LP® TOPNOTCH® 350 SUB-FLOORING ENVIRONMENTAL PRODUCT DECLARATION

EPD FOR LP® TOPNOTCH® 350 SUB-FLOORING
PRODUCED BY LOUISIANA-PACIFIC CORPORATION,
NASHVILLE, TENNESSEE, USA

LPCorp.com/TopNotch

LP TopNotch® 350
DURABLE SUB-FLOORING

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 Nashville, Tennessee USA LPCorp.com
DECLARATION NUMBER	EPD 558
DECLARED PRODUCT	LP TopNotch® 350 DURABLE SUB-FLOORING; LP Structural Solutions
DECLARED UNIT	1 m^3 of LP® TopNotch® 350 Sub-Flooring produced at LP Structural Solutions facilities in the United States 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:** Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report, v3.2 2018 [18] **Part B:** Structural and Architectural Wood Products EPD Requirements, v1.0 2020 [19]
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE	LP® TopNotch® 350 Sub-Flooring is an engineered wood product used as sheathing for walls and roofs in residential and commercial buildings.
MARKETS OF APPLICABILITY	Construction sector, sheathing applications
DATE OF ISSUE	September 18, 2023
PERIOD OF VALIDITY	5 years
EPD TYPE	Product-specific EPD
EPD SCOPE	Cradle-to-Grave
YEAR OF REPORTED MANUFACTURER PRIMARY DATA	2020

LCA SOFTWARE	SimaPro v9.4 [17]
LCI DATABASES	USLCI [13], Ecoinvent 3.5 [20], Datasmart [12]
LCIA METHODOLOGY	TRACI 2.1 [3], 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

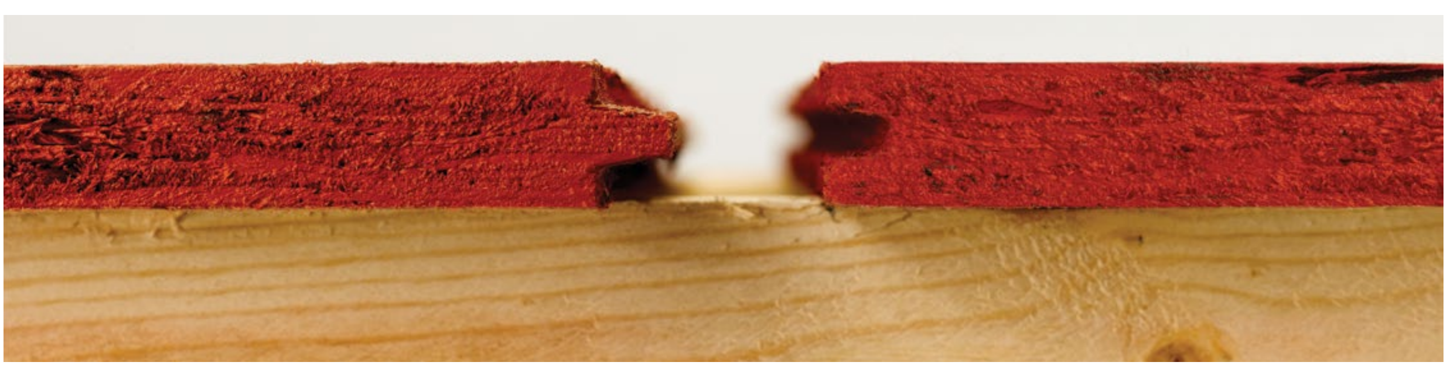
This declaration was independently verified in accordance with **ISO 14025:2006**.
The **UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v3.2** (December 2018), in conformance with **ISO 21930:2017**, serves as the core PCR, with additional considerations from the **USGBC/UL Environment Part A Enhancement (2017)**. Tim Brooke, ASTM International

☐ Internal ☒ 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

LP® TopNotch® 350 Sub-Flooring belongs to a group of oriented strand board (OSB) sheathing products. The U.S. OSB industry produces and domestically uses construction and industrial OSB. OSB is a material with favorable mechanical properties that make it particularly suitable for load-bearing applications in construction. It is now more popular than plywood, commanding 66% of the structural panel market (Random Lengths 2022).

This EPD represents the cradle-to-grave LCA for Louisiana-Pacific (LP) Corporation LP® TopNotch® 350 Sub-Flooring [hereafter LP® TopNotch® 350 panel] manufactured in the United States (Sagola, Minnesota; Hanceville, Alabama; Jasper, Texas; Carthage, Texas; and Roxboro, North Carolina). The primary application of LP® TopNotch® 350 panels is for floor sheathing. LP® TopNotch® 350 panels are made with a unique RainChannel® notch system, in which water can drain from the surface for better moisture resistance and meets Product Standard PS 2.

LP® TopNotch® 350 panel production facilities use wood fiber that is legally and sustainably sourced (SAI Global). LP is third-party certified to the Sustainable Forestry Initiative® (SFI®) Forest Management, Fiber Sourcing and Chain of Custody Standards and the Programme for the Endorsement of Forest Certification™ (PEFC™) Chain of Custody Standard.

The production data used in this EPD is presented in cubic meter (m3), representing the dimensions in Table 1 [11].

TABLE 1 Size Specification for LP® TopNotch® 350 Sub-Flooring

LENGTH FEET (METERS)	WIDTH FEET (METERS)	PERFORMANCE CATEGORY INCHES
8 ft (2.44 m)	4 ft (1.22 m)	7/16, 15/32, 19/32

*Actual length and width reduced by 1/8 in. (3.18 mm) to allow for proper spacing during installation.

The primary species used in LP® TopNotch® 350 panel is southern yellow pine (89%) and a mix of softwoods and hardwoods from the North Central region, representing 11% [14, 15, 16].

