LP® OSB ENVIRONMENTAL PRODUCT DECLARATION

EPD FOR LP® OSB PRODUCTS PRODUCED BY LOUISIANA-PACIFIC CORPORATION, NASHVILLE, TENNESSEE, USA

LPCorp.com/OSB

LP® OSB SHEATHING

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	Louisiana-Pacific Corporation 1610 West End Ave, Suite 200 Nashville, Tennessee USA LPCorp.com
DECLARATION NUMBER	EPD 858
DECLARED PRODUCT	LP OSB SHEATHING
DECLARED UNIT	1 m^3 of OSB produced at OSB facilities in North America and installed in a building for 75 years.
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 [10] **UL Environment:** Product Category Rules for Building-Related Products and Services **Part A:** Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010, UL v.4.0, March 2022 [17] **Part B:** Structural and Architectural Wood Products EPD Requirements, v1.0 2020 [18] (Currently under review and validity is extended for a minimum of 3 months till the end of "public consultation")
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE	LP® OSB products are an engineered wood product that can be used for wall, roof and sub-flooring applications.
MARKETS OF APPLICABILITY	Can be used for sheathing for walls, roofs and floors
DATE OF ISSUE	December 27, 2024
PERIOD OF VALIDITY	5 years
EPD TYPE	Product-specific EPD
EPD SCOPE	Cradle-to-Grave
YEAR OF REPORTED MANUFACTURER PRIMARY DATA	2019-2022

LCA SOFTWARE	SimaPro v9.6
LCI DATABASES	USLCI [14], Ecoinvent 3.10 [20], Datasmart [13]
LCIA METHODOLOGY	TRACI 2.1 [3], CML-baseline, v4.7 August 2016, CED, LHV 1.0, IPCC 2013 GWP100 (incl. CO2 uptake) [11]
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:	Brian Bunte, MS Principal Consultant, NextGen ESG Sustainability@nextgenesg.co https://nextgenesg.co/ NextGen ESG

This declaration was independently verified in accordance with ISO 14025:2006.
The UL Environment "Part A: Life Cycle Assessment Calculation Rules and Report Requirements" v4.0 (2022) and "Part B: Structural and Architectural Wood Products EPD Requirements" v1.1 (2020) 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 ☒ External

INDEPENDENT VERIFIER This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Lindita Bushi, PhD, Athena Sustainable Materials Institute

LIMITATIONS

- Environmental declarations from different programs (ISO 14025) may not be comparable.
- Comparison of the environmental performance using EPD information shall consider all relevant information modules over the full life cycle of the products within the building.
- This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. It should be noted that different LCA software and background LCI datasets may lead to differences in results for upstream or downstream of the life cycle stages declared.

COMPANY AND PRODUCT DESCRIPTION

This EPD represents the cradle-to-grave energy and materials required for producing LP® OSB products in North America and the subsequent releases into the environment. LP OSB facilities, at the time of data collection for the Life Cycle Assessment, were located in Alabama, North Carolina, Texas, and Michigan of the U.S., and British Columbia and Quebec, Canada. Primary application categories of OSB products include wall, roof and sub-flooring applications. These products go into a variety of applications based on their properties and desired end use. The production data used in this EPD considers all OSB products produced during 2022 and is weighted based on material output. The production data used in this EPD is presented in cubic meters and one square meter representing the dimensions in Table 1 [12].

TABLE 1 Performance Categories for LP® OSB

PERFORMANCE CATEGORY	SPAN RATING
3/8	24/0
7/16	24/16
15/32	32/16
1/2	32/16
19/32	40/20 or 20 OC
5/8	40/20 or 20 OC
23/32	48/24 or 24 OC
7/8	32 OC
1-1/8	48 OC

[a]/Comprehensive information on LP OSB Products can be found in the OSB Specification Sheet.

Photo is for illustrative purposes only.

Species contribution varies with the location of production facility and product. OSB products are categorized under United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI®) for sheathing, subflooring, and wood panel product sheathing (Table 2).

TABLE 2 United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI®) Masterformat Code for LP® OSB.

