Environmental Product Declaration

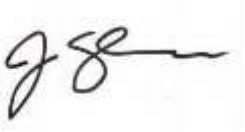
Boise Cascade®
ENGINEERED WOOD PRODUCTS

Cradle-to-Gate EPD for Laminated Veneer Lumber (Versa Lam®) and Mass Timber (VersaWorks® VLT) produced by Boise Cascade in White City, Oregon.

Summary Results – Average End of Life Treatment *Full Results in Tables 3-7*		Cradle-to-Gate Total
Global Warming Potential, Total	kg CO_2e	239.47
Global Warming Potential, Fossil	kg CO_2e	239.47
Global Warming Potential, Biogenic	kg CO_2e	0.00
Ozone Depletion	kg CFC11e	6.19E-06
Acidification	kg SO_2e	2.13
Eutrophication	kg Ne	0.63
SFP (Smog)	kg O_3e	23.13
Non-renewable Energy	MJ, NCV	5,418

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 ASTM INTERNATIONAL Helping our world work better		
General Program Instructions and Version Number	ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs) - General Program Instructions, version: 6.0		
Declaration Owner	**Boise Cascade Wood Products, LLC** 1155 Antelope Rd White City, OR 97503-1639 www.bc.com Boise Cascade® ENGINEERED WOOD PRODUCTS		
Declaration Number	EPD 230		
Declared Product	Laminated Veneer Lumber (LVL); Brand name: VERSA-LAM® Veneer Laminated Timber (VLT); Brand name: VersaWorks®		
Declared Unit	1 m^3 of LVL and VLT produced at Boise Cascade's facility in White City, Oregon.		
Reference PCR and Version Number	**ISO 21930:2017** Sustainability in Building Construction — Environmental Declaration of Building Products. [7] **UL Environment**: Product Category Rules for Building-Related Products and Services **Part A:** Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report, v3.2 [11] **Part B:** Structural and Architectural Wood Products EPD Requirements, v1.0 [12]		
Description of Product's intended application and use	Boise Cascade LVL and VLT is an engineered wood product with high structural strength and stability. It can be used as building material for headers and joists as well as panel construction.		
Markets of Applicability	Construction Sector, Mass timber design		
Date of Issue	June 21, 2021		
Period of Validity	June 21, 2026		
EPD Type	Product-specific EPD		
EPD Scope	Cradle-to-Gate		
Year of reported manufacturer primary data	2019		
LCA Software	SimaPro v8.5		
LCI Databases	USLCI [9], ecoinvent 3.5 [14], Datasmart [8]		
LCIA Methodology	TRACI 2.1 [3]		
The sub-category PCR review was conducted by:	Dr. Thomas Gloria (chair) Industrial Ecology Consultants	Dr. Indro Ganguly University of Washington	Dr. Sahoo University of Georgia

LCA and EPD Developer This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	**Athena Sustainable Materials Institute** 280 Albert Street, Suite 404 Ottawa, Ontario Canada K1P 5G8 www.athenasmi.org  James Salazar
This declaration was independently verified in accordance with **ISO 14025:2006[4]**. 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)**. ☐ INTERNAL x EXTERNAL	
Independent Verifier This life cycle assessment was independently verified in accordance with ISO 14044 [6] and the reference PCR by:	

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 different results upstream or downstream of the life cycle stages declared.

COMPANY AND PRODUCT DESCRIPTION

Boise Cascade

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

Laminated Veneer Lumber (LVL) and Veneer Laminated Timber (VLT), is an engineered wood product comprised of thin layers of wood called veneers that are laid up and glued to produce structural sized members.

VERSA-LAM® laminated veneer lumber (LVL) beams and columns provide reduced twisting, shrinking and splitting, and deliver flatter, quieter floors and walls. VERSA-LAM® LVL and VERSA-WORKS® VLT can be produced in longer lengths, depths and widths than traditional lumber, allowing for reduced waste when sizing and cutting efficiencies are employed.

Boise Cascade's mass timber product (VLT) is based on an LVL product component, produced using the same machinery and with the same composition, but assembled in larger product dimensions so that it may be used as a panel product. As the LVL and VLT products have identical composition and manufacturing processes, they can be considered to be identical in terms of their environmental impacts as calculated for this EPD.

