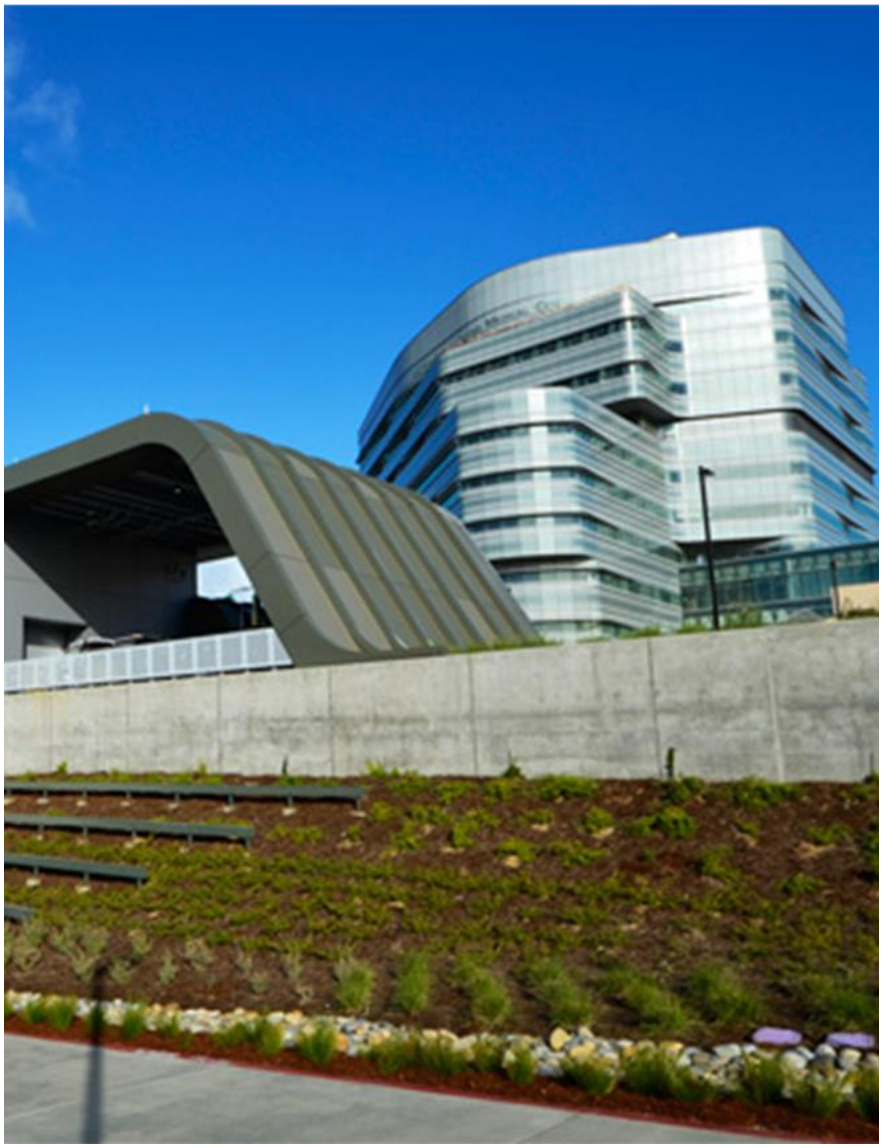
ENVIRONMENTAL PRODUCT DECLARATION

METAL COMPOSITE MATERIAL

WALL AND ROOF PANEL SYSTEMS



The Metal Construction Association (MCA) is a non-profit organization formed in 1983 with the primary purpose of expanding the use of metal in construction. MCA unites diverse industry segments for the purpose of informing decision makers about the benefits of metal through awareness and education programs. MCA also supports third-party metal product research and testing. MCA and its members are committed to creating a cleaner, safer environment evidenced by the association's LCA program and support of similar initiatives.

Metal Composite Material (MCM) panels are a major product category developed by MCA members. MCM is formed by joining two thin metal skins to a polyethylene or fire-retardant core and then bonded under a precise temperature, pressure and tension. This unique process makes MCM lighter and more versatile and flexible than a solid metal of similar thickness.

