AMERICAN
WOOD COUNCIL

Environmental Product Declaration

U.S. Inland Northwest Softwood Lumber

American Wood Council

ASTM INTERNATIONAL
Helping our world work better

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
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	ASTM Program Operator Rules. Version: 8.0, Revised 04/29/20
DECLARATION OWNER	American Wood Council
DECLARATION NUMBER	EPD 767
DECLARED PRODUCT	Softwood Lumber produced in the Inland Northwest region, United States
DECLARED UNIT	1 m^3 of softwood lumber
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. [7] 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 2018 [13] Part B: Structural and Architectural Wood Products EPD Requirements, v1.1 2020 [14]
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE	Softwood lumber is used in building construction (residential and commercial), furniture manufacturer, mass timber products, and others
MARKETS OF APPLICABILITY	Construction Sector, North America
DATE OF ISSUE	August 19, 2024
PERIOD OF VALIDITY	5 years
EPD TYPE	Industry-average
EPD SCOPE	Cradle to gate
YEAR OF REPORTED MANUFACTURER PRIMARY DATA	2022
LCA SOFTWARE	SimaPro v9.5
LCI DATABASES	USLCI [9], Ecoinvent 3.9.1 [15], Datasmart 2023 [8]

LCIA METHODOLOGY	TRACI 2.1 v1.08 [2], CML-IA Baseline V3.08, 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 www.corrim.org

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 (December 2018), in conformance with ISO 21930:2017, serves as the core PCR,
with additional considerations from the USGBC/UL Environment Part A Enhancement (2017). Tim Brooke, ASTM International

☐ Internal ☐ x 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 [Product category] 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 southern softwood lumber 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.

Description of Industry and Product

Description of Inland Northwest Softwood Lumber Industry

The lumber industry is a subset of the very broad forest products industry which also produces plywood, fiberboard, particleboard, paper, cabinetry, furniture, millwork, and other products derived from trees. A distinction is often made between primary and secondary forest product industries, with the former including products such as lumber and panels and the latter including products derived from lumber and panels, such as cabinets and furniture.

The lumber industry can be further segmented in other ways. For example, there are significant differences between processing hardwood logs and softwood logs into lumber and there are very different markets for the products. There are also regional differences. The inputs and processing of western softwood lumber and southern softwood lumber yield similar (but not identical) allocations of by-products, but the inputs come from completely different forest management regimes and the outputs go to different markets.

The Inland Northwest (INW) softwood lumber production region is primarily represented by eastern Oregon and eastern Washington, split along the Cascade Mountain crest, Idaho, and Montana. The INW region accounts for 9 percent of the 45,567 million board feet (MMBF) of U.S. softwood lumber capacity (Forisk 2024). The INW region capacity is 4,295 MMBF. Participating facilities for this EPD represent over 44 percent (1,907 MMBF) of the regional capacity.

This EPD represents the cradle-to-gate energy and materials required for manufacturing softwood lumber produced in the Inland Northwest region of the United States (U.S.). All members of the American Wood Council (AWC) and Softwood Lumber Board (SLB) meet the eligibility requirement as participants in this EPD.

Lumber can include a variety of products ranging from boards to beams and timbers. Dimension lumber and studs (framing lumber) are the main products produced at the sawmills used in this study. Dimension lumber is sold as 2”x4”, 2”x6”, 2”x8”, 2”x10”, and 2”x12”. Studs are sold as 2”x4” or 2”x6”. These numbers represent the nominal size of the lumber. The use of nominal dimensions for lumber is a long-held convention in the industry and describes the size of lumber prior to kiln-drying and planing. The actual dimensions of planed, dry lumber reflects the shrinkage of green lumber in kiln-drying and the material removed during planing, which means that a nominal dimension of 2x4 is actually 1.5 inches thick by 3.5 inches wide (Table 1). Each of these lumber sizes are available in a variety of lengths, the most common lumber product being used as framing lumber between 8 and 12 feet.

Table 1. Common Softwood Lumber Sizes in Nominal and Actual Dimensions.

Common Softwood Lumber Sizing	
Nominal Dimensions	Actual Dimensions
Inches	
1 x 4	0.75 x 3.5
1 x 6	0.75 x 5.5
2 x 4	1.5 x 3.5
2 x 2	1.5 x 1.5
2 x 6	1.5 x 5.5
2 x 8	1.5 x 7.25
2 x 10	1.5 x 9.25
2 x 12	1.5 x 11.25
4 x 4	3.5 x 3.5

Dimension lumber can be made from a wide variety of wood species. The dominant wood species for INW lumber is White fir, *Abies concolor* (Table 2).

