AMERICAN WOOD COUNCIL

# Environmental Product Declaration

# U.S. Inland Northwest Softwood Lumber

American Wood Council

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# ASTM Certified Environmental Product Declaration

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| **PROGRAM OPERATOR** | ASTM International<br>100 Barr Harbor Drive<br>PO Box C700<br>West Conshohocken, PA,<br>19428-2959 USA<br>www.astm.org |
| **GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER** | ASTM Program Operator Rules.<br>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]<br><br>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]<br>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)<br>t.gloria@industrial-ecology.com |
| **LCA AND EPD DEVELOPER**<br>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)<br>PO Box 2432<br>Corvallis, OR 97330<br>541-231-2627<br>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

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| **INDEPENDENT VERIFIER**<br>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.

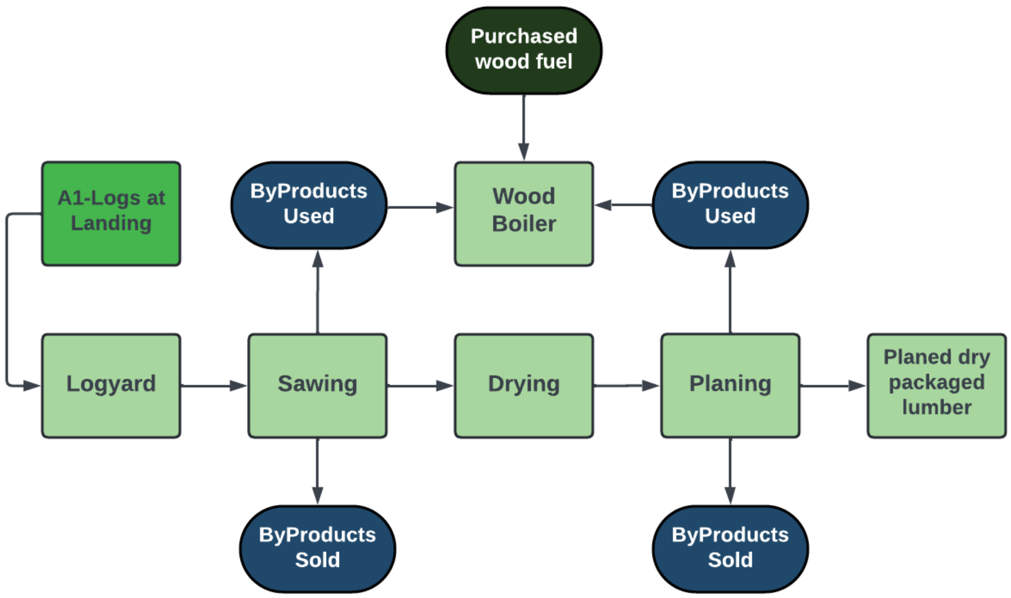



**Figure 1. Sawmill Unit Processes from Roundwood to Planed Dry Lumber from Logs.**

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.<br><br>Packaging materials represent less than one percent (0.27%) of the mass of the main product. The packaging is allocated 100 percent to lumber. |

