MDF and Thermofused Laminated (TFL) MDF Panels

Uniboard®

ENVIRONMENTAL PRODUCT DECLARATION

ISO 14025:2006

Uniboard is pleased to present this Environmental Product Declaration (EPD) for their MDF and Thermofused Laminated (TFL) MDF Panels. This EPD was developed in compliance with ISO 14025 and has been verified by Jean-François Menard, B. Sc., B. Eng. CIRAIG.

The LCA and the EPD were prepared by Vertima Inc.

The EPD includes cradle-to-gate life cycle assessment (LCA) results.

For more information about Uniboard, visit https://www.uniboard.com.

For any explanatory material regarding this EPD, please contact the program operator.

Environmental Product Declaration

CSA Group Registered Based on ISO 14025 and Other Requirements
For more information visit csaregistries.ca/epd
3511-5092
February 2024-February 2029

1. GENERAL INFORMATION

PCR GENERAL INFORMATION			
Reference PCR	PCR for Building-Related Products and Services in Part B: Structural and Architectural Wood Products EPD Requirements. Version 1.0. UL Environment October 2019 to October 2024		
The PCR review was conducted by:	*Thomas Gloria, PhD (Chair)* *t.gloria@industrial-ecology.com* *Industrial Ecology Consultants*	*Dr. Indro Ganguly* *University of Washington*	*Dr. Kamalakanta Sahoo* *University of Georgia*

EPD GENERAL INFORMATION		
Program Operator	CSA Group 178 Rexdale Blvd, Toronto, ON Canada M9W 1R3 www.csagroup.org	
Declared Products	**MDF and Thermofused Laminated (TFL) MDF Panels.**	
EPD Registration Number 3511-5092	**EPD Date of Issue** February 6, 2024	**EPD Period of Validity** February 6, 2024 - February 4, 2029
EPD Recipient Organization	UNIBOARD 5555 Ernest-Cormier Street, Suite 100 Laval, QC H7C 2S9 Canada https://www.uniboard.com	UNIBOARD®

EPD Type/Scope and Declared Unit Product specific cradle-to-gate EPD with 1m³ of MDF and thermofused laminated (TFL) MDF packaged panels.			**Year of Reported Manufacturer Primary Data** October 2021 – September 2022
Geographical Scope North America	**LCA Software** OpenLCA v.1.10.3	**LCI Databases** Ecoinvent 3.7 and US LCI	**LCIA Methodology** TRACI 2.1 - IPCC 2013

This LCA and EPD were prepared by:	Gatien Geraud Essoua Essoua Ph.D., Eng. Forestry Vertima Inc. www.vertima.ca
This EPD and LCA were independently verified in accordance with ISO 14025:2006 and ISO 14040:2006, as well as the UL Environment PCR “PCR for Building-Related Products and Services in Part B: Structural and Architectural Wood Products EPD Requirements. Version 1.0.”, which is based on ISO 21930:2017. ☐ Internal ☒ External	Jean-François Menard Jean-François Menard CIRAIG

LIMITATIONS

Environmental declarations from different programs (ISO 14025) may not be comparable[1].

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 are met. It should be noted that different LCA software and background LCI datasets may lead to differences in results upstream or downstream of the life cycle stages declared.

2. PRODUCT SYSTEM DESCRIPTION

Uniboard® has firmly established itself as a leader in the North American thermofused laminated (TFL) and medium density fiberboard (MDF) industry. Uniboard® conforms to the most stringent environmental standards. Wood fibers used by Uniboard® in its panel manufacturing process comes mainly from sawmills. Uniboard® is certified Forest Stewardship Council (FSC®) by Rainforest Alliance, for its chain of custody and controlled timber and an Eco-Certified CompositeTM (ECCTM) by the Composite Panel Association (CPA).

2.1. PRODUCT DESCRIPTION

Products studied in this report are regular medium density fiberboard (MDF) and thermofused laminated MDF.

The NU Green MR50 NAF MDF is the latest addition to the NU Green® collection, Uniboard's most eco-friendly moisture-resistant solution. This green, high-quality, versatile medium-density fiberboard is FSC® and ECCTM certified. It is made using 100% pre-consumer recycled and recovered wood fiber, which saves trees and avoids landfilling. The NU Green MR50 NAF MDF is ideal for all interior, non-structural applications where periodic humidity exposure is a factor. As a MR50 qualified product, it passes the 24-hour submersion test (MR10) and six-cycle accelerated aging test (MR30). NU Green MR50 is certified by CARB. No formaldehyde resin is used during the manufacturing process. Its ultra-low formaldehyde emissions are no greater than those released by a tree found in nature. NU Green MR50 is used in both residential and commercial applications such as food service industries, institutional buildings, healthcare establishments, kitchens and bathrooms. The NU Green MR50 NAF MDF can also help you achieve up to six LEED® points, based on the NC-2009 (USGBC), and up to four LEED points with the new LEED V.4 version (available in 2015 in Canada).

Uniboard also manufactures NU Green® fire-resistant MDF . Engineered from the finest Canadian FSC® certified fibre, Uniboard's NU Green MDF FR is a premium Class A/Class 1 fire-retardant engineered wood panel. This sustainable panel is designed for interior use in residential, commercial and institutional applications. It is also ideal for commercial and institutional non-structural applications such as retail and commercial spaces, interior design, wall partitions, kiosk or stand displays, cabinetry and furniture components. Made of 100% pre-consumer recycled wood, NU Green MDF FR is excellent for veneering, painting, cutting and routing applications. This product is FSC® certified and has a CARB exemption for formaldehyde requirements (NAF). Additionally, the NU Green MDF FR is also rated MR10. It can help to achieve up to two LEED® points, based on the LEED v4 credits.

Uniboard® MDF panels are manufactured with meticulously selected wood fibers to create high-quality, consistent panels for furniture, millwork, cabinetry and countertops

They are different grades of MDF (115, 130, 155). They cover a range of densities with the average between 750-790 kg/m3 for unlaminated MDF and between 770-812 kg/m3 for the TFL MDF. Average thicknesses are between 6 and 32 mm. They are manufactured in various dimensions (width x length), ranging from 4'x8' to 5'x12'. Uniboard MDF panels are used for the production of furniture, millwork, cabinetry and countertops. Uniboard® Canada's thermofused laminated panels (TFL) use MDF as a substrate. To obtain TFL panels, MDF surfaces are covered with a layer of Uniboard's thermofused laminate paper. Thermofused laminate paper is a melamine-impregnated paper manufactured by different suppliers. MDF TFL panels are available in many colour and texture combinations. The collection comes with the most comprehensive complementary product line in the industry.

Figure 1 shows the room scene of Uniboard® thermofused laminated panels. The primary United Nations Standard Products and Services Code (UNSPSC) code for these Uniboard panels is 11122002 and the Construction Specifications Institute (CSI) code is 06 42 00.

Figure 1: Room scene of Uniboard Thermofused Laminated Panels (TFL).

2.1.1. Product specifications

Uniboard MDF panels respect the following standards for each of their products analyzed in this study:

- ANSI A208.2 - MDF for indoor applications.
- ASTM E 1333-14 - Standard test method to determine the level of formaldehyde of wood products under specific conditions and using a large chamber.
- SOR-2021-148 - Formaldehyde Emissions from Composite Wood Products Regulations.
- AWMAC – Quality Standards for Architectural woodwork – [last edition].
- ISO 4586:2018 - High-pressure decorative laminates – sheets made from thermosetting resins.
- USGBC LEED - Green Building Rating System™.
- CAN/ULC S102-10/ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- EPA TSCA Title VI - Formaldehyde Emission Standards for Composite Wood Products.
- CARB ATCM 93120 - California Air Resources Board (CARB) 93120 Airborne Toxic Control Measure (ATCM) for formaldehyde emissions from composite wood products.

2.1.2. Technical requirements

Table 1 presents the specific properties and performance data for Uniboard's MDF and Thermofused Laminated MDF Panels. Please consult the following link for additional information: https://www.uniboard.com/en/documentation-center

Table 1: Technical data for Uniboard's finished particleboard and decorative panels.

Item	MDF Regular	MDF Regular TFL	MDF MR50	MDF MR50 TFL	MDF FR50	MDF FR50 TFL	Units
Thickness	6-32						mm
Length x Width	1.245 x 2.464 – 1.549 x 3.073						mm
Density	750	771	780	802	790	812	kg/m^3

2.2. MATERIAL COMPOSITION

The weighted average profile of each m^3 of MDF and TFL MDF panel is calculated based on production data from October 2021 to September 2022. These data represent the inputs, based on dry mass, to produce 1 m^3 including losses during the process. A summary of the values compiled are presented in Table 2.

Table 2: Materials composition of 1 m3 of MDF and Thermofused Laminated MDF Panels.

Materials	MDF Regular	MDF Regular TFL	MDF MR50	MDF MR50 TFL	MDF FR	MDF FR TFL
	Ratio (%)					
Wood fibers	83.71%	81.38%	91.50%	88.96%	76.72%	74.59%
Adhesive	8.54%	8.30%	3.20%	3.11%	3.84%	3.73%
Wax	0.46%	0.45%	0.50%	0.49%	0.77%	0.75%
Scavenger	2.29%	2.23%	0.00%	0.00%	0.00%	0.00%
Humidity	5.00%	4.86%	4.80%	4.67%	4.07%	3.95%
Impregnated Decorative Paper	0.00%	2.78%	0.00%	2.78%	0.00%	2.78%
Fire Retardant	0.00%	0.00%	0.00%	0.00%	14.50%	14.10%
Red Dye	0.00%	0.00%	0.00%	0.00%	0.11%	0.11%

Wood fiber materials used are weighted based on dry mass.

2.3. PRODUCT APPLICATION

Uniboard MDF products are used for furniture, millwork, cabinetry and countertop manufacturing. Thermofused laminated MDF panels are ideal for furniture, bathroom and kitchen furnishings, doors of all kinds, storage systems, wall/ceiling cladding, and more, and are perfect for residential and commercial furniture. They are recommended for vertical and horizontal applications with moderate impact and moderate use.

2.4. MANUFACTURING

Uniboard's MDF panels are manufactured through a refining process, bonded together with a bonding system, which may contain additives. MDF panels are then packaged or laminated and packaged. The resin wood fiber matrix is hot-pressed to obtain the desired mechanical properties dictated by ANSI A208.2-2022, sanded and cut to various sizes. 21% of the production is laminated using an alpha cellulosic paper impregnated with a melamine resin creating a TFL product (Thermofused Laminated).

Figure 2 presents the flow diagram for Uniboard's MDF panels.