Table 2. Species and Representation for the Inland Northwest Region.

Species Grouping	Scientific Name	Survey Composition
White Fir	*Abies concolor*	40%
Douglas-fir	*Pseudotsuga menziesii*	29%
Western Larch	*Larix occidentalis*	7%
Spruce-Pine-Fir	*Picea, Pinus, Abies spp.*	8%
Other - Grand Fir	*Abies*	4%
Ponderosa Pine	*Pinus Ponderosa*	4%
Western Hemlock	*Tsuga heterophylla*	5%
Western Cedars	*Thuja spp.*	3%
		100%

Description of Product

The product profile presented in this EPD is for a declared unit of 1 cubic meter (1 m^3) of softwood lumber. One cubic meter of INW softwood lumber weighs 470.74 kg, excluding the variable moisture content (Table 3).

Table 3. Properties of 1 m^3 Inland Northwest Softwood Lumber.

Average Product Composition	Unit	Weighted Avg.
Mass, oven dry	kg	470.74
Density, oven dry	kg/m^3	470.74
Density, @ 15% MC	kg/m^3	487.59
Moisture Content	%	15%

Softwood lumber is categorized as Structural Products under the United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI) for Sawn Timber (Table 4).

Table 4. United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI) MasterFormat Code for the Represented Softwood Lumber.

Classification Standard	Category	Subcategory	Product Code
UNSPSC	Structural Products	Framing Lumber	30103603
CSI	Sawn timber (Lumber)	Wood Framing	06 11 00

Softwood Lumber Production

Lumber manufacturing comprises of three main processes: Sawing, Kiln-drying, and Planing. All processes are subject to emission control. The wood boiler represents a fourth process that provides steam for drying. Figure 1 shows the relationship between the process and the wood flow to and from each process.

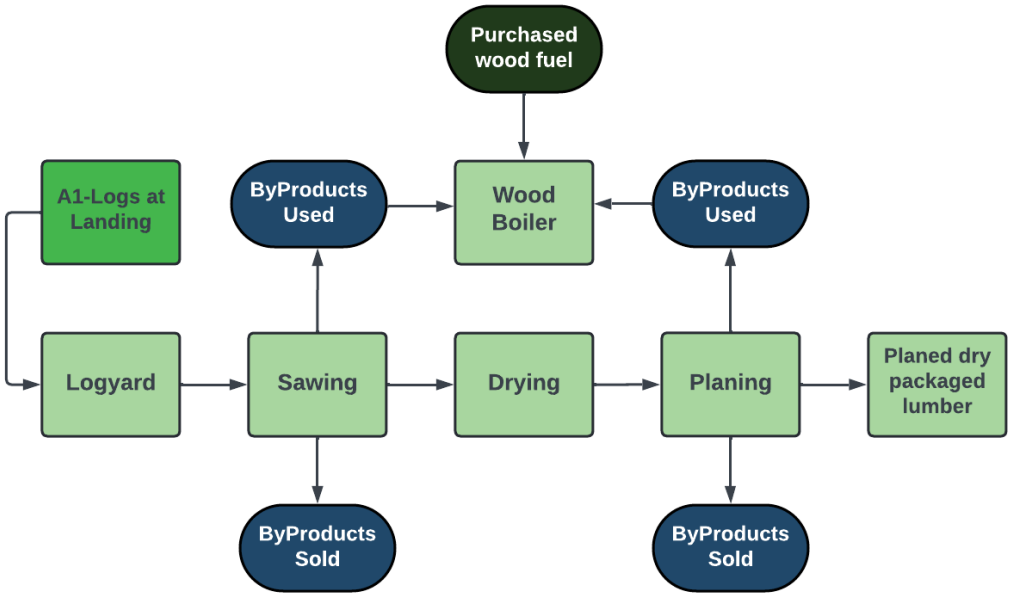


Figure 1. Sawmill Unit Processes from Roundwood to Planed Dry Lumber from Logs.

The log yard unit process begins with logs plus the attached bark on a truck at the harvest site and ends with logs plus the attached bark delivered to the infeed sawing process. Transportation (A2) of the logs from the landing is included. The logs are stored in the decks and then removed from the deck and taken to the debarker and merchandizer at the infeed of the sawmill.

