

# Environmental Product Declaration




## Cradle-to-Grave EPD for Versa-Lam<sup>®</sup> Veneer Laminated Lumber (LVL) and Boise Cascade Veneer Laminated Timber (VLT)

Summary Results – Average End-of-Life Treatment		Cradle-to-Grave - (A1-C4)
Global warming potential, Total	kg CO <sub>2</sub> e	-306.46
Global warming potential, Biogenic	kg CO <sub>2</sub> e	-570.73
Global warming potential, Fossil	kg CO <sub>2</sub> e	264.27
Ozone Depletion	kg CF11e	9.90E-06
Acidification	kg SO <sub>2</sub> e	1.28
Eutrophication	kg Ne	0.73
Smog	kg O <sub>3</sub> e	31.61
Renewable Energy	MJ, LHV	5,503.39
Non-renewable Energy	MJ, LHV	4,782.95



# ASTM Certified Environmental Product Declaration

<b>PROGRAM OPERATOR</b>	ASTM International 100 Barr Harbor Drive PO Box C700 West Conshohocken, PA, 19428-2959 USA www.astm.org	 <b>ASTM INTERNATIONAL</b> Helping our world work better
<b>GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER</b>	ASTM Program Operator Rules. Version: 8.0, Revised 04/29/20	
<b>DECLARATION OWNER</b>	Boise Cascade Company	 <b>Boise Cascade</b> ENGINEERED WOOD PRODUCTS
<b>DECLARATION NUMBER</b>	EPD 169	
<b>DECLARED PRODUCT</b>	Laminated Veneer Lumber (LVL); Brand name: Versa-Lam <sup>®</sup> LVL Veneer Laminated Timber (VLT); Brand name Boise Cascade <sup>®</sup> VLT	
<b>DECLARED UNIT</b>	One cubic meter (1 m <sup>3</sup> ) of Versa-Lam <sup>®</sup> LVL and Boise Cascade VLT produced at Boise Cascade's facilities.	
<b>REFERENCE PCR AND VERSION NUMBER</b>	ISO 21930:2017 Sustainability in Building and Civil Engineering works – Core Rules for environmental Product Declaration of Construction Products and Services. [11]  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, v4.0 2022 [16] Part B: Structural and Architectural Wood Products EPD Requirements, v1.1 2020 [17]	
<b>DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE</b>	Boise Cascade <sup>®</sup> VLT and Versa-Lam <sup>®</sup> LVL are engineered wood products with high structural strength and stability. They can be used as building material for structural floor slabs, walls, beams, ribs, and columns.	
<b>MARKETS OF APPLICABILITY</b>	Construction Sector, Mass timber design	
<b>DATE OF ISSUE</b>	March 31, 2026	
<b>PERIOD OF VALIDITY</b>	5 years	
<b>EPD TYPE</b>	Product-Specific EPD	
<b>EPD SCOPE</b>	Cradle to Grave	
<b>YEAR OF REPORTED MANUFACTURER PRIMARY DATA</b>	2023	
<b>LCA SOFTWARE</b>	SimaPro v10.2	

<p><b>LCI DATABASES</b></p>	<p>USLCI [13], Ecoinvent 3.11 [4], Datasmart 2023 [12]</p>
<p><b>LCIA METHODOLOGY</b></p>	<p>TRACI 2.1 v1.09 [3], CML-IA Baseline V3.11, CED, LHV 1.01</p>
<p><b>THE SUB-CATEGORY PCR REVIEW WAS CONDUCTED BY:</b></p>	<p>Dr. Thomas Gloria (chair) t.gloria@industrial-ecology.com</p>
<p><b>LCA AND EPD DEVELOPER</b> This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:</p>	<p>The Consortium for Research on Renewable Industrial Materials (CORRIM) PO Box 2432 Corvallis, OR 97330 541-231-2627 <a href="http://www.corrим.org">www.corrим.org</a></p>  <p><i>Maura Puetter</i></p>
<p>This declaration was independently verified in accordance with ISO 14025:2006 [8]. The UL Environment “Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report,” v4.0 (2022), in conformance with ISO 21930:2017 with additional considerations from the USGBC/UL Environment Part A Enhancement (2017).</p> <p>Tim Brooke, ASTM International  <input type="checkbox"/> Internal                      <input checked="" type="checkbox"/> External</p>	
<p><b>INDEPENDENT VERIFIER</b> This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:</p>	
<p><b>LIMITATIONS</b></p> <ul style="list-style-type: none"> <li>• Environmental declarations from different programs (ISO 14025) may not be comparable.</li> <li>• Comparison of the environmental performance of Structural and Architectural Wood Products using EPD information shall be based on the product’s use and impacts at the construction works level, and therefore EPDs may not be used for comparability purposes when not considering the construction works energy use phase as instructed under this PCR.</li> <li>• Full conformance with the PCR for LVL and VLT allows EPD comparability only when all stages of a life cycle have been considered, when they comply with all referenced standards (ISO 21930:2017 §5.5), use the same sub-category Part B PCR, and use equivalent scenarios with respect to construction works. However, variations and deviations are possible. It should be noted that different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.</li> </ul>	

# Company and Product Description

## Boise Cascade Company

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Boise Cascade® is a manufacturer of engineered wood products. Since our founding in 1957, we've grown to become a leading manufacturer and distributor of building materials in North America and beyond. Through conservation and sustainable practices, we are actively contributing to the responsible use and protection of the natural environment, which benefits our employees, our customers, and the communities we work and live in.

## Product Description

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Versa Lam® Laminated Veneer Lumber (LVL) and Boise Cascade® Veneer Laminated Timber (VLT), are engineered wood products comprised of thin layers of wood called veneers that are laid up, glued, and pressed to produce structural sized members.

Boise Cascade's mass timber VLT products are based on Versa-Lam LVL product components, produced using the same machinery and with the same composition, but assembled in larger product dimensions so that it may be used in mass timber designs. As the VLT and LVL products have identical composition and manufacturing processes, they can be considered identical in terms of their environmental impacts as calculated for this EPD.

Laminated veneer lumber (LVL) and VLT are a structural veneer-based building materials that belong to the mass timber product line. Mass timber is a category of engineered wood products characterized by large wood components used in floor, wall, and roof for both residential and commercial construction.