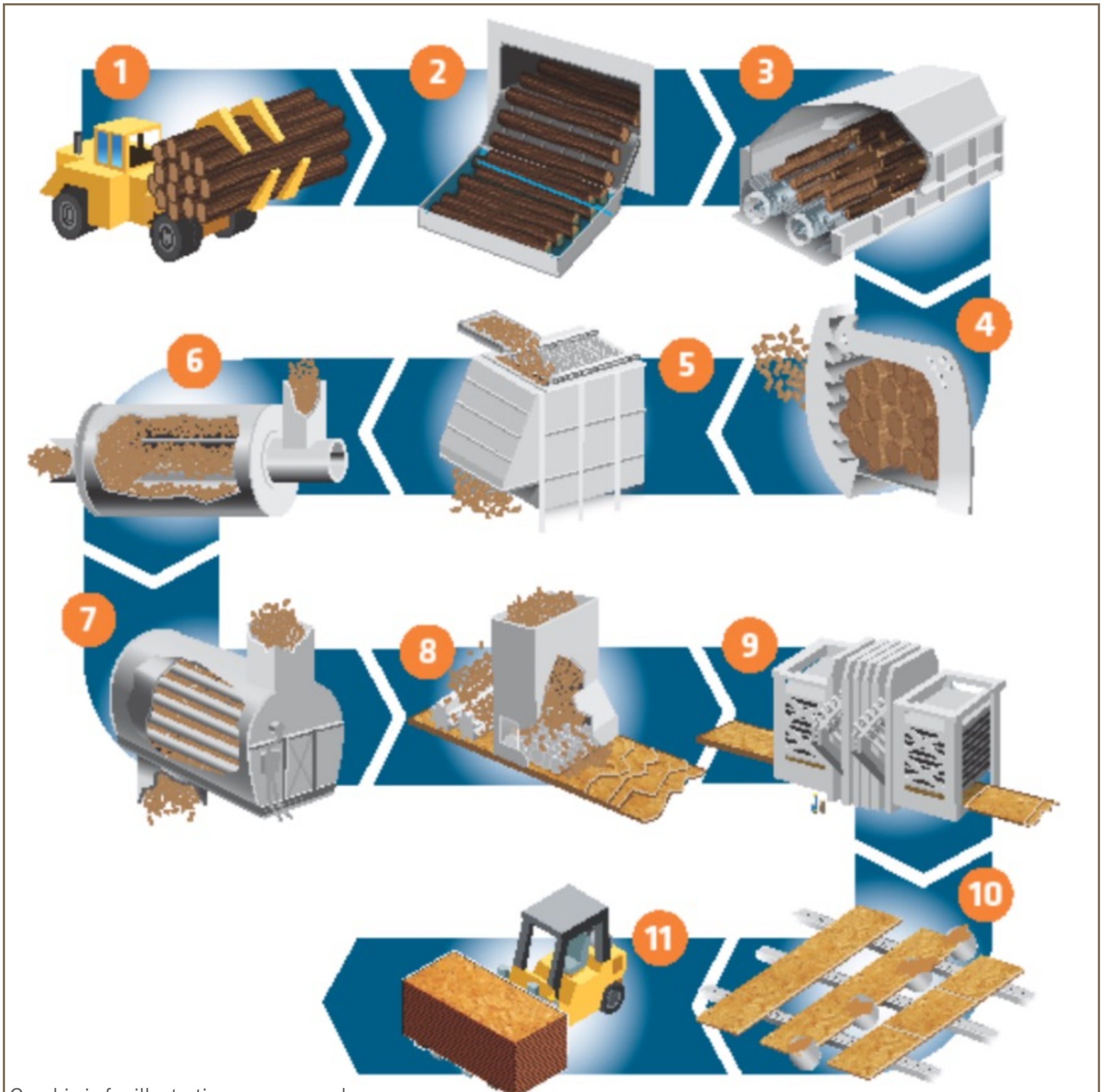
CLASSIFICATION STANDARD	CATEGORY	SUBCATEGORY	PRODUCT CODE
UNSPSC	Engineered Wood Products	Particleboard	111220 02
CSI/CSC	Oriented strand board (OSB)	Sheathing	06 16 00
		Subflooring	06 16 23
		Wood Panel Product Sheathing	06 16 36

LP® OSB PRODUCTION

The production process begins with whole logs that are debarked (Figure 1). The debarked logs are cut into strands and then dried and screened. The strands are then blended with resin, wax, and, for some products, zinc borate, and formed into mats. The formed mats are pressed under high heat and pressure, then cut and trimmed, and packaged for shipment. See Figure 1 for an illustration of the OSB production process.

Panels are protected during shipping with either polypropylene wraps or cardboard shrouds. Other packaging materials include plastic strapping, cardboard corner protectors, and wood stickers.

OSB products from LP production facilities contain wood fiber that is legally sourced and vetted through stringent third-party standards. LP is certified to the Sustainable Forestry Initiative® (SFI®) Forest Management for Canadian operations, Fiber Sourcing and Chain of Custody Standards for all of our North American operations, and the Programme for the Endorsement of Forest Certification (PEFC) Chain of Custody and Fiber Sourcing Standards in South America.



Graphic is for illustrative purposes only.

FIGURE 1 Process flow for the production of LP® OSB products

How It's Made

1 - Log Sorting After harvest, whole logs are hauled to the mill and sorted by species.

2 - Log Pond Logs soaked in water to loosen bark and to thaw for quality strands.

3 - Debarking Logs are fed into a machine that removes bark, then used as plant fuel.

4 - Stranding Rotating knives reduce the debarked logs to strands.

5 - Green Bins Strands are collected in large storage bins that allow for precise metering into the dryers.

6 - Drying Strands are dried to a target moisture content, then screened to remove particles that are recycled for plant fuel.

7 - Blending Strands are coated with resin and wax, enhancing resistance to moisture and water absorption.

8 - Forming Line Cross-directional layers of strands are formed into mats.

9 - Pressing Heat and extreme pressure are used to consolidate strands and cure resins to form a rigid, dense structural panel.

10 - Finishing Line Panels are cut to size, flooring tongue and groove joints are machined and edge sealants are applied for further moisture resistance.

11 - Shipping Panels are loaded and shipped to their final destinations.

The technical requirements for OSB products represented in this LCA are defined by the following product standards, testing, and certifications.

- DOC Voluntary Product Standard PS 2, Performance Standard for Wood Structural Panels
- APA PRP-108 Performance Standards and Qualification Policy for Structural-Use Panels

METHODOLOGICAL FRAMEWORK

TYPE OF EPD AND LIFE CYCLE STAGES

This EPD is intended to represent product specific life cycle assessment (LCA) for OSB products. Eight (8) LP facilities were surveyed and 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 [4] investigates OSB product systems from cradle to grave.

Information modules included in the LCA are shown in Table 5. This EPD includes mandatory modules A1-A3 for a cradle-to- gate analysis. Additional declared Modules include A4-Transportation to building site and A5 – Installation, Module B – Use, and EoL stages (C1 – C4) and additional benefits or reuse, energy recovery and recycling potential in Module D to complete a cradle-to-grave analysis (ISO 21090 5.2.2). Due to data gaps, the impact of deconstruction/demolishing and waste processing (Module C1 and C3) are considered null for this LCA as well as Module B1 – B7 (Table 3).

