ENVIRONMENTAL PRODUCT DECLARATION

NORTH AMERICAN CELLULOSIC FIBERBOARD

NORTH AMERICAN FIBERBOARD ASSOCIATION

The North American Fiberboard Association (NAFA) is pleased to present this Environmental Product Declaration (EPD) for Cellulosic Fiberboard.

The EPD includes Life Cycle Assessment (LCA) results for all processes up to the point that cellulosic fiberboard is packaged and ready for shipment at the manufacturing gate.

The underlying LCA and the EPD were developed in compliance with ISO 14025:2006 and ISO 21930:2017 and have been verified under the UL Environment EPD program.

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ENVIRONMENTAL PRODUCT DECLARATION

north american FIBERBOARD association

Cellulosic Fiberboard

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 v.2.5 March 2020	
DECLARATION HOLDER	North American Fiberboard Association	
DECLARATION NUMBER	4789410886.101.1	
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Cellulosic Fiberboard, 1 m^3 of Cellulosic Fiberboard produced in North America (US and CA)	
REFERENCE PCR AND VERSION NUMBER	ISO 21930:2017 Sustainability in Building Construction — Environmental Declaration of Building Products. 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 Part B: Structural and Architectural Wood Products EPD Requirements, v1.0	
DESCRIPTION OF PRODUCT APPLICATION/USE	Cellulosic fiberboard is used in building constructions for roofing substrate, structural wall sheathing, sound-deadening board, and other specialty-use materials in North America.	
MARKETS OF APPLICABILITY	North America	
DATE OF ISSUE	January 1, 2021	
PERIOD OF VALIDITY	5 Years	
EPD TYPE	Industry-Average	
EPD SCOPE	Cradle-to-gate	
YEAR(S) OF REPORTED PRIMARY DATA	2019	
LCA SOFTWARE & VERSION NUMBER	Simapro v9.1 [11]	
LCI DATABASE(S) & VERSION NUMBER	USLCI (2019) [10], Ecoinvent v3.5 [15], Datasmart (2019) [9]	
LCIA METHODOLOGY & VERSION NUMBER	TRACI v2.1 [3]	

This 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 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 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.

1. Product Definition and Information

1.1. Description of Organization

Sponsoring organization

North American Fiberboard Association
2118 Plum Grove Road #283
Rolling Meadows, IL 60008

EPD Participants

The following members of the North American Fiberboard Association meet the eligibilty requirements in this EPD:

Blue Ridge Fiberboard Inc., Danville, VA, USA

MSL, Louiseville, Quebec, Canada

1.2. Product Description

Cellulosic fiberboard falls into the North American Industry Classification System (NAICS) code 321219 of reconstituted wood products. Over the last several decades cellulosic fiberboard has evolved into a highly engineered product designed to meet specific end-use requirements. The most common dimensions of cellulosic fiberboard panels are 0.5 inch (12.7 mm) thick, 4.0 feet (1.22 m) wide and 8.0 (2.44 m) long. Thickness, width, and length can vary to meet end-use requirements [2].

Table 1: United Nations Standard Products and Services Code (UNSPSC) and Construction Specification Institute (CSI) MasterFormat Code for Cellulosic Fiberboard.

Classification Standard	Category	Product Code
UNSPSC	Fiberboard	14121505
	Wood sheathing or sheets	30103604
CSI/CSC	Insulating Sheathing	06-16-13
	Sheathing	06-16-00
	Roof Board Insulation	07-22-16
	Acoustic Board Insulation	09-81-13

EPD Scope: The Scope of this EPD is Cradle-to-Gate. Figure 1 depicts the product system for cellulosic fiberboard represented in this EPD.

