between primary and secondary forest product industries with the former including wood products such as lumber or timber products such as lamstock, veneer, or strand feeding secondary manufacturers producing engineered wood products such as CLT/GLT.

Cross-laminated timber is made by bonding layers of solid-sawn laminating stock (lamstock) together in a perpendicular orientation. Cross-laminated timber can be used as floors, interior and exterior walls, and roof systems. It is also used as ground mats at constructions sites which allow heavy equipment to operate over soft ground. Glue-laminated timber at Spokane is made on the same production line as CLT using the same species and resin application. It differs from CLT with the grain of lumber parallel to the longitudinal axis of the member. As with CLT, lamstock GLT is dried, finger-jointed, face bonded with resin during pressing. After pressing, custom sizes are cut from large panels.

This EPD represents the cradle-to-gate energy and materials required for manufacturing CLT/GLT from softwood lumber in Spokane, WA. Input data represents 2023/2024 production years.

DESCRIPTION OF PRODUCT

The main product components of CLT/GLT are softwood lamstock and the resin system, comprising 99.1% and 0.9% of the mass of the product, respectfully. The softwood lamstock used for CLT/GLT production at the Spokane, WA facility is a mix of different three species groups and regions. While lamstock can be suppled directly from mills, most commonly dimension lumber is transformed at the CLT/GLT factory to lamstock specifications and serves as a relevant proxy for all feedstock inputs. Recently published LCA models on lumber produced were used to model the feedstock input for Mercer CLT/GLT [13-15].

These LCAs detail the activities associated with forest resource extraction, transportation to mills, and lumber production. Lumber for CLT/GLT lumber inputs is sourced from the Inland Northwest (75%), the Pacific Coast (15%) and Southern regions (10%) (Table 1). The resin systems are primary composed of polyurethane for face bonding and melamine formaldehyde for finger jointing.

TABLE 1: Lumber Regions and Species Representation for Cross-laminated Timber (CLT) and Glue-laminated timber (GLT) Production, Spokane, WA

FORESTRY & LUMBER REGION	SPECIES MIX	SPECIES GROUP	LUMBER INPUTS REPRESENTATION
Pacific Coast	Douglas-fir/Larch	DFL	15%
Inland Northwest	Spruce-Pine-Fir Douglas-fir/Larch Hem-Fir	SPF, DFL, HF	75%
Southern	Southern yellow pine	SYP	10%
TOTAL			100%

CLT/GLT is categorized as Structural Products under the United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI) for Wood (Table 2).

TABLE 2: United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI) Master Format Code for the Represented CLT/GLT.

CLASSIFICATION STANDARD	CATEGORY	SUBCATEGORY	PRODUCT CODE
UNSPSC	Engineered Wood Products		111220
CSI	Wood, Plastic and Composites	• CLT • Engineered Wood Products • GLT	06 17 19 06 11 13 06 18 00

2. CLT/GLT Production

Cross-laminated timber panels produced at the Spokane facility are manufactured with 3-, 5-, 7-, and 9-layers of lumber, providing a catalogue of panel types that can be specified for a specific design application. The panels have maximum dimensions of 12 feet (3.66 meters) wide by 60 feet (18.28 meters) long, with thicknesses ranging from 3.24 inches (82.5 millimeters) to 12.40 inches (315 millimeters).

Lumber mass and volume inputs by region are shown in Table 3. The weighted average amount of wood in 1 m^3 of CLT/GLT requires an input of 548.59 kg (1.19 m^3) of lumber. Under a mass allocation approach, 83% of the lumber input is allocated to CLT/GLT, with the remaining 17% allocated to by-products.

TABLE 3: Mass Balance and Product Composition for 1 m^3 of Mercer Cross-laminated Timber or Glue-laminated timber, Spokane, WA

PRODUCT	AMOUNT/M^3	UNIT	MASS ALLOCATION
CLT/GLT Wood only-Output	456.9	odkg	83%
Co-products - Output	91.7	odkg	17%
Wood - Input	548.6	odkg	
PRODUCT COMPOSITION			
Softwood lumber	99.1	%	
TOTAL	0.9	%	

3. Methodological Framework

The underlying LCA [4] 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

The underlying LCA [4] investigates the CLT / GLT 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' (Table 4).