LP® TopNotch® 350 panel is categorized under United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI) for sheathing, sheets, siding and exterior materials (Table 2).

TABLE 2 United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI®) master format code for LP® TopNotch® 350 Sub-Flooring.

CLASSIFICATION STANDARD	CATEGORY	PRODUCT CODE
UNSPSC	Engineered Wood Products	111220 02
CSI/CSC	Wood, Plastics and Composites	06 00 00
	Sheathing	06 16 00
	Rough Carpentry	06 16 13
	Underlayment	06 16 26

LP® TOPNOTCH® 350 SUB-FLOORING PRODUCTION

LP® TopNotch® 350 panel manufacturing is a highly automated, process-controlled and linear production process. The process is illustrated in Figure 1. Once the logs reach the mill the manufacturing process begins with a whole log, which is debarked and then processed through the rotating knives of a stranding machine. Strands are screened and dried in preparation for the bonding process. The strand-resin system mixture is formed into a panel and cured using heat and pressure. The final steps are trimming and cutting panels to size, sanding and applying a protective end or edge seal before packaging and shipping. The final product moisture content is 2-6 percent (oven dry basis).

Panels are protected during shipping with a polypropylene wrapping material made from 100% recycled materials. Other packaging materials include plastic strapping, cardboard shrouds and corner protectors, and wood stickers.

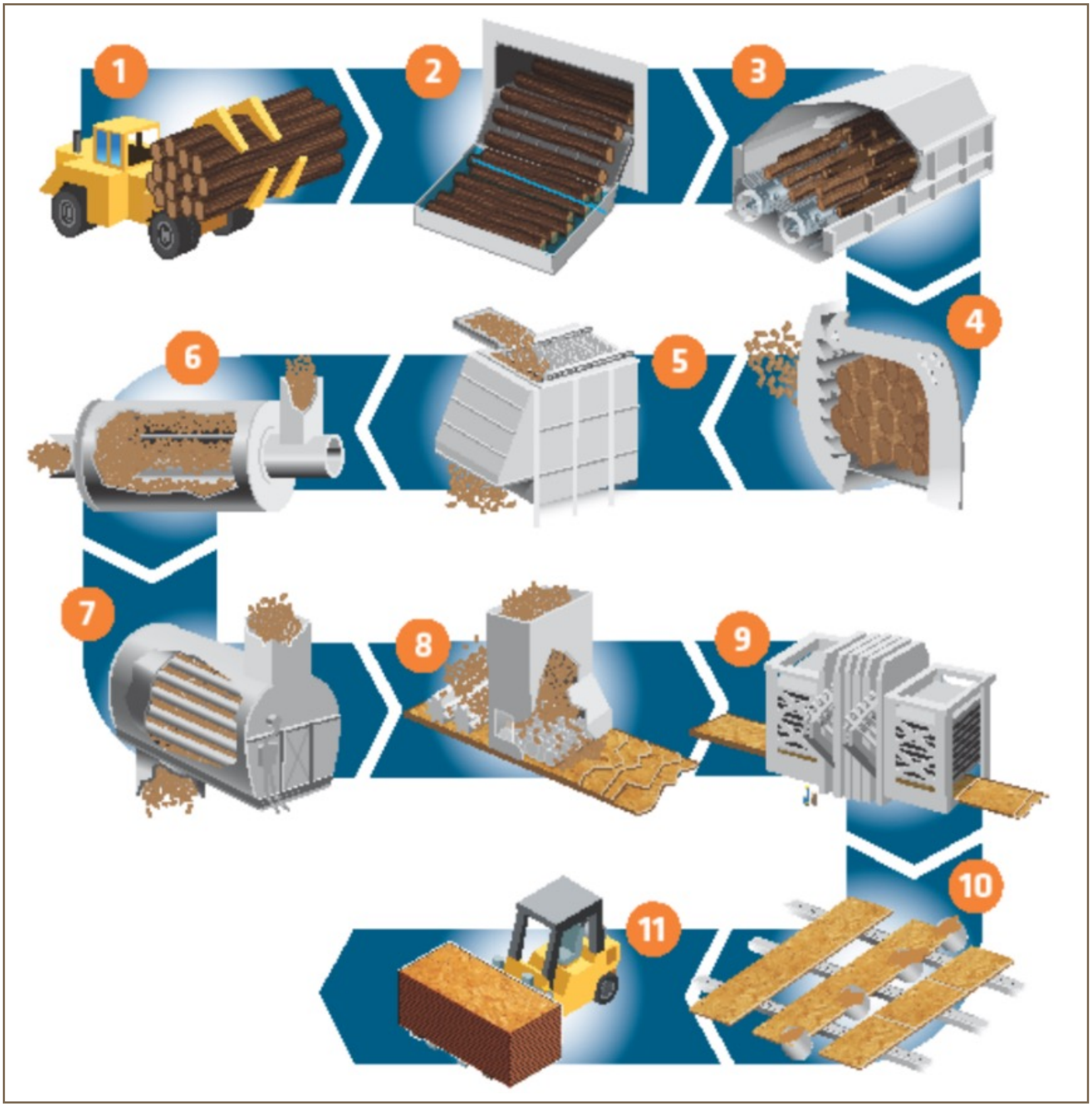


FIGURE 1 Process flow for the production of LP® TopNotch 350® Sub-Flooring

How It's Made

LP® TopNotch® 350 panels are manufactured in a similar fashion to LP® SmartSide® Trim & Siding.

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 are used to reduce to strands with specific dimensions.

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 & Overlay Heat and extreme pressure are used to consolidate strands and cure resins to form a rigid, dense structural panel with integrated weather-resistant overlay.