Product Composition

Boise Cascade's LVL and VLT products are comprised of wood veneer (> 90%) and phenol formaldehyde resin (< 10%). See Table 1 for detailed product characteristics. Wood veneer used in the LVL and VLT production is produced by Boise Cascade and is procured from sustainably managed forests in the United States.

METHODOLOGICAL FRAMEWORK

Type of EPD and Life Cycle Stages

The underlying LCA [5] investigates the product system from cradle-to-gate. This comprises the production stage including the information modules 'A1 Extraction and upstream production', 'A2 Transport to factory' and 'A3 Manufacturing' (Figure 1).

Figure 1: Life Cycle Stages and Information Modules per ISO 21930:2017.

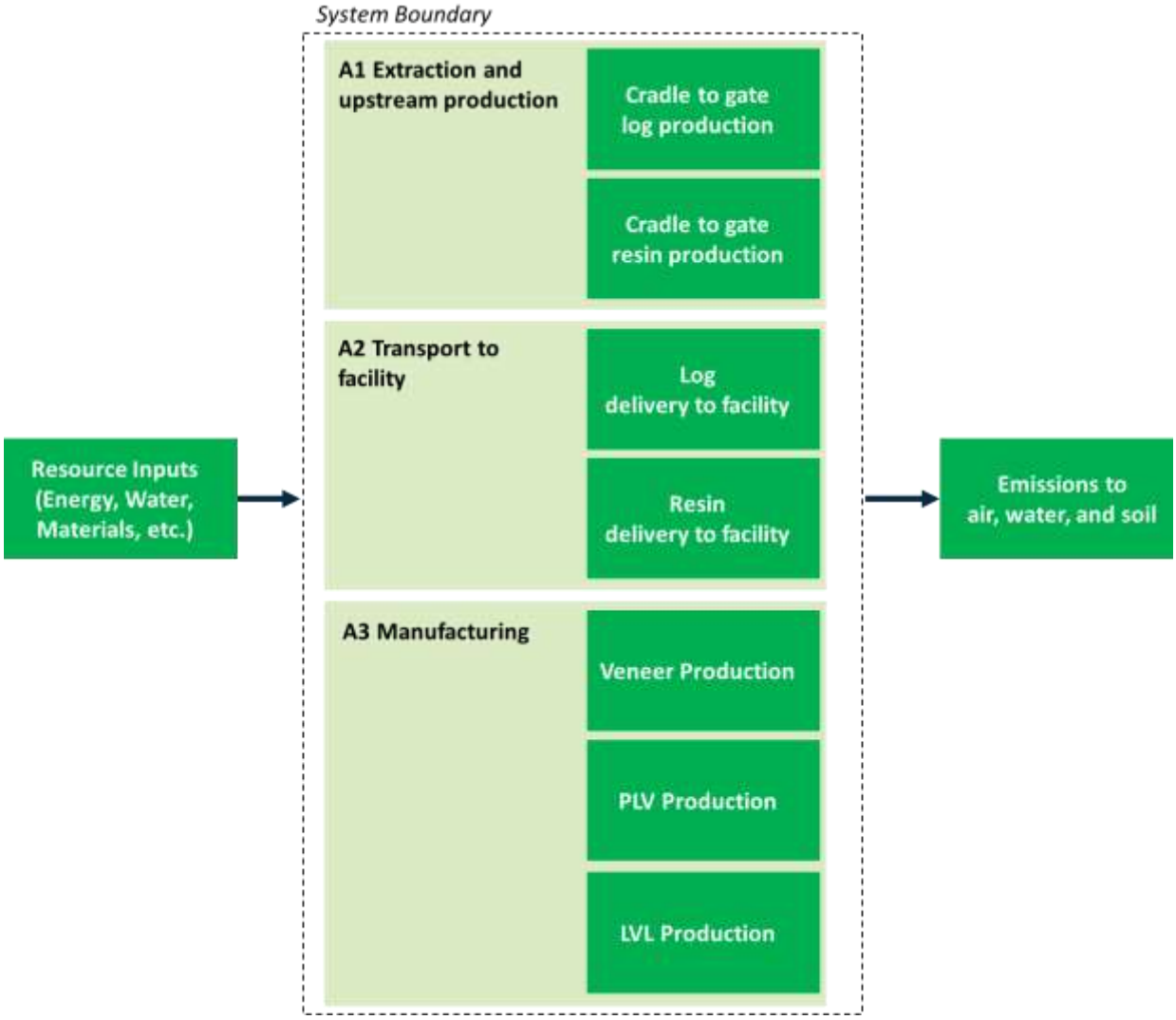
Building Life Cycle Information Modules																
Production stage			Construction Stage		Use stage							End-of-life stage				Substitution Effects
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport to waste processing or disposal	Waste processing	Disposal	Benefits Outside System
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = Module declared
MND = Module Not Declared