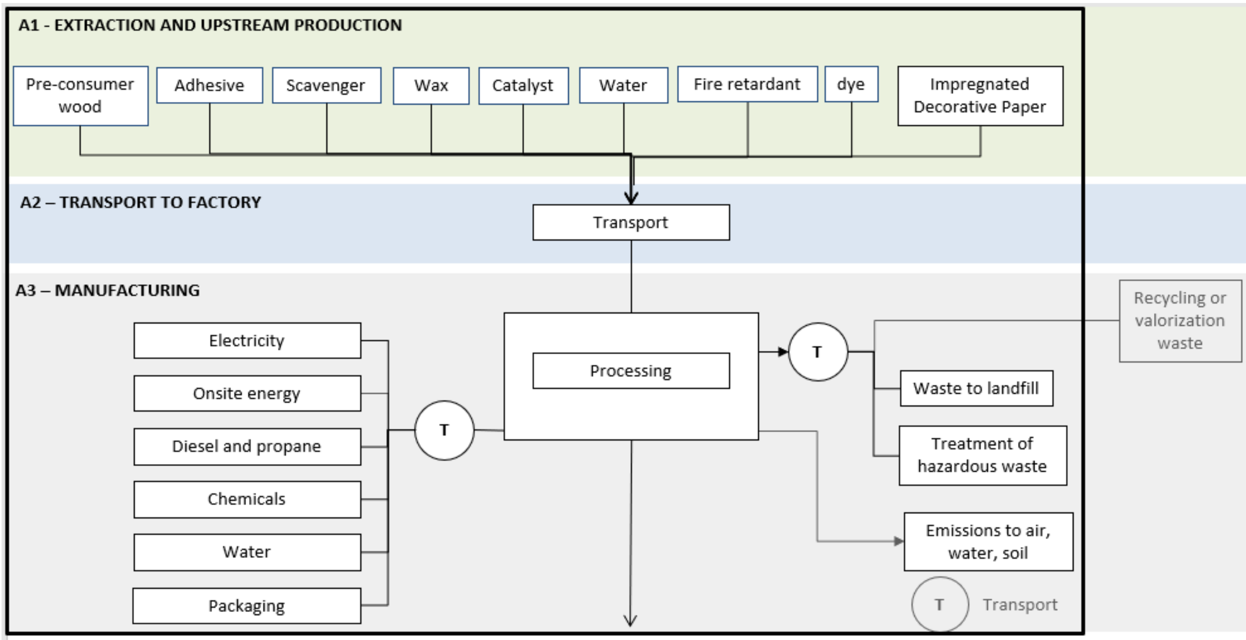

Figure 2: Flow diagram of production processes for Uniboard's MDF panels.

3. LCA CALCULATION RULES

3.1. DECLARED UNIT

The selected declared unit (DU) for this study according to the UL PCR [2] is 1 m^3 of Uniboard MDF panel, manufactured and packaged. Table 3 presents all products targeted by this report and their respective DUs.

Table 3: Declared Units of studied panels.

Materials	MDF Regular	MDF Regular TFL	MDF MR50	MDF MR50 TFL	MDF FR	MDF FR TFL	Units
Declared Unit	1.00	1.00	1.00	1.00	1.00	1.00	m^3
Average Mass	7.50E+02	7.71E+02	7.80E+02	8.02E+02	7.90E+02	8.12E+02	kg
Average Thickness	6-32						mm
Average Density	7.50E+02	7.71E+02	7.80E+02	8.02E+02	7.90E+02	8.12E+02	kg/m^3
Moisture Content (based on dry mass)	4-6						%

3.2. SYSTEM BOUNDARIES

According to UL Environment's PCR [3], the system boundaries are a cradle-to-gate system. The life cycle stage included in the analysis is the production stage. The production stage included A1) Extraction and upstream production, A2) Raw materials transportation to the manufacturing plant and A3) Manufacturing of Uniboard's panels. Table 4 presents the product life cycle stage and its modules included in the system boundaries analyzed in accordance with ISO 21930 [4].

Table 4: Description of the system boundary life cycle stages and related information modules

PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE							END-OF-LIFE STAGE			
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
Extraction and Upstream Production	Transport	Manufacturing	Transport from Gate to Site	Assembly/ Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste Processing	Disposal
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Key: X = included; MND = module not declared (excluded)

3.3. ALLOCATION

The ISO 14040 allocation procedure states that, whenever possible, allocation should be avoided by collecting data related to the process under study or by expanding the product system [5].

According to the PCR, Part B and section 3.5 allocation rules, mass should be used as the primary basis for co-product allocation and the UL PCR Part A specifies only when the difference in revenue from the co-products is low. Based on information provided by the manufacturer, the difference in market value ($) between both co-products is higher (more than 25%). In this study, economic allocation was used. Energy, ancillary and operating materials were allocated between the co-products based on the annual production data received from the manufacturer.

Waste flows undergoing recycling/reuse are excluded from the system boundary. A cut-off approach was used because recycled/reused material is part of the raw material preparation for another product system.

According to the UL PCR Part A, material flows with specific inherent properties, such as energy content or elementary composition (e.g. biogenic carbon content), shall always be allocated reflecting the physical flows, irrespective of the allocation chosen for the processes

3.4. CUT-OFF METHODOLOGY

According to the UL Environment PCR – Part A [3], if a mass flow or energy flow represents less than 1% of the cumulative mass or energy flow of the system, it may be excluded from system boundaries. However, these flows should not have a relevant environmental impact. In addition, at least 95% of the energy usage and mass flow shall be included. The cumulative material inputs and environmental impacts less than 5% of the total weight of the DU are excluded.

3.5. DATA SOURCES AND QUALITY REQUIREMENTS

Data quality parameters	Data quality discussion
Source of manufacturing data: description of sources of data	Manufacturing data was collected from Uniboard's manufacturing plant located in Mont-Laurier, in the province of Quebec (Canada) for the production year running from October 2021 to September 2022. This data included: total production mass of products produced at the manufacturing plants, as well as the total annual units in m^3 and total production mass of products under study, raw materials entering the production of the products under study, losses of materials, transport mode and distance of materials, energy consumption, water consumption, emissions to the environment at the manufacturing plant, waste treatment and packaging material.
Source of secondary data: description of sources of raw materials, energy source, transport, waste and packaging data	When appropriate, the grid mix was changed for the grid mix of the province or country where the production takes places. Otherwise, ecoinvent data representative of the global market or "rest-of-the-world" were selected as proxies. Sawdust and wood chips dataset and transport data were taken from the US LCI database, which is specific to a North American context.

Data quality parameters	Data quality discussion
Geographical representativeness	The manufacturing facility is located in the province of Quebec; hence, electricity consumption is based on the hydropower grid mix. Geographical correlation of the material supply and the selected datasets are representative of each specific area or a larger area. For example, wood material comes mainly from Canada and a low percentage from the USA.
Temporal representativeness	Primary data was collected to be representative of the full year (from October 2021 to September 2022), while this was not always the case for ecoinvent and US LCI datasets. Nevertheless, ecoinvent and US LCI remain the reference LCI databases.
Technological representativeness	Primary data, obtained from the manufacturer, is representative of the current technologies and materials used by the company.
Completeness	All relevant process steps were considered and modeled to satisfy the goal and scope. Cut-off criteria were respected.

4. LIFE CYCLE ASSESSMENT RESULTS

4.1. RESULTS TABLES

It should be noted that Life Cycle Impact Assessment (LCIA) results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The life cycle assessment results are presented per DU. According to the PCR, Part B section 5, the results presented are based on the life cycle impact assessment (LCIA) and the life cycle inventory (LCI).

According to the PCR, the life cycle impact assessment shall be presented for the North American context [3].

LCIA results are presented in Table 5, Table 6, Table 7, Table 8, Table 9 and Table 10 for regular medium density fiberboard (MDF) and thermofused laminated MDF, medium density fiberboard MR50 (MDF MR50) and thermofused laminated MDF MR50, medium density fiberboard FR (MDF FR) and thermofused laminated MDF FR, respectively.

Table 5: Regular MDF Life Cycle Impact Assessment Results

Impact Categories	Indicators	Units	Extraction (A1)	Transport (A2)	Manufacturing (A3)
Global Warming Potential	IPCC GWP 100a (2)	kg CO2 eq	2.36E+02	2.36E+01	1.54E+01
Biogenic Carbon Removal from product system	BCR	kg CO2	-1.30E+03	0.00E+00	-1.81E+02
Biogenic Carbon Emissions from product system	BCE	kg CO2	0.00E+00	0.00E+00	1.48E+03
Ozone Depletion Potential	ODP (1)	kg CFC-11 eq	2.17E-05	8.41E-07	2.21E-06
Acidification Potential	AP (1)	kg SO2 eq	1.25E+00	1.27E-01	5.98E-02
Eutrophication Potential	EP (1)	kg N eq	4.41E-01	9.70E-03	1.82E-02
Smog Formation Potential	SFP (1)	kg O3 eq	1.61E+01	3.99E+00	1.39E+00
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	ADPfossil (1)	MJ surplus	4.26E+02	4.82E+01	2.23E+01

Table 6: Thermofused Laminated Regular MDF Life Cycle Impact Assessment Results

Impact Categories	Indicators	Units	Extraction (A1)	Transport (A2)	Manufacturing (A3)
Global Warming Potential	IPCC GWP 100a (2)	kg CO2 eq	3.17E+02	8.75E+01	2.23E+01
Biogenic Carbon Removal from product system	BCR	kg CO2	-1.31E+03	0.00E+00	-2.90E+02
Biogenic Carbon Emissions from product system	BCE	kg CO2	0.00E+00	0.00E+00	1.60E+03
Ozone Depletion Potential	ODP (1)	kg CFC-11 eq	3.54E-05	3.62E-06	3.33E-06
Acidification Potential	AP (1)	kg SO2 eq	1.70E+00	5.12E-01	7.65E-02
Eutrophication Potential	EP (1)	kg N eq	6.93E-01	3.99E-02	1.98E-02
Smog Formation Potential	SFP (1)	kg O3 eq	2.06E+01	1.60E+01	2.10E+00
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	ADPfossil (1)	MJ surplus	6.15E+02	1.79E+02	3.44E+01

(1): Calculated as per U.S EPA TRACI 2.1, OpenLCA v 1.10.3.

(2): GWP 100, excludes biogenic CO2 removals and emissions associated with biobased products and packaging; 100-year time horizon. GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5).

Table 7: MDF MR50 Life Cycle Impact Assessment Results

Impact Categories	Indicators	Units	Extraction (A1)	Transport (A2)	Manufacturing (A3)
Global Warming Potential	IPCC GWP 100a (2)	kg CO2 eq	1.47E+02	3.05E+01	1.41E+01
Biogenic Carbon Removal from product system	BCR	kg CO2	-1.48E+03	0.00E+00	-1.82E+02
Biogenic Carbon Emissions from product system	BCE	kg CO2	0.00E+00	0.00E+00	1.66E+03
Ozone Depletion Potential	ODP (1)	kg CFC-11 eq	1.44E-06	1.09E-06	1.73E-06
Acidification Potential	AP (1)	kg SO2 eq	8.12E-01	1.69E-01	5.32E-02
Eutrophication Potential	EP (1)	kg N eq	1.03E-01	1.28E-02	1.65E-02
Smog Formation Potential	SFP (1)	kg O3 eq	1.33E+01	5.31E+00	1.33E+00
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	ADPfossil (1)	MJ surplus	3.40E+02	6.23E+01	2.08E+01

Table 8: Thermofused Laminated MDF MR50 Life Cycle Impact Assessment Results

Impact Categories	Indicators	Units	Extraction (A1)	Transport (A2)	Manufacturing (A3)
Global Warming Potential	IPCC GWP 100a (2)	kg CO2 eq	2.31E+02	9.70E+01	2.15E+01
Biogenic Carbon Removal from product system	BCR	kg CO2	-1.49E+03	0.00E+00	-2.92E+02
Biogenic Carbon Emissions from product system	BCE	kg CO2	0.00E+00	0.00E+00	1.78E+03
Ozone Depletion Potential	ODP (1)	kg CFC-11 eq	1.56E-05	3.98E-06	3.16E-06
Acidification Potential	AP (1)	kg SO2 eq	1.28E+00	5.69E-01	7.22E-02
Eutrophication Potential	EP (1)	kg N eq	3.64E-01	4.41E-02	1.65E-02
Smog Formation Potential	SFP (1)	kg O3 eq	1.79E+01	1.78E+01	2.07E+00
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	ADPfossil (1)	MJ surplus	5.35E+02	1.98E+02	3.38E+01

(1): Calculated as per U.S EPA TRACI 2.1, OpenLCA v 1.10.3.

