ENVIRONMENTAL PRODUCT DECLARATION

CROSS-LAMINATED TIMBER (CLT)
COLUMBIA FALLS, MONTANA

SMARTLAM™
NORTH AMERICA

Declaration Owner

SmartLam NA
610 3rd Street West
Columbia Falls, MT 59901
+1 406 892 2241| www.smartlam.com.

Product;
Cross Laminated Timber
Manufactured at Columbia Falls, Montana

Declared Unit
The declared unit is one cubic meter of structural lumber product

EPD Number and Period of Validity
SCS-EPD-06681
EPD Valid January 22, 2021 through January 21, 2026

Product Category Rule
PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 3.2. UL Environment. Sept. 2018

PCR Guidance for Building-Related Products and Services, Part B: Structural and Architectural Wood Products, EPD Requirements UL 10010-9 v.1.0. 2019.

Program Operator
SCS Global Services
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Declaration Owner:	SmartLam North America
Address:	610 3rd Street West, Columbia Falls, MT 59901
Declaration Number:	SCS-EPD-06681
Declaration Validity Period:	Valid January 22, 2021 through January 21, 2026
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Gerard Mansell, Ph.D., SCS Global Services
LCA Software and LCI database:	OpenLCA 1.10 software and the Ecoinvent v3.6 database
Product RSL:	n/a
Markets of Applicability:	Global
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Gate
LCIA Method and Version:	TRACI 2.1
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Thomas Gloria, Ph.D., Industrial Ecology Consultants
Part A Product Category Rule:	PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 3.2. UL Environment. Sept. 2018
Part A PCR Review conducted by:	Lindita Bushi, PhD (Chair); Hugues Imbeault-Tétreault, ing., M.Sc.A.; Jack Geibig
Part B Product Category Rule:	PCR Guidance for Building-Related Products and Services, Part B: Structural and Architectural Wood Products, EPD Requirements UL 10010-9 v.1.0. 2019
Part B PCR Review conducted by:	Jack Geibig (chair), Ecoform; Thomas Gloria, Industrial Ecology Consultants; Thaddeus Owen
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Thomas Gloria, Ph.D., Industrial Ecology Consultants
Declaration Contents:	

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, and 21930.*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.*

In accordance with ISO 21930:2017, EPDs are comparable only if they comply with the core PCR, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

1. SmartLam North America

We at SmartLam are proud of our role in the creation and growth of the cross laminated timber sector in the United States. We started the first domestic production in 2012. Since then, we have supplied Cross Laminated Timber for sustainable green buildings from coast-to-coast. While doing that, we have helped the sector grow as a whole through supporting education and code revision processes and conducting tests for wind, fire, and blast resistance.

Today, cross laminated timber has gone mainstream. With our expanded factory in Montana and our additional factory in Alabama, we are poised to serve you anywhere in North America. It is the right time to build with our product. Cross laminated timber buildings sequester carbon and are built from renewable wood. They are efficiently designed and prefabricated offsite so they go up faster, use smaller construction teams, and have less construction impact on adjacent urban communities. Our customer's buildings are beautiful places to live, work, and play. SmartLam's team of industry leading professionals is dedicated to producing the finest products and delivering the highest level of customer service.

2. Product

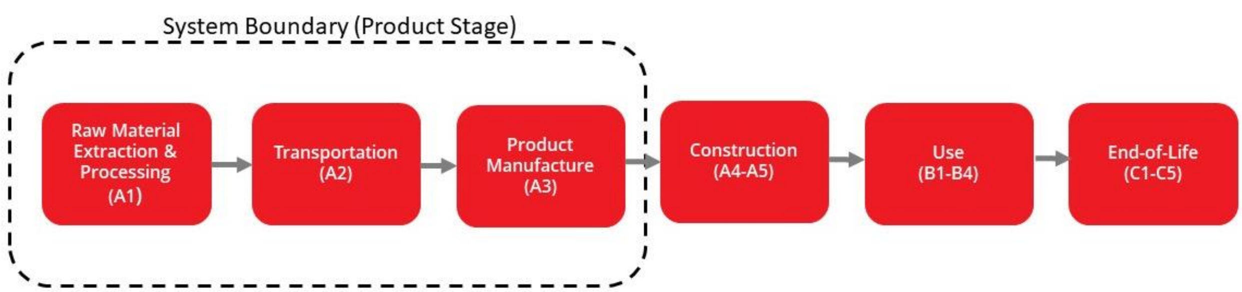
2.1 PRODUCT DESCRIPTION

Cross-laminated timber (CLT) is a large-scale, prefabricated, solid engineered wood panel. Lightweight yet very strong, with superior acoustic, fire, seismic, and thermal performance, CLT is also fast and easy to install, generating almost no waste onsite. CLT offers design flexibility and low environmental impacts.

A CLT panel consists of several layers of kiln-dried lumber boards stacked in alternating directions, bonded with structural adhesives, and pressed to form a solid, straight, rectangular panel. CLT panels consist of an odd number of layers (usually, three to seven,) and may be sanded or prefinished before shipping. Finished CLT panels are exceptionally stiff, strong, and stable, handling load transfer on all sides.