The sawing process begins when logs with bark are received from the log yard and ends when rough sawn green lumber is stacked on stickers and transported to the dryer. Additionally, chips, sawdust, bark, and hog fuel are created in the sawing process, all in the green condition.

The kiln-drying process begins with rough sawn green lumber placed at the dryer and ends with rough sawn dry lumber delivered to the planer. The kilns are either a continuous or batch process. In a continuous kiln, the lumber moves continually through the chamber at rate of a few feet per hour. In a batch kiln, the lumber is dried for 24 to 60 hours. Kilns can be heated by burning wood to produce steam or direct fired

by natural gas or wood. Most of the wood used for heat is generated in the sawing and planing processes. Wood loses water during drying, which results in approximately 4-5 percent volume loss due to shrinkage.

The planing process begins with rough dry lumber placed at the infeed to the planer and ends with packaged planed dry lumber loaded for shipment. Sawdust, planer shavings, and other wood waste are generated in the planing process, all in dry condition (~15% MC). The planed lumber is graded, trimmed, sorted, and stacked before packaging.

Packing materials represent only 0.27 percent of the mass of the main product. The wood stickers and runners make up the bulk of the mass, representing 58 percent of the total packaging. The wrapping materials represent 30 percent, followed by the strapping and cardboard at 11 percent of the total packaging mass. The packaging is allocated 100 percent to the primary product.

The technical requirements for softwood lumber represented in this EPD are defined by DOC PS 20 American Softwood Lumber product standard.

Methodological Framework

The underlying LCA [13] was performed in conformance with ISO 14040/44 [5,6], ISO 21930 [7] and EN15804 [3], as well as the PCR.

Type of EPD and Life Cycle Stages

This EPD is intended to represent an industry wide life cycle assessment (LCA) for softwood lumber produced in the INW region of the U.S. Thirteen AWC member facilities contributed production data, resource use, energy and fuel use, transportation distances, and onsite processing emissions. These data were weighted average based on production to produce the life cycle inventory data for the life cycle impact assessment (LCIA). The underlying LCA [13] investigates lumber production from cradle-to-gate. Information modules included in the LCA are shown in Table 5. This EPD includes mandatory modules A1-A3 for a cradle-to-gate analysis.

Table 5. 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 During Product Use	Building Operational Water Use During Product 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 - RAW MATERIAL EXTRACTION	A1 includes the cradle to gate forestry operation [10] 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 source to be recycled in the process).
A3 - MANUFACTURING	Manufacturing of softwood lumber including energy consumption and fuel use, resource use, water use, emissions to air and water, waste disposal, and packaging. Packaging materials represent less than one percent (0.27%) of the mass of the main product. The packaging is allocated 100 percent to lumber.