(2): GWP 100, excludes biogenic CO2 removals and emissions associated with biobased products and packaging; 100-year time horizon. GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5).

Table 9: MDF FR Life Cycle Impact Assessment Results

Impact Categories	Indicators	Units	Extraction (A1)	Transport (A2)	Manufacturing (A3)
Global Warming Potential	IPCC GWP 100a (2)	kg CO2 eq	2.75E+02	4.01E+01	1.57E+01
Biogenic Carbon Removal from product system	BCR	kg CO2	-1.25E+03	0.00E+00	-1.80E+02
Biogenic Carbon Emissions from product system	BCE	kg CO2	0.00E+00	0.00E+00	1.43E+03
Ozone Depletion Potential	ODP (1)	kg CFC-11 eq	1.01E-05	3.24E-06	2.13E-06
Acidification Potential	AP (1)	kg SO2 eq	1.42E+00	3.39E-01	6.10E-02
Eutrophication Potential	EP (1)	kg N eq	3.47E-01	2.44E-02	1.75E-02
Smog Formation Potential	SFP (1)	kg O3 eq	1.95E+01	8.51E+00	1.41E+00
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	ADPfossil (1)	MJ surplus	5.44E+02	8.04E+01	2.32E+01

Table 10: Thermofused Laminated MDF FR Life Cycle Impact Assessment Results

Impact Categories	Indicators	Units	Extraction (A1)	Transport (A2)	Manufacturing (A3)
Global Warming Potential	IPCC GWP 100a (2)	kg CO2 eq	3.59E+02	9.88E+01	2.27E+01
Biogenic Carbon Removal from product system	BCR	kg CO2	-1.26E+03	0.00E+00	-2.90E+02
Biogenic Carbon Emissions from product system	BCE	kg CO2	0.00E+00	0.00E+00	1.55E+03
Ozone Depletion Potential	ODP (1)	kg CFC-11 eq	3.59E+02	9.88E+01	2.27E+01
Acidification Potential	AP (1)	kg SO2 eq	2.44E-05	5.86E-06	3.24E-06
Eutrophication Potential	EP (1)	kg N eq	1.88E+00	6.93E-01	7.75E-02
Smog Formation Potential	SFP (1)	kg O3 eq	6.11E-01	5.22E-02	1.87E-02
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil)	ADPfossil (1)	MJ surplus	2.42E+01	1.95E+01	2.13E+00

(1): Calculated as per U.S EPA TRACI 2.1, OpenLCA v 1.10.3.

(2): GWP 100, excludes biogenic CO2 removals and emissions associated with biobased products and packaging; 100-year time horizon. GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5).

4.2. LIFE CYCLE INVENTORY RESULTS

According to the PCR, the life cycle inventory (LCI) shall be presented for resources used and output flows and waste categories [3]. The environmental parameters used for inventory analysis describe the use of renewable and non-renewable material resources, renewable and non-renewable primary energy and water. The LCI results are presented in Table 11, Table 12, Table 13, Table 14, Table 15 and Table 16 for regular medium density fiberboard (MDF) and thermofused laminated MDF, medium density fiberboard MR50 (MDF MR50) and thermofused laminated MDF MR50, medium density fiberboard FR (MDF FR) and thermofused laminated MDF FR, respectively.

Table 11: Regular MDF Life Cycle Inventory Results

Resource use				
Parameters	Units	Production stage		
		Extraction (A1)	Transport (A2)	Manufacturing (A3)
RPR_E(3)	MJ, LHV	8.08E+03	0.00E+00	7.63E+02
RPR_M(4)*	MJ, LHV	8.78E+03	N/A	N/A
$NRPR_E$(5)	MJ, LHV	2.32E+03	0.00E+00	2.16E+02
$NRPR_M$(6)*	MJ, LHV	1.69E+03	N/A	N/A
SM(7)	kg	0.00E+00	N/A	0.00E+00
RSF (8)	MJ, LHV	0.00E+00	0.00E+00	9.25E+01
NRSF(9)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00
RE(10)	MJ, LHV	N/A	N/A	0.00E+00
FW(11)	m^3	3.75E-02	N/A	5.22E-01
Output Flows and Waste				
HWD(12)	kg	N/A	N/A	0.00E+00
NHWD(13)	kg	N/A	N/A	5.27E+00
HLRW(14)	m^3	N/A	N/A	N/A
ILLRW(15)	m^3	N/A	N/A	N/A
CRU(16)	kg	N/A	N/A	N/A
MR(16)	kg	N/A	N/A	0.00E+00
MER(16)	kg	N/A	N/A	0.00E+00
EE(16)	MJ, LHV	N/A	N/A	0.00E+00

Table 12:Thermofused **Laminated** Regular MDF Life Cycle Inventory Results

Resource use				
Parameters	Units	Production stage		
		Extraction (A1)	Transport (A2)	Manufacturing (A3)
RPR_E(3)	MJ, LHV	4.79E+02	0.00E+00	1.22E+03
RPR_M(4)*	MJ, LHV	6.27E+02	N/A	N/A
$NRPR_E$(5)	MJ, LHV	3.83E+03	0.00E+00	2.87E+02
$NRPR_M$(6)*	MJ, LHV	1.69E+03	N/A	N/A
SM(7)	kg	0.00E+00	N/A	0.00E+00
RSF (8)	MJ, LHV	0.00E+00	0.00E+00	1.51E+02
NRSF(9)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00
RE(10)	MJ, LHV	N/A	N/A	8.99E+00
FW(11)	m^3	3.75E-02	N/A	8.52E-01
Output Flows and Waste				
HWD(12)	kg	N/A	N/A	6.43E-01
NHWD(13)	kg	N/A	N/A	8.61E+00
HLRW(14)	m^3	N/A	N/A	N/A
ILLRW(15)	m^3	N/A	N/A	N/A
CRU(16)	kg	N/A	N/A	N/A
MR(16)	kg	N/A	N/A	0.00E+00
MER(16)	kg	N/A	N/A	0.00E+00
EE(16)	MJ, LHV	N/A	N/A	0.00E+00

*In the calculation of RPR_M and $NRPR_M$, packaging materials were excluded.

(3): RPR_E = RPRT - RPR_M, where RPRT is equal to the value for renewable energy obtained using the CED LHV.

(4): RPR_M is calculated by multiplying the mass (kg) of the material input (or its components) by the net calorific value (lower heating value) (MJ/kg) of this input as per ACLCA ISO 21930 Guidance [6]. In the calculation of RPR_M, packaging materials were excluded.

(5): $NRPR_E$ = NRPRT - $NRPR_M$, where NRPRT is equal to the value for non-renewable energy obtained using the CED LHV methodology (both non-renewable energy fossil fuel and nuclear).

(6): $NRPR_M$, is calculated by multiplying the mass (kg) of the material input (or its components) by the net calorific value (lower heating value) (MJ/kg) of this input as per ACLCA ISO 21930 Guidance [6]. In the calculation of $NRPR_M$, packaging materials were excluded.

(7): Calculated as per ACLCA ISO 21930 Guidance [6], 6.5 Secondary material, SM: There is no SM involved in the Uniboard panel manufacturing process.

(8): Calculated as per ACLCA ISO 21930 Guidance [6], 6.6 Renewable secondary fuels, RSF: There is RSF involved in the Uniboard panel manufacturing process.

(9): Calculated as per ACLCA ISO 21930 Guidance [6], 6.7 Non-renewable secondary fuels, NRSF: There is NRSF involved in the Uniboard panel manufacturing process.

(10): Calculated as per ACLCA ISO 21930 Guidance [6], 6.8.1 Recovery Energy, RE: There is RE based on ISO 21930, Table 1.

(11): Represents the net use of fresh water at the manufacturing site.

(12): Calculated from life cycle inventory results, based on datasets marked as "hazardous."

(13): Calculated from life cycle inventory results, based on "non-hazardous" waste.

(14): Calculated as per ACLCA ISO 21930 Guidance [6], 10.3 High-level radioactive waste, conditioned, to final repository. It should be noted that the Uniboard panel manufacturing process does not generate any high-level radioactive waste (HLRW), e.g., when generated by electricity production, consists mostly of spent fuel from reactors. (ISO 21930:2017, clause 7.2.14).

(15): Calculated as per ACLCA ISO 21930 Guidance [6], 10.4 Intermediate- and low-level radioactive waste, conditioned, to final repository. It should be noted that the Uniboard panel manufacturing process does not generate any low- and intermediate-level radioactive waste (ILLRW), e.g., when generated by electricity production, arise mainly from routine facility maintenance and operations (ISO 21930:2017, clause 7.2.14).

(16): There are no Reused Components (CRU) in the Uniboard manufacturing process. Exported energy (EE), materials for recycling (MR) and materials for energy recovery (MER) are accounted for in the analysis.

Table 13: MDF MR50 Life Cycle Inventory Results

Resource use				
Parameters	Units	Production stage		
		Extraction (A1)	Transport (A2)	Manufacturing (A3)
RPR_E(3)	MJ, LHV	9.26E+03	0.00E+00	7.57E+02
RPR_M(4)*	MJ, LHV	9.98E+03	N/A	N/A
$NRPR_E$(5)	MJ, LHV	2.39E+03	0.00E+00	1.82E+02
$NRPR_M$(6)*	MJ, LHV	5.11E+02	N/A	N/A
SM(7)	kg	0.00E+00	N/A	0.00E+00
RSF (8)	MJ, LHV	0.00E+00	0.00E+00	9.25E+01
NRSF(9)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00
RE(10)	MJ, LHV	N/A	N/A	0.00E+00
FW(11)	m^3	3.74E-02	N/A	5.22E-01
Output Flows and Waste				
HWD(12)	kg	N/A	N/A	0.00E+00
NHWD(13)	kg	N/A	N/A	5.27E+00
HLRW(14)	m^3	N/A	N/A	N/A
ILLRW(15)	m^3	N/A	N/A	N/A
CRU(16)	kg	N/A	N/A	N/A
MR(16)	kg	N/A	N/A	0.00E+00
MER(16)	kg	N/A	N/A	0.00E+00
EE(16)	MJ, LHV	N/A	N/A	0.00E+00

Table 14: Thermofused Laminated MDF MR50 Life Cycle Inventory Results

Resource use				
Parameters	Units	Production stage		
		Extraction (A1)	Transport (A2)	Manufacturing (A3)
RPR_E(3)	MJ, LHV	8.83E+03	0.00E+00	1.22E+03
RPR_M(4)*	MJ, LHV	9.98E+03	N/A	N/A
$NRPR_E$(5)	MJ, LHV	3.95E+03	0.00E+00	2.77E+02
$NRPR_M$(6)*	MJ, LHV	5.11E+02	N/A	N/A
SM(7)	kg	0.00E+00	N/A	0.00E+00
RSF (8)	MJ, LHV	0.00E+00	0.00E+00	1.51E+02
NRSF(9)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00
RE(10)	MJ, LHV	N/A	N/A	9.36E+00
FW(11)	m^3	3.74E-02	N/A	8.52E-01
Output Flows and Waste				
HWD(12)	kg	N/A	N/A	6.69E-01
NHWD(13)	kg	N/A	N/A	8.61E+00
HLRW(14)	m^3	N/A	N/A	N/A
ILLRW(15)	m^3	N/A	N/A	N/A
CRU(16)	kg	N/A	N/A	N/A
MR(16)	kg	N/A	N/A	0.00E+00
MER(16)	kg	N/A	N/A	0.00E+00
EE(16)	MJ, LHV	N/A	N/A	0.00E+00

*In the calculation of RPR_M and $NRPR_M$, packaging materials were excluded.