This Environmental Product Declaration for MCM panels is one of several different product EPDs offered by MCA.

For more information visit
www.metalconstruction.org

ENVIRONMENTAL PRODUCT DECLARATION

Metal Composite Material Panels
Industry-Wide 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 v.2.4 July 2018	
MANUFACTURER NAME AND ADDRESS	Metal Construction Association 8735 W. Higgins Rd., Suite 300 Chicago IL 60631	
DECLARATION NUMBER	4789289084.102.1	
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Metal Composite Material (MCM) Panels; 100m^2	
REFERENCE PCR AND VERSION NUMBER	UL Part B: Insulated Metal Panels, Metal Composite Panels, and Metal Cladding: Roof and Wall Panels v.2.0 October 23, 2018	
DESCRIPTION OF PRODUCT APPLICATION/USE	Metal Composite Material (MCM) panels consist of a core sandwiched between two sheets of aluminum. MCMs utilize extruded polyethylene (PE) or fire-retardant thermoplastic (FR) as the core material, which is bonded to the metal layers via lamination.	
PRODUCT RSL DESCRIPTION (IF APPL.)	N/A	
MARKETS OF APPLICABILITY	North America	
DATE OF ISSUE	April 1, 2020	
PERIOD OF VALIDITY	5 Years	
EPD TYPE	Industry-average	
RANGE OF DATASET VARIABILITY	Industry-average only	
EPD SCOPE	Cradle to gate	
YEAR(S) OF REPORTED PRIMARY DATA	2017	
LCA SOFTWARE & VERSION NUMBER	GaBi ts, 9	
LCI DATABASE(S) & VERSION NUMBER	GaBi 2019 (service pack 37)	
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1	

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. EPD Content

1.1. Description of Company/Organization

The Metal Construction Association (MCA) is recognized as the leading advocate for the architectural metal products industry. Since it was formed in 1983, MCA has focused on promoting the use of metal in the building envelope through marketing, education, and action on public policies that affect metal's use. MCA is a volunteer-led organization that works to eliminate barriers to using metal in construction by supporting product performance testing, initiating research, and monitoring and responding to codes and regulations that affect metal. Visit www.metalconstruction.org for more details.

Information in this document has been prepared by MCA technical staff and members of MCA's MCM Fabricators Council and MCA's Wall Panel Council who are volunteers representing the leading manufacturers of Metal Composite Material (MCM) and companies that provide premium fabricating services for MCM. The product configurations offered herein use ranges representative of all types of MCM based on specific products from the following MCA member companies:

3A COMPOSITES	3A Composites employs 2,700 persons in 21 locations in Europe, the Americas and Asia. It is active in manufacturing and commercializing lightweight products for architecture, visual communication, transportation, industrial and wind energy markets. Its well-known brand, ALUCOBOND®, is the category leader in the markets served. 3A Composites is committed to making its products and production processes environmentally sustainable. By partnering with recyclers of ACM 3A Composites reduces its manufacturing carbon footprint, is a silver member of USGBC and contributes multiple points to LEED certification. Learn more at www.alucobondusa.com.
ARCONIC	Arconic Architectural Products LLC (AAP) is a subsidiary of Arconic, a global technology, engineering and advanced manufacturing leader that creates breakthrough products that shape industries. AAP products have helped advance innovation in building design and can be found across skylines the world over. Our Reynobond® and Reynolux® panel product offerings help reduce the environmental impact from construction by using infinitely recyclable' aluminum metal, and helps extend the life of buildings with durable, low-maintenance products that provide modern aesthetics. From exterior to interior uses, these highly versatile products create a world of design possibilities, while seamlessly integrating with architectural systems to produce dynamic visual effects. For more information or to see the full spectrum of possibilities, visit www.reynobond.com.
MITSUBISHI CHEMICAL COMPOSITES AMERICA	Mitsubishi Chemical Composites America, Inc. (MCCA) is part of the global Mitsubishi Chemical group of companies. MCCA has manufactured ALPOLIC® Metal Composite Materials (MCM) since 1991 at its Chesapeake, Va. location. ALPOLIC® MCM is among the most versatile and useful architectural materials available, and

	our manufacturing, distribution and support capabilities extend worldwide. ALPOLIC® offers the rigidity of heavy-gauge architectural metals in a lightweight composite material available in an unmatched selection of colors and finishes. For more information about ALPOLIC® ALPOLIC or to order samples, please visit www.alpolic-americas.com