TABLE 3 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 Upstream 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 Processing	Disposal	Reuse, Recycle & Recovery Benefits
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

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 production of resins that are used in manufacturing OSB products. The upstream resource extraction includes removal of raw materials and processing. A1 also 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 source to be recycled in the process).
A3 - MANUFACTURING	Manufacturing of OSB products, including packaging. Packaging materials represent less than two percent (2%) of the mass of the main product. Common packaging materials are wrapping material, plastic strapping, wood stickers, corner protectors, and shrouds. The packaging is allocated 100 percent to the primary product
A4 - PRODUCT TRANSPORTATION	Average or specific transportation of product from manufacturing facility to construction site. This LCA product system includes actual product shipping distance to either customer or distribution/reload centers for both road and rail transportation modes.
A5 - CONSTRUCTION	The installation module covers installation of the construction product into any type of constructions and includes waste of construction product, waste from packaging material, energy for construction, waste management at the site.
B1–B7 - USE	Considered null for this EPD
C1 - DEMOLITION	Considered null for this EPD
C2 - TRANSPORTATION TO EOL TREATMENT	Average or specific transportation of product from construction site to EoL processes.
C3 - WASTE PROCESSING	Considered null for this EPD
C4 - PROCESSING & DISPOSAL	Final deposition of wastes to be landfilled, incinerated, or reused/recycled.
D - BENEFITS BEYOND THE SYSTEM BOUNDARY	Optional information about the potential net benefits from reuse, recycling, and energy recovery.

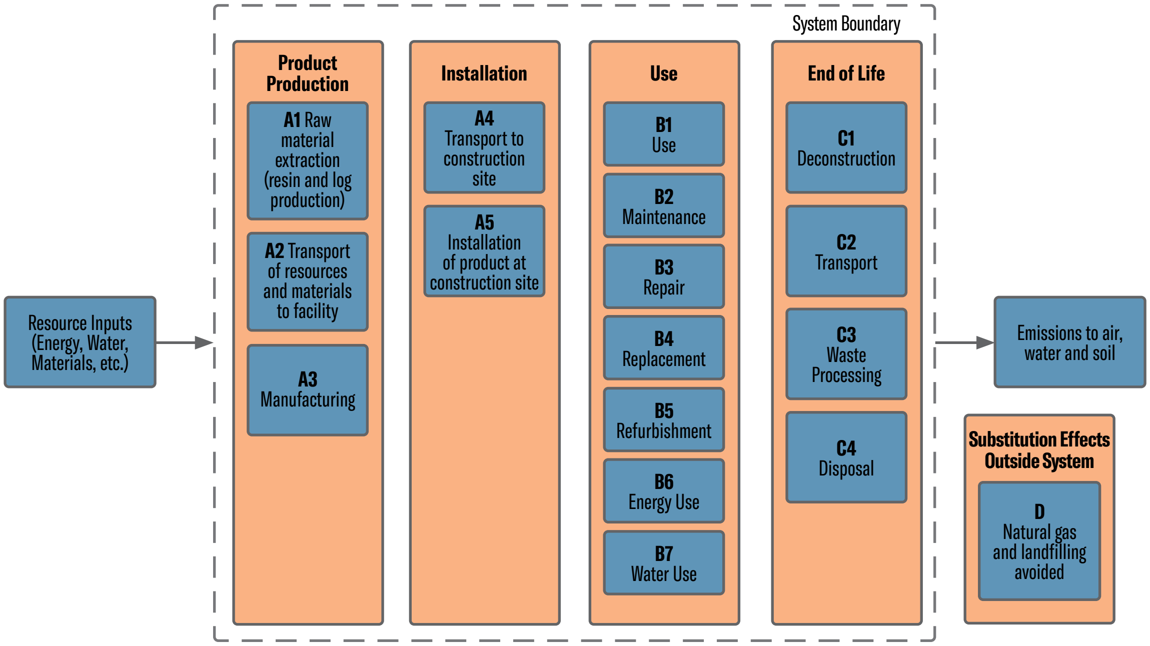


FIGURE 2 Cradle-to-Grave System Boundary for OSB products

DECLARED UNIT

Table 4 shows the declared unit and additional product information. In accordance with the PCR, the declared unit for LP® OSB is one cubic meter (m^3), which represents the area of the product multiplied by its thickness and installed in a building for 75 years [17]. This value is presented as 1.0 m^3, 9.5 mm basis.

TABLE 4 Declared Unit and Product Information

The declared unit is “the production of one cubic meter (1 m^3) of LP® OSB products.”

PROPERTY	UNIT	VALUE
Mass	kg	551
Thickness	mm	9.5
Density	kg/m^3	551
Moisture Content, Oven-Dry Basis	%	6%
PRODUCT COMPOSITION		
Wood	%	94.4
pMDI Resin	%	2
Wax	%	1
Zn Borate	%	<1
PF Resin	%	3

ALLOCATION METHODS

Allocation is the method used to partition the environmental load of a process when several products or functions share the same process. Processing logs to produce OSB product involves multiple processes with generation of co-product (sawdust, chips, bark). All OSB co-products are consumed within the OSB production system. OSB product production processes were allocated on a mass basis in accordance with UL PCR 2020 and ISO 21930:2017.

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 (1%) 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 were deliberately 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 [4] in accordance with UL PCR 2020.

TREATMENT OF BIOGENIC CARBON

Biogenic carbon emissions and removals are reported in accordance with ISO 21930 7.2.7. and 7.2.12. Detailed information is provided in the underlying LCA in Section 3.3 [4].

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 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 [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 [20]. Lower heating value of primary energy carriers is used to calculate the primary energy values reported in the study. IPCC 2013 LCIA was used to calculate GWP impacts as required by ISO 21930.

Other inventory parameters such as those concerning material use and waste were drawn from the LCI results. Selected LCI results, additional V1.06, published by ecoinvent [20], was used to quantify the water use metric. Biogenic carbon was quantified for primary data using LCI results, and the LCIA method IPCC 2013 GWP100 (incl. CO2 uptake) [11] was leveraged to quantify the net biogenic carbon emissions within secondary data. Additional information on quantifying biogenic carbon can be found in section 3.3 of the accompanying LCA report [4].

We followed the ACLCA's Guidance to Calculating non-LCIA Inventory Metrics in accordance with ISO 21930:2017 [1]. SimaPro 9.6 [17] was used to organize and accumulate the LCI data, and to calculate the LCIA results.

Product EoL fates were sourced from the US EPA [6], which estimates the probable fate durable wood products. The EoL fate of durable wood products is estimated to be 82% landfilling, 18% combustion with energy recovery, 0% recycling, and 0% composting, as a percentage of wood material generated on a mass basis. In this EPD it is reported as the "Average" EoL Scenario. The two probable EoL fates are assessed separately as 100% EoL fate scenarios.