(3): RPR_E = RPRT - RPR_M, where RPRT is equal to the value for renewable energy obtained using the CED LHV.

(4): RPR_M is calculated by multiplying the mass (kg) of the material input (or its components) by the net calorific value (lower heating value) (MJ/kg) of this input as per ACLCA ISO 21930 Guidance [6]. In the calculation of RPR_M, packaging materials were excluded.

(5): $NRPR_E$ = NRPRT - $NRPR_M$, where NRPRT is equal to the value for non-renewable energy obtained using the CED LHV methodology (both non-renewable energy fossil fuel and nuclear).

(6): $NRPR_M$, is calculated by multiplying the mass (kg) of the material input (or its components) by the net calorific value (lower heating value) (MJ/kg) of this input as per ACLCA ISO 21930 Guidance [6]. In the calculation of $NRPR_M$, packaging materials were excluded.

(7): Calculated as per ACLCA ISO 21930 Guidance [6], 6.5 Secondary material, SM: There is no SM involved in the Uniboard panel manufacturing process.

(8): Calculated as per ACLCA ISO 21930 Guidance [6], 6.6 Renewable secondary fuels, RSF: There is RSF involved in the Uniboard panel manufacturing process.

(9): Calculated as per ACLCA ISO 21930 Guidance [6], 6.7 Non-renewable secondary fuels, NRSF: There is NRSF involved in the Uniboard panel manufacturing process.

(10): Calculated as per ACLCA ISO 21930 Guidance [6], 6.8.1 Recovery Energy, RE: There is RE based on ISO 21930, Table 1.

(11): Represents the net use of fresh water at the manufacturing site.

(12): Calculated from life cycle inventory results, based on datasets marked as "hazardous."

(13): Calculated from life cycle inventory results, based on "non-hazardous" waste.

(14): Calculated as per ACLCA ISO 21930 Guidance [6], 10.3 High-level radioactive waste, conditioned, to final repository. It should be noted that the Uniboard panel manufacturing process does not generate any HLRW. High-level radioactive waste, e.g., when generated by electricity production, consists mostly of spent fuel from reactors." (ISO 21930:2017, clause 7.2.14).

(15): Calculated as per ACLCA ISO 21930 Guidance [6], 10.4 Intermediate- and low-level radioactive waste, conditioned, to final repository. It should be noted that the Uniboard panel manufacturing process does not generate any ILLRW. Low- and intermediate-level radioactive wastes, e.g., when generated by electricity production, arise mainly from routine facility maintenance and operations (ISO 21930:2017, clause 7.2.14).

(16): There are no Reused Components (CRU) in the Uniboard manufacturing process. Exported energy (EE), materials for recycling (MR) and materials for energy recovery (MER) are accounted for in the analysis.

Table 15: MDF FR Life Cycle Inventory Results

Resource use				
Parameters	Units	Production stage		
		Extraction (A1)	Transport (A2)	Manufacturing (A3)
RPR_E (3)	MJ, LHV	7.55E+03	0.00E+00	7.65E+02
RPR_M (4)*	MJ, LHV	8.48E+03	N/A	N/A
$NRPR_E$ (5)	MJ, LHV	3.79E+03	0.00E+00	2.22E+02
$NRPR_M$ (6)*	MJ, LHV	9.82E+02	N/A	N/A
SM(7)	kg	0.00E+00	N/A	0.00E+00
RSF (8)	MJ, LHV	0.00E+00	0.00E+00	9.25E+01
NRSF(9)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00
RE(10)	MJ, LHV	N/A	N/A	0.00E+00
FW(11)	m^3	3.21E-02	N/A	5.22E-01
Output Flows and Waste				
HWD(12)	kg	N/A	N/A	0.00E+00
NHWD(13)	kg	N/A	N/A	5.27E+00
HLRW(14)	m^3	N/A	N/A	N/A
ILLRW(15)	m^3	N/A	N/A	N/A
CRU(16)	kg	N/A	N/A	N/A
MR(16)	kg	N/A	N/A	0.00E+00
MER(16)	kg	N/A	N/A	0.00E+00
EE(16)	MJ, LHV	N/A	N/A	0.00E+00

Table 16: Thermofused Laminated MDF FR Life Cycle Inventory Results

Resource use				
Parameters	Units	Production stage		
		Extraction (A1)	Transport (A2)	Manufacturing (A3)
RPR_E(3)	MJ, LHV	7.13E+03	0.00E+00	1.22E+03
RPR_M(4)*	MJ, LHV	8.47E+03	N/A	N/A
$NRPR_E$(5)	MJ, LHV	5.37E+03	0.00E+00	2.94E+02
$NRPR_M$(6)*	MJ, LHV	9.81E+02	N/A	N/A
SM(7)	kg	0.00E+00	N/A	0.00E+00
RSF (8)	MJ, LHV	0.00E+00	0.00E+00	1.51E+02
NRSF(9)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00
RE(10)	MJ, LHV	N/A	N/A	9.46E+00
FW(11)	m³	3.21E-02	N/A	8.52E-01
Output Flows and Waste				
HWD(12)	kg	N/A	N/A	6.76E-01
NHWD(13)	kg	N/A	N/A	8.61E+00
HLRW(14)	m³	N/A	N/A	N/A
ILLRW(15)	m³	N/A	N/A	N/A
CRU(16)	kg	N/A	N/A	N/A
MR(16)	kg	N/A	N/A	0.00E+00
MER(16)	kg	N/A	N/A	0.00E+00
EE(16)	MJ, LHV	N/A	N/A	0.00E+00

*In the calculation of RPR_M and $NRPR_M$, packaging materials were excluded.

(3): RPR_E = RPRT - RPR_M, where RPRT is equal to the value for renewable energy obtained using the CED LHV.

(4): RPR_M is calculated by multiplying the mass (kg) of the material input (or its components) by the net calorific value (lower heating value) (MJ/kg) of this input as per ACLCA ISO 21930 Guidance [6]. In the calculation of RPR_M, packaging materials were excluded.

(5): $NRPR_E$ = NRPRT - $NRPR_M$, where NRPRT is equal to the value for non-renewable energy obtained using the CED LHV methodology (both non-renewable energy fossil fuel and nuclear).

(6): $NRPR_M$, is calculated by multiplying the mass (kg) of the material input (or its components) by the net calorific value (lower heating value) (MJ/kg) of this input as per ACLCA ISO 21930 Guidance [6]. In the calculation of $NRPR_M$, packaging materials were excluded.

(7): Calculated as per ACLCA ISO 21930 Guidance [6], 6.5 Secondary material, SM: There is no SM involved in the Uniboard panel manufacturing process.

(8): Calculated as per ACLCA ISO 21930 Guidance [6], 6.6 Renewable secondary fuels, RSF: There is RSF involved in the Uniboard panel manufacturing process.

(9): Calculated as per ACLCA ISO 21930 Guidance [6], 6.7 Non-renewable secondary fuels, NRSF: There is NRSF involved in the Uniboard panel manufacturing process.

(10): Calculated as per ACLCA ISO 21930 Guidance [6], 6.8.1 Recovery Energy, RE: There is RE based on ISO 21930, Table 1.

(11): Represents the net use of fresh water at the manufacturing site.

(12): Calculated from life cycle inventory results, based on datasets marked as “hazardous.”

(13): Calculated from life cycle inventory results, based on “non-hazardous” waste.

(14): Calculated as per ACLCA ISO 21930 Guidance [6], 10.3 High-level radioactive waste, conditioned, to final repository. It should be noted that the Uniboard panel manufacturing process does not generate any high-level radioactive waste (HLRW), e.g., when generated by electricity production, consists mostly of spent fuel from reactors. (ISO 21930:2017, clause 7.2.14).

(15): Calculated as per ACLCA ISO 21930 Guidance [6], 10.4 Intermediate- and low-level radioactive waste, conditioned, to final repository. It should be noted that the Uniboard panel manufacturing process does not generate any low- and intermediate-level radioactive waste (ILLRW), e.g., when generated by electricity production, arise mainly from routine facility maintenance and operations (ISO 21930:2017, clause 7.2.14).

(16): There are no Reused Components (CRU) in the Uniboard manufacturing process. Exported energy (EE), materials for recycling (MR) and materials for energy recovery (MER) are accounted for in the analysis.

4.3. CONTRIBUTION ANALYSIS

The aim of this section is to present more details on the contribution to the impacts and resource use of the different life cycle modules of each product studied.

The contribution analysis of Uniboard regular MDF (Figure 3) indicate that the major contributor module is module A1 for all impact categories, with impacts are between 75% and 94%. The major contribution of module A2 are present in the Photochemical Ozone Formation (POF) impacts category (19%) due to diesel combustion during truck operation.

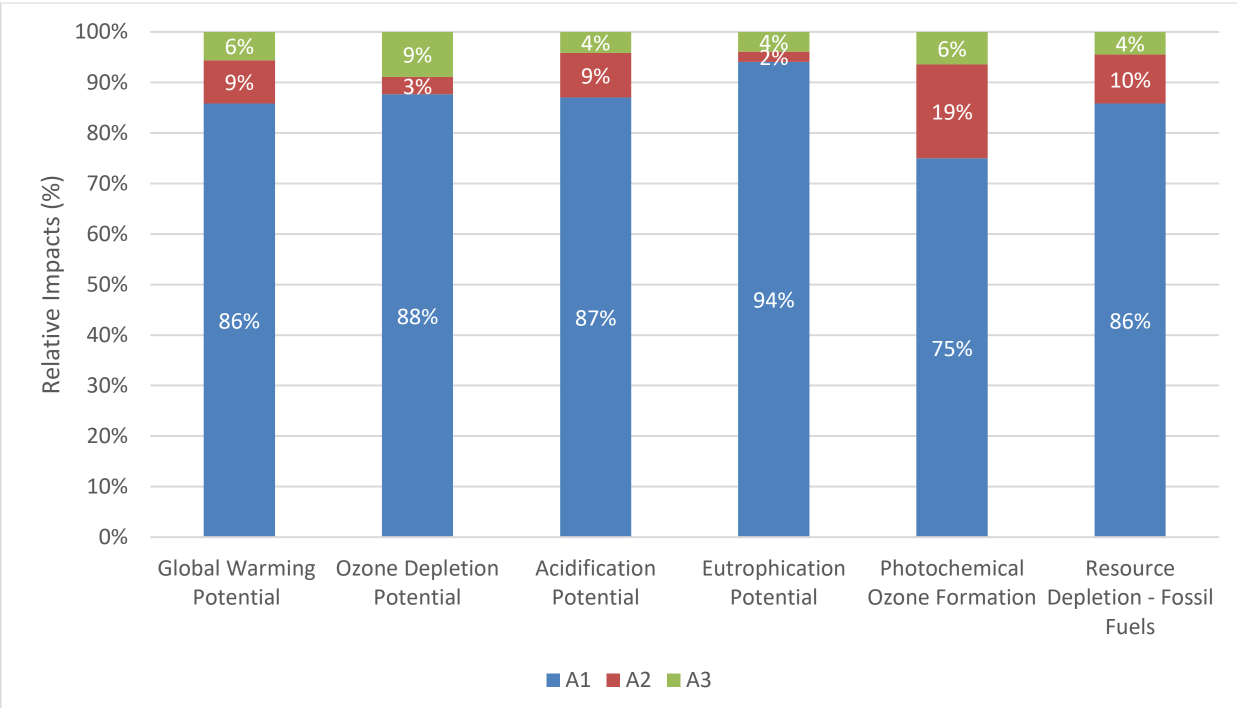

Figure 3: Contribution of each life cycle module for Regular MDF.