TABLE 4: Life Cycle Stages & Information Modules per ISO 21930:2017. (MND = Module not declared)

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

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4. System Boundaries and Product Flow Diagram

The product system described in Figure 1 includes the following information modules and unit processes:

A1 - RAW MATERIAL EXTRACTION	A1 includes the cradle to gate softwood lumber production and resin production. 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 includes 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 - RAW MATERIAL TRANSPORT	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 sources to recycled in the process).
A3 - MANUFACTURING	Manufacturing of CLT / GLT including energy consumption and fuel use, resource use, water use, emissions to air and water, and waste disposal. Polyethylene resin, paper, and polypropylene resin are used in the wrapping materials during transportation and storage.

DECLARED UNIT

The declared product consists solely of softwood lumber and resin. The percent composition of the product is shown in Table 5. The declared unit is one cubic meter (1 m^3) of CLT/GLT produced at Mercer's Spokane, WA facility.

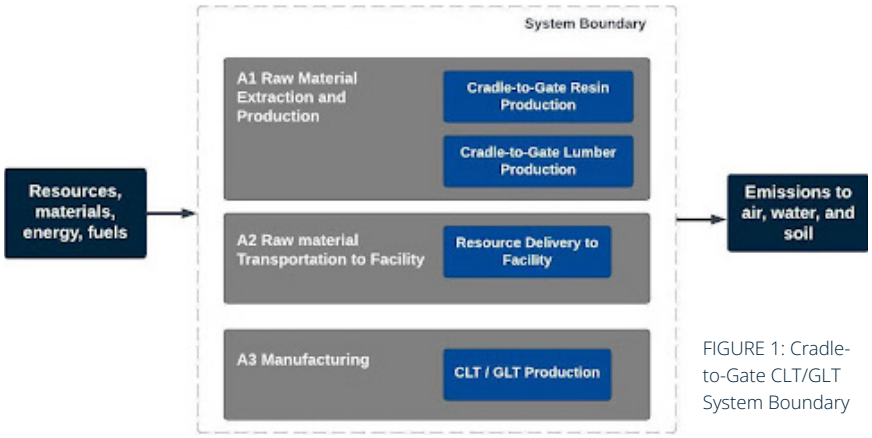


FIGURE 1: Cradle-to-Gate CLT/GLT System Boundary

TABLE 5: Declared Unit and Product Information

PROPERTY	VALUE	UNIT
Volume	1	m^3
Mass	461	odkg
Thickness to achieve declared unit	82.5 - 315	mm
Density, oven dry	461	kg/m^3
Moisture content	12	%
PRODUCT COMPOSITION		
Softwood lumber	99.1	%
Resin system	0.9	%

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 wood material for producing CLT/GLT is planed dried softwood lumber and resin. Processing CLT/GLT generates a small quantity of by-products (e.g., sawdust, shavings, off-cuts). Following the PCR, Parts A and B, allocation is based on physical properties (e.g., mass or volume). For this study, a mass allocation was applied for the primary product and subsequent by-products.

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 applied is 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 2020.

Third party verified ISO [6,7,8] secondary LCI data sets contribute greater than 65% of total impact to any of the required impact categories identified by the applicable PCR [16,17].

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 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 CO_2eq/kg CO_2.

5. 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 2.1 v1.08 [3]. The total primary energy consumption is tabulated from the LCI results based on the Cumulative Energy Demand Method (CED, LHV, V1.0) 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 9.5 [12] was used to organize and accumulate the LCI data, and to calculate the LCIA results (Table 6).