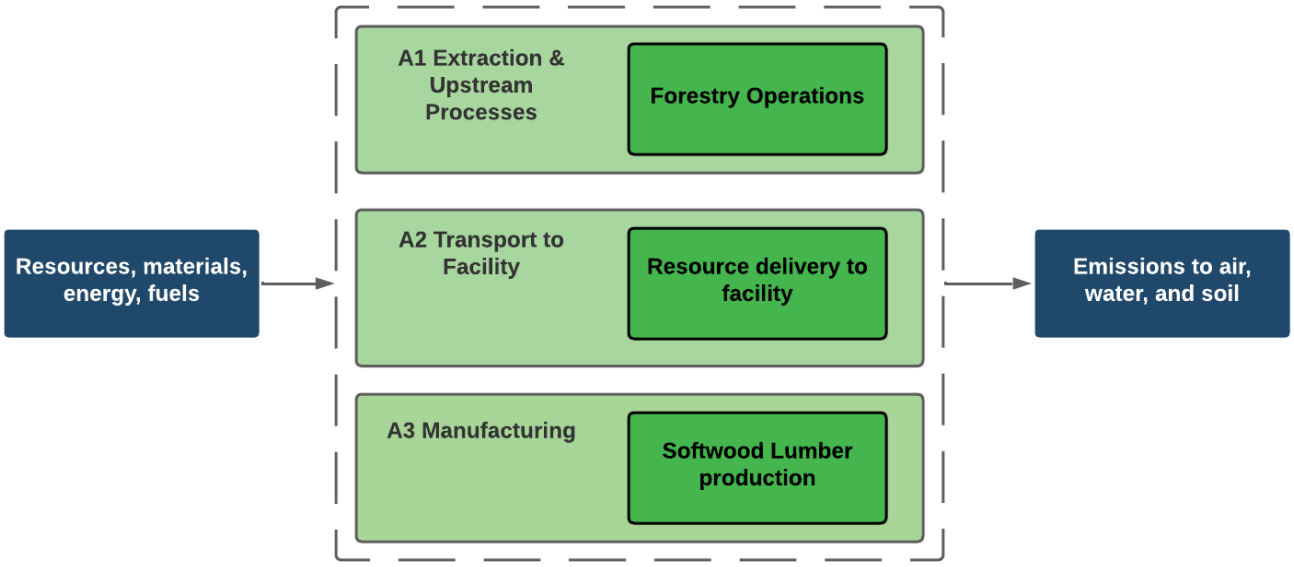


Figure 2. Cradle-to-Gate (A1-A3) System Boundary for Inland Northwest Softwood Lumber Production.

Declared Unit

The declared product consists solely of softwood. The percent composition is shown in Table 6.

Table 6. Product Composition.

Product Component	Percentage of Declared Product
Softwood	100%

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 softwood lumber is a round log with bark. Processing the log involves multiple steps with generation of by-products (e.g., sawdust, chips, bark). Following the PCR (UL 2018, 2020) and ISO 21930:2017, allocation is based on physical properties (e.g., mass or volume). For this study, a mass allocation was used 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 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 5,6,7] secondary LCI data sets contribute 78-100% of total impact to any of the required impact categories identified by the applicable PCR [13,14].

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.

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 [2]. 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 [15]. 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 [11] was used to organize and accumulate the LCI data, and to calculate the LCIA results (Table 7).

Table 7. Selected Impact Category Indicators and Inventory Parameters.

Core Mandatory Impact Indicator	Abbreviation	Units	Method
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 2.1 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 CFC11 eq	TRACI 2.1 V1.08
Acidification potential of soil and water sources	AP	kg SO_2 eq	TRACI 2.1 V1.08
Eutrophication potential	EP	kg N eq	TRACI 2.1 V1.08
Formation potential of tropospheric ozone	SFP	kg O_3 eq	TRACI 2.1 V1.08
Abiotic depletion potential (ADP fossil) for fossil resources;	ADPf	MJ, LHV	CML-IA Baseline V3.08
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 [a/]	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
Materials for energy recovery	MER	kg	LCI Indicator
Recovered energy exported from the product system	EE	MJ, LHV	LCI Indicator
Additional Inventory Parameters			
Biogenic Carbon Removal from Product	BCRP	kg CO_2	LCI Indicator
Biogenic Carbon Emission from Product	BCEP	kg CO_2	LCI Indicator
Biogenic Carbon Removal from Packaging	BCRK	kg CO_2	LCI Indicator
Biogenic Carbon Emission from Packaging	BCEK	kg CO_2	LCI Indicator
Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production	BCEW	kg CO_2	LCI Indicator

Life Cycle Impact Assessment Results

Tables 8-10 presents the cradle-to-gate (A1-A3) LCIA and LCI parameter results for the functional unit of 1 m^3 of softwood lumber. 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 lumber on a relative basis are presented in Tables 11-13 and Figure 3.

Table 8. Cradle-to-Gate LCIA Results for 1 m^3 of Inland Northwest Softwood Lumber – Absolute Basis.

Core Mandatory Impact Indicator	Total	A1	A2	A3
GWP_{TOTAL} [kg CO_2 eq]	71.35	(2,004.51)	11.07	2,064.79
$GWP_{BIOGENIC}$ [kg CO_2 eq]	0.00	(2,024.63)	0.00	2,024.63
GWP_{FOSSIL} [kg CO_2 eq]	71.35	20.12	11.07	40.16
ODP [kg CF-11eq]	7.74E-07	1.26E-07	1.85E-08	6.30E-07
AP [kg SO_2 eq]	0.74	0.42	0.06	0.26
EP [kg N eq]	0.23	0.03	0.00	0.20
SFP [kg O_3 eq]	23.82	12.10	1.76	9.95
FFD [MJ, surplus]	121.15	35.07	20.81	65.27
ADP_{FOSSIL} [MJ, LHV]	920.70	234.14	138.54	548.01

Table 9. Cradle-to-Gate Resource Use Results for 1 m^3 of Inland Northwest Softwood Lumber – Absolute Basis.