Breaking down the extraction and upstream production module (A1), Figure 4 indicates that production of MUF adhesive is the major contributor with impacts between 49% and 81% of the total impacts for all indicators.

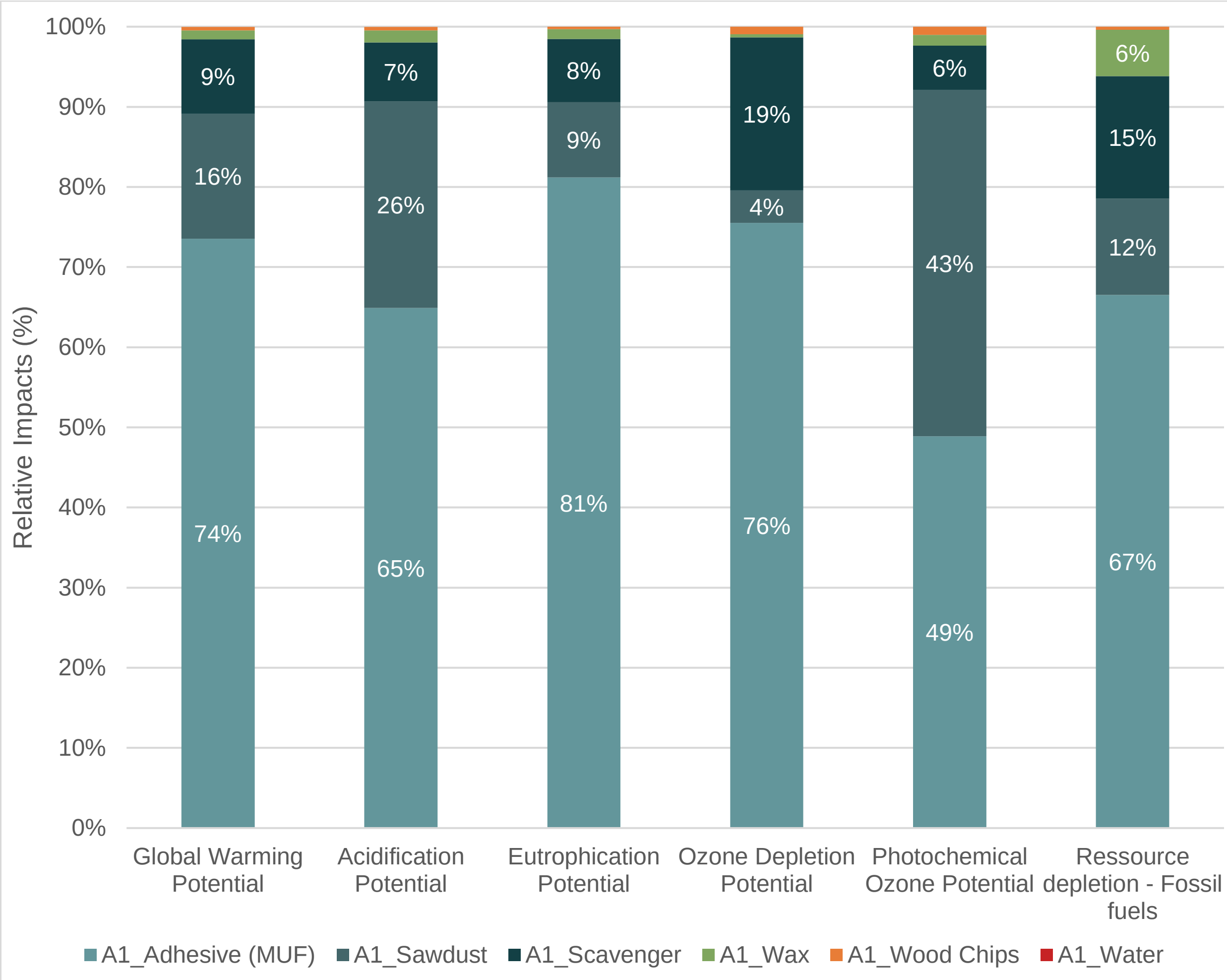

Figure 4: Contribution of material input in module A1 for regular MDF.

As presented for regular MDF, the trend is relatively the same for thermofused laminated MDF as presented (Figure 5). This is because the products studied have similar inputs and outputs. The difference comes from the fact that thermofused laminated MDF have impregnated decorative paper applied on their surfaces. The impacts of the extraction and upstream production modules (A1) represent between 53% and 92% of the total impacts. The impacts of the transportation module (A2) represent the second contributor to the total impacts, for all indicators (5% to 41%) due to the impacts of melamine paper transportation. The impacts of the manufacturing module (A3), represents between 3% and 8% of the total impacts.

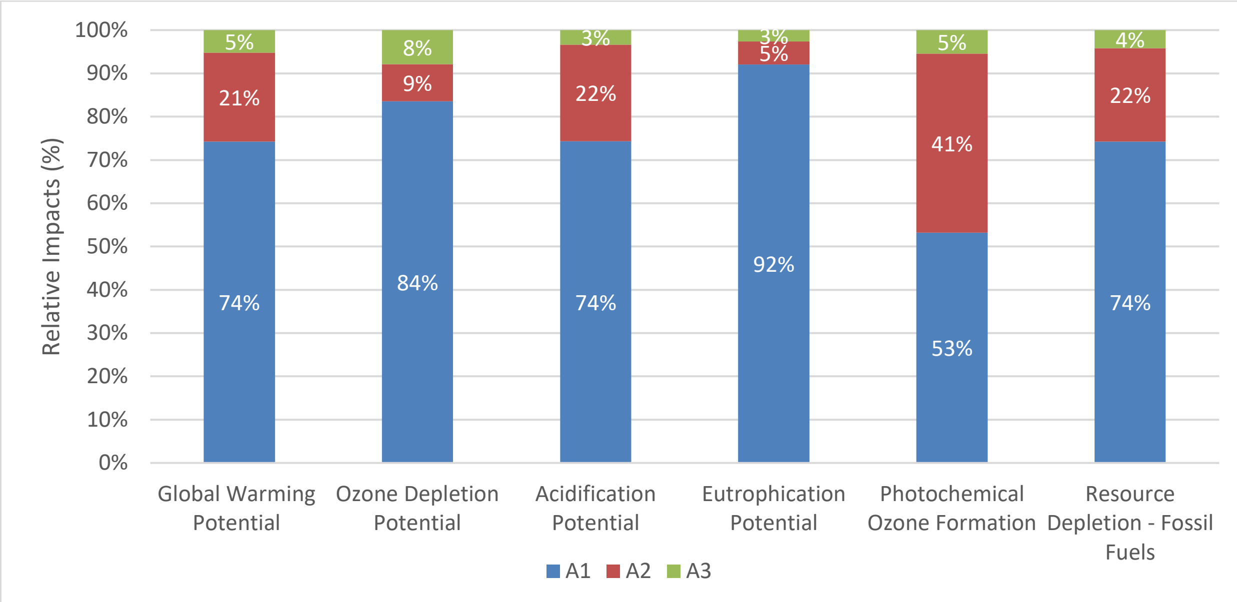

Figure 5: Contribution of each life cycle module for thermofused laminated regular MDF panels.

Breaking down the extraction and upstream production module (A1), Figure 6 indicate that production of MUF adhesive and melamine paper are the major contributors with impacts between 60% and 88% of the total impacts for all indicators.

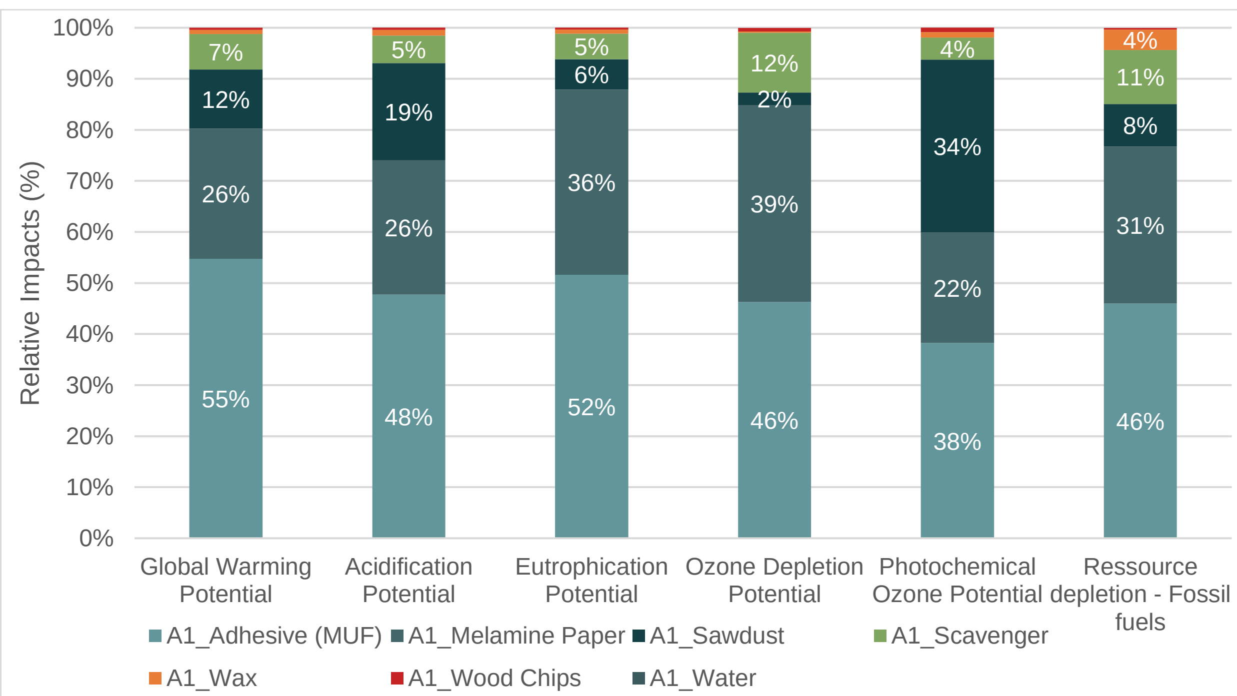

Figure 6: Contribution of material input in module A1 for thermofused laminated regular MDF panels.

The contribution analysis of the Uniboard MDF MR50 (Figure 7) indicates that the major contributor module is module A1 for all impact categories, with impacts between 34% and 80%. The major contributions of module A3 are present in the Ozone Depletion (OD) impacts category with 41% due to diesel combustion in the machine during the loading and handling of wood material in the factory.

