Environmental Product Declaration

U.S. Engineered Wood I-Joists

American Wood Council

ASTM Certified Environmental Product Declaration

PROGRAM OPERATOR	ASTM International 100 Barr Harbor Drive PO Box C700 West Conshohocken, PA, 19428-2959 USA www.astm.org
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	ASTM Program Operator Rules. Version: 8.0, Revised 04/29/20
DECLARATION OWNER	American Wood Council
DECLARATION NUMBER	EPD 1057
DECLARED PRODUCT	Engineered Wood I-Joist produced in the United States
DECLARED UNIT	One linear meter (1 m) of Wood I-Joist
REFERENCE PCR AND VERSION NUMBER	ISO 21930:2017 Sustainability in Building and Civil Engineering works – Core Rules for environmental Product Declaration of Construction Products and Services. [9] UL Environment: Product Category Rules for Building-Related Products and Services Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report, v3.2 2018 [17] Part B: Structural and Architectural Wood Products EPD Requirements, v1.1 2020 [18]
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE	Wood I-Joists are used in building construction (residential and commercial), furniture manufacturer, and others.
MARKETS OF APPLICABILITY	Construction Sector, North America
DATE OF ISSUE	August 19, 2025
PERIOD OF VALIDITY	5 years
EPD TYPE	Industry-average
EPD SCOPE	Cradle to gate
YEAR OF REPORTED MANUFACTURER PRIMARY DATA	2023
LCA SOFTWARE	SimaPro v9.6
LCI DATABASES	USLCI [11], Ecoinvent 3.9.1 [19], Datasmart 2023 [10]

LCIA METHODOLOGY	TRACI 2.1 v1.08 [4], CML-IA Baseline V3.08, CED, LHV 1.0
THE SUB-CATEGORY PCR REVIEW WAS CONDUCTED BY:	Dr. Thomas Gloria (chair) t.gloria@industrial-ecology.com
LCA AND EPD DEVELOPER This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	The Consortium for Research on Renewable Industrial Materials (CORRIM) PO Box 2432 Corvallis, OR 97330 541-231-2627 www.corrim.org CORRIM Consortium for Research on Renewable Industrial Materials

This declaration was independently verified in accordance with ISO 14025:2006 [6].
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 with additional considerations from the USGBC/UL Environment Part A Enhancement (2017).

Tim Brooke, ASTM International

☐ Internal ☐ x External

INDEPENDENT VERIFIER This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Dr. Thomas Gloria (chair) t.gloria@industrial-ecology.com

LIMITATIONS

- Environmental declarations from different programs (ISO 14025) may not be comparable.
- 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.
- Full conformance with the PCR for Engineered Wood I-Joist 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.

Description of Industry and Product

Description of Wood I-joist

The wood I-joist industry plays a critical role in modern residential and light commercial construction, offering a high-performance alternative to traditional solid-sawn lumber for floor and roof framing. The I-joist design results in a lightweight yet strong member that resists warping, shrinkage, and twisting, while allowing for longer spans and more open floor plans. The industry has grown steadily over the past few decades, driven by increasing demand for resource-efficient, cost-effective, and dimensionally stable framing solutions. Major manufacturers operate large-scale automated facilities and rely on sustainably sourced wood, often backed by third-party certification and environmental product declarations (EPDs), to meet stringent building codes and sustainability goals.

The I-joist production region represented in this EPD includes facilities located in the Pacific coast and Southern regions of the United States (U.S.). I-joist production facilities accounted for 94 percent (380 million linear feet (LF); 116 million linear meters) of the 403 million LF of U.S. I-joist capacity in 2023 (FEA 2024). Of the reporting facilities, the annual production ranged from 3 to 115 million LF, with a weighted average based on production of 69.81 million LF (21.28 million meters).

This EPD represents the cradle-to-gate energy and materials required for manufacturing I-joists in the U.S. All members of the American Wood Council (AWC), Softwood Lumber Board (SLB), and/or APA – The Engineered Wood Association that meet the eligibility requirement are participants in this EPD.

The UNSPSC (United Nations Standard Products and Services Code) code for I-joists is 301036 07, which falls under the category of "Structural products/ Wood joists" and Construction Specifications Institute (CSI) code for engineered wood products 06 11 13 and wood I-joist 06 17 33 (Table 1).

Table 1. United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI) MasterFormat Code for Wood I-Joist.