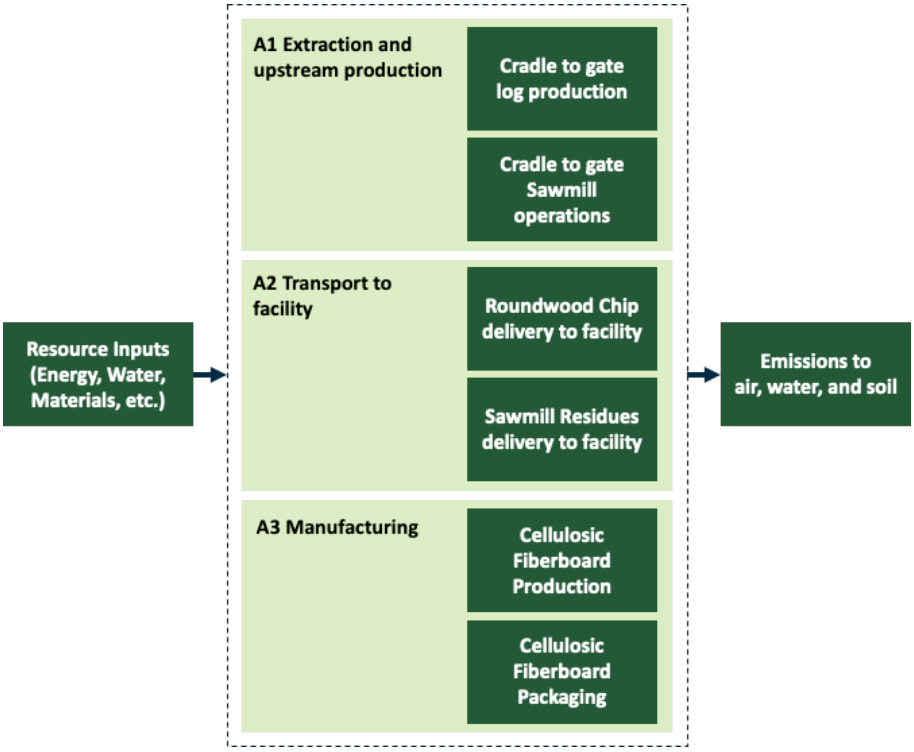

Figure 1. Cradle-to-Gate Cellulosic Fiberboard Product System

Product Average

This EPD represents the industry average of Cellulosic Fiberboard production in North America. The study is the result of a weighted average of harvesting and forest management methods in North America.

1.3. Application

Cellulosic fiberboard falls within the engineered wood products category or wood insulation board (i.e., fiberboard) in which wood elements of varying sizes are held together by an adhesive bond using a vegetable starch binder. Cellulosic fiberboard is used in building constructions for roofing substrate, structural wall sheathing, sound-deadening board, and other specialty-use materials in North America.

1.4. Material Composition

The declared product consists of softwood and several additives. The percentage material composition is shown in Table 4.

Table 4. Material composition of North American Cellulosic Fiberboard

PRODUCT COMPONENT	PERCENTAGE OF DECLARED PRODUCT
Wood Feedstock	91.70%
Starch	5.09%
Wax	1.43%
Other	1.78%

1.5. Technical Requirements

The technical requirements of the products represented in this EPD are defined in the following product standards:

ASTM C208: Standard Specification for Cellulosic Fiber Insulating Board
ASTM C209: Standard Test Methods for Cellulosic Fiber Insulating Board
ULC CAN-S706: Standard of Wood Fibre Insulating Boards for Buildings

1.6. Manufacturing

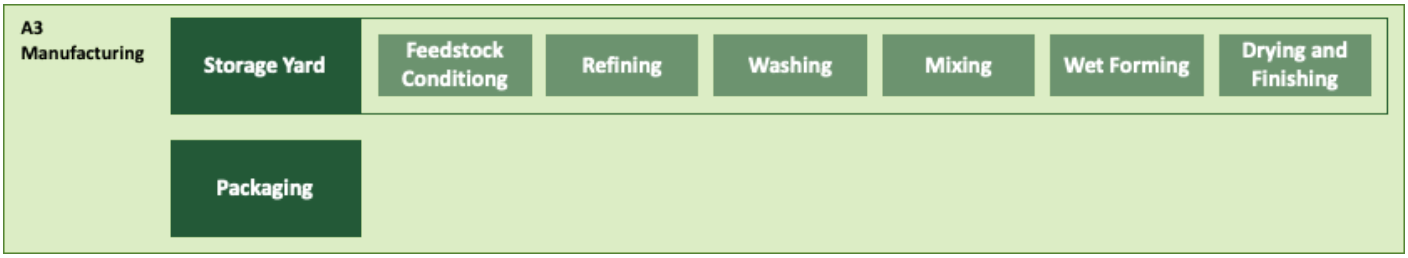

Figure 2. Cellulosic Fiberboard manufacturing process

The production process at the mill begins with the processing of wood chips. The chips are screened and washed then placed into storage bins that are transferred to the pulping process where the chips are converted into fibers. During the pulping process the fibers are washed to further remove debris. Once clean, the fibers are mixed with additives to bond the pulp fibers for further processing. The mixture is sent to forming machines where wet mats are produced then pressed to remove excess water. The wet fiberboards are dried, trimmed, and then packaged for shipping.