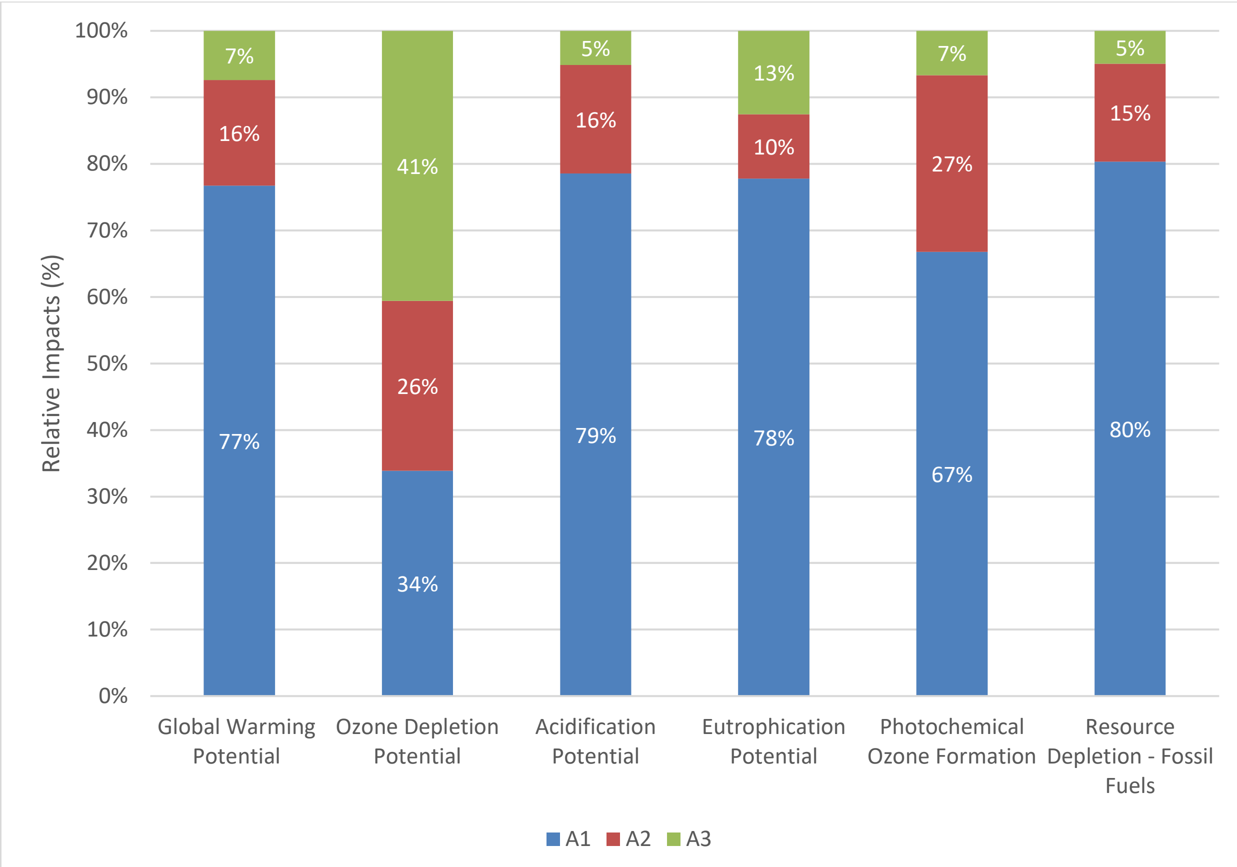

Figure 7: Contribution of each life cycle module for MDF MR50.

Breaking down the extraction and upstream production module (A1), Figure 8 indicates that the production of pMDI adhesive and sawdust is a major contributor with impacts between 74% and 97% of the total impacts for all indicators.

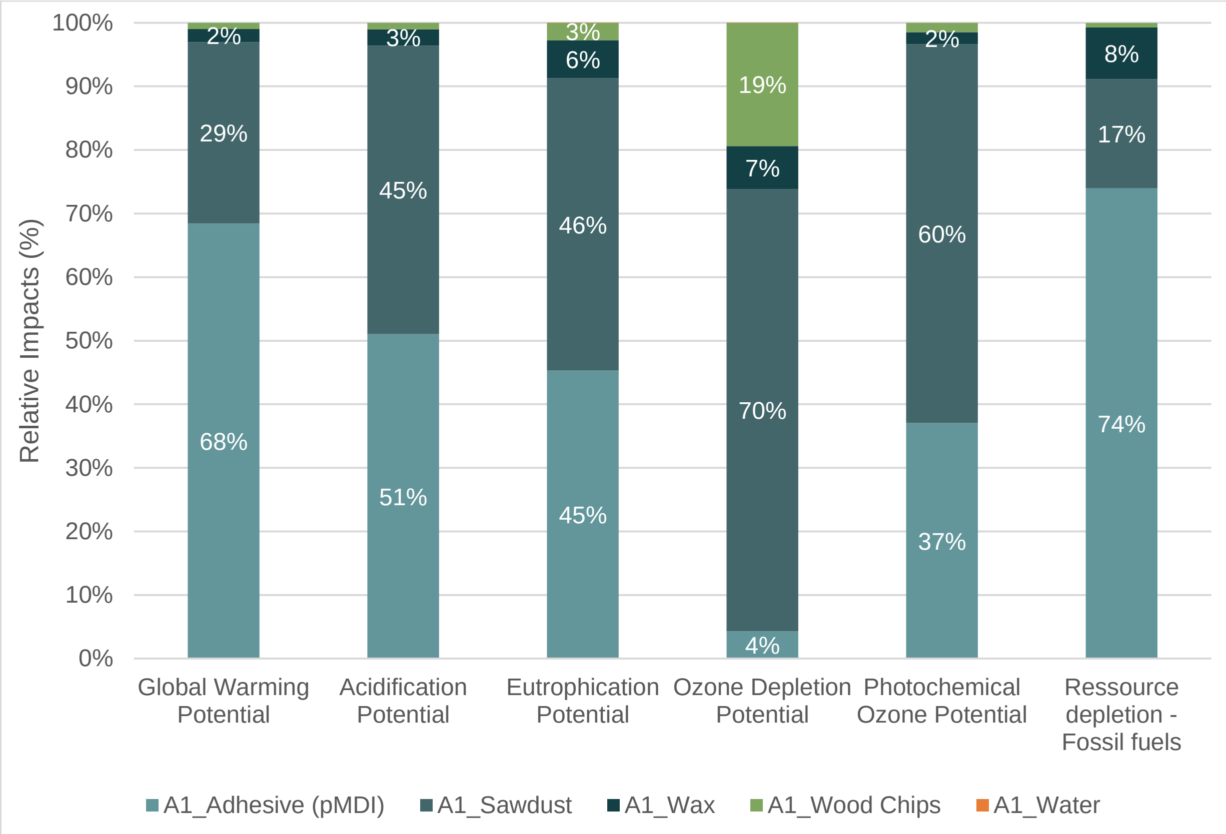

Figure 8: Contribution of material input in module A1 for MDF MR50.

As presented for the MDF MR50 product, the trend is relatively the same for thermofused laminated MDF MR50 panels. This is because the products studied have similar inputs and outputs. The difference comes from the fact that thermofused laminated panels have impregnated decorative paper applied on their surfaces. The impacts the of extraction and upstream production modules (A1) represents between 47% and 86% of the total impacts (Figure 9). The major contribution of module A2 are present in the photochemical ozone formation impacts category (47%) due to diesel combustion during truck operation. The impacts of the manufacturing module (A3) are between 4% and 14% of the total impacts for all indicators.

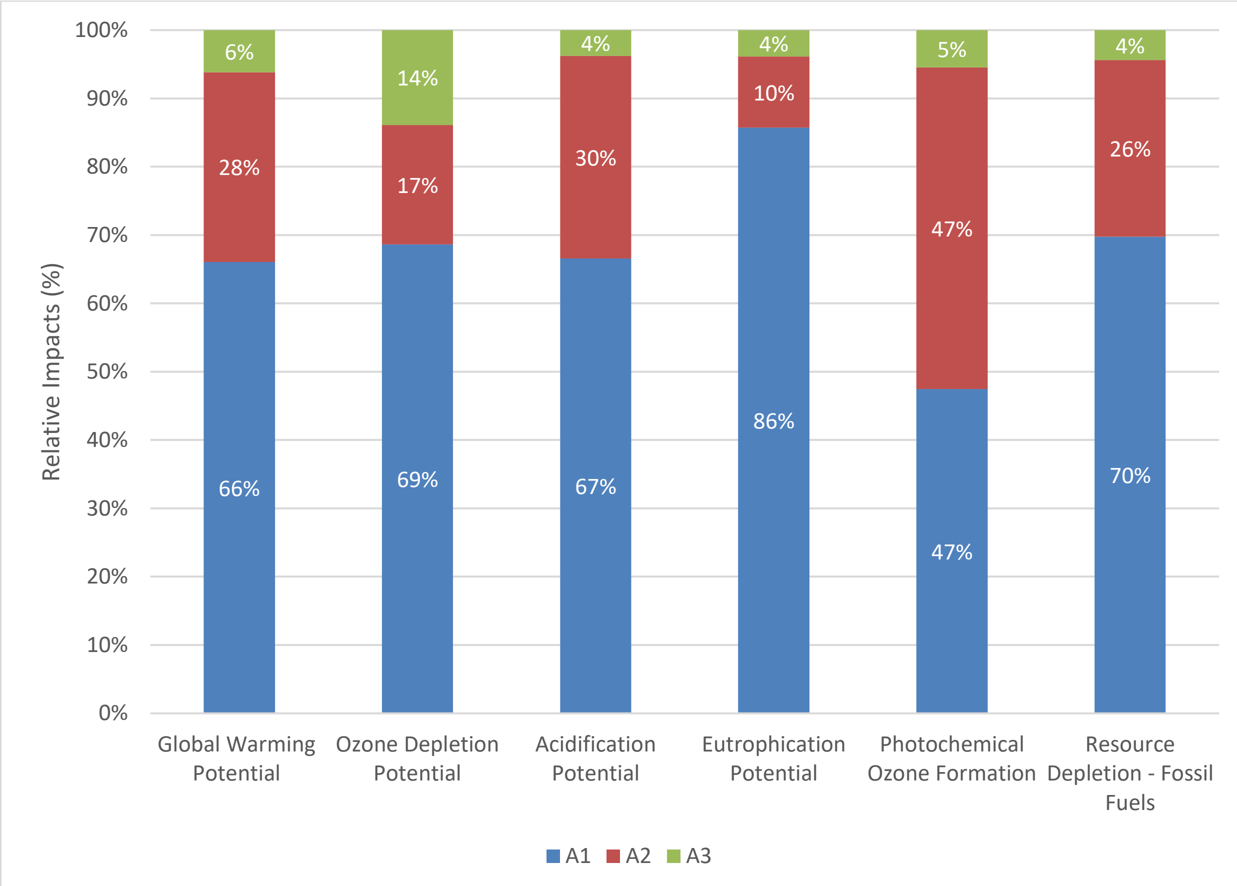

Figure 9: Contribution of each life cycle module for thermofused laminated MDF MR50.

Breaking down the extraction and upstream production module (A1), Figure 10 indicates that the production of pMDI adhesive and melamine paper are the major contributors with impacts between 53% and 91% of the total impacts for all indicators.

