ENVIRONMENTAL PRODUCT DECLARATION

ZIP SYSTEM® SHEATHING

J.M HUBER CORPORATION

ZIP System® sheathing and tape is an innovative structural roof and wall system with an integrated water resistant and air barrier.

Huber Engineered Woods LLC continually strives to create innovative products that suit their customers' needs. Each one delivers outstanding performance, easy installation and greater strength in single family, multifamily and light commercial projects. ZIP System® sheathing and tape is an innovative structural roof and wall system with an integrated water resistant and air barrier that streamlines the weatherization process and transforms it with a simple two-step installation. Just put up the panels and tape the seams. ZIP System can be installed by one person whereas traditional wall and roof assemblies require multiple people to install the panels, housewrap or underlayment and any associated seam tape. To learn more, visit www.zipsystem.com

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

ZIPsystem™ SHEATHING & TAPE

ZIP System
Premium Structural Roof and Wall System

CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION ULCOM/EPD

According to ISO 14025, EN 15804, and ISO 21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Environment 333 Pfingsten Road, Northbrook, IL 60611	https://www.ul.com https://spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	General Program Instructions v2.4 July 2018	
MANUFACTURER NAME AND ADDRESS	Huber Engineered Woods, 10925 David Taylor Drive, Suite 300 Charlotte, NC 28262	
DECLARATION NUMBER	4789103593.102.1	
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	1 cubic meter	
REFERENCE PCR AND VERSION NUMBER	Product Category Rules Guidance for Building-Related Products and Services Part B: Structural and Architectural Wood Products EPD Requirements, UL, First Edition, October 21, 2019	
DESCRIPTION OF PRODUCT APPLICATION/USE	Oriented Strand Board Roof and Wall Sheathing	
PRODUCT RSL DESCRIPTION (IF APPL.)	75 years	
MARKETS OF APPLICABILITY	Residential, Multi-Family, Commercial	
DATE OF ISSUE	July 1, 2020	
PERIOD OF VALIDITY	5 Years	
EPD TYPE	Product-Specific	
RANGE OF DATASET VARIABILITY	n/a	
EPD SCOPE	Cradle to gate with options (A4, A5, C2, and C4)	
YEAR(S) OF REPORTED PRIMARY DATA	July 2018 to June 2010	
LCA SOFTWARE & VERSION NUMBER	SimaPro v9	
LCI DATABASE(S) & VERSION NUMBER	ecoinvent v3.5	
LCIA METHODOLOGY & VERSION NUMBER	TRACI	

The PCR review was conducted by:	UL Environment PCR Review Panel epd@ulenvironment.com
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☐ EXTERNAL	Grant R Martin, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

LIMITATIONS

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

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.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

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Product Classification and Description

Product Description

Huber Engineered Wood's ZIP System® Sheathing is made of combined wood strands and resin arranged in layers with deliberate orientation providing superior strength, stiffness, durability and quality. The ZIP System tape leverages an advanced acrylic adhesive that provides a watertight and airtight seal.

ZIP System® Sheathing & Tape is designed to streamline work on the jobsite. It's a revolutionary structural roof and wall system with a built-in energy-efficient barrier that keeps moisture out and reduces air leakage, while still allowing panels to properly dry. ZIP System sheathing & tape is engineered for use on both roof and wall applications, meaning one panel is all you need.

As an all-in-one structural panel system with a built-in water-resistive and air barrier, ZIP System Sheathing & Tape creates an airtight seal and eliminates the need for felt, synthetic underlayment or peel & stick options, saving significant labor time and costs. The simple panel-and-tape system installs quickly creating a rough dry-in that helps keep construction progress on track.

SIMPLY INSTALL ZIP SYSTEM® PANELS AND TAPE THE SEAMS FOR MOISTURE AND AIR PROTECTION.

1. **High quality structural sheathing panel** made of engineered wood delivers strength and durability.
2. **Built-in vapor permeable, water-resistive barrier enhances drainage** and eliminates the hassles of house wrap and felt.
3. A continuous, rigid air barrier decreases unwanted air leakage for **greater energy efficiency**.
4. ZIP System™ tape with a specially engineered, **high performance acrylic adhesive** bonds with ZIP System® panels for a permanent protective seal.

Figure 1: ZIP System Description and Integration into a Building

Product Styles

This EPD covers two ZIP System® products: Roof and Wall Sheathing and Insulated R-Sheathing. The products are produced in five different thicknesses, measured in inches, 7/16”, 1/2”, 5/8”, 1” and 1 ½”. The results presented in the following tables reflect one cubic meter of product. Scaling factors are provided in Table 2 so that the environmental impacts can be multiplied by the scaling factor to obtain the total environmental impacts per square meter for each product.

Table 1: ZIP System Declared Unit

Volume	Roof and Wall Sheathing	Insulated R-3 Sheathing	Insulated R-6 Sheathing	Insulated R-9 Sheathing	Insulated R-12 Sheathing
Declared Unit	1 m^3	1 m^3	1 m^3	1 m^3	1 m^3
Mass per Declared Unit (kg)	660	325	223	174	145
Thickness to Achieve Declared Unit (m)	0.011 m (7/16")	0.011 m (7/16") OSB; 0.013 m (0.5”) Foam	0.011 m (7/16") OSB; 0.025 m (1”) Foam	0.011 m (7/16") OSB; 0.038 m (1.5”) Foam	0.011 m (7/16") OSB; 0.051 m (2”) Foam
Density (kg/m^3)	660	325	223	174	145
Moisture Content	3.5%	3.5%	3.5%	3.5%	3.5%
Number of Square Meters to Achieve Declared Unit at Smallest Thickness	90	42	27.39	20.32	16.15

Table 2: ZIP System Scaling Factors

	Roof and Wall Sheathing		R-3 Insulated Sheathing		R-6 Insulated Sheathing		R-9 Insulated Sheathing		R-12 Insulated Sheathing	
Thickness (in/m^2) of OSB	Scaling Factor*	# of m^2 in declared unit†	Scaling Factor*	# of m^2 in declared unit†	Scaling Factor*	# of m^2 in declared unit†	Scaling Factor*	# of m^2 in declared unit†	Scaling Factor*	# of m^2 in declared unit†
7/16"	0.0111	90	0.0238	42	0.0365	27.39	0.0492	20.32	0.0619	16.15
1/2”	0.0127	78.74	-	-	-	-	-	-	-	-
5/8”	0.0159	62.99	-	-	-	-	-	-	-	-

*Scaling Factors to Obtain 1 square meter of desired thickness from declared unit
†Number of square meters to 1 cubic meter at a specified thickness

Range of Application

ZIP System Sheathing and Tape products can be used in both roof and wall applications as a wood-structural panel alternate with superior moisture protection and energy efficiency with quick and easy installation.