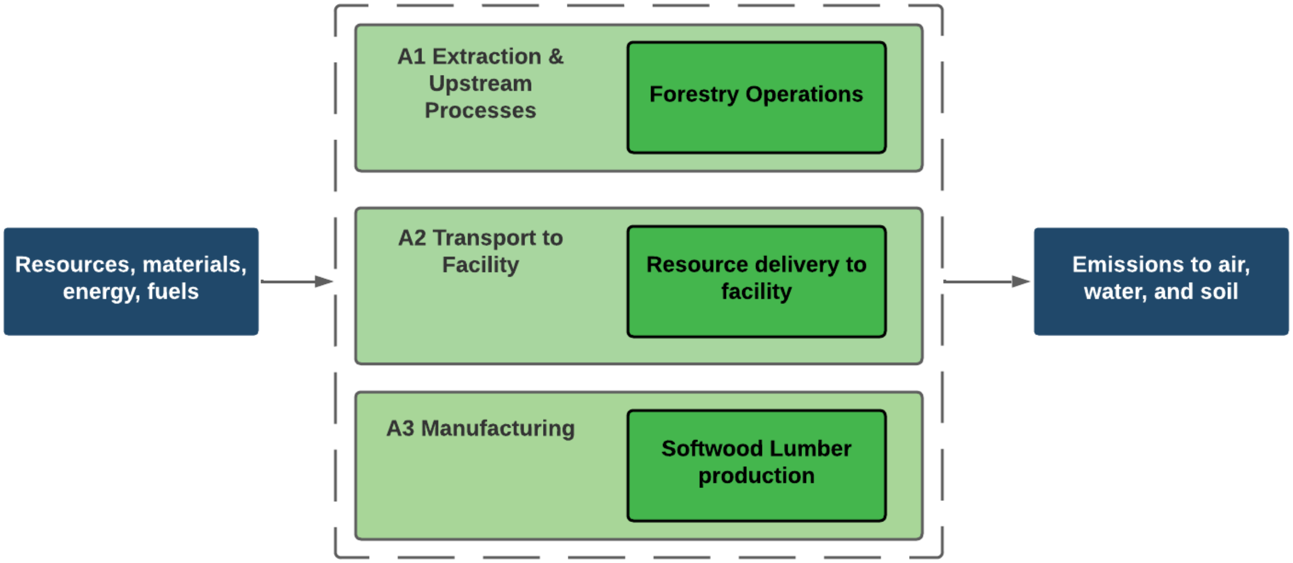



**Figure 2. Cradle-to-Gate (A1-A3) System Boundary for Inland Northwest Softwood Lumber Production.**

## 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 $CO_2$eq/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 $CO_2$eq/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.**

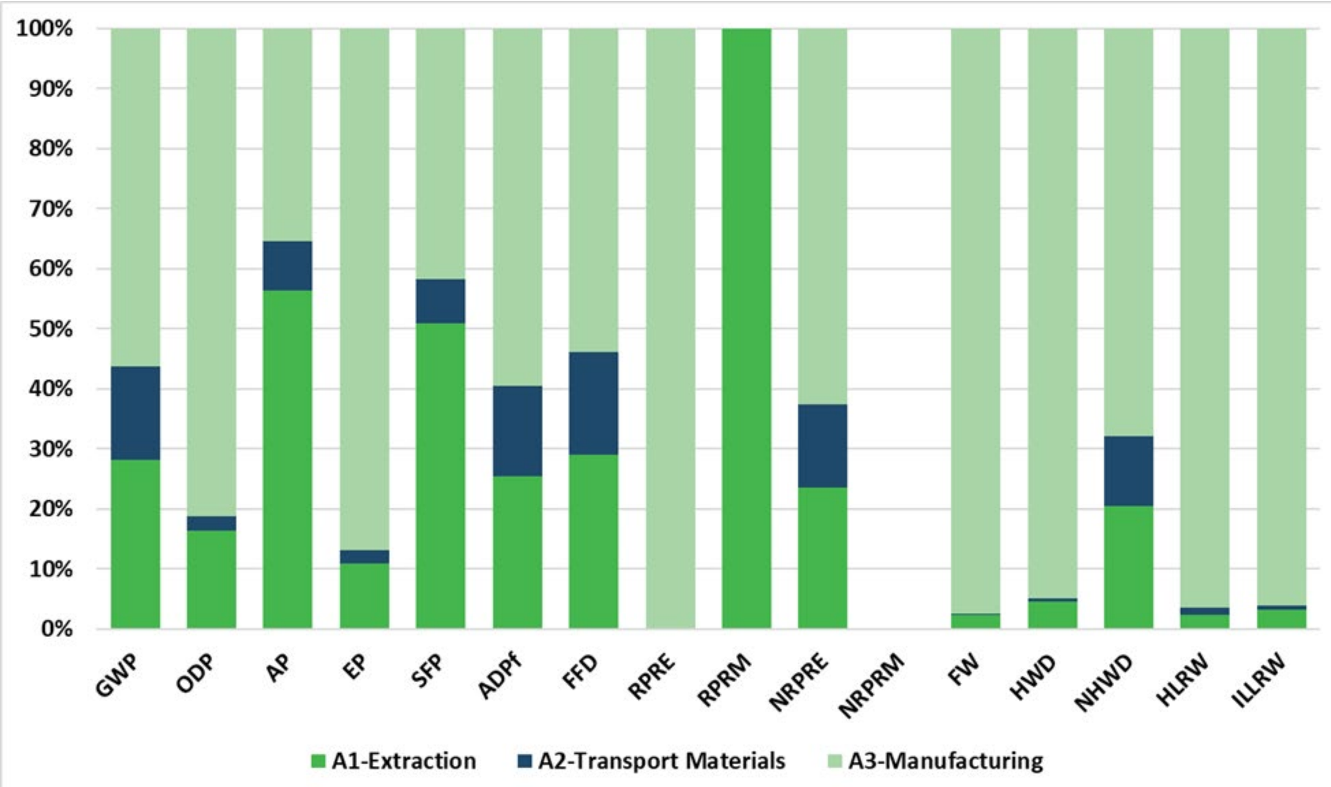
| Core Mandatory Impact Indicator | Total | A1 | A2 | A3 |
|---|---|---|---|---|
| $GWP_{FOSSIL}$ [kg $CO_2$ eq] | 100% | 28% | 16% | 56% |
| ODP [kg CF-11eq] | 100% | 16% | 2% | 81% |
| AP [kg $SO_2$ eq] | 100% | 56% | 8% | 35% |
| EP [kg N eq] | 100% | 11% | 2% | 87% |
| SFP [kg $O_3$ eq] | 100% | 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% |