2.2 PRODUCT FLOW DIAGRAM

A flow diagram illustrating the life cycle phases included in the scope of the EPD is provided below.



2.3 APPLICATION

The products are intended for use as building material for floor, wall, roof, or core construction for residential and commercial applications.

2.4 DECLARATION OF METHODOLOGICAL FRAMEWORK

The scope of the EPD is cradle-to-gate, including raw material extraction and processing, upstream transportation and product manufacture, including packaging. The life cycle phases included in the product system boundary are shown below.

Cut-off and allocation procedures are described below and conform to the PCR and ISO standards.

Table 1. *Life cycle phases included in the SmartLam product system boundary.*

Product			Construction Process		Use							End-of-life				Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B1	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material extraction and processing	Transport to manufacturer	Manufacturing	Transport	Construction - installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery and/or recycling potential
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = Module Included | MND = Module Not Declared

The EPD conforms to ISO 14040/44 and the PCR. The impact indicators considered for the assessment include:

- Potential for Global Warming,
- Acidification Potential,
- Eutrophication Potential,
- Photochemical Ozone (Smog) Creation Potential,
- Ozone Depletion Potential,
- Fossil Fuel Depletion Potential.

2.5 TECHNICAL DATA

Technical specifications for the SmartLam product are available at the manufacturer's website https://www.smartlam.com/products/.

2.6 MATERIAL COMPOSITION

The primary materials include softwood lumber and various adhesives, sealers and epoxies.

Table 2. *Material content for the SmartLam CLT products as a percentage of total mass per m^3.*

Material	Cross Laminated Timber
Lumber	98%
Adhesive/Sealer/Epoxy	2%
Total	***100%***

No substances required to be reported as hazardous are associated with the production of this product

2.7 MANUFACTURING

The SmartLam products are manufactured at the company's production facility in Montana. The products are constructed from dimensional lumber and various adhesives, coatings and epoxies. Commercially available dimension lumber is first sorted by grade and moisture content, prior to being finger jointed into continuous boards and cut to length according to the specifications. The boards are planed to tight tolerance, arranged in orthogonal layers according to the layup recipe and as each layer (ply) is stacked on the preceding layer adhesive is applied and the assembled unit is pressed into a solid panel. Once the adhesive is cured the panels are edge trimmed and left as a whole unit or further processed into sub-panels according to project requirements. The products then undergo sanding and finishing prior to being labeled and wrapped for shipment.

Wood waste and co-products are both generated at the manufacturing facility. Co-products (wood chips) are sold to a third party for use as fuel.

Electricity use at the manufacturer's facility is modeled based on the regional electricity supply mix for Montana using the USEPA eGRID emissions database. Electricity and resources (e.g., natural gas) used at the manufacturing facility are allocated to the products based on annualized production data (August 2019 – July 2020).

2.8 PACKAGING

The products are packaged for shipment using cardboard and plastic wrap.

Table 3. *Material content for the product packaging in kg/m^3 and as a percentage of total mass.*

Material	Cross Laminated Timber
Corrugated	0.875 (100%)
Total Packaging	***0.875 (100%)***

2.9 FURTHER INFORMATION

Further information on the products can be found on the manufacturers' website at https://www.smartlam.com/products/.

3. LCA: Calculation Rules

3.1 DECLARED UNIT

The declared unit for the product system is one cubic meter (1m^3) of engineered wood product. The reference flow and declared unit for the products are summarized in Table 4.

Table 4. *Declared unit and reference flows for the SmartLam products (per m^3).*

Property	Unit	Cross Laminated Timber
Mass	kg	561
Thickness to achieve declared unit	mm	105 - 313
Density	kg/m^3	561
Moisture content	%	12 ±3%

3.2 SYSTEM BOUNDARY

The scope of the EPD is cradle-to-gate, including raw material extraction and processing, transportation, product manufacture, product delivery, installation and use, and product disposal. The life cycle phases included in the EPD scope are described in Table 5 and illustrated in Figure 1.

Table 5. *The modules and unit processes included in the scope for the SmartLam product system.*

Module	Module description from the PCR	Unit Processes Included in Scope
A1	Extraction and processing of raw materials; any reuse of products or materials from previous product systems; processing of secondary materials; generation of electricity from primary energy resources; energy, or other, recovery processes from secondary fuels	Extraction and processing of raw materials for the structural lumber product system components.
A2	Transport (to the manufacturer)	Transport of component materials to the manufacturing facility
A3	Manufacturing, including ancillary material production	Manufacturing of products and packaging (incl. upstream unit processes)
A4	Transport (to the building site)	Module Not Declared
A5	Construction-installation process	Module Not Declared
B1	Product use	Module Not Declared
B2	Product maintenance	Module Not Declared
B3	Product repair	Module Not Declared
B4	Product replacement	Module Not Declared
B5	Product refurbishment	Module Not Declared
B6	Operational energy use by technical building systems	Module Not Declared
B7	Operational water uses by technical building systems	Module Not Declared
C1	Deconstruction, demolition	Module Not Declared
C2	Transport (to waste processing)	Module Not Declared
C3	Waste processing for reuse, recovery and/or recycling	Module Not Declared
C4	Disposal	Module Not Declared
D	Reuse-recovery-recycling potential	Module Not Declared