Product Specification

- Evaluation of Wood Structural Panels (ICC-ES AC266)
- Evaluation of Proprietary Sheathing (ICC-ES AC269.1, AC269.2)
- Flashing Adhesion & Durability (AAMA 711)
- Evaluation of Flexible Flashing (ICC-ES AC148)
- Air Barrier (ASTM E 2178-03, ASTM E2357-05)
- Water Resistance (ICC-ES AC310)
- Drainage Efficiency (ASTM E 2273)

Material Composition

Functional Unit

The functional unit utilized for this study is one cubic meter (1 m^3) with a service life of 75 years, including end-of-life disposition.

Product Material Composition

Wood strands represent the largest ZIP System® formulation component. The overlay (a polymer-modified sheet material) is the second largest formulation component in the Roof & Wall Sheathing products, and third largest in the R-Sheathing product. The insulating polyisocyanate foam is the second largest formulation component in the R-Sheathing product. The ZIP System formulation components are displayed in the following table.

Table 3: ZIP System Product Recipes

Product Recipe	Roof & Wall Sheathing	Insulated R-Sheathing
Wood	90-95%	70-90%
Core Resin	0.5-5%	0-5%
Surface Resin	0.5-1%	0-1%
Wax	0.25-2%	0-2%
Release Agent	<0.5%	<0.5%
Ink	<0.1%	<0.1%
Overlay	2-4%	0-2%
Foam	-	5-30%
Edge Seal	<0.1%	<0.1%

Packaging Material Composition

ZIP System panels are stacked on top of each other onto 3 wood strips to enable loading and unloading via fork truck. The stacks are protected with vertical cardboard side covers and banded together with the wood strips with plastic banding.

Table 4: ZIP System Packaging Materials (kg/cubic meter)

Packaging Material	Roof and Wall Sheathing	Insulated R-Sheathing	Unit
Side Cover (Plastic)	0.9	0.9	kg/m^3
Sticker/Batten (Wood)	1.2	1.2	kg/m^3
Plastic Strapping	0.1	0.1	kg/m^3

Technical Requirements

The standards that can be applied for ZIP system sheathing products are as follows:

- Evaluation of Wood Structural Panels (ICC-ES AC266)
- Evaluation of Proprietary Sheathing (ICC-ES AC269.1, AC269.2)
- Flashing Adhesion & Durability (AAMA 711)
- Evaluation of Flexible Flashing (ICC-ES AC148)
- Air Barrier (ASTM E 2178-03, ASTM E2357-05)
- Water Resistance (ICC-ES AC310)
- Drainage Efficiency (ASTM E 2273)

Properties of Declared Product as Delivered

The product is delivered in the following status:

Table 5: Declared Unit Properties

	Roof and Wall Sheathing	Insulated R-Sheathing
Standard Length	8 ft (2.4 m)	8 ft (2.4 m)
Standard Width	4 ft (1.2 m)	4 ft (1.2 m)
Standard Height of Packaging Unit	2.9 ft – 3 ft (0.82 – 0.91 m)	2.7 ft – 3.75 ft (0.82 – 1.14 m)
Total Weight	3,800 – 3,850 lbs (1,720 kg – 1,746 kg)	1,150 – 1,830 lbs (520 kg – 830 kg)
Panels Per Unit	80 panels (7/16” thickness) 70 panels (1/2” thickness) 55 panels (5/8” thickness)	32 panels (R-3) 31 panels (R-6) 23 panels (R-9) 18 panels (R-12)

Life Cycle Stages

EPD Scope

The life cycle analysis performed for this EPD is characterized as a “cradle-to-gate with options” study, examining the ZIP System® products from raw material extraction through final disposal excluding the use phase.

Table 6: ZIP System Boundary

Product Stage			Construction Process Stage		Use Stage							End of Life Stage*				Benefits and Loads Beyond the System Boundaries
Raw material supply	Transport	Manufacturing	Transport from gate to the site	Construction/ installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction /demolition	Transport	Waste processing	Disposal	Reuse- Recovery- Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	X	MND	X	MND

Time Boundary

Data for this LCA was collected from July 2018 through June 2019.

Cut-off Criteria

Processes with a cumulative mass or energy of the system flows/model less than 1% may be excluded, provided its environmental relevance is minor. Processes that meet that criteria but contribute at least 2% to the selected impact categories shall be included in the system boundary. In no case shall less than 95% of mass or environmental impact be included in the system boundary.

All hazardous or toxic substances shall be included in the system boundary.

This LCA is in compliance with the cut-off criteria since no known processes were neglected or excluded from this analysis except an accelerant in the resin. The accelerant is used only at one of the four manufacturing facilities, comprising an average of 0.02% of the total input material. No composition information was available from the supplier.

Data Sources

Primary data were collected directly from the facilities for ever yproces in the product system under the control of J.M. Huber Corporation. SimaPro v9 software was utilized for modeling the complete cradle-to-gate with options inventory. The ecoinvent v3.5 life cycle inventory database was the primary sources of secondary data utilized for this study. Supplemental secondary data was used from the US LCI database.

System Boundaries

This project considers the life cycle activities from resource extraction through product use for a 75 year service life.

Allocation

Allocation of multi-output processes was performed following the requirements and guidance of ISO 14044:2006, clause 4.3.4, and was based on mass. Any co-products were less than 10x the economic value of the main products and were not included in the allocation.

Treatment of Biogenic Carbon

Biogenic carbon was considered neutral throughout this study. Separate carbon uptake and emissions from bio-derived sources are reported separately in the “Output Flows and Waste Categories” for both product and packaging biogenic carbon.

Data Quality

For consistency in the model, specific, primary data from the manufacturing process was provided by the relevant facilities. Upstream and downstream raw materials and other data were modeled using secondary data obtained from relevant databases as documented in the LCA Report. Thse databases are from nationally accepted and publicly available databases, ensuring reproducibility. This study is representative only of Huber ZIP System® Roof and Wall Sheathing, and Insulated R-sheathing.

Estimates and Key Assumptions

For installation, packaging waste was modeled as landfilled. Any required energy of this product to be installed into building was considered below the cut-off criteria and excluded.