1.2. Product Description

Metal composite material (MCM) panels in their simplest form are a polyethylene (PE) or fire-resistant (FR) core sandwiched between two sheets of coated metal. The panels are molded in a variety of styles and sizes depending on application. Aluminum is the type of metal skin represented in this declaration. Properly designed and installed, these metal composite panels provide a very reliable building envelope that resists the elements and protects against air and water infiltration.

MCA MCM products are used in a multitude of building coverage applications and offer a wide range of benefits, including aesthetics, durability, rain screening, fireproofing, and reduced energy costs, with each product type offering its own unique properties. This EPD focuses on panel products that are considered representative of common products manufactured by member companies, as seen in Table 1. A flow diagram depicting the manufacturing process can be found in Figure 2: MCM manufacturing process

. The EPD is intended to represent an industry average for MCM panels. The average is weighted based on on the area of product manufactured at each of the member's facilities (i.e., vertical averaging).

Table 1: Panel products under study

PRODUCT	DESCRIPTION	PRIMARY PROCESSES
Metal composite material panel (MCM)	Metal substrate thickness: 0.01 and 0.02 inches PE or FR core thickness: 3, 4, and 6 mm Primary product: 0.02 inches aluminum cladding skins with 4mm thick polyethylene/fire-resistant core	• Continuous coil coating • MCM sheet manufacturing • MCM panel fabrication

1.3. Application

Metal Composite Material (MCM) panels have been used in North American construction for over 30 years. They are formed by bonding two metal skins to a highly engineered plastic core. Originally known as Aluminum Composite Material (ACM), the name of the product category has evolved to Metal Composite Material to reflect the introduction of new skin metals such as zinc, copper, stainless steel, and titanium. This declaration, however, only covers MCA member company products that utilize aluminum, as it remains the predominant skin material. MCMs not only provide exceptional flatness, but also a broad choice of finishes. Aluminum MCMs can be finished in virtually any color a building owner or architect desires.

Initial construction costs are often lower with MCM systems because the panels can typically be installed faster than alternative exteriors such as precast, granite or brick. Because of their light weight, MCM systems can also save money by reducing structural steel requirements, since less support structure is needed.In addition, ongoing maintenance costs are reduced as a result of continuing improvements in paints and coatings. Today's MCM products retain their luster for decades, ensuring that the building maintains its aesthetic appeal and its property value for the

long term. This longevity makes a difference when it comes time to sell the building. Facilities clad with MCM systems retain their curb appeal and never look dated, often reducing the need for pre-sale refurbishing costs.

Successful applications include: commercial facilities, healthcare facilities, industrial facilities, transportation, schools and universities, warehousing and distribution centers, sports complexes, and convention centers.

Declared unit of this product system is coverage of 100 square meters (1076.4 square feet) of building area.

1.4. Declaration of Methodological Framework

The production stage (i.e., cradle-to-gate), including raw material extraction and processing, processing of secondary material, transport to the manufacturer, and manufacturing, is required by the PCR. The PCR considers installation, use, end-of-life, and recovery stages (modules A4 through D) as optional. As such, this study excludes the optional stages. Since this is a "cradle-to-gate" study, the products are not declared as fulfilling a building reference service life. This study also excludes construction of capital equipment, including tools used to produce, install and maintain the products; maintenance and operation of support equipment; human labor and commute; building energy consumption; and all other impacts associated with the use stage relative to energy use for building in which the product is installed. The included and excluded life cycle stages are summarized in Table 2.