Classification Standard	Category	Subcategory	Product Code
UNSPSC	Structural products	Wood joist	301036 07
CSI / CSC	Wood I-Joist / Prefabricated Wood I-Joist	Engineered Wood Products	06 11 13
		Wood I-Joist	06 17 33

Description of Product

As the name implies, I-joist have an “I” shaped cross-section with the top and bottom flanges separated by a narrow webbing material (Figure 1). I-joists flanges are typically made from LVL, but some manufacturers use machine-stressed lumber. The web material is made with oriented strand board (OSB). There are many different dimensions of I-joists, but the most common are dimensions that directly replace 2 x 10 and 2 x 12-inch structural lumber. The I-joists are usually made in continuous length and then cut to 60-foot lengths for shipping. Southern pine dominated the species mix for both OSB and LVL used in I-joist manufacturing. Southern pine is a mixture of several species with similar characteristics (Puettmann 2025a-b).The weighted average moisture content of the I-joist ready for shipment was 5.7 percent. Surveys reported a range of moisture contents for finished I-joist from 4.9–6.0 percent. All wood moisture content values are reported on an oven-dry basis.

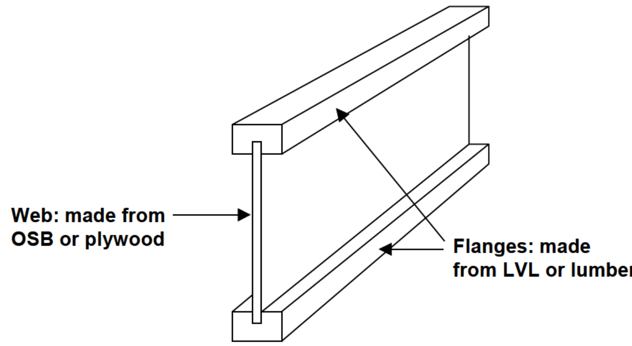


Figure 1. Typical I-joist Made With Laminated Veneer Lumber Flanges and an Oriented Strand Board Web (Photo credit, APA-The Engineered Wood Association (Left), Wilson and Dancer 2004 (Right).

The product profile presented in this EPD is for a declared unit of 1 linear meter (1 m) of I-joist. One meter of I-joist weighs 3.84 kg, excluding the variable moisture content (Table 2).

Table 2. Properties of 1 meter of Wood I-Joists.

Product Property	Unit	Weighted Average
Mass of Product, oven dry	kg	3.8363
OSB, oven dry	kg	1.6845
LVL, oven dry	kg	2.1421
Lumber, oven dry	kg	0.0097
Mass of Product, at moisture content	kg	3.8935
Moisture content	%	5.72

Wood I-Joist Production

Routing and shaping of web and flanges are the first step in producing I-joists. This process requires machining of the OSB web pieces so they fit together at the ends as well as tapering them on the top and bottom edges so that they can be fitted into the flanges (Figure 2, Table 3). Flanges are made primarily from LVL along with some lumber (Table 3). The flanges are machined their entire length to accept the inserted tapered OSB web material. The coproduct created during this process is dry sawdust.

Resin application and pressing of the I-joist web and flanges members is the next step. Resin is applied in web-to-web and web-to-flange joints. Assembly is done mechanically, pressing web sections end-to-end and into the top and bottom flange, which are also pressed end-to-end; the result is a continuous ribbon of I-joist that can be of infinite length. The final step before packaging is sawing the I-joists to length and allowing the joints to cure. In some cases, the I-joist may be heated in a convection or radio-frequency oven to accelerate resin cure time.