Production of ZIP System Products

Production Process

The incoming logs are delivered by truck to the scale house. The logs are stripped of bark and fed into a strander which slices the material into small pieces (strands). The strands then enter a drying process and are dried down to a low moisture content. The strands are then sent through a cyclone where they are separated from the dryer airstream and into a screening process where any unusable strands are removed. These newly screened strands are sent to dry bins for storage. From there, the strands are blended with resins, waxes, and other binders to hold them together. A forming machine lays down the strands into a mat on a forming belt. During this forming process, the strands are oriented in alternating directions as they are conveyed, resulting in a more structurally consistent panel. The mats are trimmed into the desired lengths, and heat and pressure are applied to activate the resin and bond the strands into a solid panel. The panel edges are trimmed and cut to length. Panels are sanded, labeled and edge coated. Finished panels are stacked, packaged, and shipped to customers.

ZIP System products are produced at plants in Commerce, Georgia; Broken Bow, Oklahoma; Crystal Hill, Virginia;

Spring City, Tennessee; Easton, Maine; and St-Georges de Champlain, Quebec, Canada. Detailed operational and production data was collected from each facility and combined into a weighted average in collaboration with process experts.

Construction

Transportation and Delivery

Final products were modeled as being shipped by truck and rail. Records of customer sales were used to generate the average distances.

Table 7: Transport to the Building Site (A4)

Name	Roof and Wall Sheathing	R-3 Insulated Sheathing	R-6 Insulated Sheathing	R-9 Insulated Sheathing	R-12 Insulated Sheathing	Unit
Fuel Type	Diesel	Diesel	Diesel	Diesel	Diesel	
Liters of fuel	38	38	38	38	38	l/100km
Vehicle type	17% by rail 83% by truck	11% by rail 89% by truck	11% by rail 89% by truck	11% by rail 89% by truck	11% by rail 89% by truck	
Average Transport Distance	683	607	607	607	607	km
Capacity Utilization	90	90	90	90	90	% by mass
Gross Density of Products Transported	660	325	223	174	145	kg/m^3
Weight of products transported	660	325	223	174	145	kg
Volume of products transported	1	1	1	1	1	m^3
Capacity utilization volume factor	1	1	1	1	1	

Installation

Huber products are designed for superior durability and installation ease. For installation, thirteen nails (0.0257 kg) or twenty-six staples per square meter are required for fastening and were included in this study; this quantity is a similar requirement to other types of OSB or plywood. The electricity from an air compressor for a nail gun was also included in this scope.The ZIP System products have the panel seams sealed with ZIP System tape to maintain a superior airtight and watertight seal. This seal aids Huber products in withstanding harsh weather and provides moisture protection and reduced air infiltration. Huber estimates that 7 panels (4'x8' boards) use 90 feet of ZIP System tape, or 0.048 lb per m^2.

Table 8: Installation into the Building (A5)

Name	Roof and Wall Sheathing	R-3 Insulated Sheathing	R-6 Insulated Sheathing	R-9 Insulated Sheathing	R-12 Insulated Sheathing	Unit
Ancillary materials	Tape: 1.96 kg Nails: 2.31 kg	Tape: 0.91 kg Nails: 1.08 kg	Tape: 0.60 kg Nails: 0.70 kg	Tape: 0.45 kg Nails: 0.52 kg	Tape: 0.35 kg Nails: 0.42 kg	kg
Net freshwater consumption specified by water source and fate	n/a	n/a	n/a	n/a	n/a	m^3
Other resources type	n/a	n/a	n/a	n/a	n/a	Kg
Electricity consumption	<0.01	<0.01	<0.01	<0.01	<0.01	kWh

Name	Roof and Wall Sheathing	R-3 Insulated Sheathing	R-6 Insulated Sheathing	R-9 Insulated Sheathing	R-12 Insulated Sheathing	Unit
Other energy carriers	n/a	n/a	n/a	n/a	n/a	MJ
Product loss per functional unit	33	16.25	11.15	8.7	7.25	kg
Waste materials at the construction site	37.3	18.2	12.5	9.7	8.0	kg
Output materials (landfill)	35.2	18.5	13.4	10.9	9.5	kg
Mass of packaging waste specified by type	1.2 (wood) 1.0 (plastic)	1.2 (wood) 1.0 (plastic)	1.2 (wood) 1.0 (plastic)	1.2 (wood) 1.0 (plastic)	1.2 (wood) 1.0 (plastic)	kg
Biogenic carbon contained in packaging	0.36	0.36	0.36	0.36	0.36	kg CO_2
Direct emissions to ambient air, soil and water	n/a	n/a	n/a	n/a	n/a	kg
VOC emissions	unk	unk	unk	unk	unk	µg/m^3

Waste

During installation, saw dust, wood scrap, and packaging waste are generated. A 5% product scrap rate was assumed based on product installation expertise.

Use Stage

Product Service Life

The ZIP System® premium sheathing products are weather and moisture resistant and can withstand a long duration when exposed to the elements during the construction process. Once properly installed in a finished Code complying building, these products can last the duration of an average building, that is, at least 75 years.

Table 9: Reference Service Life

Name	Roof & Wall Sheathing	Insulated R-Sheathing	Unit
Reference Service Life (RSL)	75	75	years
Declared Product Properties	Please refer to the installation guide for further information regarding installation practices. https://www.huberwood.com/uploads/documents/technical/literature/ZIP_System-Wall-Install-Guide-2013-03.pdf		
Design Application Parameters			
Quality of Work			
Outdoor Environment	Combined with the ZIP sealing tape, the ZIP system sheathing and insulated sheathing has a 180-Day Exposure Guarantee for weathering from the elements.		
Indoor Environment	n/a	n/a	n/a
Use conditions	Please visit zipsystem.com for more information.		
Estimated Building Life	75	75	years
Number of Replacements	0	0	number
Maintenance	n/a	n/a	n/a

Use Stage Assumptions

During use, the product is contained within the exterior structure of the building. ZIP System sheathing uses no energy or water during use. ZIP System sheathing requires no maintenance, repair, replacement, or refurbishment during its service life.

End of Life

Disposal

The end-of-life scenario was modeled based on the 2017 US EPA solid waste and waste diversion statistics. The study assumes 85.2% being disposed as the average US municipal solid waste disposition. The average US disposition includes 81% landfill and 19% incineration. The cut-off methodology (also known as the recycled content method in the GHG Protocol for Products) was used for any materials that were sent to recycling such as scrap and the end of life disposition.