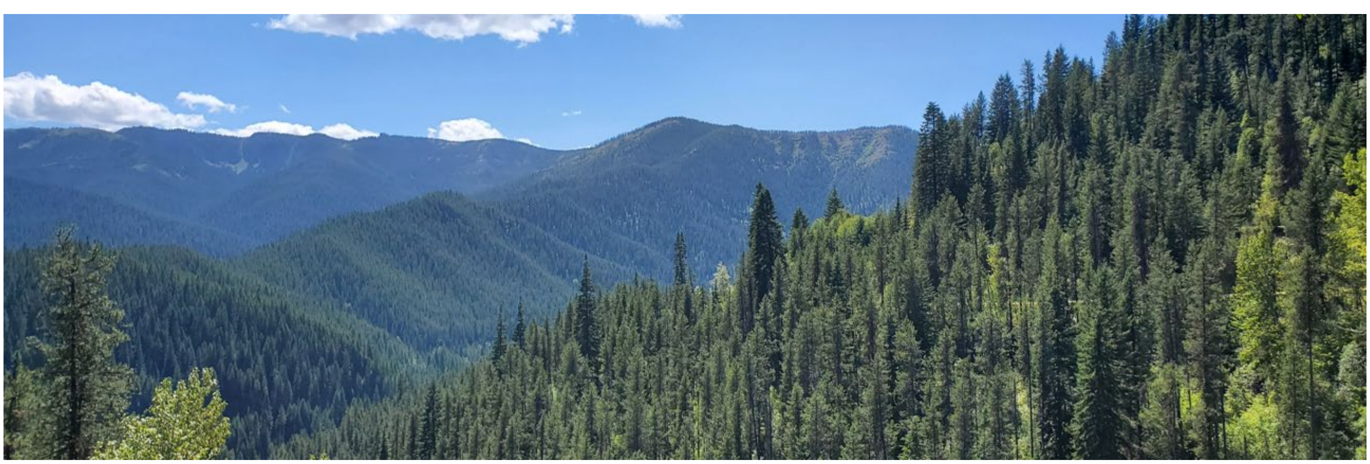
**Table 13. Cradle-to-Gate Output Flows for 1 $m^3$ of Inland Northwest Softwood Lumber – Relative Basis.**

| 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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