10 - Finishing Line Panels are cut to size, sanded and edge sealants are applied for further moisture resistance.

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

The technical requirements for LP® TopNotch® 350 panel 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

METHODOLOGICAL FRAMEWORK

TYPE OF EPD AND LIFE CYCLE STAGES

This EPD is intended to represent product specific life cycle assessment (LCA) for LP® TopNotch® 350 panel. Five 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 all LP® TopNotch® 350 product systems from cradle to grave. Information modules included in the LCA are shown in Table 3. 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).

BUILDING LIFE CYCLE INFORMATION MODULES

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 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	X	X	X	X	X	X	X	X	X	X	X	X	X	X

SYSTEM BOUNDARIES AND PRODUCT FLOW DIAGRAM

The product system 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 LP® TopNotch® 350 Sub-Flooring. 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 LP® TopNotch® 350 Sub-Flooring, including packaging. Packaging materials represent less than one percent (0.5%) 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% 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 and 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	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.

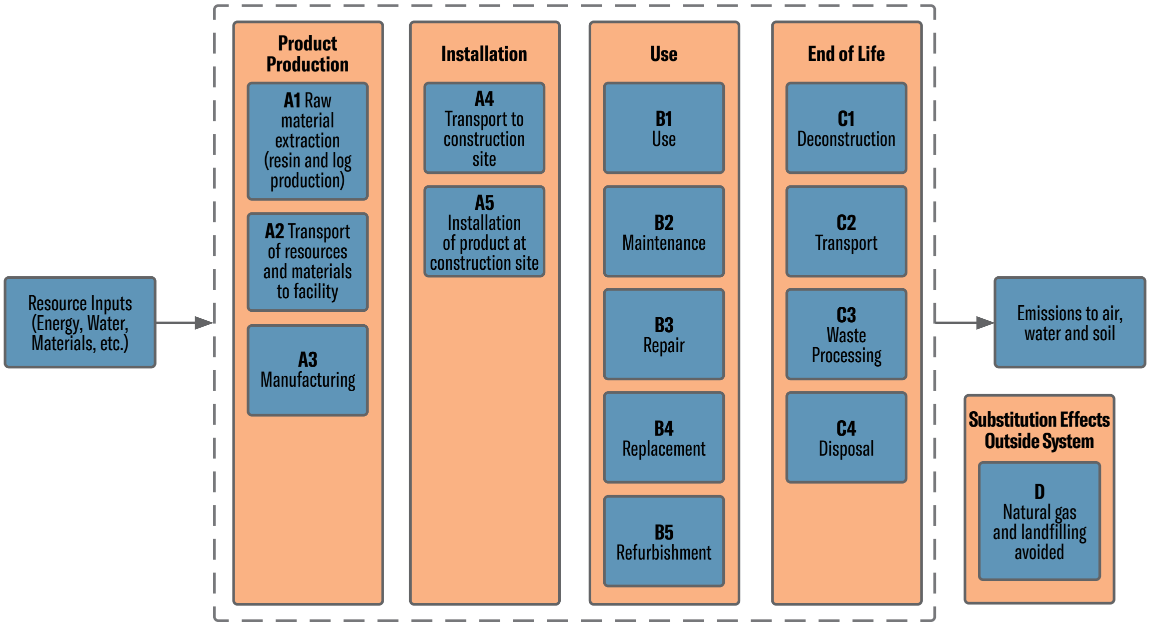


FIGURE 2 Cradle-to-Grave System Boundary for LP® TopNotch® 350 Sub-Flooring

DECLARED UNIT

Table 4 shows the declared unit and additional product information. In accordance with the PCR, the declared unit for LP® TopNotch® 350 Sub-Flooring is one cubic meter (m^3), which represents the area of the panel multiplied by its thickness and installed in a building for 75 years (UL 2020). 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® TopNotch® 350 Sub-Flooring."

PROPERTY	UNIT	VALUE
Mass	kg	765
Thickness	mm	9.5
Density	kg/m^3	765
Moisture Content, Oven-Dry Basis	%	2-6%
PRODUCT COMPOSITION		
Wood	%	>90%
Resin System (MDI, PF, Wax)	%	<4
Overlay	%	<6

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 LP® TopNotch® 350 panel involves multiple processes with generation of co-products (sawdust, chips, bark). LP® TopNotch® 350 panel 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 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 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.

This EPD LCA datasets for forest management from the industry average southeastern softwoods and north central resources and north central hardwoods [14, 15, 16]. All secondary LCI dataset comply with ISO 14040/44 standards for relevance, geographical origin, age and data quality [7, 8, 9].

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.

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.

Other inventory parameters concerning material use, waste, water 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 9.4 [17] was used to organize and accumulate the LCI data and to calculate the LCIA results. The reporting of landfill emission factors used are 0.0035 metric tons of methane (CH_4)/metric ton of product and 0.2060 metric tons of carbon dioxide, CO_2/metric ton of product.

To consider the biogenic carbon dynamics that occur in landfills, UL Environment published an Appendix to the reference PCR that estimates the emissions from landfilling of wood products. The landfill modeling for biogenic carbon is based on the United States EPA WARM model [5] and aligns with the biogenic accounting rules in ISO 21930 Section 7.2.7 and Section 7.2.12. The WARM model is documented by the EPA at https://www.epa.gov/warm/documentation-waste-reduction-model-warm. These background accounting assumptions (Appendix A of the PCR) [18] form the basis for landfill modeling that adjusts the carbon storage as a portion of the initial carbon while accounting for remaining carbon converted to landfill gas. It does not assign the percentage of the wood product sent to the landfill. In 2017, the average U.S. EoL treatments for durable wood products were estimated to be 0% recycling, 0% composting, 18% combustion with energy recovery and 82% landfilling as a percentage of wood material generated by weight. In this EPD it is reported as the "Average" EoL Scenario. Other scenarios adjusted the allocation for 100% landfill and 100% reuse.