Table 10: End of Life (C1-C4)

Name		Roof and Wall Sheathing	R-3 Insulated Sheathing	R-6 Insulated Sheathing	R-9 Insulated Sheathing	R-12 Insulated Sheathing	Unit
Assumptions for scenario development		Products are manually removed and disposed with construction and demolition (C&D) waste, and may be sorted and recycled, landfilled or incinerated.					
Collection process	Collected separately	n/a	n/a	n/a	n/a	n/a	kg
	Collected with mixed construction waste	660	325	223	174	145	kg
Recovery and Disposal	Reuse	0	0	0	0	0	kg
	Recycling	0	0	0	0	0	kg
	Landfill	534	263	181	141	117	kg
	Incineration	125	62	42	33	27	kg
	Incineration (with energy recovery)	0	0	0	0	0	kg
	Energy conversion	n/a	n/a	n/a	n/a	n/a	
Removals of biogenic carbon (excluding packaging)		140.3	65.5	42.7	31.7	25.2	kg

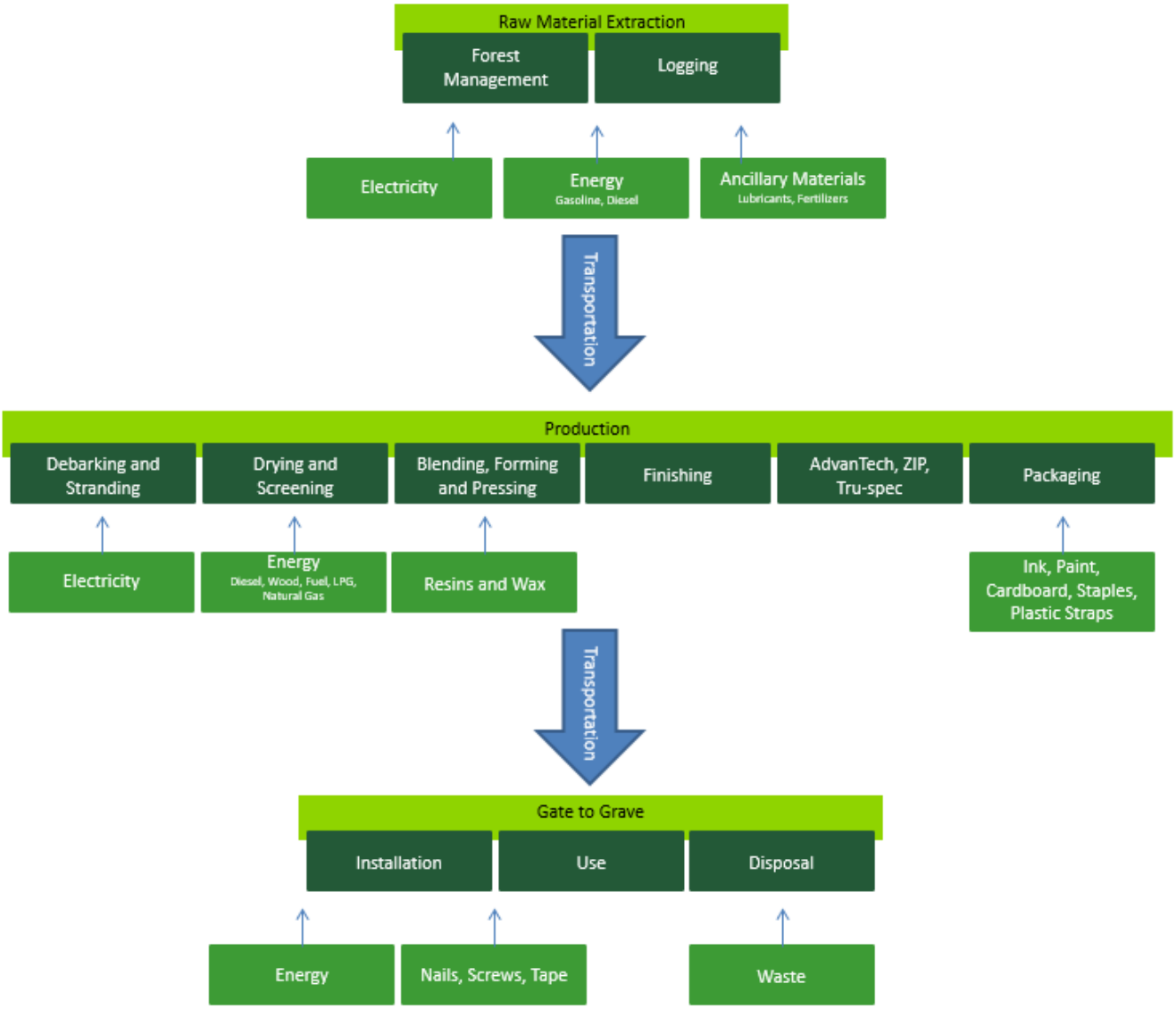

Figure 2: System Flow Diagram

Potential Environmental Impacts

ZIP System Roof and Wall Sheathing

The tables below present the selected categories of potential environmental impacts (global warming, ozone depletion, acidification, eutrophication, smog formation , fossil fuel depletion, and abiotic depletion) generated for each cradle-to-gate with options life cycle stage for 1 cubic meter ZIP System Roof and Wall Sheathing. Refer to the scaling factors above to convert these results to the appropriate product thicknesses.

Table 11: Life Cycle Impact Assessment of 1m^3 ZIP System Roof and Wall Sheathing

TRACI 2.1 Impact Assessment							
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	3.8E+02	3.8E+01	7.8E+01	0.0E+00	4.4E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	2.5E-06	1.5E-09	1.8E-06	0.0E+00	1.2E-06
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	1.9E+01	2.5E-01	3.3E-01	0.0E+00	1.1E-01
EP	Eutrophication potential	kg N-Eq.	1.3E+00	1.4E-02	2.2E-01	0.0E+00	2.3E+00
SP	Smog formation potential	kg O_3-Eq.	7.3E+02	7.0E+00	2.6E+00	0.0E+00	3.3E+00
FFD	Fossil Fuel Depletion	MJ-surplus	1.1E+03	7.3E+01	2.8E+02	0.0E+00	1.6E+01
CML 3.05 Impact Assessment							
Parameter	**Parameter**		**A1-A3**	**A4**	**A5**	**C2**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	3.8E+02	3.8E+01	8.0E+01	0.0E+00	4.6E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	2.0E-06	1.4E-09	1.5E-06	0.0E+00	9.6E-07
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	1.4E+01	2.0E-01	3.4E-01	0.0E+00	8.3E-02
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	3.1E+00	3.7E-02	9.7E-02	0.0E+00	8.8E-01
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	5.9E+00	8.7E-03	2.2E-02	0.0E+00	4.7E-03
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	2.6E-04	0.0E+00	3.2E-04	0.0E+00	2.5E-05
ADPF	Abiotic depletion potential for fossil resources	MJ	8.7E+03	4.9E+02	2.0E+03	0.0E+00	1.2E+02