Table 2: Life cycle modules included in EPD

Production			Installation		Use stage							End-of-Life				Next product system
Raw material supply (extraction, processing, recycled material)	Transport to manufacturer	Manufacturing	Transport to building site	Installation into building	Use / application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to EoL	Waste processing for reuse, recovery or recycling	Disposal	Reuse, recovery or recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = declared module; MND = module not declared

1.5. Product Specification

Performance Standards - Air Tightness

ASTM E 283 Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen*

Performance Standards - Fire

ASTM D1929	Standard Test Method for Determining Ignition Temperature of Plastics
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials
CAN/ULC S101	Standard Methods of Fire Endurance Tests of Building Construction and Materials
CAN/ULC S102	Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies
CAN/ULC S134	Standard Method of Fire Test of Exterior Wall Assemblies

Materials and Assemblies

NFPA 285	Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components
ASTM D 635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in Horizontal Position
ASTM E 162	Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
UL 1715	Fire Test of Interior Finish Material

Performance Standards – Structural

ASTM C 297	Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions
ASTM C 393	Standard Test Method for Core Shear Properties of Sandwich Constructions
ASTM C 481	Standard Test Method for Laboratory Aging of Sandwich Constructions
ASTM D 1002	Standard Test Method for Apparent Shear Strength of Single-Lap -Joint Adhesively Bonded Metal Specimens
ASTM D 1781	Standard Test Method for Climbing Drum Peel Test for Adhesive Materials
ASTM E 72	Structural Test of Panels
ASTM E 228	Standard Test Method for Linear Thermal Expansion of Solid Materials
ASTM E 330	Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference*

Performance Standards - Water Resistance

ASTM E 331	Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference*
AAMA 501.1	Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure

AAMA **5**01.2	Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems
AAMA 508	Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems
AAMA 509	Voluntary Test and Classification Method for Drained and Back Ventilated Rain Screen Wall Cladding Systems

Performance Standards - Finishes

AAMA 611	Specification for Anodized Architectural Aluminum
AAMA 2604	Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 2605	Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
ASTM D 822	Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer and Related Products
ASTM D 968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1308	Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1735	Standard Practice for Testing Water Fog Testing of Organic Coatings
ASTM D 2244	Standard Practice for Calculation of Color Tolerances and Color Differences
ASTM D 2794	Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	Methods for Measuring Adhesion by Tape Test
ASTM D 3363	Standard Test Method for Film Hardness by Pencil Test
ASTM D 4145	Standard Test Method for Coating Flexibility of Prepainted Sheet
ASTM D 4212	Method for Testing Chalk and Paint Delamination
ASTM D 4214	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films

1.6. Properties of Declared Product as Delivered

Manufacturers supply MCMs in a variety of sizes and configurations customized to each project's requirements. The data for this EPD is representative of panels offered by the participating manufacturers. Technical properties of panel products under study can be seen in Table 3.

Table 3: Product properties

PARAMETER	VALUE	UNIT
Length	1 – 6	m
Width	1 – 1.5	m
Thickness	4	mm

1.7. Material Composition

Alumininum coil represents steel that has been rolled out into 24 or 30 gauge sheet.

Polyethylene is one of the primary components of the MCM core which is laminated to the metal skins.

Fire-resistant thermoplastic is another one of primary components of the MCM core which is laminated to the metal skins.

Table 4: Base material mass by percentage, MCA Industry-average

MATERIAL	MASS (%)
Aluminum	50%
Core	50%

1.8. Manufacturing

MCM panels are formed by bonding two metal skins to a highly engineered plastic core placed between them. This occurs under very precise conditions of temperature, pressure and tension. The result is a strong composite sheet of metal and plastic. Properly designed and installed, these metal composite panels provide a very reliable building envelope that resists the elements and protects against air and water infiltration. Producing the panels requires a five-stage process, as shown in Figure 1 below.