Southern pine dominated the species mix for Boise Cascade LVL and VLT products, based on responses from the participating facilities, representing 74 percent followed by Douglas-fir (*Pseudotsuga menziesii*) at 26 percent. Southern pine is a mixture of several species with similar characteristics. The species are primarily longleaf pine (*Pinus palustris*), loblolly pine (*P. taeda*), shortleaf pine (*P. echinata*), and slash pine (*P. elliottii*). The weighted average moisture content of the LVL and VLT ready for shipment was 6.1 percent, oven dry basis.

Versa-Lam applications are for beams, headers, columns, stair stringers and rim boards and come in a variety of sizes from 1 ½ - 5 ¼ inch thickness, 3 ½ - 24-inch widths with maximum lengths up to 80 feet (most common 48-66 feet). Boise Cascade VLT panel thickness can range from 2-1/8 to 12-3/4 inch and 4-foot widths and lengths up to 60 feet. Boise Cascade VLT is designed for wall, floor, and roof panel applications.

## LVL and VLT Certifications

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- VLT - APA PR L335-2025
- LVL - APA ICC-ES ESR-1040-2025
- LVL - APA PR-S201-2025

Classification codes for LVL and VLT are the United Nations Standard Products and Services Code (UNSPSC) – 111220 00 and Construction Specifications Institute (CSI) code for engineered wood products 06 11 13, heavy timber framing 06 13 23, and shop-fabricated structural wood 06 17 00 (Table 1).

**Table 1. United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI) MasterFormat Code for LVL and VLT**

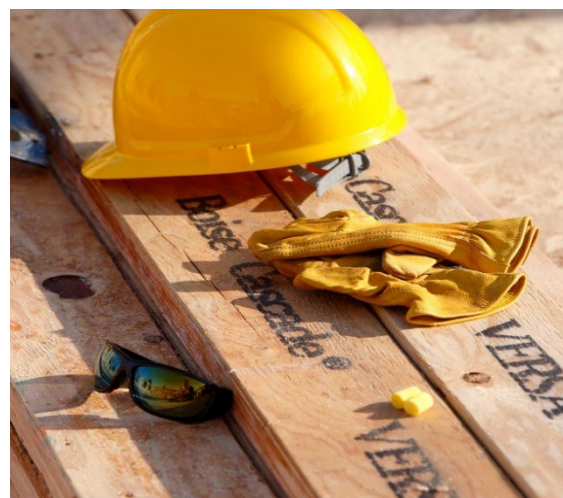
Classification Scheme	Product category	Product Code
<b>Laminated Veneer Lumber - LVL</b>		
UNSPSC	Wood Veneers	11122004
CSI/CSC	Engineered Wood Products	06 11 13
	Heavy Timber Framing	06 13 23
	Laminated Veneer Lumber	06 17 13
<b>Veneer Laminated Timber - VLT</b>		
UNSPSC	Wood Sheathing or Sheets	30103604
CSI/CSC	Engineered Wood Products	06 11 13
	Heavy Timber Construction	06 13 00
	Shop-Fabricated Structural Wood	06 17 00

## Methodological Framework

The underlying LCA [13] was performed in conformance with ISO 14040/44 [9,10], ISO 21930 [11] and EN15804 [5], as well as the PCR.

### Type of EPD and Life Cycle Stages

This EPD is intended to represent a product specific life cycle assessment (LCA) for LVL and VLT products produced by Boise Cascade facilities in the U.S. The manufacturer provided production data, resource use, energy and fuel use, transportation distances, and onsite processing emissions. The underlying LCA [13] investigates LVL and VLT production from cradle-to-gate. Information modules included in the LCA are shown in Table 2. This EPD includes mandatory modules A1-A3 for a cradle-to-gate analysis.



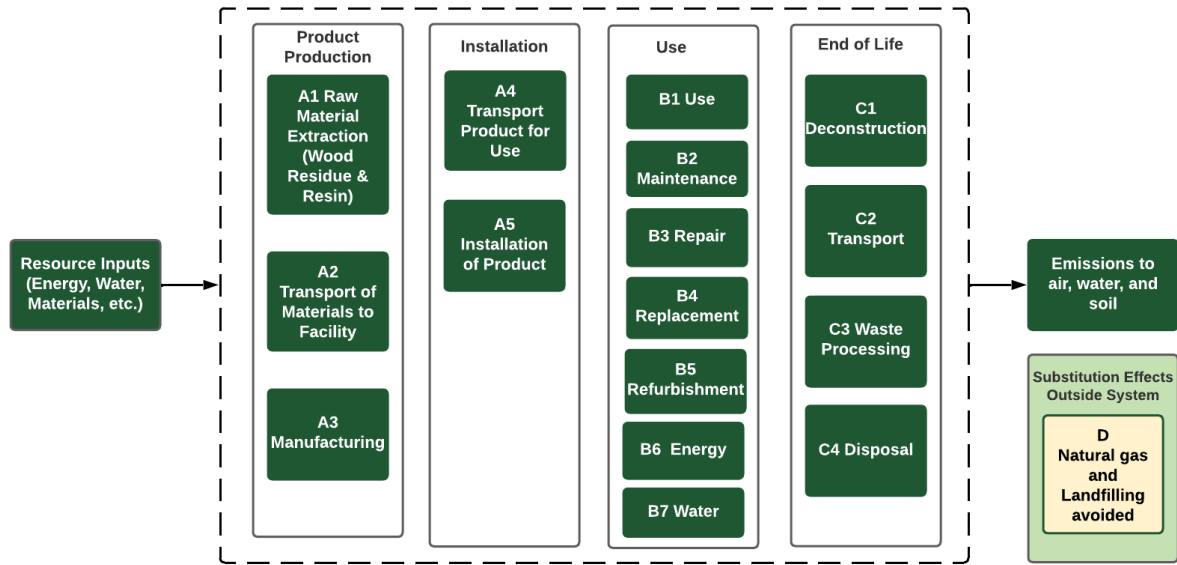
**Table 2. Life Cycle Stages & Information Modules per ISO 21930**

PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE						END-OF-LIFE STAGE				OPTIONAL BENEFITS	
A1	A2	A3	A4	A5	B1 – 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 During Use	Building Operational Water Use During Use	Deconstruction	Transport	Waste	Disposal	Reuse, Recycle, & Recovery benefits
X	X	X	X	X	X						X	X	X	X	X	