BIOGENIC CARBON RESULTS

Table 5 shows additional inventory parameters related to biogenic carbon removal and emissions. The carbon dioxide flows are presented unallocated to consider any coproducts leaving the product system in information Module A3. LP® TopNotch® 350 facilities reported 3.57% (53.92 kg CO_2 eq) of coproduct leaving the system as reported in A3. The biogenic CO_2 component for LP® TopNotch® 350 panel show that the landfill scenario causes a net removal of biogenic carbon from the atmosphere equivalent to 618 kg CO_2 eq. This is caused by the permanent storage of 84% of the biogenic carbon that enters the landfill; only 16% of the wood decomposes as estimated by the U.S. EPA [5]. The net incineration and reuse are zero because of the assumption 100% of product is either completely combusted or reused. 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® TopNotch® 350 Sub-Flooring

ADDITIONAL INVENTORY PARAMETERS		A1 ALL SCENARIOS	A3 ALL SCENARIOS	C4 LANDFILL SCENARIO	C4 INCINERATION SCENARIO	C4 REUSE SCENARIO	C4 AVG
Biogenic Carbon Removal from Product	kg CO_2 eq	-1,207.51	-	-	-	-	-
Biogenic Carbon Emission from Product	kg CO_2 eq	-	53.92	257.67	875.67	875.67	370.14
Biogenic Carbon Removal from Packaging	kg CO_2 eq	-	-	-	-	-	-
Biogenic Carbon Emission Removal from Packaging	kg CO_2 eq	-	-	-	-	-	-
Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production	kg CO_2 eq	-	277.92	-	-	-	-
TOTAL BIOGENIC CO_2 REMOVALS & EMISSIONS							
Net Biogenic Carbon Emission Landfill Scenario	kg CO_2 eq	-618.01					
Net Biogenic Carbon Emission Incineration Scenario	kg CO_2 eq	0.00					
Net Biogenic Carbon Emission Recycling Scenario	kg CO_2 eq	0.00					
Average End-Of-Life Treatment	**kg CO_2 eq**	**-505.53**					

THE RESULTS

A1–A3 - PRODUCT MANUFACTURING

Table 8 presents the cradle-to-gate (A1-A3) LCIA and LCI parameter results for the functional unit of 1 m^3 of LP® TopNotch® 350 panel. 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. Product shipping distances were distributed over a weighted average of 147 km by road and 595 km by rail.

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 2.04 L. The reference service life for the product is 75 years which is the default specified by the UL Part B PCR (UL 2020).

C2 AND C4 EOL SCENARIOS

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 6 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	477.64[1/]	Dry kg
Recovery	Reuse		Dry kg
Recovery	Recycling		Dry kg
Recovery	Landfill	390.71	Dry kg
Recovery	Incineration		Dry kg
Recovery	Incineration with Energy Recovery	86.93[2/]	Dry kg
Recovery	Product or Material for Final Deposition	390.71	Dry kg
Removal of Biogenic Carbon (Excluding Packaging)		(505.53)	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 81% of the total product mass was landfilled

[2/] Remaining 19% 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. 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 11,054 MJ/m^3. The energy equivalent amount of natural gas was calculated based on a lower heating value, or 36.6 MJ/m^3.

Wood Panel energy content = (20.9MJ/kg x 477.64 kg/m^3) + (35.7 MJ/kg x 30.0 kg) = 11,054 MJ/m^3

$$\text{Substitution with Natural gas} = \frac{11{,}054\ MJ/m^3}{36.6\frac{MJ}{m^3}} = 302\ m^3/m^3$$

Displacing 302 cubic meters of natural gas for every cubic meter of LP® TopNotch® 350 panel combusted

TABLE 7 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)	9,395.5	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	

SUMMARY TABLES

Tables 9 to 12 present the cradle-to-grave results for the delivery of the product to the construction site (A4) and the EoL (C2/C4). Table 9 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 10), 100% incineration (Table 11) and 100% reuse (Table 12).