1.7. Packaging

Packaging materials represent less than one percent of the mass of the primary product. Common packaging materials are plastic wrapping, cardboard and plastic strapping. The packaging is allocated 100% to the primary product.

2. Life Cycle Assessment Background Information

2.1. Declaration of Methodological Framework

The underlying LCA [12] was performed in conformance with ISO 14040/44 [6, 7], ISO 21930 [8] and EN 15804 [4], as well as the PCR from UL Environment, Part A [13] and Part B [14]. In addition, the ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017 were considered [1].

2.2. Functional or Declared Unit

The declared unit of the underlying LCA study was “the production of one cubic meter (1 m^3) of cellulosic fiberboard produced in North America”. Table 5 specifies the properties of the declared unit.

Table 5. Properties of 1 m^3 Cellulosic Fiberboard

PROPERTY	UNIT	VALUE
Mass	odkg	239.46
Moisture Content	%	3-8%

2.3. System Boundary

The LCA investigated the life cycle from “cradle to gate”. The product system comprises the production stage including the information modules ‘A1 Extraction and upstream production’, ‘A2 Transport to factory’ and ‘A3 Manufacturing’.

A1 Extraction and upstream production
A1 is the upstream resource extraction that includes the removal of raw materials and processing and processing of secondary material input (e.g., recycling processes). A1 also includes reforestation processes that include nursery operations (which include fertilizer, irrigation, energy for greenhouses if applicable, etc.), site preparation, as well as planting, fertilization, thinning and other management operations.

A2 Transport to facility
A2 is the 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
A3 inculdes the manufacturing of the cellulosic fiberboard product, including packaging.

2.4. Cut-off Criteria

The cut-off criteria for all 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.

2.5. Data Sources

Primary data was utilzed to represent the manufacturing process. The impacts of forest management were estimated by a weighted average based on regional surveys of truck and equipment use.

Secondary data was derived from representative databases and scientific literature, including USLCI [10], ecoinvent v3.5 [15], Datasmart [9], CORRIM [12] and the background LCA [1].

Secondary data sources were evaluated regarding their temporal, geographical, technological representativeness and completeness. The temporal representativeness ranged from fair (data within 10 years) to very good (data within 1 year). The geographical representativeness was very good or good (data was specific to North America or represented global

processes). The technological representativeness was very good (data represented North American technology). A detailed description of data sources as well as the respective data quality assessment are documented in the background LCA project report. Primary and secondary data sources represented the product system and were complete. Therefore, no estimates or assumptions were used.

2.6. Period under Review

Primary data collected from the manufacturing facilities are representative for the year 2019.

2.7. Allocation

Allocation is the method used to partition the environmental load of a process when several products or functions share the same process. The wood products PCR recommends a mass-allocation and thus inputs and direct emissions were allocated to various outputs (i.e., cellulosic fiberboard and its coproducts) based on their respective oven-dry mass and developed LCI for further use in the process of development of the model in the LCA software.

3. Life Cycle Assessment Results

Table 6 indicates the considered life cycle stages and information modules. This EPD includes the production stage with information modules A1-A3. All other information modules are not declared (MND).

Table 6. Description of the system boundary modules

	PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE							END-OF-LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Extraction and up-stream production	Transport to facility	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 processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Table 7. Selected Impact Category Indicators and Inventory Parameters