## System Boundaries and Product Flow Diagram

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

<b>A1 Extraction and upstream production</b>	A1 includes the cradle-to-gate production of veneer, PLV, and resins that are used in LVL and VLT manufacturing.  Also included is 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.
<b>A2 Transport to facility</b>	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).
<b>A3 Manufacturing</b>	LVL and VLT Manufacturing including packaging. Packing materials represent only 0.046 percent of the mass of the main product. Lumber Wrap represents 87% and strapping represents 13% of the total packaging mass.
<b>A4 - Product transportation</b>	This LCA product system includes actual product shipping distance to customers, secondary manufacturers retail, and distribution centers. Road and rail transportation modes were utilized.
<b>A5 - Installation</b>	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.
<b>B1 – B7 - Use</b>	Considered null for this EPD
<b>C1- Demolition</b>	Considered null for this EPD
<b>C2 – Transportation to EOL treatment</b>	Average or specific transportation of product from construction site to EoL processes.
<b>C3 – Waste</b>	Considered null for this EPD
<b>C4 - Processing &amp; Disposal</b>	Final deposition of wastes to be landfilled, incinerated, or reused/recycled.
<b>D - Benefits beyond the system boundary</b>	Optional information about the potential net benefits from reuse, recycling, and energy recovery.



**Figure 1. Cradle-to-Gate (A1-A3) System Boundary for Laminated Veneer Lumber and Veneer Laminated Lumber Production.**

### Declared Unit

This LCAs considers the life cycle from “cradle to grave” (Modules A1-A3, A4,A5, B, C1-C4, and D). The declared unit is defined as “the production of one cubic meter (1 m<sup>3</sup>) of LVL and VLT produced at one of Boise Cascade’s three facilities. The product properties and composition associated with the declared unit are provided in Table 3.

**Table 3. Product Properties and Composition of 1 Cubic Meter (m<sup>3</sup>) of Laminated Veneer Lumber and Veneer Laminated Lumber, Unallocated**

Product Properties	Unit per m <sup>3</sup>	Value
Mass @ moisture content	kg	572.18
Mass @ oven dry	odkg	539.24
Moisture content	%	6.21
Product Composition	Unit	Value
Wood	odkg	515.18
Adhesive	kg	24.06

## Allocation Methods

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Allocation is the method used to partition the environmental load of a process when several products or functions share the same process. The input material for producing LVL and VLT are veneers and PLV. Following the PCR [16,17] and ISO 21930:2017, allocation is based on physical properties (e.g., mass or volume). For this study, a mass allocation was achieved for the primary product and subsequent by-products. Some by-products used internally were used for on-site energy generation. Packaging inputs are not related to the by-products and are allocated 100% to the final product.

## Cut-off Criteria

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The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute to 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

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Primary and secondary data sources, as well as the respective data quality assessment, are documented in the underlying LCA project report in accordance with PCR [17]. Third party verified ISO [7,8,9] secondary LCI data sets contribute <1-14% of total impact to any of the required impact categories identified by the applicable PCR [16,17].

## Treatment of Biogenic Carbon

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Biogenic carbon emissions and removals are reported in accordance with ISO 21930 7.2.7. and 7.2.12. ISO 21930 requires a demonstration of forest sustainability to characterize carbon removals with a factor of -1 kg CO<sub>2</sub>eq/kg CO<sub>2</sub>. 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 report 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<sub>2</sub>eq/kg CO<sub>2</sub>.

## Environmental Parameters Derived from the LCA

The impact categories and characterization factors for the LCIA were derived from the U.S. EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts - TRACI 2.1 v1.09 [3]. The total primary energy consumption is tabulated from the LCI results based on the Cumulative Energy Demand Method (CED, LHV, v1.01) published by Ecoinvent [4]. Lower heating value of primary energy carriers is used to calculate the primary energy values reported in the study.

Other inventory parameters concerning material use, waste, water use, and biogenic carbon were drawn from the LCI results. We followed the ACLCA's Guidance to Calculating non-LCIA Inventory Metrics in accordance with ISO 21930:2017 [1]. SimaPro 10.1 [14] was used to organize and accumulate the LCI data, and to calculate the LCIA results.

The landfill modeling for biogenic carbon is based on the United States EPA WARM model [7] 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>. In 2018, 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 [6] 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.

**Table 4. Selected Impact Category Indicators and Inventory Parameters**

Impact Indicators per ISO 21930	Abbreviation	Units	Method
<b>Core Mandatory Impact Indicator</b>			
Global warming potential, Total	GWP <sub>TOTAL</sub>	kg CO <sub>2</sub> eq	GWP <sub>BIOGENIC</sub> + GWP <sub>FOSSIL</sub>
Global warming potential, Biogenic	GWP <sub>BIOGENIC</sub>	kg CO <sub>2</sub> eq	TRACI 2.1 V1.09 + LCI Indicator
Global warming potential, Fossil	GWP <sub>FOSSIL</sub>	kg CO <sub>2</sub> eq	TRACI 2.1 V1.09
Depletion potential of the stratospheric ozone layer	ODP	kg CF-11eq	TRACI 2.1 V1.09
Acidification potential of soil and water sources	AP	kg SO <sub>2</sub> eq	TRACI 2.1 V1.09
Eutrophication potential	EP	kg N eq	TRACI 2.1 V1.09
Formation potential of tropospheric ozone	SFP	kg O <sub>3</sub> eq	TRACI 2.1 V1.09
Fossil fuel depletion	FFD	MJ Surplus	TRACI 2.1 V1.09
Abiotic depletion potential (ADP fossil) for fossil resources;	ADP <sub>f</sub>	MJ, LHV	CML-IA Baseline V3.11
<b>Use of Primary Resources</b>			
Renewable primary energy carrier used as energy	RPRE	MJ, LHV	CED (LHV) V1.01
Renewable primary energy carrier used as material	RPRM	MJ, LHV	LCI Indicator
Non-renewable primary energy carrier used as energy	NRPRE	MJ, LHV	CED (LHV) V1.01
Renewable primary energy carrier used as material	NRPRM	MJ, LHV	LCI Indicator
<b>Secondary material, secondary fuel and recovered energy</b>			
Secondary material	SM	kg	LCI Indicator
Renewable secondary fuel	RSF	MJ, LHV	LCI Indicator
Non-renewable secondary fuel	NRSF	MJ, LHV	LCI Indicator
Recovered energy	RE	MJ, LHV	LCI Indicator
<b>Mandatory Inventory Parameters</b>			
Consumption of freshwater resources;	FW	m <sup>3</sup>	LCI Indicator
<b>Indicators Describing Waste</b>			
Hazardous waste disposed	HWD	kg	LCI Indicator
Non-hazardous waste disposed	NHWD	kg	LCI Indicator
High-level radioactive waste, conditioned, to final repository	HLRW	m <sup>3</sup>	LCI Indicator
Intermediate- and low-level radioactive waste, conditioned, to final repository	ILLRW	m <sup>3</sup>	LCI Indicator
Components for re-use	CRU	kg	LCI Indicator
Materials for recycling	MR	kg	LCI Indicator
Materials for energy recovery	MER	kg	LCI Indicator
Recovered energy exported from the product system	EE	MJ, NCV	LCI Indicator
<b>Additional Inventory Parameters for Transparency</b>			
Biogenic Carbon Removal from Product	BCRP	kg CO <sub>2</sub> e	Manual
Biogenic Carbon Emission from Product	BCEP	kg CO <sub>2</sub> e	Manual
Biogenic Carbon Removal from Packaging	BCRK	kg CO <sub>2</sub> e	Manual
Biogenic Carbon Emission from Packaging	BCEK	kg CO <sub>2</sub> e	Manual
Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	BCEW	kg CO <sub>2</sub> e	Manual