TABLE 6: 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	$GWP_{BIOGENIC}$ + $GW_{PFOSSIL}$
Global warming potential, Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	TRACI 2.1 V1.08+ LCI Indicatory
Global warming potential, Fossil	GWP_{FOSSIL}	kg CO_2 eq	TRACI 2.1 V1.08
Depletion potential of the stratospheric ozone layer	ODP	kg CF-11e	TRACI 2.1 V1.08
Acidification potential of soil and water sources	AP	kg SO_2e	TRACI 2.1 V1.08
Eutrophication potential	EP	kg PO_4e	TRACI 2.1 V1.08
Formation potential of tropospheric ozone	SFP	kg O_3e	TRACI 2.1 V1.08
Abiotic depletion potential (ADP fossil) for fossil resources;	ADPf	MJ, LHV	CML-IA Baseline V3.09
Fossil fuel depletion	FFD	MJ Surplus	TRACI 2.1 V1.08
Use of Primary Resources			
Renewable primary energy carrier used as energy	RPRE	MJ, LHV	CED (LHV) V1.00
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) V1.00
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

LIFE CYCLE IMPACT ASSESSMENT RESULTS

Tables 7-9 and 13 present the cradle-to-gate (A1-A3) LCIA and LCI parameter results for the declared unit of 1m^3 of CLT / GLT. 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 CLT / GLT on a relative basis are presented in Tables 10-12 and Figure 2.

TABLE 7: Cradle-to-Gate LCIA Results for 1m^3 of Cross-laminated Timber and Glue-laminated timber – Absolute Basis.

CORE MANDATORY IMPACT INDICATOR	TOTAL	A1	A2	A3
GWP_{TOTAL} [kg CO_2 eq]	155.29	(914.25)	31.73	1,037.82
$GWP_{BIOGENIC}$ [kg CO_2 eq]	0.00	(1,010.04)	0.00	1,010.04
GWP_{FOSSIL} [kg CO_2 eq]	155.29	95.78	31.73	27.78
ODP [kg CFC-$_{11}$ eq]	5.28E-06	5.06E-06	5.60E-08	1.55E-07
AP [kg SO_2 eq]	1.11	0.83	0.22	0.07
EP [kg N eq]	0.42	0.28	0.02	0.12
SFP [kg O_3 eq]	31.96	23.99	6.70	1.27
FFD [MJ, surplus]	276.81	171.84	59.61	45.36
ADP_{FOSSIL} [MJ, LHV]	2,084.08	1,328.93	397.03	358.11

TABLE 8: Cradle-to-Gate Resource use Results for 1m^3 of Cross-laminated Timber and Glue-laminated timber – Absolute Basis.

USE OF PRIMARY RESOURCES	TOTAL	A1	A2	A3
RPRE [MJ, LHV]	3,119.43	3,027.56	0.91	90.96
RPRM [MJ, LHV]	9,593.10	9,593.10	0.00	0.00
NRPRE [MJ, LHV]	2,279.30	1,467.54	402.86	408.90
NRPRM [MJ, LHV]	219.35	219.35	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]	0.51	0.41	0.00	0.10

TABLE 9: Cradle-to-Gate Output Flows for 1m³ of Cross-laminated Timber and Glue-laminated timber – Absolute Basis.

INDICATORS DESCRIBING WASTE	TOTAL	A1	A2	A3
HWD [kg]	1.95E-01	1.78E-01	4.74E-04	1.60E-02
NHWD [kg]	2.94E+01	2.40E+01	3.13E+00	2.31E+00
HLRW [m³]	1.54E-07	1.01E-07	0.00E+00	5.36E-08
ILLRW [m³]	2.26E-06	1.54E-06	1.25E-08	6.99E-07
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 10: Cradle-to-Gate LCIA Results for 1m³ of Cross-laminated Timber and Glue-laminated timber – Relative Basis.

CORE MANDATORY IMPACT INDICATOR	TOTAL	A1	A2	A3
GWP_{FOSSIL} [kg CO_2 eq]	100%	62%	20%	18%
ODP [kg CFC-$_{11}$ eq]	100%	96%	1%	3%
AP [kg SO_2 eq]	100%	74%	20%	6%
EP [kg N eq]	100%	67%	4%	28%
SFP [kg O_3 eq]	100%	75%	21%	4%
FFD [MJ, surplus]	100%	62%	22%	16%
ADP_{FOSSIL} [MJ, LHV]	100%	64%	19%	17%

TABLE 11: Cradle-to-Gate LCIA Results for 1m³ of Cross-laminated Timber and Glue-laminated timber – Relative Basis.