Table 12: Use of Resources of 1m³ ZIP Roof and Wall Sheathing

Resource Use							
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
PERE	Renewable primary energy as energy carrier	MJ	1.5E+04	0.0E+00	1.5E+01	0.0E+00	2.0E+00
PERM	Renewable primary energy resources as material utilization	MJ	1.1E+03	0.0E+00	5.9E+00	0.0E+00	8.1E-01
PENRE	Nonrenewable primary energy as energy carrier	MJ	8.6E+03	5.2E+02	2.1E+03	0.0E+00	1.3E+02
PENRM	Nonrenewable primary energy as material utilization	MJ	7.3E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SM	Use of secondary material	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RSF	Use of renewable secondary fuels	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RE	Use of recovered energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
FW	Use of net fresh water	m^3	6.3E+00	0.0E+00	1.5E-01	0.0E+00	-5.7E-02

Table 13: Output Flows and Waste Categories of 1m³ Roof and Wall Sheathing

Output Flows and Waste Categories							
Parameter	**Parameter**	**Units**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
HWD	Hazardous waste disposed	kg	4.6E-04	0.0E+00	3.7E-04	0.0E+00	2.2E-04
NHWD	Non-hazardous waste disposed	kg	1.4E+01	0.0E+00	1.6E+01	0.0E+00	5.6E+02
HLRW	High-level radioactive waste, conditioned, to final repository	kg	2.6E-03	0.0E+00	5.2E-04	0.0E+00	3.8E-04
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CRU	Components for re-use	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
MFR	Materials for recycling	kg	8.9E+00	0.0E+00	5.1E+00	0.0E+00	1.0E+02
MER	Materials for energy recovery	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
EEE	Exported electrical energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ETE	Exported thermal energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Removals associated with biogenic carbon content of the bio-based product;		kg CO_2	8.8E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions associated with biogenic carbon content of the bio-based product;		kg CO_2	0.0E+00	0.0E+00	4.2E+01	0.0E+00	8.3E+02
Emissions from calcination and removals from carbonation;		kg CO_2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Removals associated with biogenic carbon content of the bio-based packaging		kg CO_2	1.7E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions associated with biogenic carbon content of the bio-based packaging		kg CO_2	0.0E+00	0.0E+00	1.7E+00	0.0E+00	0.0E+00
Emissions from combustion of waste from renewable sources used in production processes;		kg CO_2	9.7E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions from combustion of waste from non-renewable sources used in production processes.		kg CO_2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

ZIP System R-3 Insulated Sheathing

The tables below, Tables 9-11, present the selected categories of potential environmental impacts (global warming, ozone depletion, acidification, eutrophication, smog formation, fossil fuel depletion, and abiotic depletion) generated for each cradle-to-gate with options life cycle stage for 1 cubic meter ZIP System Insulated R-3 Sheathing. Refer to the scaling factors above in Table 2 to convert these results to the appropriate product thicknesses.

Table 14: Life Cycle Impact Assessment of 1m^3 ZIP System Insulated R-3 Sheathing

TRACI 2.1 Impact Assessment							
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	3.1E+02	2.1E+01	3.4E+01	3.1E+00	1.8E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	1.5E-06	7.9E-10	7.7E-07	1.3E-10	6.8E-07
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	3.0E+00	1.3E-01	1.4E-01	4.1E-02	5.2E-02
EP	Eutrophication potential	kg N-Eq.	1.9E-01	7.3E-03	9.1E-02	2.5E-03	9.6E-01
SP	Smog formation potential	kg O_3-Eq.	3.1E+01	3.6E+00	1.1E+00	1.1E+00	1.6E+00
FFD	Fossil Fuel Depletion	MJ-surplus	1.3E+03	4.0E+01	1.3E+02	6.6E+00	8.2E+00
CML 3.05 Impact Assessment							
Parameter	**Parameter**		**A1-A3**	**A4**	**A5**	**C2**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	3.1E+02	2.1E+01	3.5E+01	3.1E+00	1.9E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	1.2E-06	7.8E-10	6.5E-07	1.3E-10	5.4E-07
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	3.1E+00	1.1E-01	1.5E-01	3.1E-02	4.0E-02
EP	Eutrophication potential	kg $(PO_4)^3$-Eq.	2.1E-01	1.9E-02	4.0E-02	6.9E-03	3.7E-01
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	2.0E-01	4.7E-03	9.8E-03	-6.6E-03	2.4E-03
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	5.3E-05	0.0E+00	6.4E-05	0.0E+00	6.1E-06
ADPF	Abiotic depletion potential for fossil resources	MJ	9.3E+03	2.7E+02	8.9E+02	4.5E+01	5.9E+01

Table 15: Use of Resources of 1m³ ZIP System Insulated R-3 Sheathing

Resource Use							
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
PERE	Renewable primary energy as energy carrier	MJ	5.7E+03	0.0E+00	5.6E+00	0.0E+00	9.4E-01
PERM	Renewable primary energy resources as material utilization	MJ	5.7E+02	0.0E+00	2.0E+00	0.0E+00	2.9E-01
PENRE	Nonrenewable primary energy as energy carrier	MJ	9.6E+03	2.8E+02	9.6E+02	0.0E+00	6.5E+01
PENRM	Nonrenewable primary energy as material utilization	MJ	3.7E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SM	Use of secondary material	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RSF	Use of renewable secondary fuels	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RE	Use of recovered energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
FW	Use of net fresh water	m^3	9.2E+00	0.0E+00	6.5E-02	0.0E+00	-3.7E-02

Table 16: Output Flows and Waste Categories of 1m³ ZIP System Insulated R-3 Sheathing