# Life Cycle Impact Assessment Results

## A1-A3 Results

Table 5 presents the cradle-to-gate (A1-A3) LCIA and LCI parameter results for the declared unit of one m<sup>3</sup> of LVL. The cradle-to-gate results align with the US industry average EPD for LVL developed by the American Wood Council in 2025. No permanent carbon storage is included in the cradle-to-gate (A1-A3) results. As a result, the biogenic carbon balance for the cradle-to-gate portion of the life cycle is net neutral. Cradle-to-gate results for LVL and VLT on a relative basis are presented in Table 6.

**Table 5. Cradle-to-Gate LCIA Results for 1 m<sup>3</sup> of Laminated Veneer Lumber and Veneer Laminated Timber – Absolute Basis**

Core Mandatory Impact Indicator	Total	A1	A2	A3
GWP <sub>TOTAL</sub> [kg CO <sub>2</sub> eq]	217.16	(1,111.77)	8.63	1,320.30
GWP <sub>BIOGENIC</sub> [kg CO <sub>2</sub> eq]	0.00	(1,269.22)	0.00	1,269.22
GWP <sub>FOSSIL</sub> [kg CO <sub>2</sub> eq]	217.16	157.45	8.63	51.08
ODP [kg CF-11eq]	8.73E-06	0.00	0.00	0.00
AP [kg SO <sub>2</sub> eq]	0.87	0.70	0.06	0.11
EP [kg N eq]	0.67	0.49	0.00	0.17
SFP [kg O <sub>3</sub> eq]	20.98	16.88	1.55	2.54
FFD [MJ, surplus]	427.65	328.04	15.61	84.01
ADP <sub>FOSSIL</sub> [MJ, LHV]	3,487.99	2,681.10	111.06	695.83
<b>Use of Primary Resources</b>				
RPRE [MJ, LHV]	3,367.11	2,949.96	0.00	417.16
RPRM [MJ, LHV]	11,608.22	11,608.22	0.00	0.00
NRPRE [MJ, LHV]	4,090.07	3,100.54	112.07	877.47
NRPRM [MJ, LHV]	689.01	689.01	0.00	0.00
<b>Secondary Material, Secondary Fuel and Recovered Energy</b>				
SM [kg]	0.00	0.00	0.00	0.00
RSF [MJ, LHV]	0.00	0.00	0.00	0.00
NRSF [MJ, LHV]	0.00	0.00	0.00	0.00
RE [MJ, LHV]	0.00	0.00	0.00	0.00
<b>Mandatory Inventory Parameters</b>				
FW [m <sup>3</sup> ]	1.66	1.41	0.00	0.25
<b>Indicators Describing Waste</b>				
HWD [kg]	1.77E-02	8.49E-03	0.00	9.19E-03
NHWD [kg]	9.14E+00	5.72E+00	3.30E-06	3.42E+00
HLRW [m <sup>3</sup> ]	2.56E-07	1.81E-07	0.00	7.45E-08
ILLRW [m <sup>3</sup> ]	1.19E-06	8.44E-07	0.00	3.47E-07
CRU [kg]	0.00	0.00	0.00	0.00
MR [kg]	0.00	0.00	0.00	0.00
MER [kg]	0.00	0.00	0.00	0.00
EE [MJ, LHV]	0.00	0.00	0.00	0.00

**Table 6. Cradle-to-Gate LCIA Results for 1 m<sup>3</sup> of Laminated Veneer Lumber – Relative Basis**

Core Mandatory Impact Indicator	Total	A1	A2	A3
GWP <sub>FOSSIL</sub> [kg CO <sub>2</sub> eq]	100%	72.5%	4.0%	23.5%
ODP [kg CF-11eq]	100%	97.5%	0.0%	2.5%
AP [kg SO <sub>2</sub> eq]	100%	80.9%	6.4%	12.7%
EP [kg N eq]	100%	73.8%	0.4%	25.8%
SFP [kg O <sub>3</sub> eq]	100%	80.5%	7.4%	12.1%
FFD [MJ, surplus]	100%	76.7%	3.6%	19.6%
ADP <sub>FOSSIL</sub> [MJ, LHV]	100%	76.9%	3.2%	19.9%
<b>Use of Primary Resources</b>				
RPRE [MJ, LHV]	100%	87.6%	0.0%	12.4%
RPRM [MJ, LHV]	100%	100.0%	0.0%	0.0%
NRPRE [MJ, LHV]	100%	75.8%	2.7%	21.5%
NRPRM [MJ, LHV]	100%	100.0%	0.0%	0.0%
<b>Secondary Material, Secondary Fuel and Recovered Energy</b>				
SM [kg]	0.00	0.00	0.00	0.00
RSF [MJ, LHV]	0.00	0.00	0.00	0.00
NRSF [MJ, LHV]	0.00	0.00	0.00	0.00
RE [MJ, LHV]	0.00	0.00	0.00	0.00
<b>Mandatory Inventory Parameters</b>				
FW [m <sup>3</sup> ]	100%	85.0%	0.0%	15.0%
<b>Indicators Describing Waste</b>				
HWD [kg]	100%	48.0%	0.0%	52.0%
NHWD [kg]	100%	62.6%	0.0%	37.4%
HLRW [m <sup>3</sup> ]	100%	70.9%	0.0%	29.1%
ILLRW [m <sup>3</sup> ]	100%	70.8%	0.0%	29.2%
CRU [kg]	0.00	0.00	0.00	0.00
MR [kg]	0.00	0.00	0.00	0.00
MER [kg]	0.00	0.00	0.00	0.00
EE [MJ, LHV]	0.00	0.00	0.00	0.00

## A4 -Product Transportation

The A4 module includes transportation of the final product to customers or distribution center/resale center). Laminated veneer lumber and VLT were transported mostly by road (74%) and 26 percent by rail. Product shipping distances were distributed over a weighted average of 365 km by road and 628 km by rail.