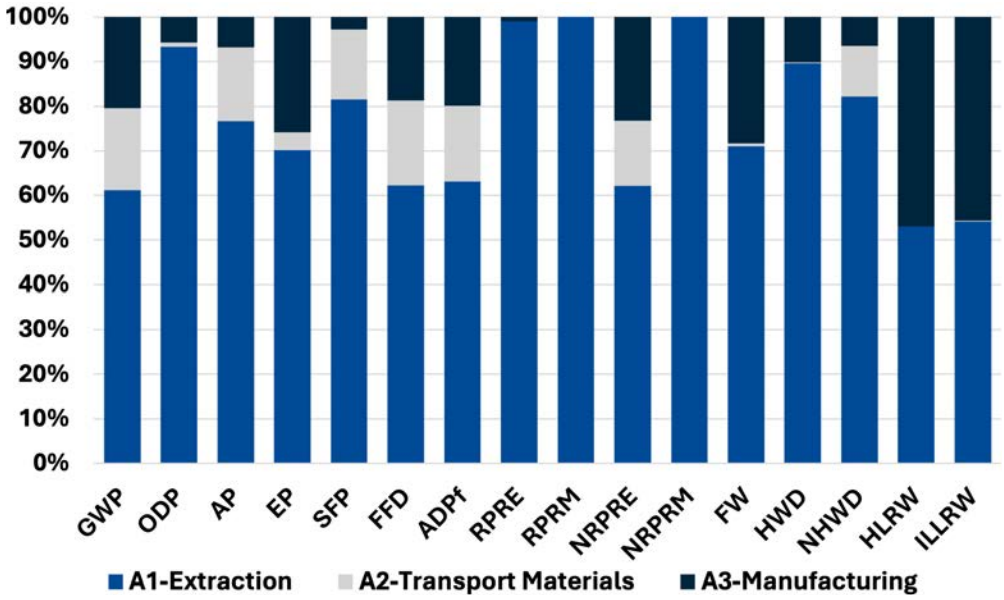
USE OF PRIMARY RESOURCES	TOTAL	A1	A2	A3
RPRE [MJ, LHV]	100%	97%	0%	3%
RPRM [MJ, LHV]	100%	100%	0%	0%
NRPRE [MJ, LHV]	100%	64%	18%	18%
NRPRM [MJ, LHV]	100%	100%	0%	0%
FW [m³]	100%	80%	0%	20%

TABLE 12: Cradle-to-Gate LCIA Results for 1m³ of Cross-laminated Timber and Glue-laminated timber – Relative Basis.

INDICATORS DESCRIBING WASTE	TOTAL	A1	A2	A3
HWD [kg]	100%	92%	0%	8%
NHWD [kg]	100%	81%	11%	8%
HLRW [m³]	100%	65%	0%	35%
ILLRW [m³]	100%	68%	1%	31%

TABLE 13: Cradle-to-Gate Cumulative Energy Demand (CED) Results for 1m³ of Cross-laminated Timber and Glue-laminated timber – Absolute Basis.

IMPACT CATEGORY	TOTAL	A1	A2	A3
Non-renewable, fossil	2,072.88	1,317.70	396.97	358.21
Non-renewable, nuclear	194.40	137.90	5.80	50.69
Non-renewable, biomass	0.01	0.01	0.00	0.00
Renewable, biomass	2,899.00	2,891.64	0.19	7.18
Renewable, wind, solar, geothermal	106.07	64.71	0.20	41.16
Renewable, water	113.49	70.34	0.52	42.62
Total	5,385.85	4,482.31	403.68	499.86