Section 7.1.71 of ISO 21930 states that "Within an EPD, the indicators declared in the individual information modules of a product life cycle (i.e. A1 to A5, B1 to B7, C1 to C4) and the optional supplementary information beyond the life cycle (module D) shall not be aggregated in any combination of the individual information modules into a total or subtotal of the life cycle stages." However, the lumber industry is interested in full life cycle results (A1 through C4) and therefore aggregated results are also presented. Note that the aggregated A1 through C4 totals are to be interpreted with care as modules A4 through C4 are based on scenarios.

BIOGENIC CARBON RESULTS

Table 5 shows additional inventory parameters related to biogenic carbon removal and emissions. The biogenic CO_2 component for OSB products show that the landfill scenario causes a net removal of biogenic carbon from the atmosphere equivalent to 700 kg CO_2eq. The net average uses the U.S. EPA Materials Management Fact Sheet for durable wood products assuming 0% recycling, 0% composting, 18% incineration, and 82% landfilling [6].

TABLE 5 Biogenic Carbon Inventory Parameters for LP® OSB products per m^3

ADDITIONAL INVENTORY PARAMETERS		A1 ALL SCENARIOS	A3 ALL SCENARIOS	C4 LANDFILL SCENARIO	C4 INCINERATION SCENARIO	C4 AVERAGE
Biogenic Carbon Removal from Product	kg CO_2	-1.70E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Biogenic Carbon Emission from Product	kg CO_2	0.00E+00	0.00E+00	4.30E+01	8.11E+02	3.49E+02
Biogenic Carbon Removal from Packaging	kg CO_2	0.00E+00	-2.58E+01	0.00E+00	0.00E+00	0.00E+00
Biogenic Carbon Emission from Packaging	kg CO_2	0.00E+00	0.00E+00	1.14E+00	2.15E+01	9.26E+00
Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production	kg CO_2	0.00E+00	6.24E+02	0.00E+00	0.00E+00	0.00E+00

TABLE 6 Net Biogenic Carbon Inventory for LP® OSB products per m^3

SUMMARY OF TOTAL BIOGENIC CO_2 REMOVALS & EMISSIONS		NET BIOGENIC CO_2 (kg CO_2)
Net Biogenic Carbon Emission Landfill Scenario	kg CO_2	-1.06E+03
Net Biogenic Carbon Emission Incineration Scenario	kg CO_2	-2.74E+02
Average End-Of-Life Treatment (82% landfill, 18% incinerate)	kg CO_2	-7.49E+02

THE RESULTS

A1—A3 - PRODUCT MANUFACTURING

Table 10 presents the cradle-to-gate (A1-A3) LCIA and LCI parameter results for the functional unit of 1 m^3 of OSB product. 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.

A4 - PRODUCT TRANSPORTATION

The product system includes actual product shipping distance to either customer or distribution/reload centers for both road and rail transportation modes.

A5 - INSTALLATION

For this LCA waste of product and packaging waste is considered null and waste management is not relevant. Construction energy (A5) is based on diesel fuel consumption using a default value for building construction from Athena Impact Estimator [2]. Diesel construction energy use is 2.16 L. The reference service life for the product is 75 years which is the default specified by the UL Part B PCR (UL 2020).

B1—B7 - USE

The use phase of a product includes seven information modules, B1 - B7. This product does not require any inputs including energy and water during the use phases (B1-B7) and is declared null.

C1—C4 - END OF LIFE

This product system includes the end-of-life (EoL) modules C1-C4. For the purpose of this LCA, C1 and C3 are null. For EoL processing, we applied the weighted average of the typical waste treatment in the United States for durable wood products: 82% landfill and 18% incineration (EPA 2019). As per the PCR, the results for each of the individual options are also separately reported, as required by ISO 21930 Section 7.1.7. Table 8 lists the assumptions for C1-C4 and the net values.

TABLE 7 END OF LIFE (C1-C4) Assumptions for Scenario Development (Description of Deconstruction, Collection, Recovery, Disposal Method and Transportation)

C1-C4 DESCRIPTION OF PROCESSES	DESCRIPTION	VALUE	UNIT
Collection Process	Collected Separately	NA	Dry kg
Collection Process	Collected with Mixed Construction Waste	521[1/]	Dry kg
Recovery	Reuse		Dry kg
Recovery	Recycling		Dry kg
Recovery	Landfill	427	Dry kg
Recovery	Incineration		Dry kg
Recovery	Incineration with Energy Recovery[/]	94[2/]	Dry kg
Recovery	Product or Material for Final Deposition	427	Dry kg
Removal of Biogenic Carbon (Excluding Packaging)		-955	kg CO_2 eq

Note: C1 - Building demolishing is considered null

[1/] Waste was collected as construction waste using dump truck to the disposal site with 82% of the total product mass was landfilled

[2/] Remaining 18% of the product mass was incinerated with energy recovery

D - SUBSTITUTION EFFECTS OUTSIDE SYSTEM

Per ISO 21930 Section 7.1.7.6, the net output flow for all products for reuse, secondary materials, secondary fuels and/or recovered energy leaving a product system is calculated by adding all output flows of the secondary material or fuel or recovered energy and subtracting any input flows of this secondary material or fuel or recovered energy from each information module (A1 to A5, B1 to B7, C1 to C4) thus arriving at the net output flow of secondary material or fuel or recovered energy from the product system. Table 9 lists the assumptions for module D substitution benefits and the net values.

Incineration with energy recovery causes the potential displacement of fossil fuels with an equivalent heat content. To estimate the natural gas displacement, we first calculated the potential fuel heating value of a wood panel on a lower heating value (LHV) of 20.9 MJ/ oven dry kg and 35.7 MJ/kg for resin, which equates to 13,561 MJ/m^3. The energy equivalent amount of natural gas was calculated based on a lower heating value, or 36.6 MJ/m^3.