## A5 – Installation

The installation module A5 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. For this LCA, Module A5 was calculated using the ACLA ISO 21930 Guidance by calculating 5% of the A1-A4 burden and adding the waste disposal from packaging. The reference service life (RSL) for the product is 75 years, which is the default specified by the UL Part B PCR [17]. Total non-renewable energy use for A5 is conservatively estimated at 215 MJ/m<sup>3</sup> of LVL and VLT.

## 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 to 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 [6]. 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 7 lists the assumptions for C1-C4 and the net values.

**Table 7. Laminated Veneer Lumber and Veneer Laminated Timber End-of-Life (C1-C4) Assumptions for Scenario Development**

C1-C4 Description of Processes	Description	Value	Unit
Collection Process	Collected separately	NA	Dry kg
Collection Process	Collected with mixed construction waste	539.24	Dry kg
Recovery	Reuse	-	Dry kg
Recovery	Recycling	-	Dry kg
Recovery	Landfill	441.10	Dry kg
Recovery	Incineration		Dry kg
Recovery	Incineration with energy recovery <sup>1/</sup>	98.14	Dry kg
Recovery	Product or material for final deposition	441.10	Dry kg
Removal of biogenic carbon (excluding packaging)		(570.73)	kg CO <sub>2</sub> eq

Note: C1 - Building demolition is considered null

## 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 re-covered energy from the product system. Table 8 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, potential fuel heating value of LVL and VLT was calculated using a lower heating value (LHV) of 20.9 MJ/kg (oven dry) and 35.7 MJ/kg for resin, which equates to 11,552 MJ/m<sup>3</sup>. The energy equivalent amount of natural gas was calculated based on a lower heating value of 36.6 MJ/m<sup>3</sup>.

$$\text{LVL and VLT energy content} = (20.9\text{MJ/kg} \times 520.21 \text{ kg/m}^3) + (35.7 \text{ MJ/kg} \times 19.03 \text{ kg/m}^3) = 11,552 \text{ MJ/m}^3$$

$$\text{Substitution with Natural gas} = \frac{11,552\text{MJ/m}^3}{36.6\frac{\text{MJ}}{\text{m}^3}} = 315.62 \text{ m}^3/\text{m}^3$$

Displacing 316 cubic meters of natural gas for every cubic meter of LVL and VLT combusted for energy.

**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)	9,819.0	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	

Tables 9-12 present the LCIA and LCI parameter results for the functional unit of 1 m<sup>3</sup> of LVL and VLT over a service life of 75 years. The cradle-to-grave results include the delivery of the product, installation, use, and the end-of-life. Table 9 presents the weighted average results for the typical 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. These options also include 100% landfilling (Table 10), 100% incineration (Table 11) and 100% reuse (Table 12).

**Table 9. LCIA Results Summary for 1 m<sup>3</sup> Laminated Veneer Lumber and Veneer Laminated Timber – Average End-of-Life Treatment, Cradle-to-Grave Scope**

Core Mandatory Impact Indicator	A-C	A-D	A1-A3	A4	A5	B	C1	C2	C3	C4	D
GWP <sub>TOTAL</sub> [kg CO <sub>2</sub> eq]	-306.46	-445.98	-771.44	16.72	11.69	0.00	0.00	7.05	0.00	429.52	-139.52
GWP <sub>BIOGENIC</sub> [kg CO <sub>2</sub> eq]	-570.73	-570.73	-988.61	0.00	0.00	0.00	0.00	0.00	0.00	417.88	0.00
GWP <sub>FOSSIL</sub> [kg CO <sub>2</sub> eq]	264.27	124.75	217.16	16.72	11.69	0.00	0.00	7.05	0.00	11.64	-139.52
ODP [kg CF-11eq]	9.90E-06	9.90E-06	8.73E-06	2.43E-08	4.38E-07	0.00	0.00	2.98E-10	0.00	7.13E-07	-3.16E-12
AP [kg SO <sub>2</sub> eq]	1.28	1.24	0.87	0.12	0.05	0.00	0.00	0.08	0.00	0.16	-0.03
EP [kg N eq]	0.73	0.73	0.67	0.01	0.03	0.00	0.00	0.00	0.00	0.01	0.00
SFP [kg O <sub>3</sub> eq]	31.61	31.52	20.98	3.52	1.23	0.00	0.00	2.08	0.00	3.80	-0.08
FFD [MJ, surplus]	510.26	173.25	427.65	29.62	22.86	0.00	0.00	7.68	0.00	22.45	-337.01
ADP <sub>FOSSIL</sub> [MJ, LHV]	4083.37	2052.42	3487.99	209.22	174.40	0.00	0.00	51.14	0.00	160.62	-2030.95
<b>Use of Primary Resources</b>											
RPRE [MJ, LHV]	5,503.39	5,503.39	3,367.11	0.44	168.38	0.00	0.00	0.00	0.00	1,967.46	0.00
RPRM [MJ, LHV]	11,608.22	11,608.22	11,608.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRPRE [MJ, LHV]	4,782.95	4,713.62	4,090.07	212.25	215.12	0.00	0.00	107.21	0.00	158.30	-69.33
NRPRM [MJ, LHV]	689.01	689.01	689.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Secondary Material, Secondary Fuel and Recovered Energy</b>											
SM [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF [MJ, LHV]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF [MJ, LHV]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RE [MJ, LHV]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Mandatory Inventory Parameters</b>											
FW [m <sup>3</sup> ]	1.84	1.84	1.66			0.00	0.00	0.00	0.00	0.10	0.00
<b>Indicators Describing Waste</b>											
HWD [kg]	0.0186	0.0186	0.0177	0.0000	0.0009	0.00	0.00	0.00	0.00	0.00	0.00
NHWD [kg]	4.51E+02	4.51E+02	9.14E+00	0.00	4.57E-01	0.00	0.00	0.00	0.00	4.41E+02	0.00
HLRW [m <sup>3</sup> ]	2.69E-07	2.69E-07	2.56E-07	0.00	1.28E-08	0.00	0.00	0.00	0.00	8.26E-10	0.00
ILLRW [m <sup>3</sup> ]	1.37E-06	1.37E-06	1.19E-06	0.00	5.96E-08	0.00	0.00	0.00	0.00	1.20E-07	0.00
CRU [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MER [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EE [MJ, LHV]	0.00	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 m<sup>3</sup> Laminated Veneer Lumber and Veneer Laminated Timber – 100% Landfill End-of-Life Treatment, Cradle-to-Grave Scope**