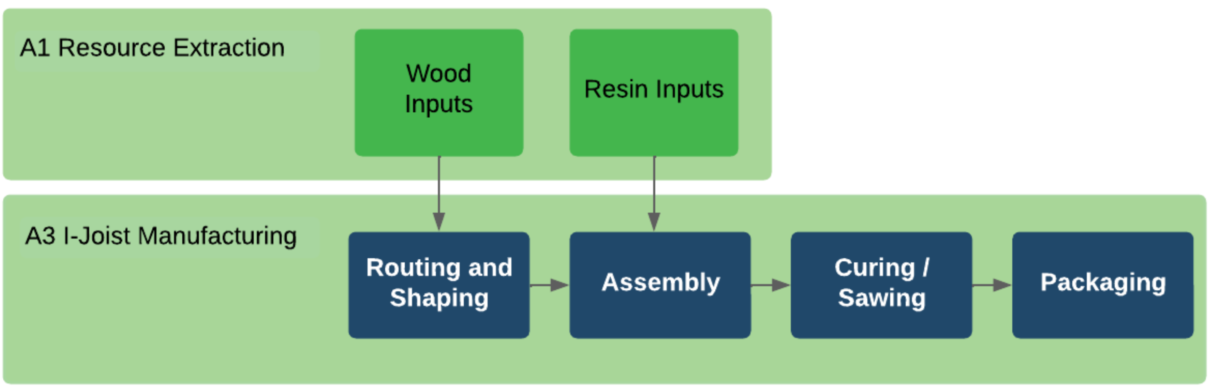


Figure 2. Flow diagram of the Production Process of Wood I-Joist

Table 3. Wood Input Representation for Wood I-Joist Production, U.S.

Wood Input Category	Survey Composition, by mass	Survey Composition, by volume
Laminated Veneer Lumber	55.84%	59.47%
Oriented Strand Board	43.91%	40.22%
Lumber	0.25%	0.31%
	100%	100%

Packing materials represent 1.26 percent of the mass of the main product. The packaging wrap makes up the bulk of the mass of the total materials representing 99.5 percent of the total packaging.

Methodological Framework

The underlying LCA [16] was performed in conformance with ISO 14040/44 [7,8], ISO 21930 [9] and EN15804 [5], as well as the PCR.

Type of EPD and Life Cycle Stages

This EPD is intended to represent an industry wide life cycle assessment (LCA) for I-joist in the U.S. Eight facilities contributed production data, resource use, energy and fuel use, transportation distances, and onsite processing emissions. These data were weighted average based on production to produce the life cycle inventory data for the life cycle impact assessment (LCIA). The underlying LCA [16] investigates I-joist production from cradle-to-gate. Information modules included in the LCA are shown in Table 4. This EPD includes mandatory modules A1-A3 for a cradle-to-gate analysis.

Table 4. Life Cycle Stages & Information Modules per ISO 21930.

PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE							END-OF-LIFE STAGE				OPTIONAL BENEFITS
A1	**A2**	**A3**	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Extraction and up-stream production	**Transport to factory**	**Manufacturing**	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste	Disposal	Reuse, Recycle, & Recovery benefits
X	**X**	**X**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**

System Boundaries and Product Flow Diagram

The product system described in Figure 3 includes the following information modules and unit processes:

A1 - RAW MATERIAL EXTRACTION	A1 includes the cradle to gate production of OSB, LVL, and Lumber [13,14,15]. A1 includes the cradle to gate resin production data [3].
A2 - RAW MATERIAL TRANSPORT	Average or specific transportation of raw materials (including secondary materials and fuels) from extraction site or source to manufacturing site (including any recovered materials from source to be recycled in the process).
A3 - MANUFACTURING	Manufacturing of I-joist including energy consumption and fuel use, resource use, water use, emissions to air and water, waste disposal, and packaging. Packaging materials represent less than one percent (1.26%) of the mass of the main product. The packaging is allocated 100 percent to I-joist.