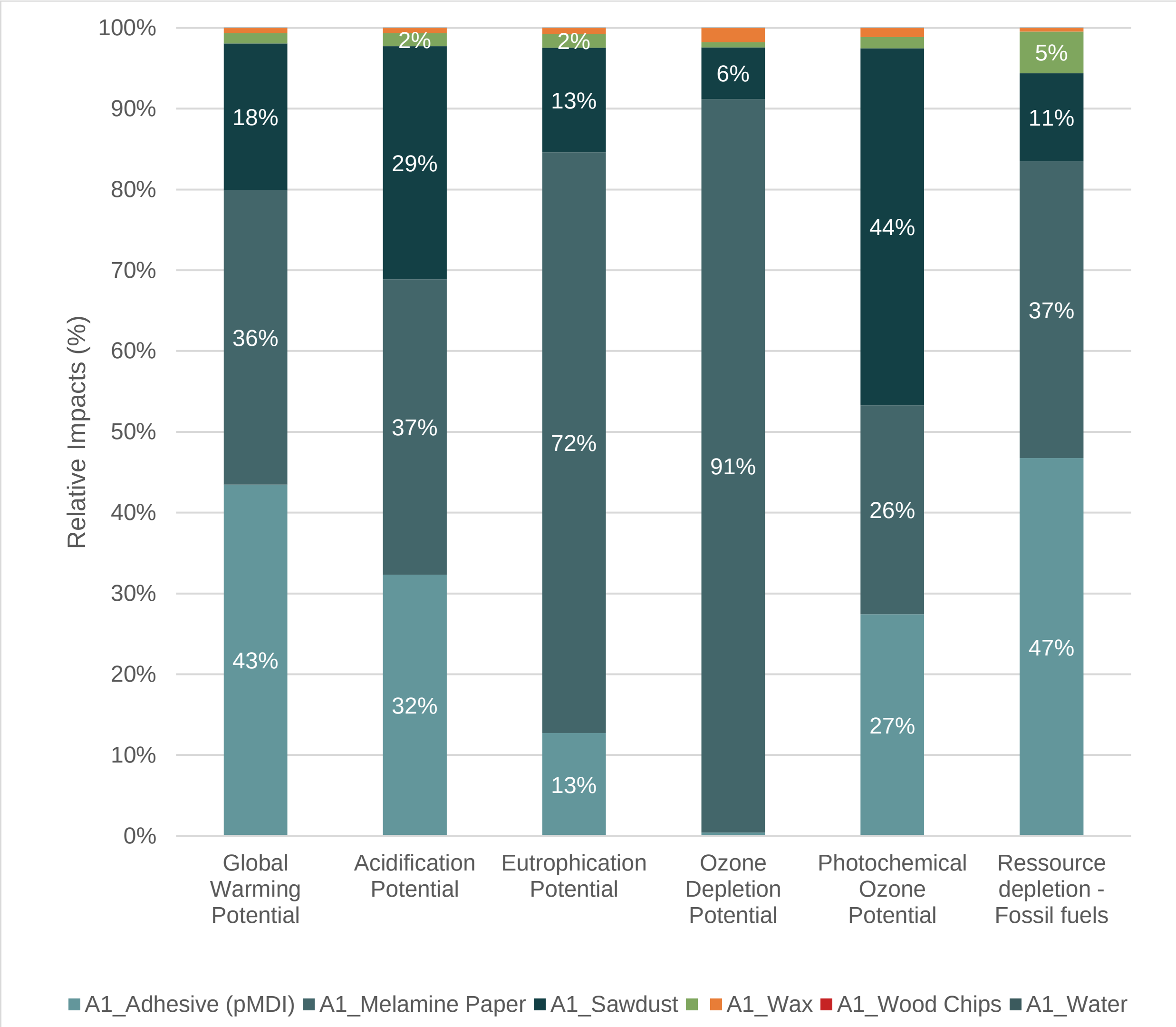

Figure 10: Contribution of material input in module A1 for thermofused laminated MDF MR50.

The contribution analysis of the Uniboard MDF FR (Figure 11) indicates that the major contributor module is module A1 for all impact categories, with impacts between 65% and 89%. The major contribution of module A2 lies in the Photochemical Ozone Formation (POF) impacts category (29%) due to diesel combustion during truck operation. The major contribution of module A3 lies in the Ozone Depletion (OD) impacts category (14%) due to diesel combustion in the machine during the loading and handling of wood material in the factory.

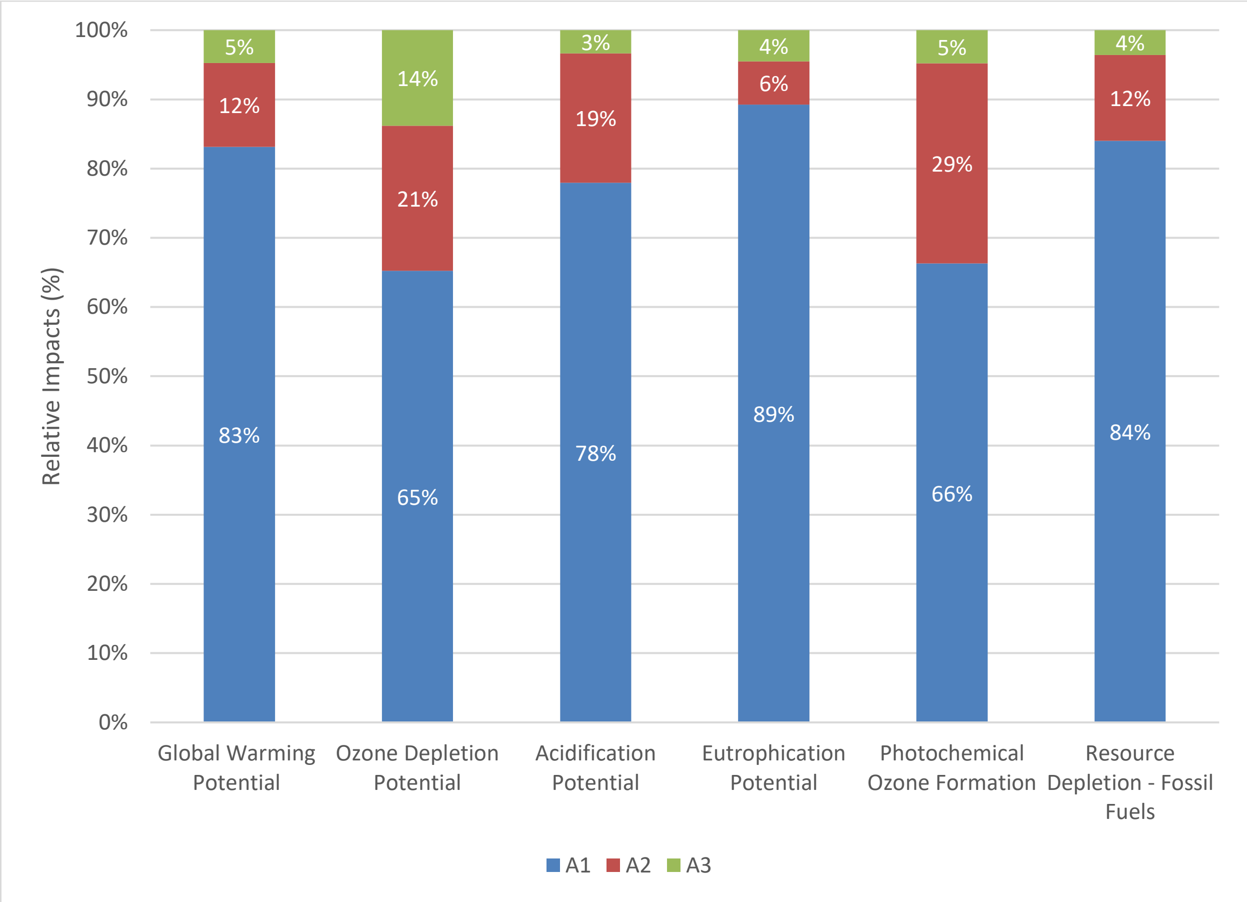

Figure 11: Contribution of each life cycle module for MDF FR.

Breaking down the extraction and upstream production module (A1), Figure 12 indicates that production of pMDI adhesive and fire retardant are the major contributors, with impacts between 63% and 85% of the total impacts for all indicators.

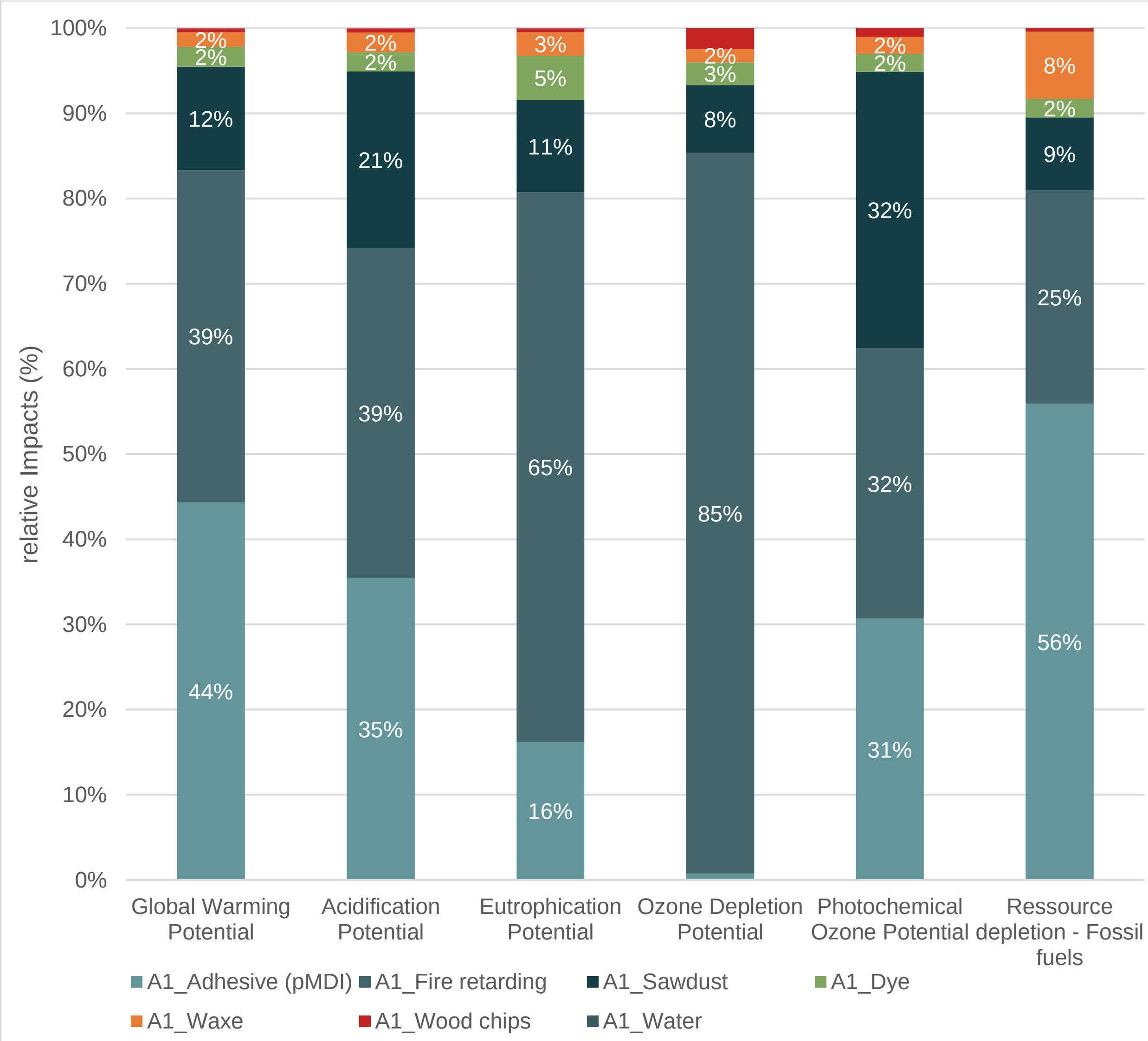

Figure 12: Contribution of material input in module A1 for MDF FR.