Core Mandatory Impact Indicator	A-C	A-D	A1-A3	A4	A5	B	C1	C2	C3	C4
GWP <sub>TOTAL</sub> [kg CO <sub>2</sub> eq]	-439.36	-439.36	-771.44	16.72	11.69	0.00	0.00	7.05	0.00	296.62
GWP <sub>BIOGENIC</sub> [kg CO <sub>2</sub> eq]	-697.71	-697.71	-988.61	0.00	0.00	0.00	0.00	0.00	0.00	290.90
GWP <sub>FOSSIL</sub> [kg CO <sub>2</sub> eq]	258.35	258.35	217.16	16.72	11.69	0.00	0.00	7.05	0.00	5.72
ODP [kg CF-11eq]	1.01E-05	1.01E-05	8.73E-06	0.00	0.00	0.00	0.00	2.98E-10	0.00	8.71E-07
AP [kg SO <sub>2</sub> eq]	1.13	1.13	0.87	0.12	0.05	0.00	0.00	0.08	0.00	0.02
EP [kg N eq]	0.73	0.73	0.67	0.01	0.03	0.00	0.00	0.00	0.00	0.01
SFP [kg O <sub>3</sub> eq]	28.28	28.28	20.98	3.52	1.23	0.00	0.00	2.08	0.00	0.47
FFD [MJ, surplus]	515.25	515.25	427.65	29.62	22.86	0.00	0.00	7.68	0.00	27.45
ADP <sub>FOSSIL</sub> [MJ, LHV]	4,119.11	4,119.11	3,487.99	209.22	174.40	0.00	0.00	51.14	0.00	196.36
<b>Use of Primary Resources</b>										
RPRE [MJ, LHV]	3,537.80	3,537.80	3,367.11	0.44	168.38	0.00	0.00	0.00	0.00	1.86
RPRM [MJ, LHV]	11,608.22	11,608.22	11,608.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRPRE [MJ, LHV]	4,691.17	4,691.17	4,090.07	212.25	215.12	0.00	0.00	107.21	0.00	66.52
NRPRM [MJ, LHV]	689.01	689.01	689.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Secondary Material, Secondary Fuel and Recovered Energy</b>										
SM [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF [MJ, LHV]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF [MJ, LHV]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RE [MJ, LHV]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Mandatory Inventory Parameters</b>										
FW [m <sup>3</sup> ]	1.81	1.81	1.66	0.00	0.08	0.00	0.00	0.00	0.00	0.07
<b>Indicators Describing Waste</b>										
HWD [kg]	0.0186	0.0186	0.0177	0.00	0.00	0.00	0.00	0.0000	0.00	0.0000
NHWD [kg]	548.83	548.83	9.14	0.00	0.00	0.00	0.00	0.00	0.00	539.24
HLRW [m <sup>3</sup> ]	2.70E-07	2.70E-07	2.56E-07	0.00	0.00	0.00	0.00	0.00	0.00	1.01E-09
ILLRW [m <sup>3</sup> ]	1.40E-06	1.40E-06	1.19E-06	0.00	0.00	0.00	0.00	0.00	0.00	1.47E-07
CRU [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MER [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EE [MJ, LHV]	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 m<sup>3</sup> Laminated Veneer Lumber and Veneer Laminated Timber – 100% Incineration End-of-Life Treatment, Cradle-to-Grave Scope**

Core Mandatory Impact Indicator	A-C	A-D	A1-A3	A4	A5	B	C1	C2	C3	C4	D
GWP <sub>TOTAL</sub> [kg CO <sub>2</sub> eq]	290.88	-475.71	-771.44	16.72	11.69	0.00	0.00	7.05	0.00	1026.86	-766.59
GWP <sub>BIOGENIC</sub> [kg CO <sub>2</sub> eq]	0.00	0.00	-988.61	0.00	0.00	0.00	0.00	0.00	0.00	988.61	0.00
GWP <sub>FOSSIL</sub> [kg CO <sub>2</sub> eq]	290.88	-475.71	217.16	16.72	11.69	0.00	0.00	7.05	0.00	38.26	-766.59
ODP [kg CF-11eq]	9.19E-06	9.19E-06	8.73E-06	0.00	0.00	0.00	0.00	2.98E-10	0.00	6.29E-10	-1.73E-11
AP [kg SO <sub>2</sub> eq]	1.92	1.73	0.87	0.12	0.05	0.00	0.00	0.08	0.00	0.80	-0.18
EP [kg N eq]	0.75	0.75	0.67	0.01	0.03	0.00	0.00	0.00	0.00	0.03	0.00
SFP [kg O <sub>3</sub> eq]	46.58	46.12	20.98	3.52	1.23	0.00	0.00	2.08	0.00	18.77	-0.46
FFD [MJ, surplus]	487.81	-1,363.91	427.65	29.62	22.86	0.00	0.00	7.68	0.00	0.00	-1,851.72
ADP <sub>FOSSIL</sub> [MJ, LHV]	3,922.75	-7,236.31	3,487.99	209.22	174.40	0.00	0.00	51.14	0.00	0.00	-11,159.06
<b>Use of Primary Resources</b>											
RPRE [MJ, LHV]	15,374.41	15,374.41	4,572.58	0.00	0.00	0.00	0.00	0.00	0.00	10,801.83	0.00
RPRM [MJ, LHV]	11,608.22	11,608.22	11,608.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRPRE [MJ, LHV]	5,675.55	5,294.61	4,997.56	0.00	0.00	0.00	0.00	107.21	0.00	570.78	-380.94
NRPRM [MJ, LHV]	689.01	689.01	689.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Secondary Material, Secondary Fuel and Recovered Energy</b>											
SM [kg]	14,337.76	14,337.76	3,367.11	0.44	168.38	0.00	0.00	0.00	0.00	10,801.83	0.00
RSF [MJ, LHV]	11,608.22	11,608.22	11,608.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF [MJ, LHV]	5,195.43	4,814.49	4,090.07	212.25	215.12	0.00	0.00	107.21	0.00	570.78	-380.94
RE [MJ, LHV]	689.01	689.01	689.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Mandatory Inventory Parameters</b>											
FW [m <sup>3</sup> ]	2.00	2.00	1.66	0.00	0.08	0.00	0.00	0.00	0.00	0.25	0.00
<b>Indicators Describing Waste</b>											
HWD [kg]	0.0186	0.0186	0.0177	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NHWD [kg]	9.59	9.59	9.14	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00
HLRW [m <sup>3</sup> ]	2.69E-07	2.69E-07	2.56E-07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ILLRW [m <sup>3</sup> ]	1.25E-06	1.25E-06	1.19E-06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRU [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MER [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EE [MJ, LHV]	0.00	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 m<sup>3</sup> Laminated Veneer Lumber and Veneer Laminated Timber – 100% Recycle/Reuse End-of-Life Treatment, Cradle-to-Grave Scope**