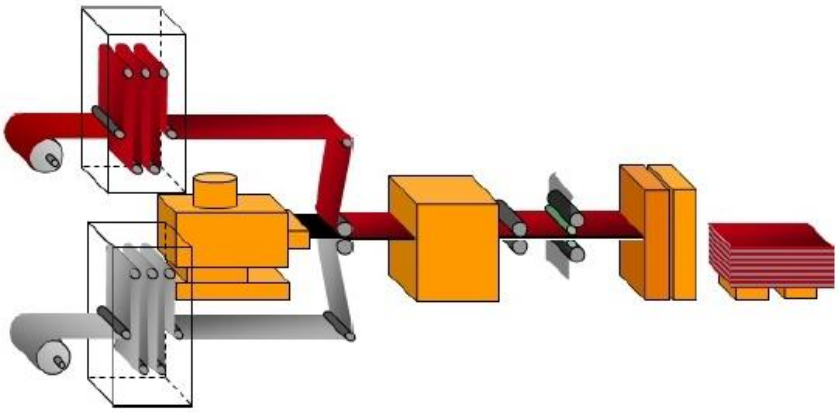


Figure 1: Schematic of MCM production process

The metal coils are introduced from two pay-off reels (1). Next the laminating rollers bond the aluminum to the continuously extruded thermoplastic core (2). The laminated material then enters the cooling chamber and is constantly moved at a steady rate by the pulling rollers (3). A protective masking film is then applied to the MCM to protect the surface finish (4). Finally, the MCM is trimmed to the required width, sheared to the required length, and stacked for inspection and final packaging (5).

This production process occurs under very precise conditions of temperature, pressure and tension, resulting in a strong composite sheet of metal and plastic. Properly designed and installed, these metal composite panels provide a very reliable building envelope that resists the elements and protects against air and water infiltration. Figure 2 shows a detailed IMP manufacturing process.

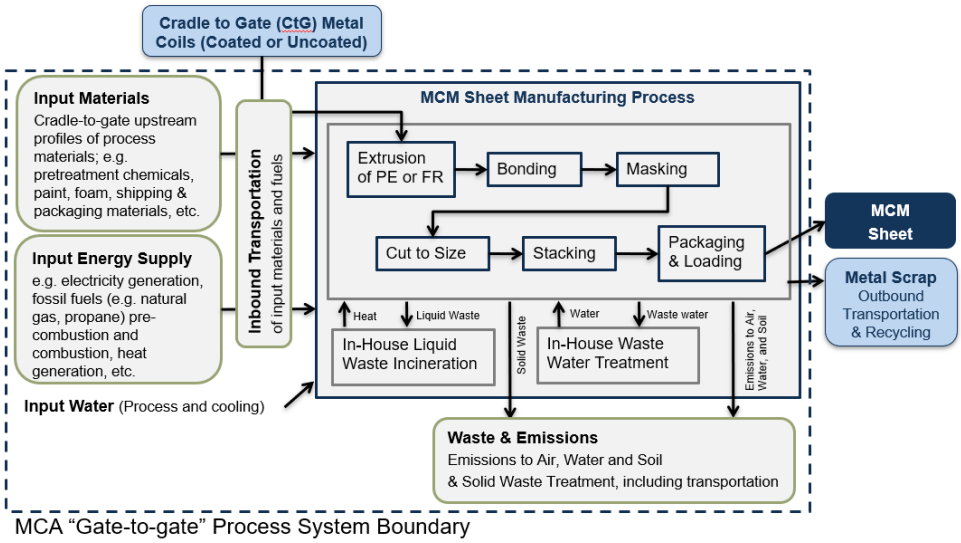


Figure 2: MCM manufacturing process

1.9. Packaging

Foam sheets are layered between insulated metal panels before the panels are stacked on oriented strand board and expanded polystyrene underlayment and wrapped with plastic banding. Depending on the manufacturer, chipboard and/or oriented strand board are also used in packaging.

1.10. Product Average

This declaration covers MCMs manufactured by 3 different participating MCA member companies, representing a significant majority of annual production in the US and Canada, as seen in Table 5.

Table 5: Products by manufacturer

COMPANY	MANUFACTURING LOCATION
3A Composites, USA	Benton, KY
Arconic / Alcoa Architectural Products	Eastman, Georgia
Mitsubishi Chemical Composites America	Chesapeake, VA

1.11. Transportation

Average transportation distances and modes of transport are included for the transport of the raw materials, operating materials, and auxiliary materials to production and assembly facilities.

2. Life Cycle Assessment Background Information

2.1. Declared Unit

The main purpose of metal cladding and panels is to provide weather protection for building walls and roofs. The panels create barriers that control noise, water, and air transmission between an external environment and interior building space. Accordingly, the PCR's functional unit for metal panels, metal composite panels, and metal cladding is the coverage of 100 square meters (1076.4 square feet) of building area. The coverage area refers to the projected flat area covered by the product as output by the final manufacturing process step and does not account for losses due to overlap and scrap during installation.