CORE MANDATORY IMPACT INDICATORS	ABBREVIATION	UNIT	METHOD
Global warming potential – TRACI 2.1	GWP_{TRACI}	kg CO_2 eq	TRACI 2.1 V1.02
Global warming potential – w/ biogenic CO_2	GWP_{BIO}	kg CO_2 eq	TRACI 2.1 V1.02 + LCI Ind.
Depletion potential of the stratospheric ozone layer	ODP	kg CFC-11 eq	TRACI 2.1 V1.02
Acidification potential of soil and water sources	AP	kg SO_2 eq	TRACI 2.1 V1.02
Eutrophication potential	EP	kg N eq	TRACI 2.1 V1.02
Formation potential of tropospheric ozone	SFP	kg O_3 eq	TRACI 2.1 V1.02
Abiotic depletion potential for fossil resources	ADP_{fossil}	MJ, LHV	CML-IA Baseline V3.02
Fossil fuel depletion	FFD	MJ Surplus	TRACI 2.1 V1.02
USE OF PRIMARY RESOURCES			
Renewable primary energy carrier used as energy	RPR_E	MJ, LHV	CED V1.10
Renewable primary energy carrier used as material	RPR_M	MJ, LHV	LCI Indicator
Non-renewable primary energy carrier used as energy	$NRPR_E$	MJ, LHV	CED V1.10
Non-renewable primary energy carrier used as material	$NRPR_M$	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	HLRW	m^3	LCI Indicator
Intermediate- and low-level radioactive waste	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

3.1. Life Cycle Impact Assessment Results

Table 8. Impact Assessment Results for 1 m³ of Cellulosic Fiberboard

TRACI v2.1/CML	TOTAL	A1	A2	A3
GWP_{TRACI} [kg CO_2 eq]	196.13	5.34	6.75	184.04
GWP_{BIO} (incl. biogenic carbon) [kg CO_2 eq]	196.13	-432.28	6.75	621.66
ODP [kg CFC-11 eq]	7.13E-06	9.85E-08	1.19E-08	7.02E-06
AP [kg SO_2 eq]	0.63	0.05	0.04	0.54
EP [kg N eq]	0.29	0.01	0.00	0.27
SFP [kg O_3 eq]	8.46	1.43	1.07	5.96
ADP_{fossil} [MJ, LHV]	2581.24	67.85	84.50	2428.89
Fossil fuel depletion [MJ surplus]	375.67	9.58	12.69	353.40

*A3 Results for GWP_{BIO} include downstream emissions that occur in information module A5 and C3/C4. See Table 11 for detailed LCI of biogenic carbon.

3.2. Life Cycle Inventory Results

Table 9. Resource Use for 1 m³ of Cellulosic Fiberboard

PARAMETER	TOTAL	A1	A2	A3
RPR_E [MJ, LHV]	568.24	0.90	0.19	567.15
RPR_M [MJ, LHV]	4591.48	4591.48	0.00	0.00
$NRPR_E$ [MJ, LHV]	3282.45	73.64	85.74	3123.08
$NRPR_M$ [MJ, LHV]	0.00	0.00	0.00	0.00
SM [kg]	0.00	0.00	0.00	0.00
RSF [MJ, LHV]	0.00	0.00	0.00	0.00
NRSF [MJ, LHV]	0.00	0.00	0.00	0.00
RE [MJ, LHV]	0.00	0.00	0.00	0.00
FW [m^3]	1.38E+00	1.10E-02	6.80E-04	1.37E+00

Table 10. Output Flows and Waste Categories for 1 m³ of Cellulosic Fiberboard

PARAMETER	TOTAL	A1	A2	A3
HWD [kg]	3.74E-02	6.66E-04	1.03E-04	3.66E-02
NHWD [kg]	93.11	0.49	0.66	91.96
HLRW [m^3]	1.06E-07	5.31E-09	0.00E+00	1.01E-07
ILLRW [m^3]	4.72E-06	7.66E-08	7.08E-09	4.64E-06
CRU [kg]	0.00	0.00	0.00	0.00
MR [kg]	0.08	0.00	0.00	0.08
MER [kg]	0.00	0.00	0.00	0.00
EE [MJ, LHV]	0.00	0.00	0.00	0.00

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) is 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 CO2e/kg CO2) in module A1 is calculated as being emitted to the atmosphere in other modules (characterized in the LCIA as +1 kg CO2e/kg CO2). 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. Therefore, in Table 8 the results for total GWP_{TRACI} and total GWP_{BIO} are equal.

Table 11 shows additional inventory parameters related to biogenic carbon removal and emissions. The carbon dioxide flows are presented unallocated to consider co-products leaving the product system in information module A3. Even though the system boundary of this study included only the information modules A1-A3, in accordance with ISO 21930, BCEK is reported in A5 and BCEP of the main 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. 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, as well as the report from Canada 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.