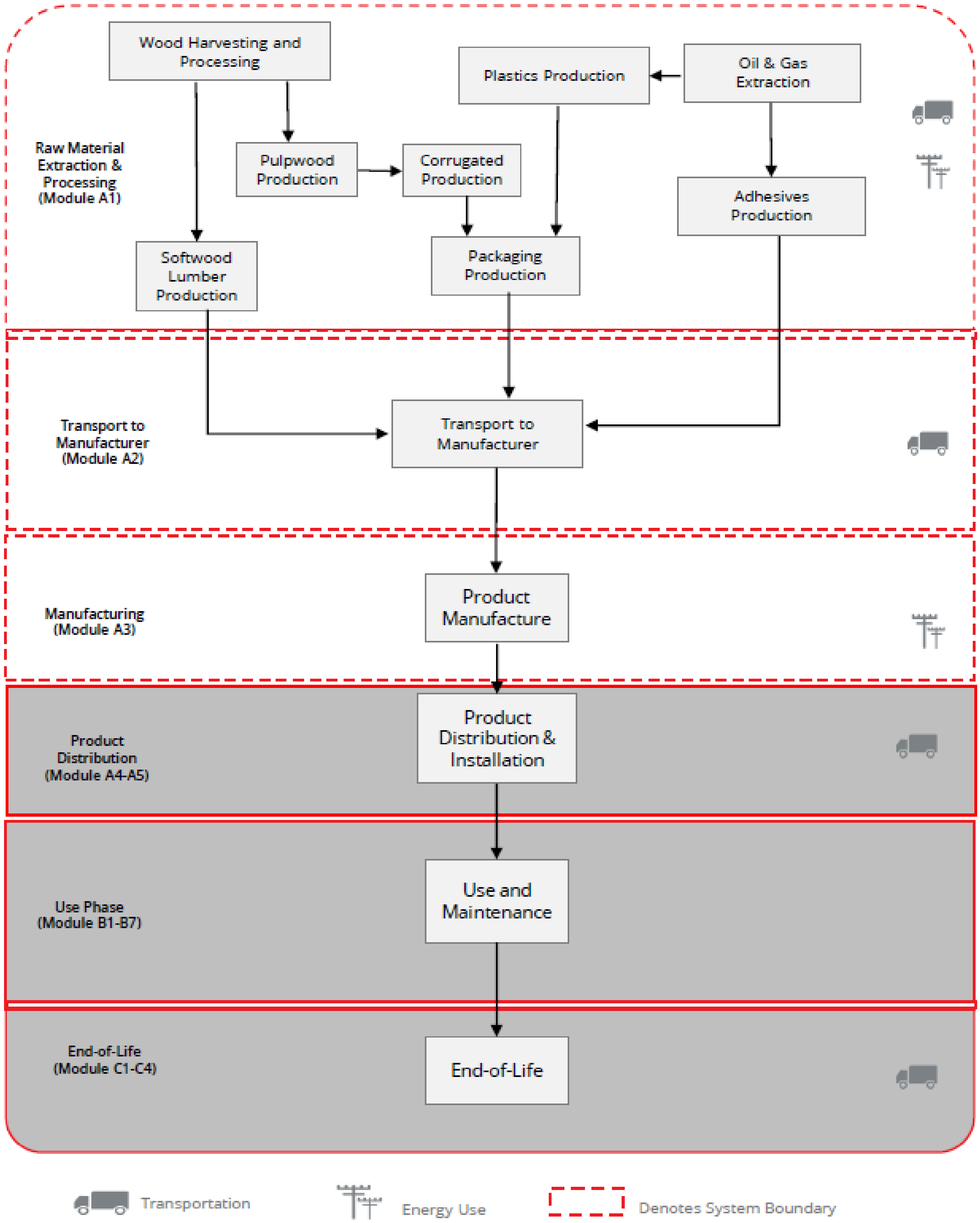


Figure 1. *Flow Diagram for the life cycle of the SmartLam product system.*

3.3 UNITS

All data and results are presented using SI units.

3.4 ESTIMATES AND ASSUMPTIONS

- Energy resource use and emissions at the SmartLam manufacturing facility in Montana were reported separately for electricity and fuel consumption. Resource use and emissions were allocated to the product based on the mass of the product as a fraction of the total facility production (i.e., mass-based allocation).
- The manufacturing process generates both wood waste and co-products (wood chips) which are sold downstream as fuel and secondary raw materials. Impacts for the products and co-products are allocated based on mass, as specified by the PCR.
- SmartLam's manufacturing facility is located in Montana. Ecoinvent inventory datasets for the applicable eGRID electricity grid mixes were used to model resource use and emissions from electricity use at the SmartLam manufacturing facility.
- LCI data for the dimensional lumber used as raw material for the products are based on the most recent data for regionally sourced softwood lumber in the US.
- Primary data for upstream component materials were not available. Representative LCI datasets from the ecoinvent LCI database and published literature were used as appropriate.