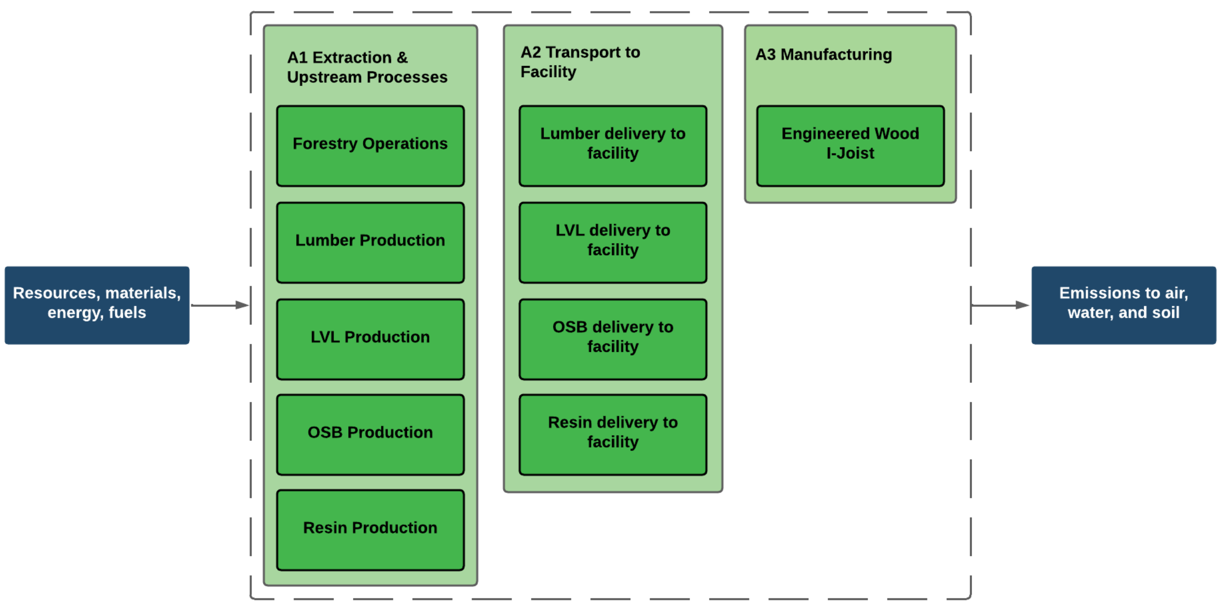


Figure 3. Cradle-to-Gate (A1-A3) System Boundary for Wood I-Joist Production.

Declared Unit

In accordance with the PCR, the declared unit for I-joist is 1.0 m of product packaged for shipment. A declared unit is used in instances where the function and the reference scenario for the whole life cycle of a wood building cannot be stated (UL 2018). The inventory input data is presented as unallocated flows, with all input and output flows allocated to the main product. This analysis does not take the declared unit to the use stage; therefore, no service life is assigned. Wood I-joists were reported on a LF and converted to a meter. One LF of I-joist equals 0.305 m. The percent composition is shown in Table 5.

Table 5. Product Composition.

Product Component	Percentage of Declared Product
Wood (OSB, LVL, Lumber)	99.32%
Resins, additives, and sealants[1/]	0.68%

[1/] Value does not include resin content of OSB and LVL. See Puettmann 2025a-b to get resin content of input materials.

Allocation Methods

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 I-joist can be lumber, LVL, and OSB. A small number of by-products generated were used internally for on-site energy generation. Following the PCR (UL 2018, 2020) 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

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 in accordance with UL PCR 2020.

Third party verified ISO [6,7,8] secondary LCI data sets contribute 41-100% of total impact to any of the required impact categories identified by the applicable PCR [17,18].

Treatment of Biogenic Carbon

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_2eq/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_2eq/kg CO_2.

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 v1.08 [4]. The total primary energy consumption is tabulated from the LCI results based on the Cumulative Energy Demand Method (CED, LHV, V1.0) published by Ecoinvent [19]. 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 9.6 [12] was used to organize and accumulate the LCI data, and to calculate the LCIA results (Table 6).

Table 6. Selected Impact Category Indicators and Inventory Parameters.

Core Mandatory Impact Indicator	Abbreviation	Units	Method
Global warming potential, Total	GWP_{TOTAL}	kg CO_2 eq	$GWP_{BIOGENIC}$ + GWP_{FOSSIL}
Global warming potential, Biogenic	$GWP_{BIOGENIC}$	kg CO_2 eq	TRACI 2.1 V1.08+ LCI Indicatory
Global warming potential, Fossil	GWP_{FOSSIL}	kg CO_2 eq	TRACI 2.1 V1.08
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11 eq	TRACI 2.1 V1.08
Acidification potential of soil and water sources	AP	kg SO_2 eq	TRACI 2.1 V1.08
Eutrophication potential	EP	kg N eq	TRACI 2.1 V1.08
Formation potential of tropospheric ozone	SFP	kg O_3 eq	TRACI 2.1 V1.08
Abiotic depletion potential (ADP fossil) for fossil resources;	ADPf	MJ, LHV	CML-IA Baseline V3.08
Fossil fuel depletion	FFD	MJ Surplus	TRACI 2.1 V1.08
Use of Primary Resources			
Renewable primary energy carrier used as energy	RPRE	MJ, LHV [a/]	CED (LHV) V1.00
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) V1.00
Renewable primary energy carrier used as material	NRPRM	MJ, LHV	LCI Indicator
Secondary material, secondary fuel and recovered energy			
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
Mandatory Inventory Parameters			
Consumption of freshwater resources;	FW	m^3	LCI Indicator
Indicators Describing Waste			
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^3	LCI Indicator
Intermediate- and low-level radioactive waste, conditioned, to final repository	ILLRW	m^3	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, LHV	LCI Indicator
Additional Inventory Parameters			
Biogenic Carbon Removal from Product	BCRP	kg CO_2	LCI Indicator
Biogenic Carbon Emission from Product	BCEP	kg CO_2	LCI Indicator
Biogenic Carbon Removal from Packaging	BCRK	kg CO_2	LCI Indicator
Biogenic Carbon Emission from Packaging	BCEK	kg CO_2	LCI Indicator
Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production	BCEW	kg CO_2	LCI Indicator