TABLE 8 LCIA Results Summary for 1 m³ of LP® TopNotch® 350 Sub-Flooring – 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	264.52	-1073.15	11.17	1,326.51
Global Warming Potential – Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	0.00	-1207.51	0.00	1,207.51
Global Warming Potential – Fossil	GWP_{FOSSIL}	kg CO_2 eq	264.52	134.35	11.17	119.00
Depletion Potential of the Stratospheric Ozone Layer	ODP	kg CFC-11 eq	1.17E-05	5.60E-06	1.96E-08	6.12E-06
Acidification Potential of Soil and Water Sources	AP	kg SO_2 eq	1.64	0.70	0.06	0.87
Eutrophication Potential	EP	kg N eq	0.60	0.13	0.01	0.46
Formation Potential of Tropospheric Ozone	SFP	kg O_3 eq	40.54	13.93	1.87	24.74
Abiotic Depletion Potential (Adpfossil) for Fossil Resources	ADPf	MJ, NCV	2,136.72	1,080.45	917.72	138.55
Fossil Fuel Depletion	FFD	MJ Surplus	496.73	280.87	20.98	194.88
USE OF PRIMARY RESOURCES						
Renewable Primary Energy Used as Energy	RPRE	MJ, NCV	3,681.70	18.35	0.32	3,663.02
Renewable Primary Energy Used as Material	RPRM	MJ, NCV	15,896.68	15,896.68	0.00	0.00
Non-Renewable Primary Energy Used as Energy	NRPRE	MJ, NCV	4,146.40	2,043.99	141.78	1,960.63
Non-Renewable Primary Energy Used as Material	NRPRM	MJ, NCV	1,070.83	1,070.83	0.00	0.00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY						
Secondary Material	SM	kg	0.00	0.00	0.00	0.00
Renewable Secondary Fuel	RSF	MJ, NCV	0.00	0.00	0.00	0.00
Non-Renewable Secondary Fuel	NRSF	MJ, NCV	0.00	0.00	0.00	0.00
Recovered Energy	RE	MJ, NCV	0.00	0.00	0.00	0.00
MANDATORY INVENTORY PARAMETERS						
Consumption of Freshwater Resources	FW	m³	1.58	0.27	0.00	1.31
INDICATORS DESCRIBING WASTE						
Hazardous Waste Disposed	HWD	kg	0.00	0.00	0.00	0.00
Non-Hazardous Waste Disposed	NHWD	kg	27.19	0.00	0.00	27.19
High-Level Radioactive Waste, Conditioned, to Final Repository	HLRW	m³	4.17E-07	4.99E-09	1.11E-09	4.11E-07
Intermediate- and Low-Level Radioactive Waste, Conditioned, to Final Repository	ILLRW	m³	5.87E-06	1.05E-07	9.71E-09	5.76E-06
Components for Re-Use	CRU	kg	0.00	0.00	0.00	0.00
Materials for Recycling	MR	kg	0.00	0.00	0.00	0.00
Materials for Energy Recovery	MER	kg	0.00	0.00	0.00	0.00
Recovered Energy Exported	EE	MJ, NCV	0.00	0.00	0.00	0.00