The PCR requires the results for several inventory flows related to construction products to be reported including energy and resource use and waste and outflows. These are aggregated inventory flows, and do not characterize any potential impact; results should be interpreted considering this limitation.

3.5 CUT-OFF RULES

According to the PCR, processes contributing greater than 1% of the total environmental impact indicator for each impact are included in the inventory. No data gaps were allowed which were expected to significantly affect the outcome of the indicator results. No known flows are deliberately excluded from this EPD.

3.6 DATA SOURCES

Primary data were provided by SmartLam for their manufacturing facility. The sources of secondary LCI data are the Ecoinvent LCU database and published literature.

Table 6. *Data sources for the SmartLam product system.*

Component	Material Dataset	Data Source	Publication Date
Product			
Wood	Softwood lumber, planed, dry - CORRIM - INW	CORRIM	2020
Adhesive/Sealer/Epoxy	methylene diphenyl diisocyanate production | methylene diphenyl diisocyanate | Cutoff, S/RoW	EI v3.6	2019
	epoxy resin production, liquid | epoxy resin, liquid | Cutoff, S/RoW	EI v3.6	2019
	chemical production, organic | chemical, organic | Cutoff, S/GLO	EI v3.6	2019
Packaging			
Corrugated	corrugated board box production | corrugated board box | Cutoff, S/RoW	EI v3.6	2019
Paper	kraft paper production, unbleached | kraft paper, unbleached | Cutoff, S/RoW	EI v3.6	2019
Resources			
Grid electricity - MT	Electricity, medium voltage, per kWh - NWPP/NWPP	eGRID; EI v3.6	2018; 2019
Heat – biomass boiler	heat production, wood chips from waste wood, at furnace 300kW | heat, district or industrial, other than natural gas | Cutoff, S/GLO	EI v3.6	2019
Heat – natural gas	heat production, natural gas, at boiler modulating >100kW | heat, district or industrial, natural gas | Cutoff, S/RoW	EI v3.6	2019
Transport			
Truck	market for transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | Cutoff/RoW	EI v3.6	2019
Rail	market for transport, freight train | transport, freight train | Cutoff/US	EI v3.6	2019

3.7 DATA QUALITY

The data quality assessment addressed the following parameters: time-related coverage, geographical coverage, technological coverage, precision, completeness, representativeness, consistency, reproducibility, sources of data, and uncertainty.