OSB energy content = (20.9MJ/kg x 519 kgv) + (35.7 MJ/kg x 31.7 kg/m^3) = 11,980 MJ/m^3

Substitution with Natural gas = $\frac{11{,}980/m^3}{36.6\frac{MMMM}{mm^3}}$ = 327 m^3/m^3

Displacing 327 cubic meters of natural gas for every cubic meter of OSB product combusted.

TABLE 8 Use, Recovery and/or Recycling Potentials (D), Relevant Scenario Information

C1-C4 DESCRIPTION OF PROCESSES	VALUE	UNIT
Net Energy Benefit from Energy Recovery from Waste Treatment Declared as Exported Energy in C3 (R>0.6)	NA	MJ
Net Energy Benefit from Thermal Energy Due to Treatment of Waste Declared as Exported Energy in C4 (R <0.6)	17,182.7	MJ
Net Energy Benefit from Material Flow Declared in C3 for Energy Recovery	NA	MJ
Process and Conversion Efficiencies (Thermal Efficiency)	85.0	%
Further Assumptions for Scenario Development (e.g. Further Processing Technologies, Assumptions on Correction Factors)	NA	

Table 9 shows the mandatory cradle-to-gate results (A1-A3) for 1 cubic meter OSB products. Tables 10 to 12 present the cradle-to-grave results includes the delivery of the product to the construction site (A4), construction energy (A5), the use phase (B1-B7) and the EoL (C1-C4). Table 10 presents the weighted average results for the average waste treatment in the United States for durable wood products, 82% landfill and 18% incineration [6]. As per the PCR and ISO 21930 Section 7.1.7, the results for each of the individual options are also separately reported and include 100% landfilling (Table 11), and 100% incineration (Table 12).

TABLE 9 LCIA Results Summary for 1 m^3 of LP® OSB Products – Cradle-to-Gate Scope

CORE MANDATORY IMPACT INDICATOR	INDICATOR	UNIT	A1-A3	A1	A2	A3
Global Warming Potential – Total	GWP_{TOTAL}	kg CO_2 eq	-8.22E+02	-1.55E+03	2.57E+01	7.00E+02
Global Warming Potential – Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	-1.11E+03	-1.70E+03	2.06E-01	5.98E+02
Global Warming Potential – Fossil	GWP_{FOSSIL}	kg CO_2 eq	2.85E+02	1.57E+02	2.55E+01	1.03E+02
Depletion Potential of the Stratospheric Ozone Layer	ODP	kg CFC-11 eq	5.04E-06	3.06E-06	1.11E-07	1.87E-06
Acidification Potential of Soil and Water Sources	AP	kg SO_2 eq	9.34E+00	8.78E+00	1.55E-01	4.05E-01
Eutrophication Potential	EP	kg N eq	1.22E+00	8.41E-01	1.45E-02	3.61E-01
Formation Potential of Tropospheric Ozone	SFP	kg O_3 eq	3.11E+02	2.97E+02	4.54E+00	9.67E+00
Abiotic Depletion Potential (Adpfossil) for Fossil Resources	ADPf	MJ, NCV	4.89E+03	3.10E+03	3.19E+02	1.47E+03
Fossil Fuel Depletion	FFD	MJ Surplus	6.24E+02	3.93E+02	4.51E+01	1.86E+02
USE OF PRIMARY RESOURCES						
Renewable Primary Energy Used as Energy	RPRE	MJ, NCV	9.08E+03	6.73E+01	8.03E-01	9.01E+03
Renewable Primary Energy Used as Material	RPRM	MJ, NCV	1.16E+04	1.15E+04	0.00E+00	1.30E+02
Non-Renewable Primary Energy Used as Energy	NRPRE	MJ, NCV	5.31E+03	3.25E+03	3.24E+02	1.73E+03
Non-Renewable Primary Energy Used as Material	NRPRM	MJ, NCV	1.14E+03	1.13E+03	0.00E+00	8.72E+00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY						
Secondary Material	SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable Secondary Fuel	RSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-Renewable Secondary Fuel	NRSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered Energy	RE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MANDATORY INVENTORY PARAMETERS						
Consumption of Freshwater Resources	FW	m^3	1.26E+01	1.27E+00	3.22E-02	1.13E+01
INDICATORS DESCRIBING WASTE						
Hazardous Waste Disposed	HWD	kg	9.41E-02	0.00E+00	0.00E+00	9.41E-02
Non-Hazardous Waste Disposed	NHWD	kg	8.54E+00	0.00E+00	0.00E+00	8.54E+00
High-Level Radioactive Waste, Conditioned, to Final Repository	HLRW	m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Intermediate- and Low-Level Radioactive Waste, Conditioned, to Final Repository	ILLRW	m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for Re-Use	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Recycling	MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Energy Recovery	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered Energy Exported	EE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TABLE 10 LCIA Results Summary for 1 m^3 of LP® OSB Products – Average End-of-Life, Treatment, 82% Landfill/18% Combustion With Energy Recovery – Cradle-to-Grave Scope