GWP	GLOBAL WARMING POTENTIAL
ODP	DEPLETION POTENTIAL OF THE STRATOSPHERIC OZONE LAYER
AP	ACIDIFICATION POTENTIAL OF SOIL AND WATER SOURCES
EP	EUTROPHICATION POTENTIAL
SFP	FORMATION POTENTIAL OF TROPOSPHERIC OZONE
ADPF	ABIOTIC DEPLETION POTENTIAL (ADP FOSSIL) FOR FOSSIL RESOURCE
FFD	FOSSIL FUEL DEPLETION
RPRM	RENEWABLE PRIMARY ENERGY CARRIER USED AS ENERGY
RPRM	RENEWABLE PRIMARY ENERGY CARRIER USED AS MATERIAL.
NRPE	NON-RENEWABLE PRIMARY ENERGY CARRIER USED AS ENERGY
NRPRM	RENEWABLE PRIMARY ENERGY CARRIER USED AS MATERIAL
FW	CONSUMPTION OF FRESHWATER RESOURCES
HWD	HAZARDOUS WASTE DISPOSED
NHWD	NON-HAZARDOUS WASTE DISPOSED
HLRW	HIGH-LEVEL RADIOACTIVE WASTE, CONDITIONED, TO FINAL REPOSITORY
ILLRW	INTERMEDIATE- AND LOW-LEVEL RADIOACTIVE WASTE, CONDITIONED TO FINAL REPOSITORY

FIGURE 1: Cradle-to-Gate LCIA Results for 1 m3 of Cross-laminated Timber and Glue-laminated timber – Relative Basis

LIFE CYCLE IMPACT ASSESSMENT RESULTS – REGIONAL DIFFERENCES

This section discusses the cradle-to-gate results by region. The cradle-to-gate (A1-A3) impacts of each geographical region are presented for 1m³ of CLT/GLT production (Tables 14-20). Tables 14-16 and 20 show the unweighted absolute values for each impact category from each region while Tables 17-19 show the unweighted relative differences from the region with lowest impact.

TABLE 14: Regional Cradle-to-Gate LCIA Results for 1m³ of Cross-laminated Timber and Glue-laminated timber, Absolute Basis Unweighted.

CORE MANDATORY IMPACT INDICATOR	PACIFIC COAST A1-A3	INLAND NW A1-A3	SOUTH A1-A3
GWP_{TOTAL} [kg CO_2 eq]	148.90	151.71	307.29
ODP [kg CFC-$_{11}$ eq]	4.82E-06	5.37E-06	5.43E-06
AP [kg SO_2 eq]	0.87	1.09	1.83
EP [kg N eq]	0.35	0.43	0.44
SFP [kg O_3 eq]	24.13	30.72	54.95
FFD [MJ, surplus]	275.21	267.25	567.63
ADP_{FOSSIL} [MJ, LHV]	2,014.51	2,033.59	4,010.54

TABLE 15: Regional Cradle-to-Gate Resource Use Results for 1m³ of Cross-laminated Timber and Glue-laminated timber, Absolute Basis, Unweighted.

USE OF PRIMARY RESOURCES	PACIFIC COAST A1-A3	INLAND NW A1-A3	SOUTH A1-A3
RPRE [MJ, LHV]	3,337.47	2,990.46	3,762.91
RPRM [MJ, LHV]	9,071.05	10,680.39	12,122.00
NRPRE [MJ, LHV]	2,169.86	2,222.83	4,331.38
NRPRM [MJ, LHV]	218.48	219.29	221.05
SM [kg]	0.00	0.00	0.00
RSF [MJ, LHV]	0.00	0.00	0.00
NRSF [MJ, LHV]	0.00	0.00	0.00
RE [MJ, LHV]	0.00	0.00	0.00
FW [m³]	0.37	0.55	0.47

TABLE 16: Regional Cradle-to-Gate Output Flow Results for 1m³ of Cross-laminated Timber and Glue-laminated timber, Absolute Basis Unweighted.