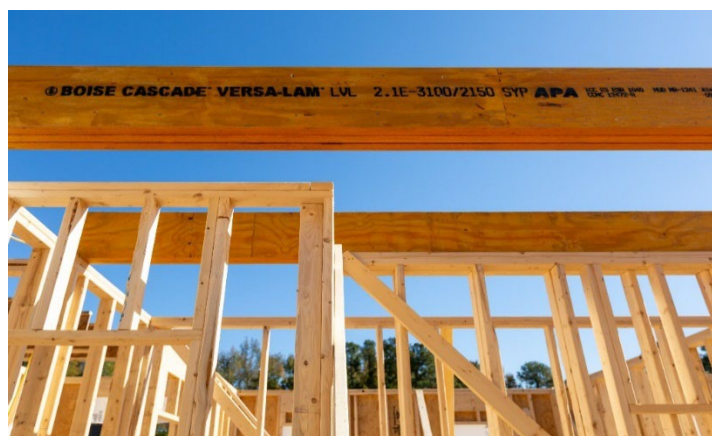
<b>Core Mandatory Impact Indicator</b>	<b>A-C</b>	<b>A-D</b>	<b>A1-A3</b>	<b>A4</b>	<b>A5</b>	<b>B</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>	<b>D</b>
GWP <sub>TOTAL</sub> [kg CO <sub>2</sub> eq]	252.62	35.46	-771.44	16.72	11.69	0.00	0.00	7.05	0.00	988.61	-217.16
GWP <sub>BIOGENIC</sub> [kg CO <sub>2</sub> eq]	0.00	0.00	-988.61	0.00	0.00	0.00	0.00	0.00	0.00	988.61	0.00
GWP <sub>FOSSIL</sub> [kg CO <sub>2</sub> eq]	252.62	35.46	217.16	16.72	11.69	0.00	0.00	7.05	0.00	0.00	-217.16
ODP [kg CF-11eq]	9.19E-06	4.62E-07	8.73E-06	0.00	0.00	0.00	0.00	2.98E-10	0.00	0.00	-8.73E-06
AP [kg SO <sub>2</sub> eq]	1.11	0.25	0.87	0.12	0.05	0.00	0.00	0.08	0.00	0.00	-0.87
EP [kg N eq]	0.72	0.05	0.67	0.01	0.03	0.00	0.00	0.00	0.00	0.00	-0.67
SFP [kg O <sub>3</sub> eq]	27.81	6.83	20.98	3.52	1.23	0.00	0.00	2.08	0.00	0.00	-20.98
FFD [MJ, surplus]	487.81	60.16	427.65	29.62	22.86	0.00	0.00	7.68	0.00	0.00	-427.65
ADP <sub>FOSSIL</sub> [MJ, LHV]	3922.75	434.76	3487.99	209.22	174.40	0.00	0.00	51.14	0.00	0.00	-3487.99
<b>Use of Primary Resources</b>											
RPRE [MJ, LHV]	3,535.93	168.82	3,367.11	0.44	168.38	0.00	0.00	0.00	0.00	0.00	-3,367.11
RPRM [MJ, LHV]	11,608.22	0.00	11,608.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-11,608.22
NRPRE [MJ, LHV]	4,624.65	534.58	4,090.07	212.25	215.12	0.00	0.00	107.21	0.00	0.00	-4,090.07
NRPRM [MJ, LHV]	689.01	0.00	689.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-689.01
<b>Secondary Material, Secondary Fuel and Recovered Energy</b>											
SM [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RSF [MJ, LHV]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NRSF [MJ, LHV]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RE [MJ, LHV]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Mandatory Inventory Parameters</b>											
FW [m <sup>3</sup> ]	1.74	0.08	1.66	0.00	0.08	0.00	0.00	0.00	0.00	0.00	-1.66
<b>Indicators Describing Waste</b>											
HWD [kg]	0.0186	0.0009	0.0177	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	-0.0177
NHWD [kg]	9.59	0.46	9.14	0.00	0.46	0.00	0.00	0.00	0.00	0.00	-9.14
HLRW [m <sup>3</sup> ]	2.69E-07	1.28E-08	2.56E-07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.56E-07
ILLRW [m <sup>3</sup> ]	1.25E-06	5.96E-08	1.19E-06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1.19E-06
CRU [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MER [kg]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EE [MJ, LHV]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

## Biogenic Carbon Results

Table 13 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 (242 kg CO<sub>2</sub>eq). The biogenic CO<sub>2</sub> component for LVL and VLT shows that the landfill scenario causes a net removal of biogenic carbon from the atmosphere equivalent to 698 kg CO<sub>2</sub>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 US EPA [7]. 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 13 Biogenic Carbon Inventory Parameters for 1 m<sup>3</sup> of Laminated Veneer Lumber and Veneer Laminated Timber**