CORE MANDATORY IMPACT INDICATOR	INDICATOR	UNIT	A1-C4	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
Global Warming Potential – Total	GWP_{TOTAL}	kg CO_2 eq	-4.06E+02	-8.22E+02	3.81E+01	7.08E+00	0.00E+00	0.00E+00	5.46E+00	0.00E+00	3.65E+02	-1.49E+02
Global Warming Potential – Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	-7.48E+02	-1.11E+03	1.60E-01	6.21E-02	0.00E+00	0.00E+00	4.45E-02	0.00E+00	3.58E+02	1.44E-02
Global Warming Potential – Fossil	GWP_{FOSSIL}	kg CO_2 eq	3.42E+02	2.85E+02	3.79E+01	7.02E+00	0.00E+00	0.00E+00	5.41E+00	0.00E+00	6.91E+00	-1.49E+02
Depletion Potential of the Stratospheric Ozone Layer	ODP	kg CFC-11 eq	7.66E-06	5.04E-06	2.43E-06	1.32E-08	0.00E+00	0.00E+00	9.48E-09	0.00E+00	1.65E-07	-5.71E-08
Acidification Potential of Soil and Water Sources	AP	kg SO_2 eq	9.80E+00	9.34E+00	2.85E-01	9.19E-02	0.00E+00	0.00E+00	2.98E-02	0.00E+00	4.89E-02	-1.15E-01
Eutrophication Potential	EP	kg N eq	1.40E+01	1.22E+00	3.52E-02	7.13E-03	0.00E+00	0.00E+00	2.83E-03	0.00E+00	1.27E+01	-1.43E-02
Formation Potential of Tropospheric Ozone	SFP	kg O_3 eq	3.25E+02	3.11E+02	8.41E+00	2.99E+00	0.00E+00	0.00E+00	8.59E-01	0.00E+00	1.35E+00	-2.91E+00
Abiotic Depletion Potential (Adpfossil) for Fossil Resources	ADPf	MJ, NCV	5.66E+03	4.89E+03	4.85E+02	9.41E+01	0.00E+00	0.00E+00	6.74E+01	0.00E+00	1.28E+02	-2.00E+03
Fossil Fuel Depletion	FFD	MJ Surplus	7.31E+02	6.24E+02	6.71E+01	1.33E+01	0.00E+00	0.00E+00	9.54E+00	0.00E+00	1.71E+01	-2.99E+02
USE OF PRIMARY RESOURCES												
Renewable Primary Energy Used as Energy	RPRE	MJ, NCV	9.09E+03	9.08E+03	4.20E+00	2.12E-01	0.00E+00	0.00E+00	1.51E-01	0.00E+00	1.99E+00	0.00E+00
Renewable Primary Energy Used as Material	RPRM	MJ, NCV	1.16E+04	1.16E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-Renewable Primary Energy Used as Energy	NRPRE	MJ, NCV	6.10E+03	5.31E+03	4.98E+02	9.55E+01	0.00E+00	0.00E+00	6.84E+01	0.00E+00	1.30E+02	-2.00E+03
Non-Renewable Primary Energy Used as Material	NRPRM	MJ, NCV	1.14E+03	1.14E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY												
Secondary Material	SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable Secondary Fuel	RSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-Renewable Secondary Fuel	NRSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered Energy	RE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MANDATORY INVENTORY PARAMETERS												
Consumption of Freshwater Resources	FW	m^3	1.10E+01	1.26E+01	1.49E-01	8.66E-03	0.00E+00	6.19E-03	0.00E+00	0.00E+00	-1.71E+00	0.00E+00
INDICATORS DESCRIBING WASTE												
Hazardous Waste Disposed	HWD	kg	9.41E-02	9.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-Hazardous Waste Disposed	NHWD	kg	8.54E+00	8.54E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
High-Level Radioactive Waste, Conditioned, to Final Repository	HLRW	m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Intermediate- and Low-Level Radioactive Waste, Conditioned, to Final Repository	ILLRW	m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for Re-Use	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Recycling	MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Energy Recovery	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered Energy Exported	EE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TABLE 11 LCIA Results Summary for 1 m^3 of LP® OSB Products – 100% Landfilling at End-of-Life – Cradle-to-Grave Scope

CORE MANDATORY IMPACT INDICATOR	INDICATOR	UNIT	A1-C4	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
Global Warming Potential – Total	GWP_{TOTAL}	kg CO_2 eq	-7.21E+02	-8.22E+02	3.81E+01	7.08E+00	0.00E+00	0.00E+00	5.46E+00	0.00E+00	5.06E+01	0.00E+00
Global Warming Potential – Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	-1.06E+03	-1.11E+03	1.60E-01	6.21E-02	0.00E+00	0.00E+00	4.45E-02	0.00E+00	4.41E+01	0.00E+00
Global Warming Potential – Fossil	GWP_{FOSSIL}	kg CO_2 eq	3.42E+02	2.85E+02	3.79E+01	7.02E+00	0.00E+00	0.00E+00	5.41E+00	0.00E+00	6.49E+00	0.00E+00
Depletion Potential of the Stratospheric Ozone Layer	ODP	kg CFC-11 eq	7.67E-06	5.04E-06	2.43E-06	1.32E-08	0.00E+00	0.00E+00	9.48E-09	0.00E+00	1.78E-07	0.00E+00
Acidification Potential of Soil and Water Sources	AP	kg SO_2 eq	9.79E+00	9.34E+00	2.85E-01	9.19E-02	0.00E+00	0.00E+00	2.98E-02	0.00E+00	4.09E-02	0.00E+00
Eutrophication Potential	EP	kg N eq	1.67E+01	1.22E+00	3.52E-02	7.13E-03	0.00E+00	0.00E+00	2.83E-03	0.00E+00	1.55E+01	0.00E+00
Formation Potential of Tropospheric Ozone	SFP	kg O_3 eq	3.25E+02	3.11E+02	8.41E+00	2.99E+00	0.00E+00	0.00E+00	8.59E-01	0.00E+00	1.06E+00	0.00E+00
Abiotic Depletion Potential (Adpfossil) for Fossil Resources	ADPf	MJ, NCV	5.67E+03	4.89E+03	4.85E+02	9.41E+01	0.00E+00	0.00E+00	6.74E+01	0.00E+00	1.39E+02	0.00E+00
Fossil Fuel Depletion	FFD	MJ Surplus	7.33E+02	6.24E+02	6.71E+01	1.33E+01	0.00E+00	0.00E+00	9.54E+00	0.00E+00	1.88E+01	0.00E+00
USE OF PRIMARY RESOURCES												
Renewable Primary Energy Used as Energy	RPRE	MJ, NCV	9.09E+03	9.08E+03	4.20E+00	2.12E-01	0.00E+00	0.00E+00	1.51E-01	0.00E+00	2.01E+00	0.00E+00
Renewable Primary Energy Used as Material	RPRM	MJ, NCV	1.16E+04	1.16E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-Renewable Primary Energy Used as Energy	NRPRE	MJ, NCV	6.11E+03	5.31E+03	4.98E+02	9.55E+01	0.00E+00	0.00E+00	6.84E+01	0.00E+00	1.41E+02	0.00E+00
Non-Renewable Primary Energy Used as Material	NRPRM	MJ, NCV	1.14E+03	1.14E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY												
Secondary Material	SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable Secondary Fuel	RSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-Renewable Secondary Fuel	NRSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered Energy	RE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MANDATORY INVENTORY PARAMETERS												
Consumption of Freshwater Resources	FW	m^3	1.06E+01	1.26E+01	1.49E-01	8.66E-03	0.00E+00	6.19E-03	0.00E+00	0.00E+00	-2.11E+00	0.00E+00
INDICATORS DESCRIBING WASTE												
Hazardous Waste Disposed	HWD	kg	9.41E-02	9.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-Hazardous Waste Disposed	NHWD	kg	8.54E+00	8.54E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
High-Level Radioactive Waste, Conditioned, to Final Repository	HLRW	m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Intermediate- and Low-Level Radioactive Waste, Conditioned, to Final Repository	ILLRW	m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for Re-Use	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Recycling	MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Energy Recovery	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered Energy Exported	EE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TABLE 12 LCIA Results Summary for 1 m³ of LP® OSB Products – 100% Incineration With Energy Recovery at End-of-Life – Cradle-to-Grave Scope