Output Flows and Waste Categories							
Parameter	**Parameter**	**Units**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
HWD	Hazardous waste disposed	kg	5.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NHWD	Non-hazardous waste disposed	kg	4.0E+00	0.0E+00	1.3E+01	0.0E+00	2.2E+02
HLRW	High-level radioactive waste, conditioned, to final repository	kg	3.3E-04	0.0E+00	1.2E-04	0.0E+00	1.6E-04
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CRU	Components for re-use	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
MFR	Materials for recycling	kg	2.6E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
MER	Materials for energy recovery	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
EEE	Exported electrical energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ETE	Exported thermal energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Removals associated with biogenic carbon content of the bio-based product;		kg CO_2	8.8E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions associated with biogenic carbon content of the bio-based product;		kg CO_2	0.0E+00	0.0E+00	4.2E+01	0.0E+00	8.3E+02
Emissions from calcination and removals from carbonation;		kg CO_2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Removals associated with biogenic carbon content of the bio-based packaging		kg CO_2	1.6E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions associated with biogenic carbon content of the bio-based packaging		kg CO_2	0.0E+00	0.0E+00	1.6E+00	0.0E+00	0.0E+00
Emissions from combustion of waste from renewable sources used in production processes;		kg CO_2	1.5E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions from combustion of waste from non-renewable sources used in production processes.		kg CO_2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

The tables below, Tables 12-14, present the selected categories of potential environmental impacts (global warming, ozone depletion, acidification, eutrophication, smog formation, fossil fuel depletion, and abiotic depletion) generated for each cradle-to-gate with options life cycle stage for 1 cubic meter ZIP System Insulated R-6 Sheathing. Refer to the scaling factors above in Table 2 to convert these results to the appropriate product thicknesses.

Table 17: Life Cycle Impact Assessment of 1m^3 ZIP System Insulated R-6 Sheathing

TRACI 2.1 Impact Assessment							
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	2.8E+02	1.4E+01	2.2E+01	2.1E+00	1.9E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	1.0E-06	5.4E-10	5.0E-07	9.0E-11	5.2E-07
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	2.8E+00	9.0E-02	9.3E-02	2.8E-02	4.0E-02
EP	Eutrophication potential	kg N-Eq.	1.5E-01	5.0E-03	7.3E-02	1.7E-03	9.1E-01
SP	Smog formation potential	kg O_3-Eq.	2.7E+01	2.5E+00	7.1E-01	7.3E-01	1.2E+00
FFD	Fossil Fuel Depletion	MJ-surplus	1.4E+03	2.7E+01	8.5E+01	4.5E+00	6.2E+00
CML 3.05 Impact Assessment							
Parameter	**Parameter**		**A1-A3**	**A4**	**A5**	**C2**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	2.8E+02	1.4E+01	2.3E+01	2.1E+00	1.9E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	8.1E-07	5.4E-10	4.3E-07	8.9E-11	4.1E-07
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	2.9E+00	7.3E-02	9.9E-02	2.2E-02	3.1E-02
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	1.8E-01	1.3E-02	3.2E-02	4.7E-03	3.6E-01
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	2.0E-01	3.2E-03	6.4E-03	-4.5E-03	1.8E-03
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	3.5E-05	0.0E+00	4.2E-05	0.0E+00	4.4E-06
ADPF	Abiotic depletion potential for fossil resources	MJ	9.5E+03	1.8E+02	5.8E+02	3.1E+01	4.4E+01

Table 18: Use of Resources of 1m³ ZIP System Insulated R-6 Sheathing

Resource Use							
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
PERE	Renewable primary energy as energy carrier	MJ	3.7E+03	0.0E+00	3.7E+00	0.0E+00	7.4E-01
PERM	Renewable primary energy resources as material utilization	MJ	3.7E+02	0.0E+00	1.3E+00	0.0E+00	2.2E-01
PENRE	Nonrenewable primary energy as energy carrier	MJ	9.9E+03	1.9E+02	6.2E+02	0.0E+00	4.9E+01
PENRM	Nonrenewable primary energy as material utilization	MJ	2.4E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SM	Use of secondary material	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RSF	Use of renewable secondary fuels	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RE	Use of recovered energy	m^3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
FW	Use of net fresh water	m^3	1.0E+01	0.0E+00	4.3E-02	0.0E+00	-1.4E-02

Table 19: Output Flows and Waste Categories of 1m³ ZIP System Insulated R-6 Sheathing

Output Flows and Waste Categories							
Parameter	**Parameter**	**Units**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
HWD	Hazardous waste disposed	kg	5.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NHWD	Non-hazardous waste disposed	kg	4.0E+00	0.0E+00	1.3E+01	0.0E+00	2.2E+02
HLRW	High-level radioactive waste, conditioned, to final repository	kg	3.3E-04	0.0E+00	1.2E-04	0.0E+00	1.6E-04
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CRU	Components for re-use	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
MFR	Materials for recycling	kg	2.6E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
MER	Materials for energy recovery	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
EEE	Exported electrical energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ETE	Exported thermal energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Removals associated with biogenic carbon content of the bio-based product;		kg CO_2	2.0E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions associated with biogenic carbon content of the bio-based product;		kg CO_2	0.0E+00	0.0E+00	9.5E+00	0.0E+00	1.9E+02
Emissions from calcination and removals from carbonation;		kg CO_2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Removals associated with biogenic carbon content of the bio-based packaging		kg CO_2	1.6E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions associated with biogenic carbon content of the bio-based packaging		kg CO_2	0.0E+00	0.0E+00	1.6E+00	0.0E+00	0.0E+00
Emissions from combustion of waste from renewable sources used in production processes;		kg CO_2	9.8E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions from combustion of waste from non-renewable sources used in production processes.		kg CO_2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

ZIP System Insulated R-9 Sheathing

The tables below, Tables 15-17, present the selected categories of potential environmental impacts (global warming, ozone depletion, acidification, eutrophication, smog formation, fossil fuel depletion, and abiotic depletion) and life cycle inventory generated for each cradle-to-gate with options life cycle stage for 1 cubic meter ZIP System Insulated R-9 Sheathing. Refer to the scaling factors above in Table 2 to convert these results to the appropriate product thicknesses.