Table 11. Carbon Emissions and Removals for 1 m³ of Cellulosic Fiberboard

PARAMETER	TOTAL	A1	A2	A3	A5	C3/C4
BCRP [kg CO_2]	-437.62	-437.62	-	-	-	-
BCEP [kg CO_2]	437.62	-	-	35.06	-	402.56
BCRK [kg CO_2]	-4.66	-	-	-4.66	-	-
BCEK [kg CO_2]	4.66	-	-	-	4.66	-

4. LCA Interpretation

Comparability

Environmental declarations from different programs (ISO 14025)[5] 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.

Comparison of the environmental performance of construction works and construction products using EPD information shall be based on the product's use and impacts at the construction works level. In general, EPDs may not be used for comparability purposes when not considered in a construction works context. Given this PCR ensures products meet the same functional requirements, comparability is permissible provided the information given for such comparison is transparent and the limitations of comparability explained.

Full conformance with the UL PCR Part B for 'Structural and Architectural Wood Products' allows EPD comparability only when all stages of a life cycle have been considered, when they comply with all referenced standards, use the same

sub-category Part B PCR, and use equivalent scenarios with respect to construction works. However, variations and deviations are possible.

Forest Management

While this EPD does not address landscape level forest management impacts, potential impacts may be addressed through requirements put forth in regional regulatory frameworks, ASTM 7612-15 guidance, and ISO 21930 Section 7.2.11 including notes therein. These documents, combined with this EPD, may provide a more complete picture of environmental and social performance of wood products.

While this EPD does not address all forest management activities that influence forest carbon, wildlife habitat, endangered species, and soil and water quality, these potential impacts may be addressed through other mechanisms such as regulatory frameworks and/or forest certification systems which, combined with this EPD, will give a more complete picture of environmental and social performance of wood products.

Scope of the EPD

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

Data

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

Accuracy of Results

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

5. Additional Environmental Information

5.1. Environment and Health During Manufacturing

No substances required to be reported as hazardous are associated with the production of the declared product. Furthermore, no dangerous substance emissions, i.e. indoor air emissions, gamma or ionizing radiation emissions or chemicals released to air or leached to water and soil, were reported for the declared product.

5.2. Extraordinary Effects

Fire, Water and Mechanical destruction

Testing data on fire, water and mechanical destruction are available from individual manufacturers.

5.3. Cradle-to-Grave Carbon Sequestration

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 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 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 UL PCR Part A Section 2.8.5, 100% landfill.

The following results apply the UL PCR addendum methodology to the biogenic carbon present in the primary product as it leaves the manufacturer in Module A3.

1 m^3 Cellulosic Fiberboard = 219.58 oven dry kg wood = 109.79 kg carbon = 402.56 kg CO_2 eq

Carbon sequestered in product at manufacturing gate:
402.56 kg CO_2 eq = -402.56 kg CO_2 eq emission

Methane emitted from fugitive landfill gas:
0.26 kg CH_4 = 6.48 kg CO_2 eq emission

Carbon dioxide emitted from fugitive landfill gas and the combustion captured landfill gas:
55.99 kg CO_2 eq emission

Permanent carbon sequestration, net of biogenic carbon emissions:
340.10 kg CO_2 eq = -340.10 kg CO_2 eq emission

6. Supporting Documentation

This industry average EPD is built from an LCA study covering cellulosic fiberboard production in North America:

Sahoo, K. and Bergman, R. (2020) Cradle-to-gate Life Cycle Assessment of North American Cellulosic Fiberboard Production.

7. References

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

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

6. International Organization for Standardization (2006) International Standard ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework

7. International Organization for Standardization (2006) International Standard ISO 14044:2006, Environmental management – Life cycle assessment – Requirements and guidelines

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

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

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12. Sahoo, K. and Bergman, R. (2020) Cradle-to-gate Life Cycle Assessment of North American Cellulosic Fiberboard Production. USDA Forest Service, 1, 1-36

13. UL. (2018). Product Category Rules for Building-Related Products and Services - Part A: Life Cycle Assessment Calculation Rules and Report Requirements, v3.2.

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

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