TABLE 9 LCIA Results Summary for 1 m³ of LP® TopNotch® 350 Sub-Flooring – 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	-173.01	-611.15	44.85	6.59	0.00	0.00	6.24	0.00	380.46	-133.50
Global Warming Potential – Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	-505.53	-875.67	0.00	0.00	0.00	0.00	0.00	0.00	370.14	0.00
Global Warming Potential – Fossil	GWP_{FOSSIL}	kg CO_2 eq	332.52	264.52	44.85	6.59	0.00	0.00	6.24	0.00	10.31	-133.50
Depletion Potential of the Stratospheric Ozone Layer	ODP	kg CFC-11 eq	1.69E-05	1.17E-05	4.47E-06	1.25E-08	0.00E+00	0.00E+00	2.64E-10	0.00E+00	6.31E-07	-3.02E-12
Acidification Potential of Soil and Water Sources	AP	kg SO_2 eq	5.07	1.64	0.39	2.82	0.00	0.00	0.07	0.00	0.14	-0.03
Eutrophication Potential	EP	kg N eq	0.74	0.60	0.04	0.09	0.00	0.00	0.00	0.00	0.01	0.00
Formation Potential of Tropospheric Ozone	SFP	kg O_3 eq	57.34	40.54	11.59	0.01	0.00	0.00	1.84	0.00	3.36	-0.08
Abiotic Depletion Potential (Adpfossil) for Fossil Resources	ADPf	MJ, NCV	4,322.47	2,136.72	585.01	88.89	1.00	0.00	45.30	1.00	142.27	-1943.35
Fossil Fuel Depletion	FFD	MJ Surplus	825.27	496.73	84.56	13.35	2.00	0.00	6.80	2.00	19.89	-322.48
USE OF PRIMARY RESOURCES												
Renewable Primary Energy Used as Energy	RPRE	MJ, NCV	5,431.57	3,681.70	6.96	0.21	0.00	0.00	0.00	0.00	1,742.71	0.00
Renewable Primary Energy Used as Material	RPRM	MJ, NCV	15,896.68	15,896.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Renewable Primary Energy Used as Energy	NRPRE	MJ, NCV	5,074.13	4,146.40	602.36	90.20	0.00	0.00	94.96	0.00	140.21	-66.34
Non-Renewable Primary Energy Used as Material	NRPRM	MJ, NCV	1,070.83	1,070.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY												
Secondary Material	SM	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable Secondary Fuel	RSF	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Renewable Secondary Fuel	NRSF	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recovered Energy	RE	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MANDATORY INVENTORY PARAMETERS												
Consumption of Freshwater Resources	FW	m^3	1.93	1.58	0.27	0.00	0.00	0.00	0.00	0.00	0.09	0.00
INDICATORS DESCRIBING WASTE												
Hazardous Waste Disposed	HWD	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Hazardous Waste Disposed	NHWD	kg	4.18E+02	2.72E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.91E+02	0.00E+00
High-Level Radioactive Waste, Conditioned, to Final Repository	HLRW	m^3	4.24E-07	4.17E-07	4.99E-09	1.11E-09	1.00E+00	0.00E+00	0.00E+00	0.00E+00	7.31E-10	0.00E+00
Intermediate- and Low-Level Radioactive Waste, Conditioned, to Final Repository	ILLRW	m^3	6.09E-06	5.87E-06	1.05E-07	9.71E-09	2.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-07	0.00E+00
Components for Re-Use	CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for Recycling	MR	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for Energy Recovery	MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recovered Energy Exported	EE	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 10 LCIA Results Summary for 1 m³ of LP® TopNotch® 350 Sub-Flooring – 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	-290.73	-611.15	44.85	6.59	0.00	0.00	6.24	0.00	262.73	0.00
Global Warming Potential – Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	-618.01	-875.67	0.00	0.00	0.00	0.00	0.00	0.00	257.67	0.00
Global Warming Potential – Fossil	GWP_{FOSSIL}	kg CO_2 eq	327.28	264.52	44.85	6.59	0.00	0.00	6.24	0.00	5.07	0.00
Depletion Potential of the Stratospheric Ozone Layer	ODP	kg CFC-11 eq	1.70E-05	1.17E-05	4.47E-06	1.25E-08	0.00E+00	0.00E+00	2.64E-10	0.00E+00	7.72E-07	0.00E+00
Acidification Potential of Soil and Water Sources	AP	kg SO_2 eq	4.94	1.64	0.39	2.82	0.00	0.00	0.07	0.00	0.02	0.00
Eutrophication Potential	EP	kg N eq	0.73	0.60	0.04	0.09	0.00	0.00	0.00	0.00	0.01	0.00
Formation Potential of Tropospheric Ozone	SFP	kg O_3 eq	54.39	40.54	11.59	0.01	0.00	0.00	1.84	0.00	0.41	0.00
Abiotic Depletion Potential (Adpfossil) for Fossil Resources	ADPf	MJ, NCV	4,354.12	2,136.72	1,080.45	917.72	0.00	0.00	45.30	0.00	173.93	0.00
Fossil Fuel Depletion	FFD	MJ Surplus	829.70	496.73	280.87	20.98	0.00	0.00	6.80	0.00	24.31	0.00
USE OF PRIMARY RESOURCES												
Renewable Primary Energy Used as Energy	RPRE	MJ, NCV	3,690.52	3,681.70	6.96	0.21	0.00	0.00	0.00	0.00	1.65	0.00
Renewable Primary Energy Used as Material	RPRM	MJ, NCV	15,896.68	15,896.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Renewable Primary Energy Used as Energy	NRPRE	MJ, NCV	4,992.84	4,146.40	602.36	90.20	0.00	0.00	94.96	0.00	58.92	0.00
Non-Renewable Primary Energy Used as Material	NRPRM	MJ, NCV	1,070.83	1,070.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY												
Secondary Material	SM	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable Secondary Fuel	RSF	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Renewable Secondary Fuel	NRSF	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recovered Energy	RE	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MANDATORY INVENTORY PARAMETERS												
Consumption of Freshwater Resources	FW	m^3	1.90	1.58	0.27	0.00	0.00	0.00	0.00	0.00	0.06	0.00
INDICATORS DESCRIBING WASTE												
Hazardous Waste Disposed	HWD	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Hazardous Waste Disposed	NHWD	kg	504.83	27.19	0.00	0.00	0.00	0.00	0.00	0.00	477.64	0.00
High-Level Radioactive Waste, Conditioned, to Final Repository	HLRW	m3	4.24E-07	4.17E-07	4.99E-09	1.11E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.94E-10	0.00E+00
Intermediate- and Low-Level Radioactive Waste, Conditioned, to Final Repository	ILLRW	m3	6.12E-06	5.87E-06	1.05E-07	9.71E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E-07	0.00E+00
Components for Re-Use	CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for Recycling	MR	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for Energy Recovery	MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recovered Energy Exported	EE	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 11 LCIA Results Summary for 1 m³ of LP® TopNotch® 350 Sub-Flooring – 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	356.10	-611.15	44.85	6.59	0.00	0.00	6.24	0.00	909.56	-733.52
Global Warming Potential – Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	0.00	-875.67	0.00	0.00	0.00	0.00	0.00	0.00	875.67	0.00
Global Warming Potential – Fossil	GWP_{FOSSIL}	kg CO_2 eq	356.10	264.52	44.85	6.59	0.00	0.00	6.24	0.00	33.89	-733.52
Depletion Potential of the Stratospheric Ozone Layer	ODP	kg CFC-11 eq	1.62E-05	1.17E-05	4.47E-06	1.25E-08	0.00E+00	0.00E+00	2.64E-10	0.00E+00	5.57E-10	-1.66E-11
Acidification Potential of Soil and Water Sources	AP	kg SO_2 eq	5.63	1.64	0.39	2.82	0.00	0.00	0.07	0.00	0.71	-0.18
Eutrophication Potential	EP	kg N eq	0.76	0.60	0.04	0.09	0.00	0.00	0.00	0.00	0.03	0.00
Formation Potential of Tropospheric Ozone	SFP	kg O_3 eq	70.60	40.54	11.59	0.01	0.00	0.00	1.84	0.00	16.63	-0.44
Abiotic Depletion Potential (Adpfossil) for Fossil Resources	ADPf	MJ, NCV	4,180.19	2,136.72	1,080.45	917.72	0.00	0.00	45.30	0.00	0.00	-1,0677.74
Fossil Fuel Depletion	FFD	MJ Surplus	805.38	496.73	280.87	20.98	0.00	0.00	6.80	0.00	0.00	-1,771.85
USE OF PRIMARY RESOURCES												
Renewable Primary Energy Used as Energy	RPRE	MJ, NCV	13,256.75	3,681.70	6.96	0.21	0.00	0.00	0.00	0.00	9,567.88	0.00
Renewable Primary Energy Used as Material	RPRM	MJ, NCV	15,896.68	15,896.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Renewable Primary Energy Used as Energy	NRPRE	MJ, NCV	5,439.49	4,146.40	602.36	90.20	0.00	0.00	94.96	0.00	505.58	-364.51
Non-Renewable Primary Energy Used as Material	NRPRM	MJ, NCV	1,070.83	1,070.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY												
Secondary Material	SM	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable Secondary Fuel	RSF	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Renewable Secondary Fuel	NRSF	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recovered Energy	RE	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MANDATORY INVENTORY PARAMETERS												
Consumption of Freshwater Resources	FW	m³	2.07	1.58	0.27	0.00	0.00	0.00	0.00	0.00	0.22	0.00
INDICATORS DESCRIBING WASTE												
Hazardous Waste Disposed	HWD	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Hazardous Waste Disposed	NHWD	kg	27.19	27.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
High-Level Radioactive Waste, Conditioned, to Final Repository	HLRW	m3	4.23E-07	4.17E-07	4.99E-09	1.11E-09	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	5.99E-06	5.87E-06	1.05E-07	9.71E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for Re-Use	CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for Recycling	MR	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for Energy Recovery	MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recovered Energy Exported	EE	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 12 LCIA Results Summary for 1 m³ of LP® TopNotch® 350 Sub-Flooring – 100% Reuse 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	322.21	-611.15	44.85	6.59	0.00	0.00	6.24	0.00	875.67	-264.52
Global Warming Potential – Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	0.00	-875.67	0.00	0.00	0.00	0.00	0.00	0.00	875.67	0.00
Global Warming Potential – Fossil	GWP_{FOSSIL}	kg CO_2 eq	322.21	264.52	44.85	6.59	0.00	0.00	6.24	0.00	0.00	-264.52
Depletion Potential of the Stratospheric Ozone Layer	ODP	kg CFC-11 eq	1.62E-05	1.17E-05	4.47E-06	1.25E-08	0.00E+00	0.00E+00	2.64E-10	0.00E+00	0.00E+00	-1.17E-05
Acidification Potential of Soil and Water Sources	AP	kg SO_2 eq	4.92	1.64	0.39	2.82	0.00	0.00	0.07	0.00	0.00	-1.64
Eutrophication Potential	EP	kg N eq	0.73	0.60	0.04	0.09	0.00	0.00	0.00	0.00	0.00	-0.60
Formation Potential of Tropospheric Ozone	SFP	kg O_3 eq	53.98	40.54	11.59	0.01	0.00	0.00	1.84	0.00	0.00	-40.54
Abiotic Depletion Potential (Adpfossil) for Fossil Resources	ADPf	MJ, NCV	4,180.19	2,136.72	1,080.45	917.72	0.00	0.00	45.30	0.00	0.00	-2,136.72
Fossil Fuel Depletion	FFD	MJ Surplus	805.38	496.73	280.87	20.98	0.00	0.00	6.80	0.00	0.00	-496.73
USE OF PRIMARY RESOURCES												
Renewable Primary Energy Used as Energy	RPRE	MJ, NCV	3,688.87	3,681.70	6.96	0.21	0.00	0.00	0.00	0.00	0.00	-3,681.70
Renewable Primary Energy Used as Material	RPRM	MJ, NCV	15,896.68	15,896.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-15,896.68
Non-Renewable Primary Energy Used as Energy	NRPRE	MJ, NCV	4,933.92	4,146.40	602.36	90.20	0.00	0.00	94.96	0.00	0.00	-4,146.40
Non-Renewable Primary Energy Used as Material	NRPRM	MJ, NCV	1,070.83	1,070.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1,070.83
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY												
Secondary Material	SM	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable Secondary Fuel	RSF	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Renewable Secondary Fuel	NRSF	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recovered Energy	RE	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MANDATORY INVENTORY PARAMETERS												
Consumption of Freshwater Resources	FW	m^3	1.85	1.58	0.27	0.00	0.00	0.00	0.00	0.00	0.00	-1.58
INDICATORS DESCRIBING WASTE												
Hazardous Waste Disposed	HWD	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Hazardous Waste Disposed	NHWD	kg	27.19	27.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-27.19
High-Level Radioactive Waste, Conditioned, to Final Repository	HLRW	m3	4.23E-07	4.17E-07	4.99E-09	1.11E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-4.17E-07
Intermediate- and Low-Level Radioactive Waste, Conditioned, to Final Repository	ILLRW	m3	5.99E-06	5.87E-06	1.05E-07	9.71E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.87E-06
Components for Re-Use	CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for Recycling	MR	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for Energy Recovery	MER	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Recovered Energy Exported	EE	MJ, NCV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