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Table 20: Life Cycle Impact Assessment of 1m^3 ZIP System Insulated R-9 Sheathing

TRACI 2.1 Impact Assessment							
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	2.6E+02	1.1E+01	1.7E+01	1.7E+00	1.9E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	7.7E-07	4.2E-10	3.8E-07	7.0E-11	4.4E-07
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	2.7E+00	7.0E-02	6.9E-02	2.2E-02	3.4E-02
EP	Eutrophication potential	kg N-Eq.	1.3E-01	3.9E-03	6.5E-02	1.3E-03	8.9E-01
SP	Smog formation potential	kg O_3-Eq.	2.5E+01	1.9E+00	5.3E-01	5.6E-01	1.0E+00
FFD	Fossil Fuel Depletion	MJ-surplus	1.4E+03	2.1E+01	6.3E+01	3.5E+00	5.3E+00
CML 3.05 Impact Assessment							
Parameter	**Parameter**		**A1-A3**	**A4**	**A5**	**C2**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	2.7E+02	1.1E+01	1.7E+01	1.7E+00	1.9E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	6.1E-07	4.2E-10	3.2E-07	6.9E-11	3.5E-07
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	2.9E+00	5.7E-02	7.3E-02	1.7E-02	2.6E-02
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	1.6E-01	1.0E-02	2.8E-02	3.7E-03	3.5E-01
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.9E-01	2.5E-03	4.7E-03	-3.5E-03	1.5E-03
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	2.6E-05	0.0E+00	3.1E-05	0.0E+00	3.6E-06
ADPF	Abiotic depletion potential for fossil resources	MJ	9.6E+03	1.4E+02	4.3E+02	2.4E+01	3.8E+01

Table 21: Use of Resources of 1m³ ZIP System Insulated R-9 Sheathing

Resource Use							
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
PERE	Renewable primary energy as energy carrier	MJ	2.7E+03	0.0E+00	2.7E+00	0.0E+00	6.4E-01
PERM	Renewable primary energy resources as material utilization	MJ	2.8E+02	0.0E+00	9.9E-01	0.0E+00	1.9E-01
PENRE	Nonrenewable primary energy as energy carrier	MJ	1.0E+04	1.5E+02	4.6E+02	0.0E+00	4.2E+01
PENRM	Nonrenewable primary energy as material utilization	MJ	1.8E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SM	Use of secondary material	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RSF	Use of renewable secondary fuels	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RE	Use of recovered energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
FW	Use of net fresh water	m^3	1.1E+01	0.0E+00	3.2E-02	0.0E+00	-2.5E-03

Table 22: Output Flows and Waste Categories of 1m³ ZIP System Insulated R-9 Sheathing

Output Flows and Waste Categories							
Parameter	**Parameter**	**Units**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
HWD	Hazardous waste disposed	kg	3.9E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NHWD	Non-hazardous waste disposed	kg	2.9E+00	0.0E+00	1.1E+01	0.0E+00	1.7E+02
HLRW	High-level radioactive waste, conditioned, to final repository	kg	2.5E-04	0.0E+00	9.0E-05	0.0E+00	1.4E-04
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CRU	Components for re-use	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
MFR	Materials for recycling	kg	1.9E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
MER	Materials for energy recovery	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
EEE	Exported electrical energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ETE	Exported thermal energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Removals associated with biogenic carbon content of the bio-based product;		kg CO_2	5.2E+01	0.0E+00	0.0E+00	0.0E+00	4.9E+01
Emissions associated with biogenic carbon content of the bio-based product;		kg CO_2	0.0E+00	0.0E+00	2.5E+00	0.0E+00	4.9E+01
Emissions from calcination and removals from carbonation;		kg CO_2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Removals associated with biogenic carbon content of the bio-based packaging		kg CO_2	1.6E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions associated with biogenic carbon content of the bio-based packaging		kg CO_2	0.0E+00	0.0E+00	1.6E+00	0.0E+00	0.0E+00
Emissions from combustion of waste from renewable sources used in production processes;		kg CO_2	7.2E+00	3.2E+01	0.0E+00	0.0E+00	0.0E+00
Emissions from combustion of waste from non-renewable sources used in production processes.		kg CO_2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

ZIP System Insulated R-12 Sheathing

The tables below, Tables 18-20, present the selected categories of potential environmental impacts (global warming, ozone depletion, acidification, eutrophication, smog formation, fossil fuel depletion, and abiotic depletion) and life cycle inventory generated for each cradle-to-gate with options life cycle stage for 1 cubic meter ZIP System Insulated R-12 Sheathing. Refer to the scaling factors above in Table 2 to convert these results to the appropriate product thicknesses.

Table 23: Life Cycle Impact Assessment of 1m^3 ZIP System Insulated R-12 Sheathing

TRACI 2.1 Impact Assessment							
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	2.6E+02	1.1E+01	1.7E+01	1.7E+00	1.9E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	7.7E-07	4.2E-10	3.8E-07	7.0E-11	4.4E-07
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	2.7E+00	7.0E-02	6.9E-02	2.2E-02	3.4E-02
EP	Eutrophication potential	kg N-Eq.	1.3E-01	3.9E-03	6.5E-02	1.3E-03	8.9E-01
SP	Smog formation potential	kg O_3-Eq.	2.5E+01	1.9E+00	5.3E-01	5.6E-01	1.0E+00
FFD	Fossil Fuel Depletion	MJ-surplus	1.4E+03	2.1E+01	6.3E+01	3.5E+00	5.3E+00
CML 3.05 Impact Assessment							
Parameter	**Parameter**		**A1-A3**	**A4**	**A5**	**C2**	**C4**
GWP	Global warming potential	kg CO_2-Eq.	2.7E+02	1.1E+01	1.7E+01	1.7E+00	1.9E+01
ODP	Depletion potential of the stratospheric ozone layer	kg CFC-11 Eq.	6.1E-07	4.2E-10	3.2E-07	6.9E-11	3.5E-07
AP Air	Acidification potential for air emissions	kg SO_2-Eq.	2.9E+00	5.7E-02	7.3E-02	1.7E-02	2.6E-02
EP	Eutrophication potential	kg$(PO_4)^3$-Eq.	1.6E-01	1.0E-02	2.8E-02	3.7E-03	3.5E-01
POCP	Formation potential of tropospheric ozone photochemical oxidants	kg ethane-Eq.	1.9E-01	2.5E-03	4.7E-03	-3.5E-03	1.5E-03
ADPE	Abiotic depletion potential for non-fossil resources	kg Sb-Eq.	2.6E-05	0.0E+00	3.1E-05	0.0E+00	3.6E-06
ADPF	Abiotic depletion potential for fossil resources	MJ	9.6E+03	1.4E+02	4.3E+02	2.4E+01	3.8E+01