Life Cycle Impact Assessment Results

Tables 7-9 present the cradle-to-gate (A1-A3) LCIA and LCI parameter results for the declared unit of one m of I-joist. 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 I-joist on a relative basis are presented in Tables 10-12 and Figure 4.

Table 7. Cradle-to-Gate LCIA Results for 1 Linear Meter of Wood I-Joist – Absolute Basis.

Core Mandatory Impact Indicator	Total	A1	A2	A3
GWP_{TOTAL} [kg CO_2 eq]	2.15E+00	-5.46E+00	1.26E-01	7.49E+00
$GWP_{BIOGENIC}$ [kg CO_2 eq]	0.00E+00	-7.03E+00	0.00E+00	7.03E+00
GWP_{FOSSIL} [kg CO_2 eq]	2.15E+00	1.57E+00	1.26E-01	4.61E-01
ODP [kg CF-11 eq]	2.22E-07	1.77E-07	2.22E-10	4.48E-08
AP [kg SO_2 eq]	9.72E-03	6.89E-03	1.31E-03	1.51E-03
EP [kg N eq]	4.70E-03	3.42E-03	9.51E-05	1.18E-03
SFP [kg O_3 eq]	2.31E-01	1.63E-01	4.19E-02	2.56E-02
FFD [MJ, surplus]	5.11E+00	3.32E+00	2.37E-01	1.55E+00
ADP_{FOSSIL} [MJ, LHV]	3.67E+01	2.42E+01	1.58E+00	1.09E+01

Table 8. Cradle-to-Gate Resource use Results for 1 Linear Meter of Wood I-Joist – Absolute Basis.

Use of Primary Resources	Total	A1	A2	A3
RPRE [MJ, LHV]	2.63E+01	2.43E+01	3.62E-03	2.02E+00
RPRM [MJ, LHV]	8.00E+01	8.00E+01	0.00E+00	0.00E+00
NRPRE [MJ, LHV]	4.12E+01	2.75E+01	1.60E+00	1.21E+01
NRPRM [MJ, LHV]	9.42E-01	9.42E-01	0.00E+00	0.00E+00
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m^3]	6.64E-03	5.68E-03	3.09E-06	9.64E-04

Table 9. Cradle-to-Gate Output Flows for 1 Linear Meter of Wood I-Joist – Absolute Basis.

Indicators Describing Waste	Total	A1	A2	A3
HWD [kg]	8.08E-04	6.80E-04	1.01E-06	1.27E-04
NHWD [kg]	2.17E-01	9.01E-02	1.14E-02	1.16E-01
HLRW [m^3]	4.14E-09	2.91E-09	1.25E-11	1.22E-09
ILLRW [m^3]	5.12E-08	2.69E-08	1.10E-10	2.42E-08
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 10. Cradle-to-Gate LCIA Results for 1 Linear Meter of Wood I-Joist – Relative Basis.