INTERPRETATION

The primary sources of impacts across the life cycle are the manufacturing of LP® TopNotch® 350 panel (Modules A1-A3) and the net flows of biogenic carbon (Table 5). Table 5 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, landfill gas and incineration emissions are significantly less than the flows of biogenic carbon into the system in Module A1 (removal of biomass from a net neutral sustainable forest). The permanent biogenic carbon storage is so significant (506 kg CO_2 eq.) (Table 5) 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. The total global warming potential (GWP_{TOTAL}) of -173.01 kg CO_2 eq. (Table 9 (A1-C4)) means the product system removes more greenhouse gases from the atmosphere than are emitted in its production and disposal combined.

BIOGENIC CARBON NOT DECLARED (A1-C4):

Table 9 – Cradle-to-grave GWP_{FOSSIL} = 332.52, average EoL treatment assuming 82% landfill and 18% incineration with energy recovery

Table 10 – Cradle-to-grave GWP_{FOSSIL} = 327.28, EoL treatment assumed to be 100% landfill

Table 11 – Cradle-to-grave GWP_{FOSSIL} = 356.10, EoL treatment assumed to be 100% incineration with energy recovery

Table 12 – Cradle-to-grave GWP_{FOSSIL} = 322.21, EoL treatment assumed to be 100% reuse

BIOGENIC CARBON DECLARED (A1-C4):

Table 9 – Cradle-to-grave GWP_{TOTAL} = -173.01, average EoL treatment assuming 82% landfill and 18% incineration with energy

Table 10 – Cradle-to-grave GWP_{TOTAL} = -290.73, EoL treatment assumed to be 100% landfill

Table 11 – Cradle-to-grave GWP_{TOTAL} = 356.10, EoL treatment assumed to be 100% incineration with energy recovery

Table 12 – Cradle-to-grave GWP_{TOTAL} = 322.21, EoL treatment assumed to be 100% reuse

Summarizing the C1-C4 GWP_{FOSSIL} from Table 9, the most common representation of EoL treatment for wood products, the A1-A3 GWP_{FOSSIL} 264.52 (Table 8) increases to 332.52 kg CO_2 eq. When biogenic carbon is added, there is a dramatic drop of GWP to -173.01 kg CO_2 eq. This further can decrease by 133.50 kg CO_2 eq when substitution benefits are included.