Table 24: Use of Resources of 1m³ ZIP System Insulated R-12 Sheathing

Resource Use							
Parameter	**Parameter**	**Unit**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
PERE	Renewable primary energy as energy carrier	MJ	2.2E+03	0.0E+00	2.2E+00	0.0E+00	5.9E-01
PERM	Renewable primary energy resources as material utilization	MJ	2.2E+02	0.0E+00	7.9E-01	0.0E+00	1.7E-01
PENRE	Nonrenewable primary energy as energy carrier	MJ	1.0E+04	1.3E+02	3.7E+02	0.0E+00	3.7E+01
PENRM	Nonrenewable primary energy as material utilization	MJ	1.4E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SM	Use of secondary material	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RSF	Use of renewable secondary fuels	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NRSF	Use of nonrenewable secondary fuels	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RE	Use of recoverable energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
FW	Use of net fresh water	m^3	1.1E+01	0.0E+00	2.6E-02	0.0E+00	4.2E-03

Table 25: Output Flows and Waste Categories of 1m³ ZIP System Insulated R-12 Sheathing

Output Flows and Waste Categories							
Parameter	**Parameter**	**Units**	**A1-A3**	**A4**	**A5**	**C2**	**C4**
HWD	Hazardous waste disposed	kg	3.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NHWD	Non-hazardous waste disposed	kg	2.3E+00	0.0E+00	9.5E+00	0.0E+00	1.5E+02
HLRW	High-level radioactive waste, conditioned, to final repository	kg	2.0E-04	0.0E+00	7.2E-05	0.0E+00	1.2E-04
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CRU	Components for re-use	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
MFR	Materials for recycling	kg	1.5E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
MER	Materials for energy recovery	kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
EEE	Exported electrical energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ETE	Exported thermal energy	MJ	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Removals associated with biogenic carbon content of the bio-based product;		kg CO_2	3.4E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions associated with biogenic carbon content of the bio-based product;		kg CO_2	0.0E+00	0.0E+00	1.6E+00	0.0E+00	3.3E+01
Emissions from calcination and removals from carbonation;		kg CO_2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Removals associated with biogenic carbon content of the bio-based packaging		kg CO_2	1.6E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Emissions associated with biogenic carbon content of the bio-based packaging		kg CO_2	0.0E+00	0.0E+00	1.6E+00	0.0E+00	0.0E+00
Emissions from combustion of waste from renewable sources used in production processes;		kg CO_2	7.2E+00	3.2E+01	0.0E+00	0.0E+00	0.0E+00
Emissions from combustion of waste from non-renewable sources used in production processes.		kg CO_2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Interpretation

The product stage is the main driver of results for ZIP System products.Installation and disposal are second and third primary drivers of the life cycle potential environmental impacts.

Please note: 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. 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. 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. Variability was estimated in this EPD by facility weighted averages over a year of data.

Additional Environmental Information

Environment and Health During Manufacture

Huber developed and implemented a Global Environmental, Health and Safety Management System between 2005 and 2007. The system is titled Huber Sustainability Management System (HSMS). A combined regulatory compliance and management system conformance audit program was implemented in 2008. All Huber sites are audited on a recurring schedule, and action plans are created to address audit findings to ensure continual improvement, providing results equivalent to, or surpassing, ISO standards.

Environmental Activities and Certifications

The following certificates are relevant certifications for Huber's ZIP System roof and wall sheathing, and insulated R-sheathing products.

- Sustainable Forestry Initiative (SFI 2015-2019), SFIS-4Z968-FS4
- Performance Standard for Wood-Based Structural Use Panels (US DOC PS 2-10, CSA 0325-07)
- Product Evaluation Reports ICC-ES ESR-1473, ESR-1474, ESR-2227, ESR-3373
- UL Building Units Standard (BZXX.R27238)
- UL Wood Structural Panels (TGGN.R25677)

SUSTAINABLE FORESTRY INITIATIVE SFI-00045

ICC ES

Environment

UL

Extraordinary Effects

Fire

ZIP System sheathing panels are identified with the certification marking as “sheathing” compliant with PS-2 standards of the *U.S. Department of Commerce Voluntary Product Standard PS-2, Performance Standard for Wood-Based Structural-Use Panels*. Therefore, ZIP System sheathing panels act as other similar wood structural panels within their listed fire assemblies per the PS-2 standard.

ZIP System R-sheathing panels have been evaluated for inclusion into four different UL fire-rated wall assemblies: U364, V302, V303, and V318. For more information, please visit: http://www.huberwood.com/ZIPsystem/home-ZIP-system.

Water

The ZIP System has a built-in water-resistive barrier which eliminates the need for housewrap or felt. Combined with the ZIP sealing tape, the ZIP system sheathing and insulated sheathing has a 180-Day Exposure Guarantee for weathering from the elements. (Please see the ZIP System Product Data Sheet for Guarantee details).

Mechanical Destruction

There are no relevant data regarding mechanical destruction effects for this product.

Further Information

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1.800.933.9220

For more information, please visit: http://www.huberwood.com/ZIPsystem/home-ZIP-system.

References

- AdvanTech, ZIP System, and Tru-spec Life Cycle Assessment, Sustainable Solutions Corporation, December 2019
- Product Category Rules Guidance for Building-Related Products and Services Part B: Structural and Architectural Wood Products EPD Requirements, UL Environment, First Edition, October 21, 2019
- Product Category Rules: Part A: Life Cycle Assessment Calculation Rules and Report Requirements UL Environment, December 2018, version 3.2
- UL Environment General Program Rules Version 2.0, April 2018
- EN 15804:2012+A2:2019: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.
- ISO 14025 Environmental labels and declarations - Type III environmental declarations
- ISO 14040 Environmental management - Life cycle assessment – Principles and framework
- ISO 14044 Environmental management - Life cycle assessment – Requirements and guidelines
- ISO 21930 (2017) Sustainability in building construction – Environmental declaration of building products
- ICC-ES AC182 – Acceptance Criteria for Wood Structural Panels
- Sustainable Forestry Initiative 2015-2019 Standard
- Department of Commerce Voluntary Product Standards – Performance Standard for Wood-Based Structural-Use Panels
- EPA, Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI)
- SimaPro v9 Software
- Ecoinvent v3.5 Database for Life Cycle Engineering
- U.S. Department of Commerce Voluntary Product Standard PS-2, Performance Standard for Wood-Based Structural-Use Panels

LCA Development

This EPD and corresponding LCA were prepared in partnership with Sustainable Solutions Corporation of Royersford, Pennsylvania.

SustainableSolutions CORPORATION