Use of Primary Resources	Total	A1	A2	A3
RPRE [MJ, LHV]	2,854.83	0.80	0.30	2,853.73
RPRM [MJ, LHV]	14,954.47	14,954.47	0.00	0.00
NRPRE [MJ, LHV]	1,014.71	237.94	140.56	636.21
NRPRM [MJ, LHV]	0.00	0.00	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]	0.56	0.01	0.00	0.54

Table 10. Cradle-to-Gate Output Flows for 1 m^3 of Inland Northwest Softwood Lumber – Absolute Basis.

Indicators Describing Waste	Total	A1	A2	A3
HWD [kg]	1.53E-03	6.93E-05	8.88E-06	1.46E-03
NHWD [kg]	7.99E+00	1.64E+00	9.24E-01	5.43E+00
HLRW [m^3]	8.01E-08	1.86E-09	9.21E-10	7.73E-08
ILLRW [m^3]	1.17E-06	3.68E-08	7.92E-09	1.12E-06
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 11. Cradle-to-gate LCIA results for 1 m^3 of Inland Northwest Softwood Lumber – Relative Basis.

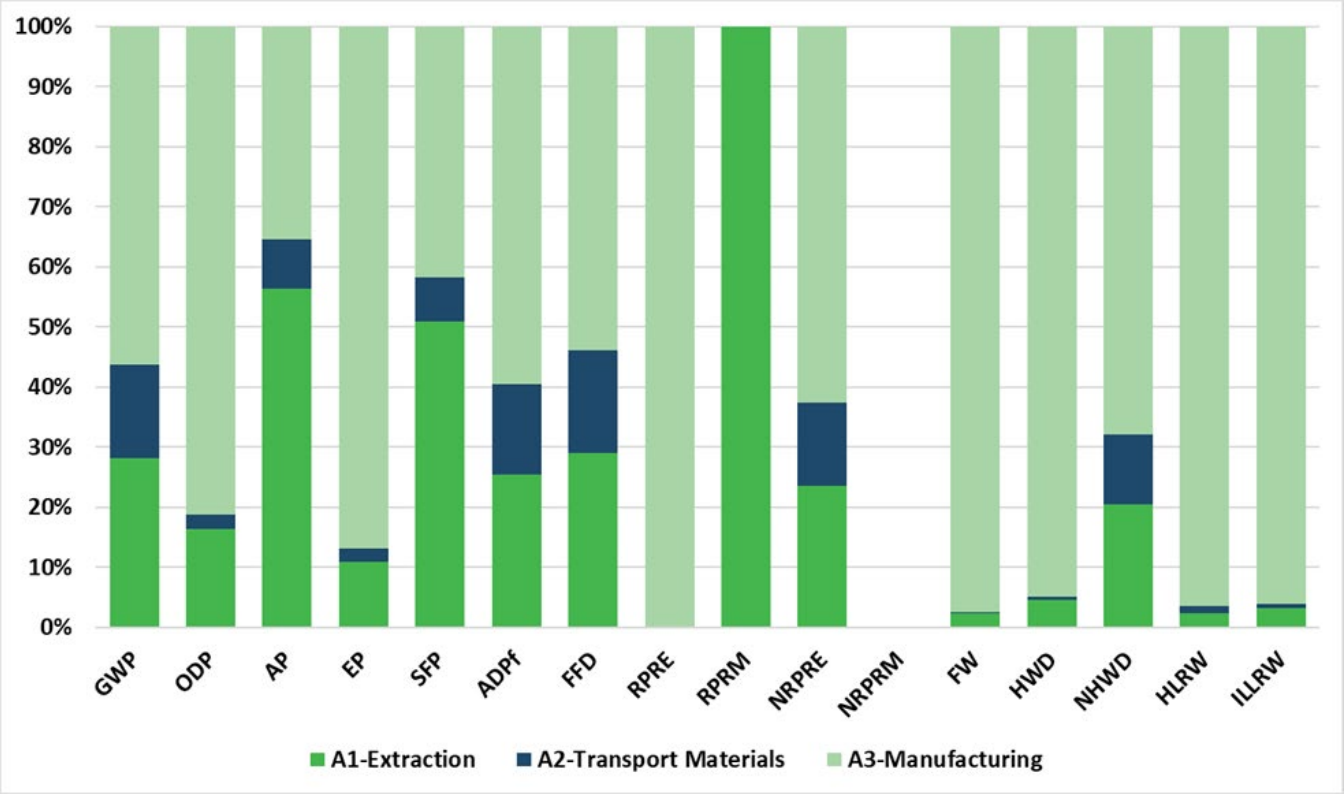
Core Mandatory Impact Indicator	Total	A1	A2	A3
GWP_{FOSSIL} [kg CO_2 eq]	100%	28%	16%	56%
ODP [kg CF-11eq]	100%	16%	2%	81%
AP [kg SO_2 eq]	100%	56%	8%	35%
EP [kg N eq]	100%	11%	2%	87%
SFP [kg O_3 eq]	100%	51%	7%	42%
FFD [MJ, surplus]	100%	193%	114%	452%
ADP_{FOSSIL} [MJ, LHV]	100%	4%	2%	7%