CORE MANDATORY IMPACT INDICATOR	INDICATOR	UNIT	A1-C4	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
Global Warming Potential – Total	GWP_{TOTAL}	kg CO_2 eq	7.00E+01	-8.22E+02	3.81E+01	7.08E+00	0.00E+00	0.00E+00	5.46E+00	0.00E+00	8.41E+02	-8.30E+02
Global Warming Potential – Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	-2.74E+02	-1.11E+03	1.60E-01	6.21E-02	0.00E+00	0.00E+00	4.45E-02	0.00E+00	8.33E+02	8.02E-02
Global Warming Potential – Fossil	GWP_{FOSSIL}	kg CO_2 eq	3.44E+02	2.85E+02	3.79E+01	7.02E+00	0.00E+00	0.00E+00	5.41E+00	0.00E+00	8.80E+00	-8.30E+02
Depletion Potential of the Stratospheric Ozone Layer	ODP	kg CFC-11 eq	7.60E-06	5.04E-06	2.43E-06	1.32E-08	0.00E+00	0.00E+00	9.48E-09	0.00E+00	1.08E-07	-3.17E-07
Acidification Potential of Soil and Water Sources	AP	kg SO_2 eq	9.84E+00	9.34E+00	2.85E-01	9.19E-02	0.00E+00	0.00E+00	2.98E-02	0.00E+00	8.51E-02	-6.38E-01
Eutrophication Potential	EP	kg N eq	1.44E+00	1.22E+00	3.52E-02	7.13E-03	0.00E+00	0.00E+00	2.83E-03	0.00E+00	1.82E-01	-7.95E-02
Formation Potential of Tropospheric Ozone	SFP	kg O_3 eq	3.26E+02	3.11E+02	8.41E+00	2.99E+00	0.00E+00	0.00E+00	8.59E-01	0.00E+00	2.69E+00	-1.61E+01
Abiotic Depletion Potential (Adpfossil) for Fossil Resources	ADPf	MJ, NCV	5.61E+03	4.89E+03	4.85E+02	9.41E+01	0.00E+00	0.00E+00	6.74E+01	0.00E+00	7.70E+01	-1.11E+04
Fossil Fuel Depletion	FFD	MJ Surplus	7.24E+02	6.24E+02	6.71E+01	1.33E+01	0.00E+00	0.00E+00	9.54E+00	0.00E+00	9.29E+00	-1.66E+03
USE OF PRIMARY RESOURCES												
Renewable Primary Energy Used as Energy	RPRE	MJ, NCV	9.09E+03	9.08E+03	4.20E+00	2.12E-01	0.00E+00	0.00E+00	1.51E-01	0.00E+00	1.86E+00	0.00E+00
Renewable Primary Energy Used as Material	RPRM	MJ, NCV	1.16E+04	1.16E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-Renewable Primary Energy Used as Energy	NRPRE	MJ, NCV	6.05E+03	5.31E+03	4.98E+02	9.55E+01	0.00E+00	0.00E+00	6.84E+01	0.00E+00	7.85E+01	-1.11E+04
Non-Renewable Primary Energy Used as Material	NRPRM	MJ, NCV	1.14E+03	1.14E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY												
Secondary Material	SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable Secondary Fuel	RSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-Renewable Secondary Fuel	NRSF	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered Energy	RE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MANDATORY INVENTORY PARAMETERS												
Consumption of Freshwater Resources	FW	m^3	1.29E+01	1.26E+01	1.49E-01	8.66E-03	0.00E+00	6.19E-03	0.00E+00	0.00E+00	1.16E-01	0.00E+00
INDICATORS DESCRIBING WASTE												
Hazardous Waste Disposed	HWD	kg	9.41E-02	9.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-Hazardous Waste Disposed	NHWD	kg	8.54E+00	8.54E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
High-Level Radioactive Waste, Conditioned, to Final Repository	HLRW	m3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Intermediate- and Low-Level Radioactive Waste, Conditioned, to Final Repository	ILLRW	m3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for Re-Use	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Recycling	MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for Energy Recovery	MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered Energy Exported	EE	MJ, NCV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

INTERPRETATION

The primary sources of impacts across the life cycle are the manufacturing of LP® OSB products (Modules A1-A3) and the net flows of biogenic carbon (Table 7). Table 7 shows the flows of biogenic carbon out of the system in Module A3 from the combustion of biomass and the export of coproducts out of the system boundary. In Module C4, biogenic emissions from landfill and incineration emissions are less than the flows of biogenic carbon into the system in Module A1 (removal of biomass from a net neutral sustainable forest). The biogenic carbon storage is so significant that this net benefit is larger than the total fossil emissions from all other modules and causes the total global warming potential to be negative (Table 7). The total global warming potential (GWP_{TOTAL}) of -406 kg CO_2 eq. (Table 11 (A1-C4)) suggests the product system removes more GHG emissions from the atmosphere than are emitted in its production and disposal combined.