The lowest GWP_{TOTAL} occurs in the EoL 100% landfill treatment where the result is -290.73 when biogenic carbon is added (A1-C4, Table 10). This scenario maximizes the permanent carbon storage in the landfill which, ***strictly in terms of the GWP only***, is the most beneficial treatment for wood at EoL.

The highest GWP_{TOTAL} (356.10) is in the 100% incineration EoL treatment which excludes the substitution benefits of fossil fuel (A1-C4, Table 11). This scenario assumes the worst-case carbon storage and fossil fuel combustion. Substitution can provide a significant reduction in the GWP (-733.52 kg CO_2 eq/m^3) (Module D, Table 11).

In this cradle-to-grave EPD there is a wide range of GWP_{TOTAL} results 356.10 to -290.73 kg CO_2 eq/m^3 illustrating the importance of making correct assumptions for the LCA and the intended use. Louisiana-Pacific 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 [18]. 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 functional unit declared in this LCA assumes the default RSL of 75 years [18].

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

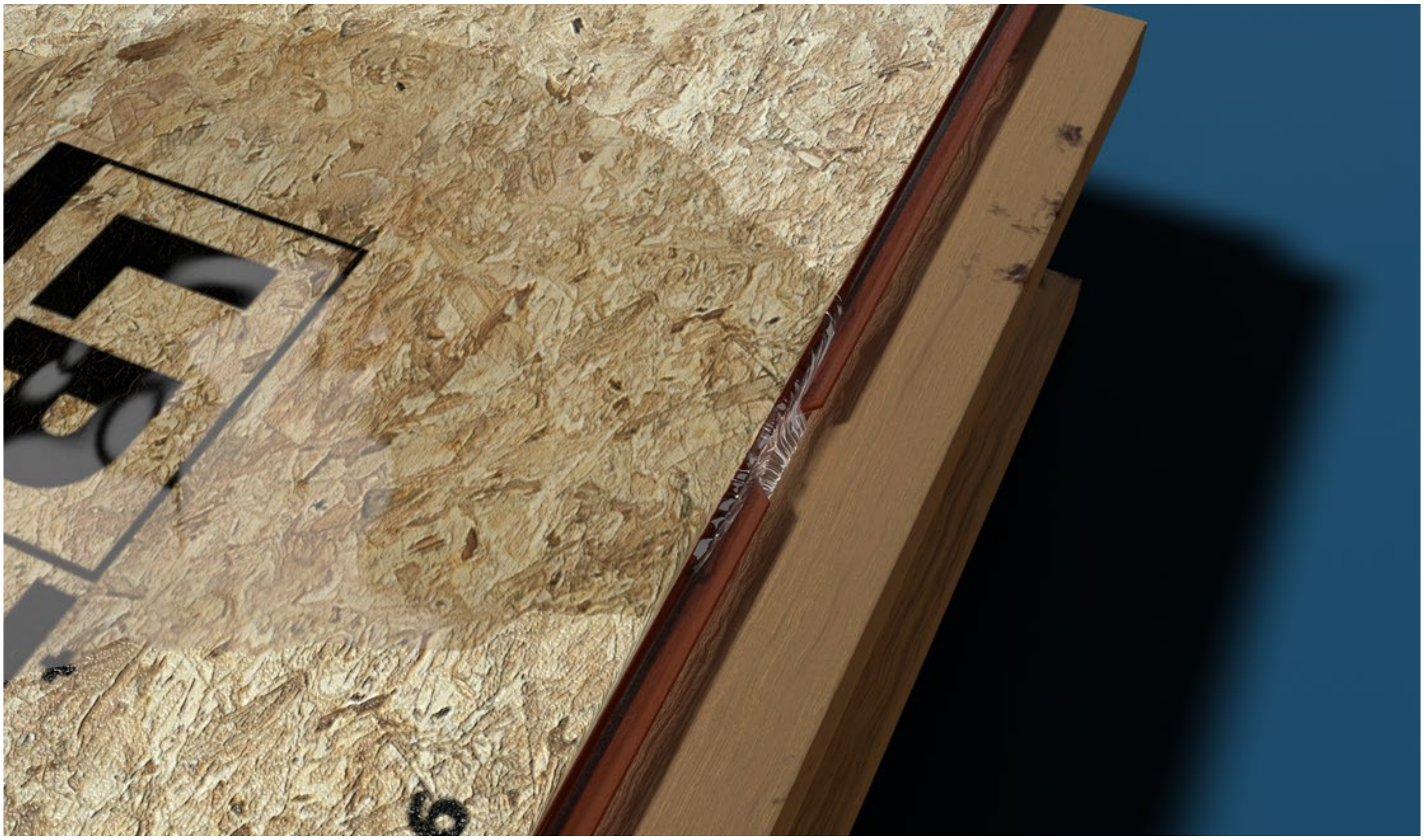
EPDs can complement but cannot replace tools and certifications that are designed to address environmental impacts and/or set performance thresholds—e.g. Type 1 certifications, health assessments and declarations, etc.

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.



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