System Boundaries and Product Flow Diagram

The product system is presented in Figure 2 below shows the information modules that are included in the system boundary. The product system includes the extraction of logs from the forest and the production of resins in module A1. Module A2 includes the delivery of logs and resin to the production facilities. The manufacturing Module A3 includes the production of veneers and parallel laminated veneer (PLV) which are both valuable products with established markets that serve as precursor products to the eventual LVL/VLT product (i.e. several veneers are glued together to produce PLV and several layers of PLV are glued together to produce LVL/VLT).

Figure 2: Cradle-to-Gate LVL and VLT Product System



Declared Unit

The declared unit for LVL and VLT is "*one cubic meter (1 m^3) of laminated veneer lumber (LVL) produced at Boise Cascade's facility in White City, Oregon*". The product properties and composition associated with the functional unit are provided in Table 1.

Table 1: Product properties and composition of 1 cubic meter of laminated veneer lumber and veneer laminated timber

Product properties:	Unit	Value
Mass (including moisture)	kg	483.4
Moisture Content	%	7%
Product composition:	**Unit**	**Value**
Wood Veneer	%	> 90%
Resins	%	< 10%

Allocation Methods

Allocation is the method used to partition the environmental load of a process when several products or functions share the same process. LVL and VLT manufacturing includes the parallel laminated veneer production process, where the primary products are one of several valuable coproducts from a common process. In accordance with UL Wood PCR 2019, "mass" was selected as the parameter for allocation of the total inputs/outputs of the production system.

Cut-off Criteria

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

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

No material or energy input or output was knowingly excluded from the system boundary.

Data Sources

Primary and secondary data sources, as well as the respective data quality assessment are documented in the underlying LCA project report [2] in accordance with UL PCR 2019. This EPD estimates the impacts of forest management by the use of average data for Pacific Northwest log production. Third-party verified ISO 14040/44 secondary LCI data sets contribute more than 67% of total impact to any of the required impact categories identified by the applicable PCR.

Treatment of Biogenic Carbon and Sustainable Forest Management Certification

Biogenic carbon emissions and removals are reported in accordance with ISO 21930 7.2.7. and 7.2.12. Detailed information is provided in Section 5.1 of the underlying LCA [2]. Table 6 provides additional inventory parameters related to biogenic carbon removal and emissions.

ISO 21930 requires a demonstration of forest sustainability to characterize carbon removals with a factor of -1 kg CO_2e/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_2e/kg CO_2.

ENVIRONMENTAL PARAMETERS DERIVED FROM LCA

The impact categories and characterization factors (CF) 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 [6]. SimaPro v8.5 [10] was used to accumulate the LCI data and to calculate the LCIA results.

The total primary energy consumption is tabulated from the LCI results based on the Cumulative Energy Demand Method published by ecoinvent [14]. 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. ACLCA's Guidance to Calculating non-LCIA Inventory Metrics was followed in accordance with ISO 21930:2017 [1].

The transparent presentation of LCA information allows the user to examine the relative difference between environmental impacts with and without biogenic carbon.