INDICATORS DESCRIBING WASTE	PACIFIC COAST A1-A3	INLAND NW A1-A3	SOUTH A1-A3
HWD [kg]	1.85E-01	1.96E-01	2.00E-01
NHWD [kg]	2.72E+01	2.97E+01	4.26E+01
HLRW [m³]	1.14E-07	1.48E-07	2.58E-07
ILLRW [m³]	1.62E-06	2.21E-06	3.62E-06
CRU [kg]	0.00	0.00	0.00
MR [kg]	0.00	0.00	0.00
MER [kg]	0.00	0.00	0.00
EE [MJ, LHV]	0.00	0.00	0.00

TABLE 17: Regional Cradle-to-Gate LCIA Results for 1m³ of Cross-laminated Timber and Glue-laminated timber, Relative Basis, Unweighted.

CORE MANDATORY IMPACT INDICATOR	PACIFIC COAST A1-A3	INLAND NW A1-A3	SOUTH A1-A3
GWP_{TOTAL} [kg CO_2 eq]	100%	102%	206%
ODP [kg CFC-$_{11}$ eq]	100%	111%	113%
AP [kg SO_2 eq]	100%	125%	210%
EP [kg N eq]	100%	125%	128%
SFP [kg O_3 eq]	100%	127%	228%
FFD [MJ, surplus]	100%	97%	206%
ADP_{FOSSIL} [MJ, LHV]	100%	101%	199%

TABLE 18: Regional Cradle-to-Gate Resource Use Results for 1m³ of Cross-laminated Timber and Glue-laminated timber, Relative Basis, Unweighted.

USE OF PRIMARY RESOURCES	PACIFIC COAST A1-A3	INLAND NW A1-A3	SOUTH A1-A3
RPRE [MJ, LHV]	100%	90%	126%
RPRM [MJ, LHV]	100%	118%	134%
NRPRE [MJ, LHV]	100%	102%	200%
NRPRM [MJ, LHV]	100%	100%	101%
FW [m³]	100%	147%	126%

TABLE 19: Regional Cradle-to-Gate Output Flows Results for 1 m3 of Glue-laminated timber, Relative Basis, Unweighted.

INDICATORS DESCRIBING WASTE	PACIFIC COAST A1-A3	INLAND NW A1-A3	SOUTH A1-A3
HWD [kg]	100%	106%	108%
NHWD [kg]	100%	109%	157%
HLRW [m^3]	100%	130%	226%
ILLRW [m^3]	100%	136%	224%

TABLE 20: Regional Cradle-to-Gate Cumulative Energy Demand (CED) Results for 1m^3 of Cross-laminated Timber and Glue-laminated timber, Absolute Basis, Unweighted.

IMPACT CATEGORY	PACIFIC COAST A1-A3	INLAND NW A1-A3	SOUTH A1-A3
Non-renewable, fossil	2,014.96	2,034.11	4,011.23
Non-renewable, nuclear	154.89	188.71	320.14
Non-renewable, biomass	0.01	0.01	0.01
Renewable, biomass	3,156.71	2,753.35	3,613.84
Renewable, wind, solar, geothermal	86.94	114.54	72.08
Renewable, water	93.83	122.58	77.00

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 21 shows the biogenic carbon removal and emissions. All carbon dioxide flows (kg CO_2) presented in Table 21 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. 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 21: Biogenic Carbon Inventory Parameters for 1m^3 of Cross-laminated Timber and Glue-laminated timber, Unallocated.

	A1	A2	A3	A5	C3/C4	TOTAL
BCRP [kg CO_2]	(1,010.04)	0.00	0.00	0.00	0.00	(1,010.04)
BCEP [kg CO_2]	0.00	0.00	172.48	0.00	837.56	1,010.04
BCRK [kg CO_2]	0.00	0.00	0.00	(0.03)	0.00	(0.03)
BCEK [kg CO_2]	0.00	0.00	0.00	0.00	0.03	0.03
BCEW [kg CO_2]	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 2018) Section 2.8.5, 100% landfill.