Table 6: Reference flows

NAME	MCM
Declared unit [m^2]	100
Product mass [kg / 100 m^2]	756

2.2. System Boundary

A "cradle-to-gate" life cycle analysis was conducted. Within these boundaries, only the product stage (A1 – A3)—r aw material supply, inbound transport of raw materials to manufacturing facility, manufacturing—is considered. The construction stage (A4 – A5), building use stage (B1 - B7), and end-of-life stage (C1 - C4) were not assessed, nor were the construction and maintenance of capital equipment (e.g., production equipment). Additionally, human labor and employee commute were not included in the analysis.

2.3. Estimates and Assumptions

This study was based on primary data collected at MCA member company facilities. Datasets selected to represent the production of raw materials by upstream suppliers are based on regional or global averages rather than on primary data collected directly from member company supply chains. When selecting these datasets, a conservative approach was applied in that datasets associated with higher impacts are used when there are multiple possible options.

Secondly, this study was conducted in accordance with a PCR. While this guidance document has been developed by industry experts to best represent this product system, real life environmental impacts of metal panel and cladding products may extend beyond those defined in this document.

2.4. Cut-off Criteria

Data were included whenever possible. If it was necessary to exclude materials in order to facilitate the analysis, only flows representing less than 1% of the cumulative mass of the product system were excluded, providing their environmental relevance was judged not to be a concern.

Packaging of incoming raw materials (e.g. pallets, totes, super-sacks) are excluded as they represent less than 1% of the product mass and are not environmentally relevant. Capital goods and infrastructure required to produce metal panel and cladding products are presumed to produce millions of units to over the course of their life, so impact of a single functional unit attributed to this equipment is negligible; therefore, capital goods and infrastructure were excluded from this study.

2.5. Data Sources

As a general rule, specific data derived from specific production processes or average data derived from specific production processes shall be the first choice as a basis for calculating LCA results.

For life cycle modeling of the considered products, the GaBi Software System for Life Cycle Engineering, developed by thinkstep AG, was used to model the product systems considered in this assessment. All relevant background datasets were taken from the GaBi 2019 software database (service pack 37). The datasets from the GaBi database are documented in the online documentation (thinkstep, 2018). To ensure comparability of results in the LCA, the basic data of GaBi database were used for energy, transportation and auxiliary materials.

2.6. Data Quality

A variety of tests and checks were performed throughout the project to ensure high quality of the completed LCA. Checks included an extensive review of project-specific LCA models as well as the background data used.

Temporal Coverage

All of the primary data is taken from 12 months of continuous operation in the 2017 fiscal year. All secondary data were obtained from the GaBi 2019 databases and published EPDs. Data are representative of the years 2010 to 2018.

Geographical Coverage

All primary and secondary data were collected specific to the countries or regions under study. Where country-specific or region-specific data were unavailable, proxy data were used.

Technological Coverage

All primary and secondary data were modeled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used.

2.7. Reference Period

Data providers were asked to provide annual data for 2017.

2.8. Allocation

Since only facility level data were available, input and output flows were allocated among each facility's co-products to determine the flows associated with the products analyzed. Allocation of materials was done on an area-basis as appropriate.

End-of-life allocation generally follows the requirements of ISO 14044, section 4.3.4.3 and the product category rule. (UL Environment, 2018) Under the PCR, the product life cycle is modeled using the cut-off approach. Scrap inputs to manufacturing are reported under the secondary materials metric. The system boundary at end-of-life is drawn after

scrap collection to account for the collection rate. This generates a scrap output flow that is reported under the materials for recycling metric.

Processing and recycling of the net amount of scrap leaving the system (i.e., scrap outputs minus secondary material inputs) is not included in this study.

2.9. Comparability

No comparisons or benchmarking is included in this EPD. LCA results across EPDs can be calculated with different background databases, modeling assumptions, geographic scope and time periods, all of which are valid and acceptable according to the Product Category Rules (PCR) and ISO standards. Caution should be used when attempting to compare EPD results.