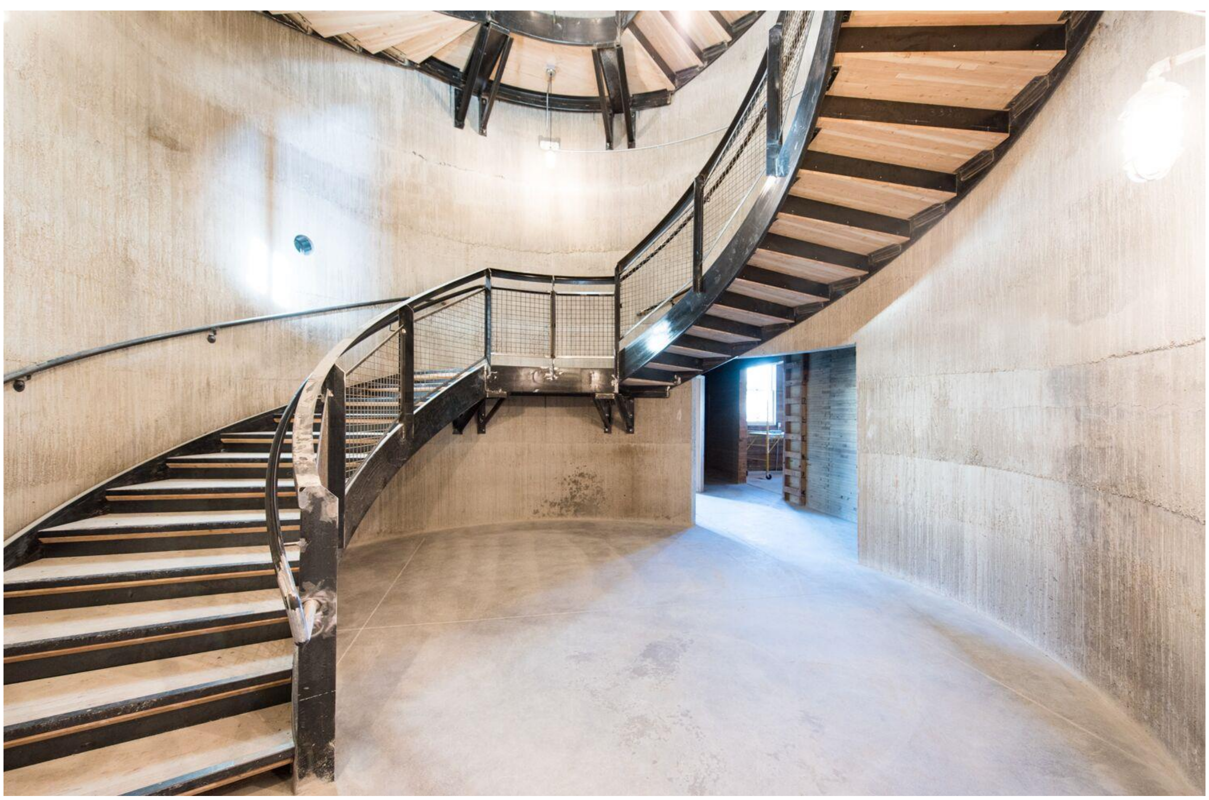


Table 7. *Data quality assessment for the SmartLam product system.*

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage Age of data and the minimum length of time over which data should be collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 5 years old (typically 2016). All of the data used represented an average of at least one year's worth of data collection, and up to three years in some cases. Manufacturer-supplied data (primary data) are based on annualized production for 2019-20.
Geographical Coverage Geographical area from which data for unit processes should be collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Electricity use for product manufacture is modeled using representative data for the regional electricity mix. Surrogate data used in the assessment are representative of global or US and North American operations. Data representative of global operations are considered sufficiently similar to actual processes.
Technology Coverage Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations.
Precision Measure of the variability of the data values for each data expressed (e.g. variance)	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of the products. In some instances, surrogate data used to represent upstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness Qualitative assessment of the degree to which the data set reflects the true population of interest (i.e. geographical coverage, time period, and technology coverage)	Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Consistency Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent v3.6 data where available. Different portions of the product life cycle are equally considered.
Reproducibility Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data Description of all primary and secondary data sources	Data representing energy use at SmartLam's manufacturing facility represents an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI datasets Ecoinvent v3.6 LCI data are used.
Uncertainty of the Information Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the product and packaging is low. Actual supplier data for upstream operations was not available for all suppliers and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

3.8 PERIOD UNDER REVIEW

The period of review is 2019-2020.

3.9 ALLOCATION

Manufacturing resource use was allocated to the products based on mass. Impacts are allocated to the co-products based on mass as specified by the PCR. Impacts from transportation were allocated based on the mass of material and distance transported.

3.10 COMPARABILITY

The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.

4. LCA: Results

Results of the Life Cycle Assessment are presented below. It is noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The following environmental impact category indicators are reported using characterization factors based on the U.S. EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts – TRACI 2.1.

Category Indicator	Impact Category and Environmental Mechanism
Global Warming Potential, GWP (kg CO2 eq)	Anthropogenic emissions of greenhouse gases and short-lived climate forcers have led to increased radiative forcing, which has in turn increased the global mean temperature by 0.8°C since pre-industrial times. This is projected to increase to 1.5°C by 2035, 2.0°C by 2050, and 4.0°C by 2100. As global mean temperatures continue to climb, global climate change will result.
Ozone Layer Depletion Potential, ODP (kg CFC-11 eq)	Emissions of ozone depleting substances such as chlorofluorocarbons contribute to a thinning of the stratospheric ozone layer. This can lead to increased cases of skin cancer, and effects on crops, other plants, marine life, and human-built materials. All chlorinated and brominated compounds stable enough to reach the stratosphere can have an effect. CFCs, halons and HCFCs are the major causes of ozone depletion. Damage to the ozone layer reduces its ability to prevent ultraviolet (UV) light entering the earth's atmosphere, increasing the amount of carcinogenic UVB light reaching the earth's surface.
Smog Formation Potential, SFP (kg O_3 eq)	Photochemical ozone, also called "ground level ozone", is formed by the reaction of volatile organic compounds and nitrogen oxides in the presence of heat and sunlight. If ozone concentrations reach above certain critical thresholds, health effects in humans can result, including bronchitis, asthma, and emphysema. The impact category depends largely on the amounts of carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxide (NO), ammonium and NMVOC (non-methane volatile organic compounds).
Acidification Potential, AP, (kg SO_2 eq)	Acidification is the increasing concentration of hydrogen ion (H^+) within the local environmental and occurs as a result of adding acids such as nitric acid and sulfuric acids into the environment. Acid precursor emissions transport in the atmosphere and deposit as acids. These acids may deposit in soils which are sensitive, or insensitive, to the increased acid burden; sensitivity can depend on a number of factors. In acid-sensitive soils, the deposition can decrease the soil pH (acidification) and increase the mobility of heavy metals in the environment, such as aluminum. This acidification can affect the pH of local soils and freshwater bodies, by increasing local hydrogen ion concentrations, causing endpoints such as tree die-offs and dead lakes. Emissions of sulfur dioxide and nitrogen oxides from the combustion of fossil fuels have been the greatest contributor to acid rain.
Eutrophication Potential, EP (kg N eq)	Eutrophication is the build-up of a concentration of chemical nutrients in an ecosystem which leads to abnormal productivity. In some regions, emissions of excess nutrients (including phosphorus and nitrogen) into water can lead to increased algal blooms. These blooms can reach such a severity that waterways become choked, with no other plant life able to establish itself. If algal blooms are intense enough, the decaying algae consumes dissolved oxygen in the water column starving other organisms of needed oxygen. Whereas phosphorous is mainly responsible for eutrophication in freshwater systems, nitrogen is mainly responsible for eutrophication in ocean water bodies. Emissions of ammonia, nitrates, nitrogen oxides and phosphorous to air or water all have an impact on eutrophication.
Fossil Fuel Depletion Potential, FFD (MJ surplus)	This impact category reflects the relative abundance and depletion of feedstock reserves resulting from the net consumption of fossil energy resources used for electric power generation, operations and transport, and for incorporation into materials such as plastics. This indicator takes into account the amount of resources used for the function under study, the availability of economically recoverable reserves, the degree to which such resources may be replenished, the relative efficiency of power generation systems and fuel systems, and whether the resource is available for reuse at end of life (e.g., recycling). All fossil fuel resources which are consumed in a non-renewable fashion are included.

These impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

The following inventory parameters, specified by the PCR, are also reported.

Resources	Unit	Waste and Outflows	Unit
RPR_E: Renewable primary resources used as energy carrier (fuel)	MJ, LHV	**HWD:** Hazardous waste disposed	kg
RPR_M: Renewable primary resources with energy content used as material	MJ, LHV	**NHWD:** Non-hazardous waste disposed	kg
$NRPR_E$: Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	**HLRW:** High-level radioactive waste, conditioned, to final repository	kg
$NRPR_M$: Non-renewable primary resources with energy content used as material	MJ, LHV	**ILLRW:** Intermediate- and low-level radioactive waste, conditioned, to final repository	kg
SM: Secondary materials	MJ, LHV	**CRU:** Components for re-use	kg
RSF: Renewable secondary fuels	MJ, LHV	**MR:** Materials for recycling	kg
NRSF: Non-renewable secondary fuels	MJ, LHV	**MER:** Materials for energy recovery	kg
RE: Recovered energy	MJ, LHV	**EE:** Recovered energy exported from the product system	MJ, LHV
FW: Use of net freshwater resources	m^3	-	-

Table 8. *Life Cycle Impact contribution analysis for the SmartLam CLT products. Results are shown per cubic meter of product.*

Impact Indicator	Unit	A1	A2	A3	Total
Global warming potential	kg CO_2 eq	92.5	48.9	36.3	178
	%	52%	28%	20%	100%
Ozone depletion potential	kg CFC-11 eq	3.69×10^{-6}	1.14×10^{-5}	3.90×10^{-6}	1.90×10^{-5}
	%	19%	60%	21%	100%
Acidification potential	kg SO_2 eq	0.585	0.230	0.169	0.984
	%	59%	23%	17%	100%
Eutrophication potential	kg N eq	0.347	5.80×10^{-2}	8.76×10^{-2}	0.492
	%	70%	12%	18%	100%
Smog formation potential	kg O_3 eq	18.5	5.53	2.24	26.3
	%	70%	21%	8.5%	100%
Resource depletion potential - fossil fuels	MJ surplus	158	96.9	62.3	317
	%	50%	31%	20%	100%

Table 9. *Resource use and waste flows for the SmartLam CLT products by life cycle phase. Results are shown per cubic meter of product from cradle-to-gate. Results reported in MJ are calculated using lower heating values.*

Parameter	Unit	A1	A2	A3	Total
Resources					
Renewable primary resources used as energy carrier	MJ	0.00	0.00	0.00	0.00
	%	0.00	0.00	0.00	0.00
Renewable primary resources with energy content used as material	MJ	799.83	0.00	0.00	799.83
	%	100%	0.00	0.00	100%
Non-renewable primary resources used as an energy carrier	MJ	INA	INA	INA	INA
Renewable primary resources with energy content used as material	MJ	INA	INA	INA	INA
Secondary materials	kg	0.00	0.00	0.00	0.00
Renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.
Non-renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.
Recovered energy		Neg.	Neg.	Neg.	Neg.
Use of net fresh water	m^3	0.894	0.532	0.268	1.69
	%	53%	31%	16%	100%
Wastes					
Hazardous waste disposed	kg	3.79×10^{-3}	1.94×10^{-3}	5.52×10^{-4}	6.28×10^{-3}
	%	60%	31%	8.8%	100%
Nonhazardous waste disposed	kg	6.35	34.2	2.33	42.8
	%	15%	80%	5.4%	100%
High-level radioactive waste	kg	2.42×10^{-7}	4.02×10^{-5}	2.45×10^{-5}	6.49×10^{-5}
	%	0.37%	62%	38%	100%
Intermediate and low-level radioactive waste	kg	1.91×10^{-6}	4.77×10^{-3}	7.41×10^{-4}	5.51×10^{-3}
	%	0.03%	87%	13%	100%
Components for re-use	kg	0.00	0.00	0.00	0.00
Materials for recycling	kg	0.00	0.00	0.00	0.00
Materials for energy recovery	kg	Neg.	Neg.	Neg.	Neg.
Exported energy	MJ	Neg.	Neg.	Neg.	Neg.