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 CLT/GLT = 456.85 oven dry kg wood = 228.43 kg carbon = 837.56 kg CO_2 eq

Carbon sequestered in product at manufacturing gate: = -837.56 kg CO_2 eq

Methane emitted from fugitive landfill gas: 1.61 kg CH_4 = 40.40 kg CO_2 eq emission[3]

Carbon dioxide emitted from fugitive landfill gas and the combustion captured landfill gas: 94.11 kg CO_2 eq emission[4]

Permanent carbon sequestration per cubic meter CLT/GLT: = -703.05 kg CO_2 eq emission

[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.

[2] Background assumptions for EoL and 100% Landfill: methane emission = 3.53E-03 kg CH_4/ kg dry wood; carbon dioxide emission = 2.06E-01 kg CO_2/kg dry wood (UL 2020).

[3] Methane emissions= 3.53E-03 kg CH_4/kg of dry wood X 456.85 kg of dry wood = 1.66 kg CH4; kg CO_2 eq = 1.66 kg CH_4 X 25.05 kg CH_4/kg CO_2 eq = 40.40 kg CO_2 eq

[4] Carbon dioxide emissions= 2.06E-01 kg CO_2/ kg of dry wood X 456.85 kg of dry wood = 94.11 kg CO_2

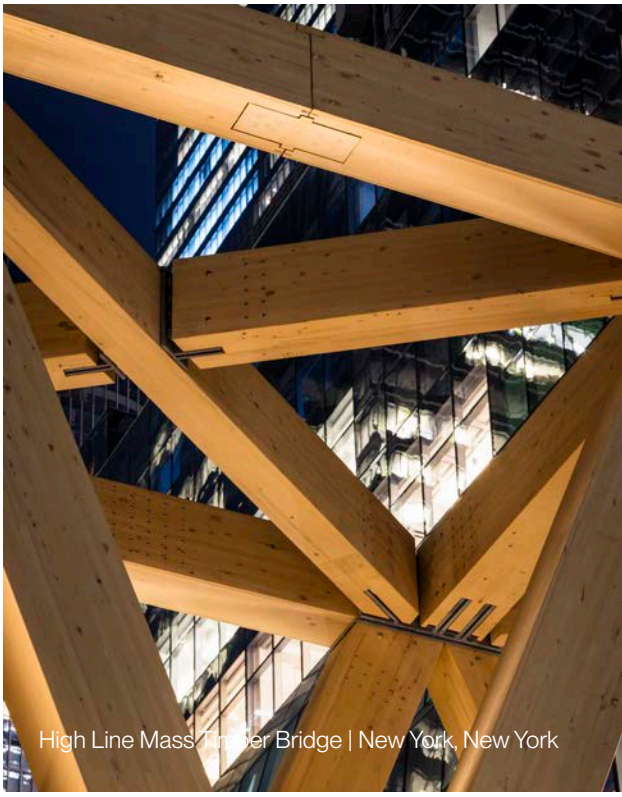
6. LCA Interpretation

Mercer Mass Timber CLT/GLT EPD results represent a cradle-to-gate environmental profile per 1m^3 of CLT/GLT as manufactured at its Spokane, WA plant for a 12-month period representing the reference years 2023/2024.

Module A1 (wood and resin production) contributes the largest share of the LCIA results accounting for 97% of the renewable energy (RPRE) and 64% of the non-renewable energy (NRPRE) consumption. Transportation (A2) accounted for 20% of the GWP_{FOSSIL} and 18% of the NRPRE. The onsite manufacturing of CLT/GLT (A3) attributed only 18% of the GWP_{FOSSIL}.

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.



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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. Under this EPD for Mercer CLT/GLT, Spokane, WA no substances apply.

Mercer Mass Timber Spokane, WA facilty obtains their wood fiber from sources that are legally and sustainably sourced. Mercer Mass Timber 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 wood producing 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).

Mercer Mass Timber operations in Spokane fiber sourcing is 100% non-controversial (legal), 80% to be responsible (following a certified procurement standard), and 50% from independently certified forest.

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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