Table 12. Cradle-to-Gate Resource Use Results for 1 m^3 of Inland Northwest Softwood Lumber – Relative Basis.

Use of Primary Resources	Total	A1	A2	A3
RPRE [MJ, LHV]	100%	0%	0%	100%
RPRM [MJ, LHV]	100%	100%	0%	0%
NRPRE [MJ, LHV]	100%	23%	14%	63%
NRPRM [MJ, LHV]	0%	0%	0%	0%
FW [m^3]	100%	2%	0%	97%

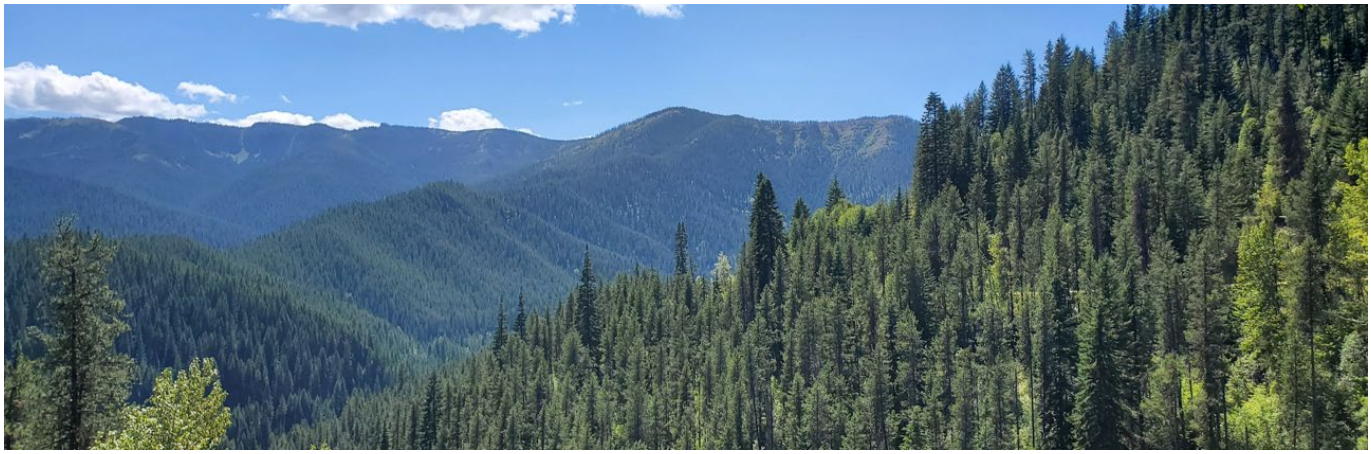
Table 13. Cradle-to-Gate Output Flows for 1 m^3 of Inland Northwest Softwood Lumber – Relative Basis.

Indicators Describing Waste	Total	A1	A2	A3
HWD [kg]	100%	5%	1%	95%
NHWD [kg]	100%	20%	12%	68%
HLRW [m^3]	100%	2%	1%	97%
ILLRW [m^3]	100%	3%	1%	96%



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 3. Cradle-to-Gate LCIA Results for the Production Inland Northwest Softwood Lumber – 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 14 shows the biogenic carbon removal and emissions. All carbon dioxide flows (kg CO_2) presented in Table 14 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 14. Biogenic Carbon Inventory Parameters for Inland Northwest Softwood Lumber.