Additional Inventory Parameters		A1 All Scenarios	A3 All Scenarios	C4 Landfill Scenario	C4 Incineration Scenario	C4 Reuse Scenario	C4 AVG Scenario
Biogenic Carbon Removal from Product	kg CO <sub>2</sub>	-1,269.22	-	-	-		
Biogenic Carbon Emission from Product	kg CO <sub>2</sub>	-	242.39	290.90	988.61	988.61	417.88
Biogenic Carbon Removal from Packaging	kg CO <sub>2</sub>	-	-	-	-		
Biogenic Carbon Emission from Packaging	kg CO <sub>2</sub>	-	-	-	-		
Biogenic Carbon Emission from Combustion of Waste from Ren. Sources Used in Production	kg CO <sub>2</sub>	-	38.22	-	-		
<b>Total Biogenic CO<sub>2</sub> Removals &amp; Emissions</b>							
Net biogenic carbon emission landfill scenario	kg CO <sub>2</sub>	-697.71					
Net biogenic carbon emission incineration scenario	kg CO <sub>2</sub>	0.00					
Net biogenic carbon emission recycling scenario	kg CO <sub>2</sub>	0.00					
<b>Average end-of-life treatment</b>	<b>kg CO<sub>2</sub></b>	<b>-570.73</b>					



## Interpretation

The primary sources of impacts across the life cycle are the manufacturing of LVL and VLT (Modules A1-A3) and the net flows of biogenic carbon. Table 13 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 698 kg CO<sub>2</sub>eq.) (Table 13) 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<sub>TOTAL</sub>) of -307 kg CO<sub>2</sub>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):

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Table 9 - Cradle-to-grave GWP<sub>FOSSIL</sub> = 264.27, average EoL treatment assuming 82% landfill and 18% incineration with energy recovery

Table 10 - Cradle-to-grave GWP<sub>FOSSIL</sub> = 258.35, EoL treatment assumed to be 100% landfill

Table 11 - Cradle-to-grave GWP<sub>FOSSIL</sub> = 290.88, EoL treatment assumed to be 100% incineration with energy recovery

Table 12 - Cradle-to-grave GWP<sub>FOSSIL</sub> = 252.62, EoL treatment assumed to be 100% reuse

### Biogenic Carbon Declared (A1-C4):

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Table 9 – Cradle-to-grave GWP<sub>TOTAL</sub> = -306.46 average EoL treatment assuming 82% landfill and 18% incineration with energy recovery

Table 10 - Cradle-to-grave GWP<sub>TOTAL</sub> = -439.36 EoL treatment assumed to be 100% landfill

Table 11 - Cradle-to-grave GWP<sub>TOTAL</sub> = 290.88, EoL treatment assumed to be 100% incineration with energy recovery

Table 12 - Cradle-to-grave GWP<sub>TOTAL</sub> = 252.62 EoL treatment assumed to be 100% reuse

Summarizing the GWP<sub>FOSSIL</sub> from Table 9, the most common representation of EoL treatment for wood products, the cradle-to-gate 124.75 kg CO<sub>2</sub>eq/m<sup>3</sup> increases to 264.27 kg CO<sub>2</sub>eq/m<sup>3</sup> when EoL modules are added without biogenic carbon or substitution effects. When biogenic carbon is added, there is a dramatic drop in GWP<sub>TOTAL</sub> to -306.46 kg CO<sub>2</sub>eq/m<sup>3</sup>. This further drops to -445.98 kg CO<sub>2</sub>eq/m<sup>3</sup> when substitution effects are included.

The lowest GWP<sub>TOTAL</sub> occurs in the EoL 100% landfill treatment where the result is -439.36 kg CO<sub>2</sub>eq/m<sup>3</sup> 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  $GWP_{TOTAL}$  (290.88 kg CO<sub>2</sub>eq/m<sup>3</sup>) 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. When the substitution effects are added, there is a significant reduction in the GWP (-475.71 kg CO<sub>2</sub>eq/m<sup>3</sup>) meaning 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 290.88 to -439.36 kg CO<sub>2</sub>eq/m<sup>3</sup> illustrating the importance of making correct assumptions for the LCA and the intended use. Boise Cascade offers this information in this EPD to help users make informed decisions. The user is responsible for determining the intended use of the product.

## Comparability

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Environmental declarations from different programs [8] may not be comparable. Comparison of the environmental performance using EPD information shall consider all relevant information modules over the full life cycle of the products within the building. This PCR allows EPD comparability only when the same functional requirements between products are ensured and the requirements of ISO 21930:2017 §5.5 are met. In addition, to be compared, EPDs must comply with the same core and sub-category PCRs (Part A and B) and include all relevant information modules. It should be noted that different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

## Limitations

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This LCA was created using manufacturer specific 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 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 [14]. 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 [17].

## **Additional Environmental Information**

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According to ISO 21930 section 9.6, a manufacturer is required to report hazardous and/or dangerous substances. Drying and pressing processes contribute to the production of emissions during product manufacturing. Mills classed as major sources under EPA rules are required to report methanol, formaldehyde, phenol, acetaldehyde, propionaldehyde, and acrolein which are on the US Environmental Agency (EPA) Toxics Release Inventory. These emissions are reported in this EPD.

Boise Cascade Company obtain their wood fiber from sources that are legally and sustainably sourced. Participating facilities reported Fiber Sourcing data for the three sourcing categories established in ASTM-D7612-21: Standard Practice for Categorizing Wood and Wood-Based Products According to Their Fiber Sources [2]. The standard provides criteria for differentiating wood products into three categories:

1. Non-controversial Sources of Forest Products,
2. Responsible Sources of Forest Products, and
3. Certified Sources of Forest Products.

Fiber from non-controversial, or legal, sources are from geographic areas with a low risk of illegal activity and are compliant with legal or other proprietary standards. Products from responsible sources are produced with wood fiber acquired according to an independently certified procurement standard or are from jurisdictions with regulatory or quasi-regulatory programs to implement best management practices. Independently certified procurement standards include FSC Controlled Wood and SFI Fiber Sourcing. To qualify for either standard, a facility must have a system in place that verifies their logs are coming from areas in compliance with forestry best management practices to protect air and water quality and ensure all fiber comes from known and legal sources. Products from certified sources are independently certified to an internationally recognized forest management certification standard, such as those from the Sustainable Forestry Initiative (SFI), Forest Stewardship Council (FSC), Programme for the Endorsement of Forest Certification (PEFC), American Tree Farm System (ATFS), or the Canadian Standards Association (CSA).

## **Forest Management**

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While this EPD does not address landscape level forest management impacts that influence forest carbon, wildlife habitat, endangered species, and soil and water quality, these potential impacts may be addressed through requirements put forth in regional regulatory frameworks, ASTM 7612-21 guidance, and ISO 21930 Section 7.2.11 including notes therein. These documents, combined with this EPD, may provide a more complete picture of environmental and social performance of wood products.

## **Scope of the EPD**

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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

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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

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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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