INA = Indicator not assessed | Neg. = Negligible

5. LCA: Interpretation

The raw material and processing phase (A1) is the primary contributor to estimated impacts for all products and impact indicators assessed, with the exception of the Ozone Depletion Potential indicator. Impacts from upstream material transport (A2) are generally the next highest contributor followed by product manufacturing.

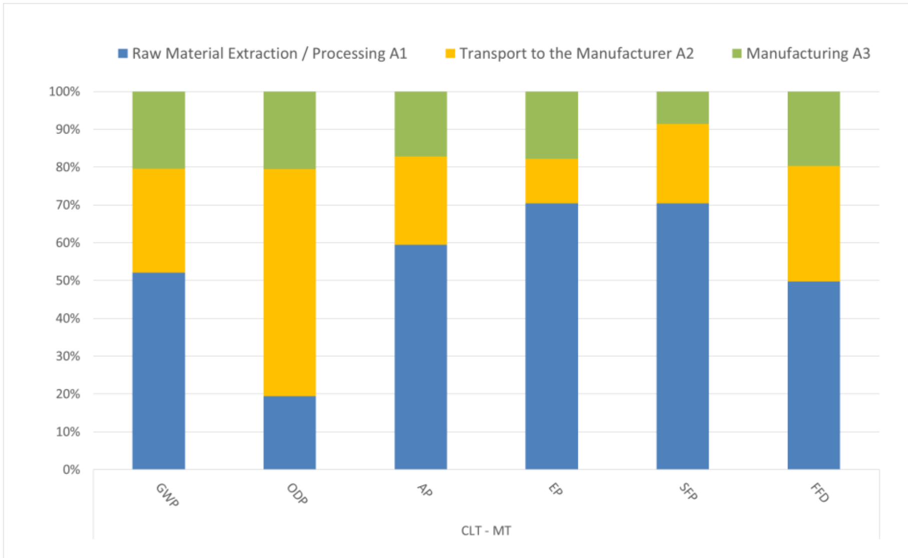


Figure 2. *Contribution analysis for the SmartLam products – TRACI v2.1.*

6. Biogenic Carbon Accounting

6.1 BIOGENIC CARBON EMISSIONS AND REMOVALS

Biogenic carbon emissions and removals are reported in accordance with ISO 21930 §7.2.7. and §7.2.12. The biogenic carbon emissions across the declared modules (A1-A3) are zero (carbon neutral). Based on ISO 21930 accounting rules for cradle-to-gate life cycle assessment, all carbon removed from the atmosphere (characterized in the LCIA as -1 kg CO_2e/kg CO_2) in module A1 is assumed emitted to the atmosphere in other modules (characterized in the LCIA as +1 kg CO_2e/kg CO_2). Total GWP_{BIO} includes biogenic carbon emissions and removals from the information modules A1-A3 and also reports values for modules A5 and C3/C4 to account for the biogenic carbon that is not emitted in the declared modules to ensure a net neutral biogenic carbon balance. The following inventory parameters related to biogenic carbon removals and emissions are reported:

Parameter	Unit	Description
BCRP	kg CO_2	Biogenic CO_2 removals associated with the product
BCEP	kg CO_2	Biogenic CO_2 emissions associated with the product
BCRK	kg CO_2	Biogenic CO_2 removals associated with the packaging
BCEK	kg CO_2	Biogenic CO_2 emissions associated with the packaging
BCEW	kg CO_2	Biogenic CO_2 emissions from combustion of waste from renewable sources

Table 10 summarize the biogenic carbon inventory parameters for the SmartLam product system. Although the scope the study included only modules A1-A3, in accordance with ISO 21930, BCEK for the packaging is reported in A5 and BCEP for the product in C3/C4. ISO 21930 requires a demonstration of forest sustainability to characterize carbon removals with a factor of -1 kg CO_2e/kg CO_2.

Table 10. *Carbon emissions and removals for the SmartLam laminated timber products, per cubic meter.*

Parameter	Total	A1	A2	A3	A5	C3/C4
BCRP (kg CO_2)	-905	-905	-	-	-	-
BCEP (kg CO_2)	724	-	-	-	-	724
BCRK (kg CO_2)	-1.6	-	-	-1.6	-	-
BCEK (kg CO_2)	1.6	-	-		1.6	-
BCEW (kg CO_2)	181	-	-	181	-	-

ISO 21930 Section 7.2.11 Note 2 states the following regarding demonstrating forest sustainability: "Other evidences 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 UNFCCC annual report of the US provide annual net GHG Flux Estimates for different land use categories. This reporting indicates national increasing and/or neutral forest carbon stocks in recent years. Thus, North American forests meet the conditions for characterization of removals with a factor of -1 kg CO_2e/kg CO_2.