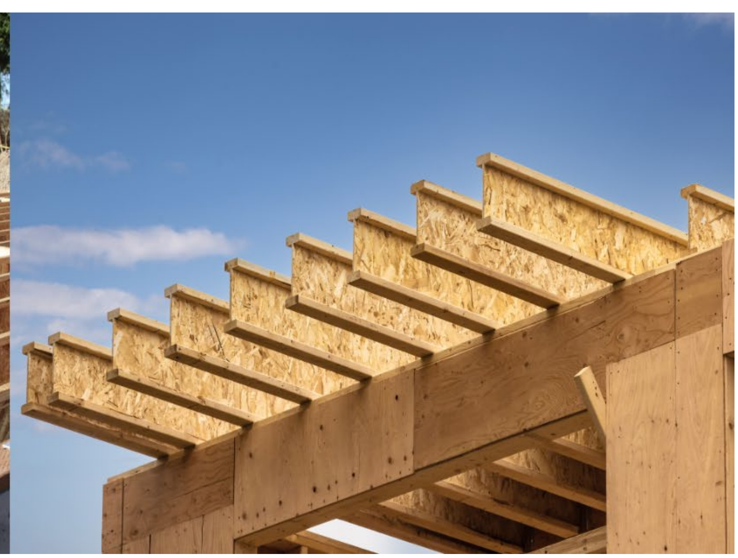
Core Mandatory Impact Indicator	Total	A1	A2	A3
GWP_{FOSSIL} [kg CO_2 eq]	100%	72.8%	5.8%	21.4%
ODP [kg CF-11 eq]	100%	79.7%	0.1%	20.2%
AP [kg SO_2 eq]	100%	70.9%	13.5%	15.6%
EP [kg N eq]	100%	72.8%	2.0%	25.2%
SFP [kg O_3 eq]	100%	70.8%	18.2%	11.1%
FFD [MJ, surplus]	100%	66.0%	4.3%	29.7%
ADP_{FOSSIL} [MJ, LHV]	100%	65.0%	4.6%	30.4%

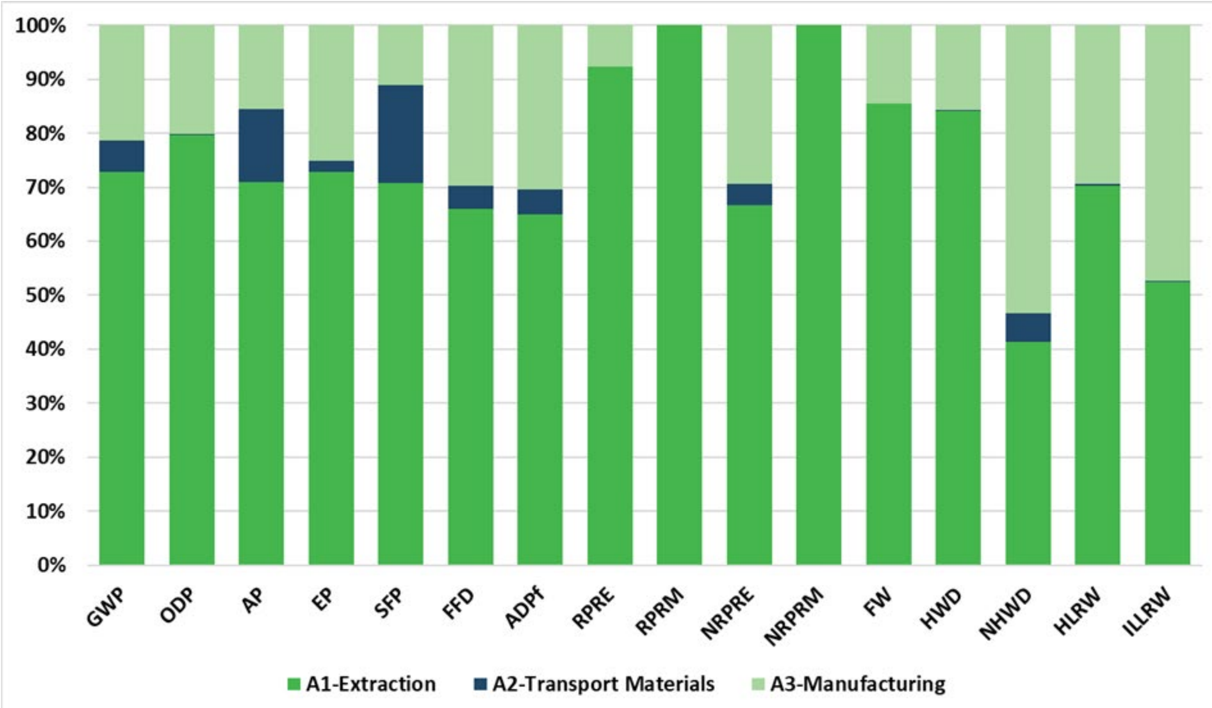
Table 11. Cradle-to-Gate LCIA Results for 1 Linear Meter of Wood I-Joist – Relative Basis.

Use of Primary Resources	Total	A1	A2	A3
RPRE [MJ, LHV]	100%	92.3%	0.0%	7.7%
RPRM [MJ, LHV]	100%	100.0%	0.0%	0.0%
NRPRE [MJ, LHV]	100%	66.7%	3.9%	29.4%
NRPRM [MJ, LHV]	100%	100.0%	0.0%	0.0%
FW [m^3]	100%	85.4%	0.0%	14.5%

Table 12. Cradle-to-Gate LCIA Results for 1 Linear Meter of Wood I-Joist – Relative Basis.