GWPFOSSIL (A1-C4):

Table 10 – Cradle-to-grave GWP_{FOSSIL} = 342, average EoL treatment assuming 82% landfill and 18% incineration with energy recovery

Table 11 – Cradle-to-grave GWP_{FOSSIL} = 342, EoL treatment assumed to be 100% landfill

Table 12 – Cradle-to-grave GWP_{FOSSIL} = 344, EoL treatment assumed to be 100% incineration with energy recovery

BIOGENIC CARBON DECLARED (A1-C4):

Table 10 – Cradle-to-grave GWP_{TOTAL} = -406, average EoL treatment assuming 82% landfill and 18% incineration with energy recovery

Table 11 – Cradle-to-grave GWP_{TOTAL} = -721, EoL treatment assumed to be 100% landfilll

Table 12 – Cradle-to-grave GWP_{TOTAL} = 70, EoL treatment assumed to be 100% incineration with energy recovery

Summarizing the GWP from Table 10, the most common representation of EoL treatment for wood products, the cradle-to-gate 285 kg CO_2 eq/m^3 increases to 342 kg CO_2 eq/m^3 when EoL modules are added without biogenic carbon. When biogenic carbon is added, there is a dramatic drop if GWP to -406 kg CO_2 eq/m^3. This further drops to -556 kg CO_2 eq/m^3 when substitution effects are included. The lowest GWP_{TOTAL} occurs in the EoL 100% landfill treatment where the result is -721 kg CO_2 eq/m^3 where biogenic carbon is added (A1-C4, Table 11).

The highest GWP_{TOTAL} (70 kg CO_2 eq/m^3) is in the 100% incineration EoL treatment (A1-C4, Table 12). This scenario assumes the worst-case biogenic carbon storage. When the substitution effect of replacing natural gas with energy from combusted OSB products is considered, there is a significant reduction in the GWP to -760 kg CO_2 eq/m^3 suggesting that the potential energy value of the product is greater than fossil fuels combusted from cradle-to-grave.

In this cradle-to-grave EPD there is a wide range of GWP_{TOTAL} results, ranging from 70 to -721 kg CO_2 eq/m^3, illustrating the importance of making informed decisions for the LCA and the intended use of the product. Louisiana-Pacific Corporation offers this information in this EPD to help users make informed decisions. The user is responsible for determining the intended use of the product.

LIMITATIONS

Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance using EPD information shall consider all relevant information modules over the full life cycle of the products within the building. This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. 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.

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.

Although this LCA is cradle-to-grave in scope, it assumes the use and maintenance stages of the products are null (B1-B7). The reference service life (RSL) refers to the declared technical and functional performance of the product within a construction works. RSL is indicated by the manufacturer. RSL is dependent on the properties of the product and reference in-use conditions [17]. This LCA acknowledges the limitation making the use phase null as one could conclude that a shorter lifespan is just as good as a life span of 75 plus years. The declared unit in this LCA assumes the default RSL of 75 years [17].

ADDITIONAL ENVIRONMENTAL INFORMATION

Pressing and drying processes contribute the most emissions in wood production facilities. These are caused by the thermal energy production through the direct fired process and by the use of emission control devices. All facilities reported the use of ECDs throughout their facility. Types of ECDs include electrostatic precipitators (ESP), wet electrostatic precipitators (WESP), regenerative thermal oxidizers (RTO), regenerative catalytic oxidizers (RCO), cyclones, and baghouses. Most ECDs use electricity or natural gas. Hence, the additional energy requirement for ECDs can potentially result in an overall increase of other greenhouse gases such as CO_2, SO_2, NOx and CH_4. The pMDI emission from using pMDI resin is listed on the US Environmental Agency (EPA) Toxics Release Inventory.

FOREST MANAGEMENT

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

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

SCOPE OF THE EPD

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

All photos are for illustrative purposes only.

REFERENCES

1. American Center for Life Cycle Assessment (2019) ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017.

2. Athena, 2002. Maintenance, repair, and replacement effects for building envelope materials. Prepared by Morrison Hershfield Limited. Ottawa, Canada. January 2002. 69pp

3. Bare, J. (2012) Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) - Version 2.1.

4. NextGen ESG (2024) Cradle to Grave Life Cycle Assessment of LP® OSB. November 2024.

5. EPA. 2021. The WARM model is documented by the EPA at https://www.epa.gov/warm/documentation-waste-reduction-model-warm. UL's wood product PCR adopted the WARM model estimations and published those assumptions under Addendum 1 as a part of the PCR.

6. EPA 2019. Advancing sustainable materials management: 2017 Fact Sheet. https://www.epa.gov/sites/default/files/2019-11/documents/2017_facts_and_figures_fact_sheet_final.pdf. (Table 4 values for Durable Goods). 22 pp. (Accessed February 2023).

7. International Organization for Standardization (2006) ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

8. 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.

9. 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/.

10. 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.

11. Intergovernmental Panel on Climate Change. (2023). AR6 Synthesis Report: Climate change 2023. IPCC. Retrieved from https://www.ipcc.ch/assessment-report/ar6/.

12. LP® OSB Product catalog 2024.

13. LTS (2023) DataSmart: http://ltsexperts.com/services/software/datasmart-life-cycle-inventory/.

14. National Renewable Energy Laboratory (2019) U.S. Life Cycle Inventory Database http://www.nrel.gov/lci/.

15. Oneil, E.E., L.R. Johnson, B.R. Lippke, J.B. Carter, M.E. McDill, P.A. Roth, and J.C. Finley. Life cycle impacts of Inland Northwest and Northeast/North central forest resources. (Accessed December 2020). Wood and Fiber Science 42(CORRIM special issue) 2010:29-51.

16. ATHENA Sustainable Materials Institute. 2018. A cradle-to-gate life cycle assessment of Canadian oriented strandboard – OSB. 34 pp.

17. PRé Consultants BV (2024) SimaPro v9.6 LCA Software.

18. UL Environment (2022) Product Category Rule (PCR) Guidance for Building-Related Products and Services, Part A Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010, v.4.

19. 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.1.0.

20. 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.

LPCorp.com/OSB