As presented for MDF FR product, the trend is relatively the same for thermofused laminated MDF FR as presented in (Figure 13). This is because the products studied have similar inputs and outputs. The difference comes from the fact that thermofused laminated panels have impregnated decorative paper applied on their surfaces. The impacts of the extraction and upstream production module (A1) represent between 53% and 90% of the total impacts. Module A2 represents the second contributor due to the transportation of fire retardant and melamine paper material (8% to 43%). The major impact of the manufacturing module (A3) is in the ODP indicator (10%) due to diesel combustion in the machine during the loading and handling of wood material in the factory.

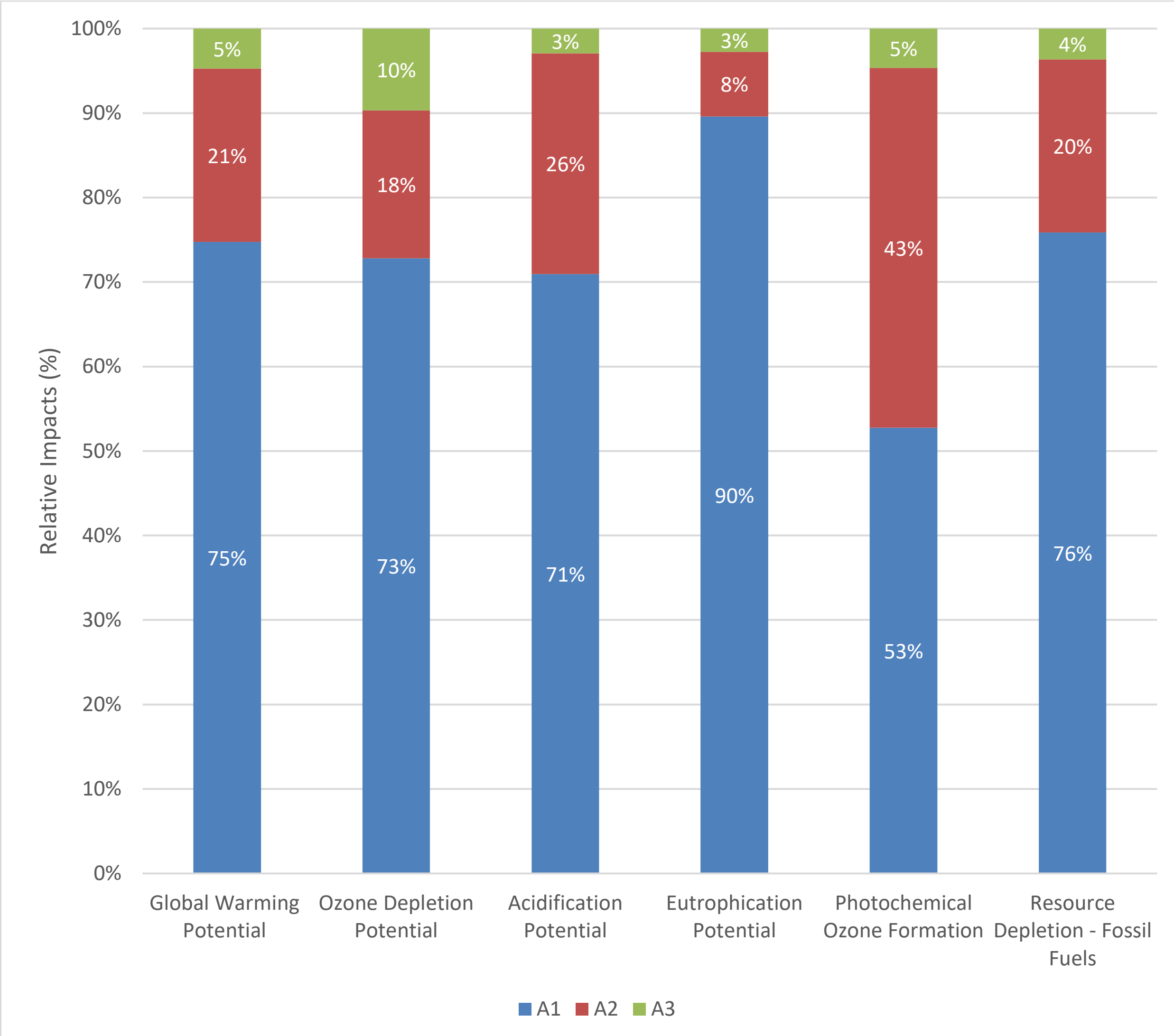

Figure 13: Contribution of each life cycle module for thermofused laminated MDF FR.

Breaking down the extraction and upstream production module (A1), Figure 14 indicates that production of pMDI adhesive, fire retardant and melamine paper are the major contributors with impacts between 69% and 94% of the total impacts for all indicators.

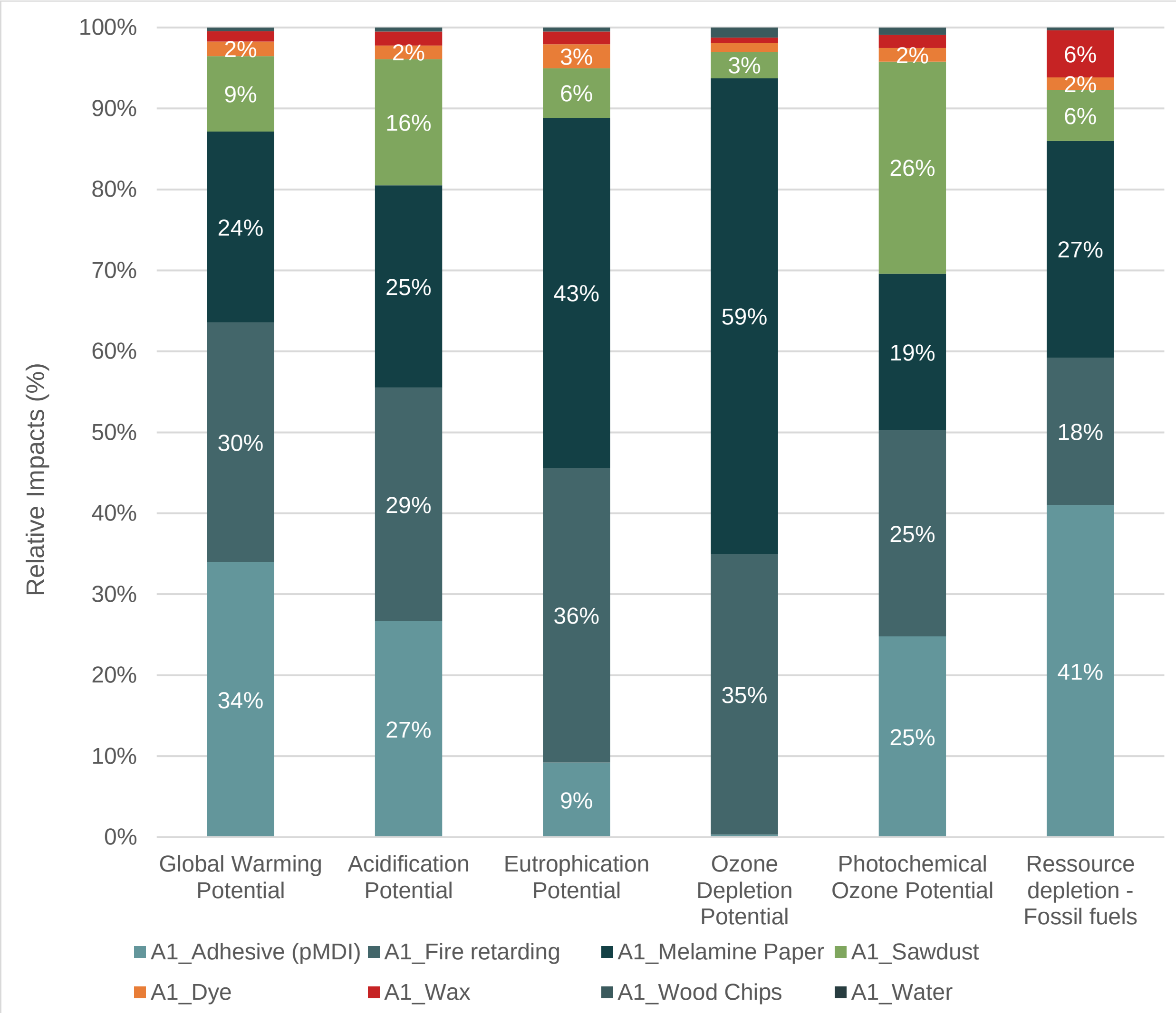

Figure 14: Contribution of material input in module A1 for thermofused laminated MDF FR.

5. ADDITIONAL ENVIRONMENTAL INFORMATION

In addition, Uniboard Canada is part of a third-party verification process with Vertima Inc. where their products and environmental documents are assessed. At the end of the process, they received a Validated Eco-Declaration® (EDS—Environmental Data Sheet) summarizing the verified environmental claims.

Uniboard also has a Health Product Declaration (HPD) for its MDF and TFL MDF panel products.

5.1. CARBON SEQUESTRATION

The amount of biogenic carbon contained within bio-based material leaving the product system shall be declared as technical scenario information in the module where the material is leaving the product system. Table 17 presents the biogenic carbon content in the product at the manufacturing gate.

Table 17: Biogenic carbon content in 1 m^3 of Uniboard's MDF panels at the manufacturing gate.

Modules	Parameters	Units	MDF Regular	MDF TFL	MDF MR50	MDF MR50 TFL	MDF FR	MDF FR TFL
A1	Biogenic Carbon Removal from Product	kg CO2	-1298.00	-1308.53	-1476.02	-1486.70	-1252.72	-1263.70
A3	Biogenic Carbon Emission from Product (exported product out to the system boundaries)	kg CO2	1151.33	1161.51	1309.00	1319.68	1111.00	1121.79
	Biogenic Carbon Removal from Packaging	kg CO2	-11.12	-13.31	-12.42	-14.91	-10.79	-12.90
	Biogenic Carbon Emission from Packaging (exported product out to the system boundaries)	kg CO2	10.05	11.99	11.20	13.41	9.76	11.63
	Biogenic Carbon Emission from Combustion of Hazardous Waste (decorative paper waste)	kg CO2	0.00	0.21	0.00	0.22	0.00	0.22
	Biogenic Carbon Removal from Combustion of Waste from Renewable Sources Used in Production Processes (Bark coming from another factory)	kg CO2	-169.58	-276.83	-169.58	-276.83	-169.58	-276.83
	Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	kg CO2	317.50	424.82	337.64	445.17	312.33	419.64

6. REFERENCES

[1] ISO 14025, "Environmental labels and declarations – Type III environmental declarations – Principles and procedures." 25 pp, 2006.

[2] UL Environment, "Product Category Rules for Part B: Structural and Architectural Wood Products EPD Requirements." v. 1.0, UL 10010-09, 2019.

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[4] ISO 21930:2017 (E), "Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services," 2017.

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