	A1	A2	A3	A5	C3/C4	Total
BCRP [kg CO_2]	(2,025.76)	0.00	0.00	0.00	0.00	(2,025.76)
BCEP [kg CO_2]	0.00	0.00	934.65	0.00	863.02	1,797.68
BCRK [kg CO_2]	0.00	0.00	(1.72)	0.00	0.00	(1.72)
BCEK [kg CO_2]	0.00	0.00	0.00	1.72	0.00	1.72
BCEW [kg CO_2]	0.00	0.00	228.08	0.00	0.00	228.08

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 is 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.

[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 softwood lumber = 470.74 oven dry kg = 235.37 kg carbon = 863.02 kg CO_2 eq

Carbon sequestered in product at manufacturing gate:
863.02 kg CO_2 eq = -863.02 kg CO_2 eq

Methane emitted from fugitive landfill gas:
1.66 kg CH_4 = 41.63 kg CO_2 eq emission[3]

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

Permanent carbon sequestration, net of biogenic carbon emissions:
724.42 kg CO_2 eq = -724.42 kg CO_2 eq emission[5]

LCA Interpretation

Comparability

Environmental declarations from different programs [5] 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

Inland Northwest lumber production facilities 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

[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 470.74 kg of dry wood = 1.66 kg CH4; kg CO2 eq = 1.66 kg CH4 X 25.05 kg CH4/kg CO2 eq = 41.63 kg CO2 eq
[4] Carbon dioxide emissions= 2.06E-01 kg CO2/kg of dry wood X 470.74 = 96.97 kg CO2
[5] Final sequestration, net of biogenic emissions = CO2 eq in product at gate = 863.02 – (41.63 + 96.97) = 724.42 kg CO2 eq

According to Their Fiber Sources. 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 lumber mill 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 thirteen facilities represented in this regional LCA reported, on average, 100 percent of the fiber entering their mills to be non-controversial (legal), 89.6 percent to be responsible (following a certified procurement standard), and 39.8 percent from independently certified forests.

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.

References

1. American Center for Life Cycle Assessment. 2019/ ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017.
2. ASTM Standard D7612-21. 2021. “Standard Practice for Categorizing Wood and Wood-Based Products According to Their Fiber Sources.” ASTM International, West Conshohocken, PA, 2021. DOI: 10.1520/D7612-21.
3. Bare, J. 2012. Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) - Version 2.1.
4. EN 15804. 2012. Sustainability of construction works, Environmental product declaration, Core rules for the product category of construction products. 47pp.
5. International Organization for Standardization. 2006. ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and procedures.
6. International Organization for Standardization ISO. 2006b. Environmental management—Life-cycle assessment—Principles and framework. ISO 14040. International Organization for Standardization, Geneva, Switzerland. 14040:2006/Amd1:2020. 20 pp/8 pp.
7. International Organization for Standardization ISO. 2006a. Environmental management—Life-cycle assessment—Requirements and guidelines. ISO 14044:2006/Amd1:2017/Amd:2:2020. International Organization for Standardization, Geneva, Switzerland. 46 pp/8 pp/12 pp/.
8. 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.
9. LTS. 2023. DataSmart: https://longtrailsustainability.com/software/datasmart-life-cycle-inventory/ (Accessed May 2024).
10. National Renewable Energy Laboratory. 2023. U.S. Life Cycle Inventory Database http://www.nrel.gov/lci/. (Accessed May 2024).
11. Oneil, E. 2022. Cradle to gate life cycle assessment of US regional forest resources – US Inland Northwest. 29pp. https://corrim.org/wp-content/uploads/2022/05/CORRIM-INW-Forest-Resources-Report.pdf. (Accessed May 2024)
12. PRé Consultants BV. 2022. SimaPro v9.5 LCA Software.
13. Puettmann, M. 2024. CORRIM Report. Life cycle assessment of softwood lumber production – Inland Northwest Region. 45pp
14. 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, v.3.2.
15. UL Environment. 2020. Product Category Rule (PCR) Guidance for Building-Related Products and Services, Part B: Structural and Architectural Wood Products EPD Requirements, UL 10010-9 v.1.1.
16. 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.

Photo credits
Western Wood Products Association: pages 1 (cover), 3, 10, and 17
Vaagen Brothers Lumber Inc.: page 4
American Wood Council: page 13
Puettmann: pages 7 and 14