Table 2: Results Summary for 1 m^3 of LVL and VLT – Cradle-to-Gate Scope

Core Mandatory Impact Indicator			A1-A3	A1	A2	A3
Global warming potential – Total	GWP_{TOTAL}	kg CO_2e	**239.47**	-1,630.63	6.79	1,863.31
Global warming potential – Fossil	GWP_{FOSSIL}	kg CO_2e	**239.47**	136.70	6.79	95.98
Global warming potential – Biogenic	GWP_{BIO}	kg CO_2e	**0.00**	-1,767.33	6.79	1,767.33
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	**6.19E-06**	9.21E-08	2.79E-10	6.10E-06
Acidification potential of soil and water sources	AP	kg SO_2e	**2.13**	1.53	0.08	0.51
Eutrophication potential	EP	kg Ne	**0.63**	0.03	0.00	0.59
Formation potential of tropospheric ozone	SFP	kg O_3e	**23.13**	12.10	2.08	8.94
Abiotic depletion potential for fossil resources	ADPf	MJ, NCV	**4,836.90**	3,525.67	95.87	1,215.35
Fossil fuel depletion	FFD	MJ Surplus	**634.27**	496.70	14.01	123.56
Use of Primary Resources						
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	**2,532.87**	0.61	0.00	2,532.26
Renewable primary energy carrier used as material	RPRM	MJ, NCV	**8,864.53**	8,864.53	0.00	0.00
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	**5,417.91**	3,799.85	101.58	1,516.48
Non-renewable primary energy carrier used as material	NRPRM	MJ, NCV	**0.00**	0.00	0.00	0.00
Secondary Material, Secondary Fuel and Recovered						
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	m^3	**0.58**	0.00	0.00	0.58
Indicators Describing Waste						
Hazardous waste disposed	HWD	kg	**0.00**	0.00	0.00	0.00
Non-hazardous waste disposed	NHWD	kg	**0.01**	0.00	0.00	0.01
High-level radioactive waste, conditioned, to final repository	HLRW	m^3	**1.01E-07**	1.40E-09	0.00E+00	9.93E-08
Intermediate- and low-level radioactive waste, conditioned, to final repository	ILLRW	m^3	**9.27E-07**	7.84E-09	0.00E+00	9.20E-07
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 from the product system	EE	MJ, NCV	**0.00**	0.00	0.00	0.00

Detailed Biogenic Carbon Results

To ensure transparency, Table 3 shows additional inventory parameters related to biogenic carbon removal and emissions. The carbon dioxide flows are presented unallocated to consider co-products leaving the product system in information module A3.

It is important to note that ISO 21930 requires that the biogenic carbon leaving the system in the primary product is accounted as an emission in a cradle-to-gate EPD. The biogenic carbon stored in the product is thus accounted in Table 2 as being emitted in Module A3 while the emission actually occurs in Module C4 as shown in Table 3 below.

The net carbon emission across the cradle-to-gate product system is zero. Total global warming potential that includes biogenic carbon emissions and removals is thus equal to the global warming potential from fossil fuels.

Table 3: Biogenic carbon inventory parameters

Additional Inventory Parameters		A1	A3	C3/C4*
Biogenic Carbon Removal from Product	kg CO_2	-1767.33	-	-
Biogenic Carbon Emission from Product	kg CO_2	-	784.35	777.59
Biogenic Carbon Removal from Packaging	kg CO_2	-	-	-
Biogenic Carbon Emission from Packaging	kg CO_2	-	-	-
Biogenic Carbon Emission from Combustion of Waste from Ren. Sources Used in Production	kg CO_2	-	205.39	-
Total Biogenic CO_2 Removals & Emissions				
Net Biogenic Carbon Emissions	**kg CO_2**	**0.00**		

*C3/C4 are outside the scope of this EPD except for the reporting of biogenic carbon stored in the product per ISO 21930:2017 §5.5 Note 3.

INTERPRETATION AND LIMITATIONS

Comparability

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 differences results upstream or downstream of the life cycle stages declared.

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 particular product line and reported impact when averaging data.

REFERENCES

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

2. Athena Sustainable Materials Institute (2020) A Life Cycle Assessment of LVL and Mass Timber Manufactured by Boise Cascade, v1.0,

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

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

5. International Organization for Standardization (2006) International Standard ISO 14040:2006 - Life cycle assessment – Principles and framework

6. ISO 14044:2006/AMD 1:2017/ AMD 2:2020 Environmental Management – Life cycle assessment – Requirements and guidelines

7. International Organization for Standardization (2017) International Standard ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.

8. LTS (2019) DataSmart: http://ltsexperts.com/services/software/datasmart-life-cycle-inventory/

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

10. PRé Consultants BV (2018) SimaPro v8.5 LCA Software

11. UL Environment (2018) Product Category Rule (PCR) Guidance for Building-Related Products and Services, Part A Life Cycle Assessment Calculation Rules and Report Requirements V 3.2.

12. UL Environment (2020) Product Category Rule (PCR) Guidance for Building-Related Products and Services, Part B: Structural and Architectural Wood Products EPD Requirement 10010-9 (Version 1.1).

13. Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., & Weidema, B. (2016) The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, 21, 1218–1230.

14. https://www.ecoinvent.org/