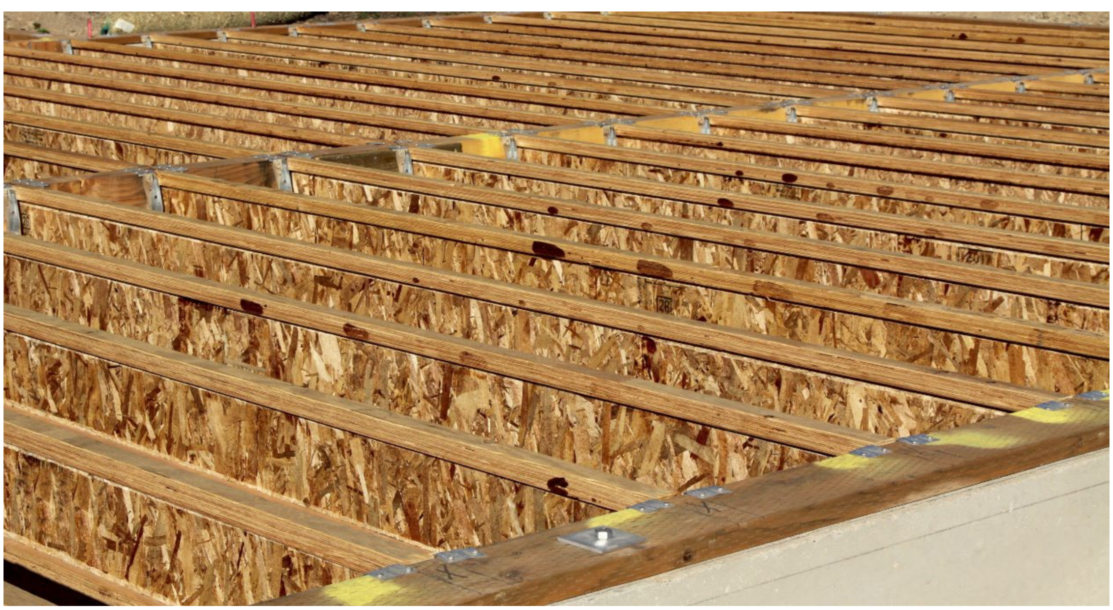
Indicators Describing Waste	Total	A1	A2	A3
HWD [kg]	100%	84.2%	0.1%	15.7%
NHWD [kg]	100%	41.4%	5.2%	53.3%
HLRW [m^3]	100%	70.3%	0.3%	29.4%
ILLRW [m^3]	100%	52.5%	0.2%	47.3%



GWP	Global warming potential	RPRM	Renewable primary energy carrier used as material.
ODP	Depletion potential of the stratospheric ozone layer	NRPE	Non-renewable primary energy carrier used as energy.
AP	Acidification potential of soil and water sources	NRPRM	Renewable primary energy carrier used as material.
EP	Eutrophication potential	FW	Consumption of freshwater resources
SFP	Formation potential of tropospheric ozone	HWD	Hazardous waste disposed.
ADPf	Abiotic depletion potential (ADP fossil) for fossil resource	NHWD	Non-hazardous waste disposed.
FFD	Fossil fuel depletion	HLRW	High-level radioactive waste, conditioned, to final repository
RPRM	Renewable primary energy carrier used as energy	ILLRW	Intermediate- and low-level radioactive waste, conditioned to final repository

Figure 4. Cradle-to-Gate LCIA Results for 1 Linear Meter of Wood I-Joist – Relative Basis.



Biogenic Carbon Results

Cradle-to-Gate Results

Wood is a biobased material and thus contains biogenic carbon. The accounting of biogenic carbon follows the requirements set out in ISO 21930:2017 where biogenic carbon enters the product system (removal) as primary or secondary material. Carbon removal is considered a negative emission. The biogenic carbon leaves the system (emission) as a product, by-products, or directly to the atmosphere when combusted for heat energy. These mass flows of biogenic carbon from and to nature are listed in the LCI and are expressed in kg CO_2.