6.2 CRADLE-TO-GRAVE CARBON SEQUESTRATION

The scope of the product system is cradle-to-gate, including the information modules: A1 - Extraction and upstream production; A2 - Transport to factory; and A3 - Manufacturing. As per ISO 21930, the net biogenic carbon emissions across the reported modules is zero (carbon neutral). This conservative assumption excludes the permanent sequestration of biogenic carbon if the LCA were to consider the typical end-of-life treatment for wood products, landfilling.

UL Environment published an addendum to the reference PCR that estimates the emissions from landfilling of wood products. The carbon sequestration addendum is based on the United States EPA WARM model and aligns with the biogenic accounting rules in ISO 21930 §7.2.7 and §7.2.12. Lacking specific data, the products are assumed disposed in a landfill at end-of-life. The following results apply the UL PCR addendum methodology to the biogenic carbon present in the SmartLam products as they leave the manufacturer in Module A3.

1 m^3 Glulam/CLT = 493.68 oven dry kg = 246.84 kg carbon = 905.08 kg CO_2eq

Carbon sequestered in product at manufacturing gate: 905.08 kg CO_2eq = -905.08 kg CO_2eq emission

Methane emitted from fugitive landfill gas: 1.74 kg CH_4= 43.57 kg CO_2eq emission

Carbon dioxide emitted from fugitive landfill gas and the combustion captured landfill gas: 101.9 kg CO_2eq emission

Permanent carbon sequestration, net of biogenic carbon emissions: 759.61 kg CO_2eq = -759.61 kg CO_2eq emission

7. Additional Environmental Information

7.1 ENVIRONMENTAL ACTIVITIES AND CERTIFICATIONS

In 2016, SmartLam NA was one of the *first producers in the US* to be certified under the new ANSI/APA PRG 320 standard to produce architectural grade CLT products. Structural CLT manufacturers must adhere to the highest performance and sourcing standards set forth by ANSI/APA PRG 320, the Forest Stewardship Council and the Sustainable Forest Initiative. The ANSI/APA PRG 320 standard has been approved by the Structural Committee of the International Code Council (ICC) for the 2015 International Building Code (IBC).

At SmartLam, quality assurance and quality control are an integral part of our culture. All SmartLam products are proudly created and delivered with the utmost focus on quality. Whether your project is large or small, you can count on the same high quality from concept to completion.

For more information on SmartLam's certifications and environmental initiatives please view the website at https://www.smartlam.com/.

8. References

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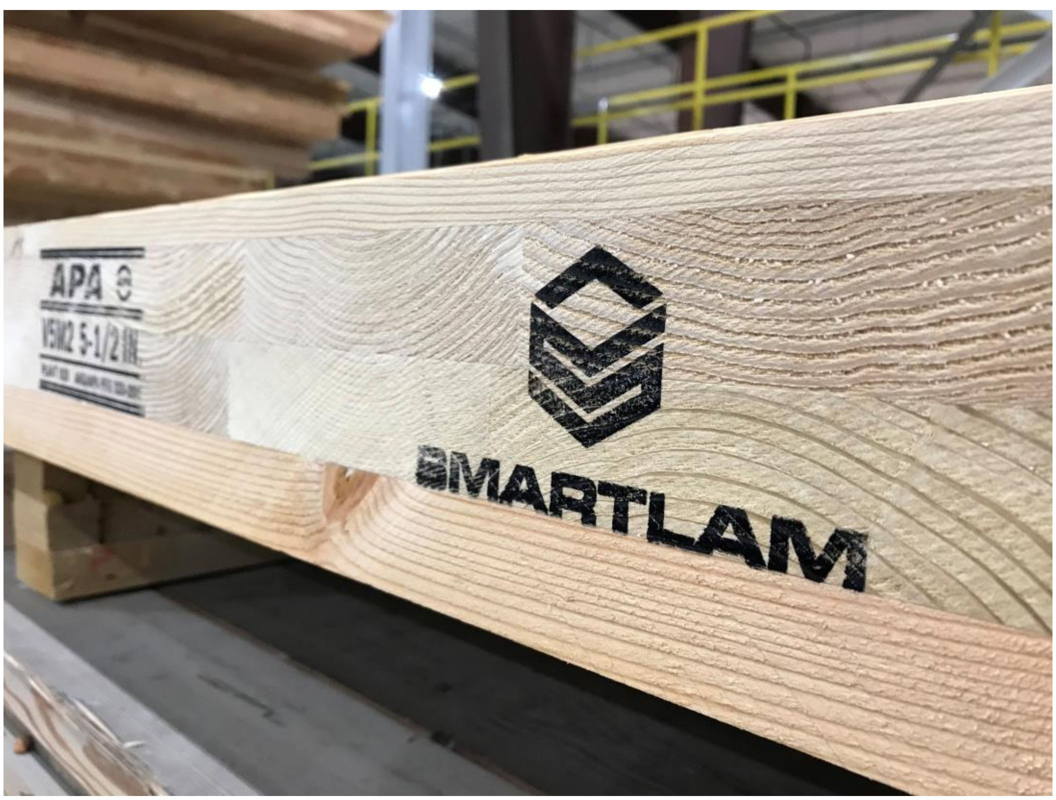

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