3. Scenarios and Additional Technical Information

This EPD represents a cradle-to-gate analysis; as such, no additional information is provided as the downstream modules are not declared.

4. Life Cycle Assessment Results

Cradle-to-gate life cycle impact assessment results are shown for TRACI 2.1 characterization factors. These results are relative expressions and do not predict impacts on category endpoints such as human health or ecosystem quality, the exceeding of thresholds, safety margins, or risks.

With respect to global warming potential, biogenic carbon is not considered as the declared products only use biogenic materials for packaging. For packaging, no credit was given for the sequestration of biogenic carbon during the growth of plants used in plant-derived packaging materials. Any carbon temporarily sequestered during the use of bio-based materials is assumed to be re-released to the atmosphere upon their decomposition. Since the lifetime of plant-derived packaging materials is shorter than the 100 year time horizon of this impact category (GWP 100), GWP including biogenic carbon is not reported.

4.1. Life Cycle Impact Assessment Results

Table 7: North American Impact Assessment Results

PARAMETER	UNIT	TOTAL	A1	A2	A3
GWP	[kg CO_2 eq.]	**2.80E+03**	2.58E+03	5.71E+01	1.64E+02
ODP	[kg CFC-11 eq.]	**1.10E-07**	1.10E-07	0.00E+00	0.00E+00
AP	[kg SO_2 eq.]	**1.16E+01**	1.11E+01	4.32E-01	1.63E-01
EP	[kg N eq.]	**3.61E-01**	3.13E-01	2.94E-02	1.80E-02
SFP	[kg O_3 eq.]	**1.29E+02**	1.15E+02	1.04E+01	3.43E+00
ADPF	Surplus MJ	**5.70E+03**	5.37E+03	1.11E+02	2.24E+02

4.2. Life Cycle Inventory Results

Table 8: Resource Use

PARAMETER	UNIT	TOTAL	A1	A2	A3
RPRE	[MJ, LHV]	**7.79E+03**	7.61E+03	2.46E+01	1.59E+02
RPRM	[MJ, LHV]	**1.32E+03**	1.32E+03	0.00E+00	0.00E+00
RPRT	[MJ, LHV]	**9.11E+03**	8.93E+03	2.46E+01	1.59E+02
NRPRE	[MJ, LHV]	**4.93E+04**	4.58E+04	8.33E+02	2.73E+03
NRPRM	[MJ, LHV]	**1.72E+04**	1.72E+04	0.00E+00	0.00E+00
NRPRT	[MJ, LHV]	**6.65E+04**	6.29E+04	8.33E+02	2.73E+03
SM	[kg]	**3.48E+02**	3.48E+02	0.00E+00	0.00E+00
RSF	[MJ, LHV]	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00
NRSF	[MJ, LHV]	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00
RE	[MJ, LHV]	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00
FW	[m3]	**3.70E+01**	3.63E+01	9.52E-02	6.73E-01

Table 9: Output Flows and Waste Categories

PARAMETER	UNIT	TOTAL	A1	A2	A3
HWD	[kg]	**1.64E-01**	1.64E-01	6.41E-06	1.25E-06
NHWD	[kg]	**4.77E+02**	4.66E+02	3.04E-02	1.01E+01
HLRW	[kg]	**7.60E-04**	5.31E-04	2.21E-06	2.27E-04
ILLRW	[kg]	**1.99E-02**	1.36E-02	5.97E-05	6.27E-03
CRU	[kg]	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00
MFR	[kg]	**6.42E+01**	0.00E+00	0.00E+00	6.42E+01
MER	[kg]	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00
EE	[MJ]	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00

5. LCA Interpretation

The majority of burdens for categories fall within module A1 (production of raw materials). Within raw materials production, the majority of impact categories are driven by the production of aluminum and masking material. Relative to other impact categories,EP and SFP have more pronounced contribution in inbound transportation due to tailpipe emissions of nitrogen compounds.

Though some raw materials are transported vast distances, the inbound transportation module (A2) has a modest contribution to overall impact.

The manufacturing module (A3) also has a modest contribution to overall impact, representing less than 10% of all life cycle impact assessment categories.

6. References

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