Table 13 shows the biogenic carbon removal and emissions. All carbon dioxide flows (kg CO_2) presented in Table 13 are unallocated to include by-products leaving the system boundary in module A3. Even though the system boundary for this LCA only includes module A1-A3, in accordance with ISO 21930, emission from packaging (BCEK) is reported in A5-Construction and emission from the main product (BCEP) is reported in C3/C4-End-of-Life[1]. The net carbon emission across the cradle-to-gate life cycle is zero. It is assumed that all carbon removed from the atmosphere is eventually emitted to the atmosphere as CO_2.

Table 13. Biogenic Carbon Inventory Parameters for 1 Linear Meter of Wood I-Joist, Unallocated.

	A1	A2	A3	A5	C3/C4	Total
BCRP [kg CO_2]	(7.03E+00)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	(7.03E+00)
BCEP [kg CO_2]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.92E+00	6.92E+00
BCRK [kg CO_2]	0.00E+00	0.00E+00	(8.71E-02)	0.00E+00	0.00E+00	(8.71E-02)
BCEK [kg CO_2]	0.00E+00	0.00E+00	0.00E+00	8.71E-02	0.00E+00	8.71E-02
BCEW [kg CO_2]	0.00E+00	0.00E+00	1.11E-01	0.00E+00	0.00E+00	1.11E-01

Cradle-to-Grave Results

The product system represented in this EPD includes 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 are 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 (UL 2020 Appendix A). The carbon sequestration addendum is based on the United States EPA WARM model and aligns with the biogenic accounting rules in ISO 21930 Section 7.2.7 and Section 7.2.12. Because the end-of-life fate of this material is unknown, we have applied the default disposal pathway from the PCR Part A (UL 2018) Section 2.8.5, 100% landfill.

[1] These products are reported in modules outside the scope of this LCA system boundary to provide reference for EoL waste and emissions if a full cradle-to-grave LCA were to be performed.

The following results apply the addendum methodology (UL 2020 Appendix A) to the biogenic carbon present in the primary product as it leaves the manufacturer in Module A3[2].

1 m I-joist = 3.77 oven dry kg = 1.89 kg carbon = 6.92 kg CO_2 eq

Carbon sequestered in product at manufacturing gate:
6.92 kg CO_2 eq = -6.92 kg CO_2 eq

Methane emitted from fugitive landfill gas:
0.01 kg CH_4 = 0.33 kg CO_2 eq emission[3]

Carbon dioxide emitted from fugitive landfill gas and the combustion captured landfill gas:
0.78 kg CO_2 eq emission[4]

Permanent carbon sequestration, net of biogenic carbon emissions:
5.81 kg CO_2 eq = -5.81 kg CO_2 eq emission[5]

[2] Background assumptions for EoL and 100% Landfill: methane emission = 3.53E-03 kg CH4/kg dry wood; carbon dioxide emission = 2.06E-01 kg CO2/kg dry wood (UL 2020).
[3] Methane emissions= 3.53E-03 kg CH4/kg of dry wood X 3.77 kg of dry wood = 0.01 kg CH4; kg CO2 eq = 0.01 kg CH4 X 25.05 kg CH4/kg CO2 eq = 0.33 kg CO2 eq
[4] Carbon dioxide emissions= 2.06E-01 kg CO2/kg of dry wood X 3.77 = 0.78 kg CO2
[5] Final sequestration, net of biogenic emissions = CO2 eq in product at gate = 6.92 – (0.33+0.78) = 5.81 kg CO2 eq

LCA Interpretation

Comparability

Environmental declarations from different programs [6] 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

This LCA was created using manufacturer average data for upstream materials. Variation can result from differences in supplier locations, manufacturing processes, manufacturing efficiency and fuel type used. This LCA does not report all of the environmental impacts due to manufacturing of the product but rather reports the environmental impacts for those categories with established LCA-based methods to track and report. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change, and habitat destruction. In order to assess the local impacts of product manufacturing, additional analysis is required.

Additional Environmental Information

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 I-joist 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.

I-joist production facilities 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, an I-joist mill 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).

The eight facilities represented in this regional LCA reported on average, 100% of the fiber entering their mills to be non-controversial (legal), 100% to be responsible (following a certified procurement standard), and 13.6% from independently certified forests.

Forest Management

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

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

Data

National or regional life cycle averaged data for raw material extraction does not distinguish between extraction practices at specific sites and can greatly affect the resulting impacts.

Accuracy of Results

EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any product line and reported impact when averaging data.

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Puettmann: cover photo, page 7
APA-The Engineered Wood Association: Page 5, upper left

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