ENVIRONMENTAL PRODUCT DECLARATION

Roll Formed Metal Wall and Roof Panels

Metal Building Manufacturers Association

Industry-Wide EPD

Illustration of metal roof panel (standing seam or through fastened) and metal wall panel (through fastened) cladding attached to the secondary structural steel framing (girts/purlins) supported by the primary structural steel framing.

Note: Generic metal roof and wall panels featured in illustration above.

MBMA
METAL BUILDING MANUFACTURERS ASSOCIATION®

The Metal Building Manufacturers Association (MBMA), Cleveland, OH, was founded in 1956. Since that time, MBMA and its manufacturer members have worked together as partners to further its mission: to conduct research, to help advance building codes and standards, and to educate the construction community. MBMA's passion is to support a strong, sustainable metal building systems industry that meets the needs of building owners and society.

MBMA's members are deeply committed to the social, environmental and economic principles of sustainability. This pledge is aimed at improving the quality of life for everyone now without compromising the ability of future generations to meet their needs.

This industry average EPD includes only the *Roll Formed Metal Wall and Roof Panels* as used in metal building systems. These panels serve as the exterior roofing and wall cladding for metal building systems as well as other building types

Separate EPDs are available that address the primary structural steel framing, and secondary structural steel framing used to form a complete metal building system.

This industry average EPD is representative of the MBMA metal building systems members.

A complete list of members is available at www.mbma.com/Systems_Members.asp.

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METAL BUILDING MANUFACTURERS ASSOCIATION®

Roll Formed Metal Wall and Roof Panels
Industry-Wide EPD

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

Declaration Information

Program Operator Name, Address, Logo & Website	UL Environment, 333Pfingsten Rd., Northbrook, IL 606011 https://www.ul.com
General Program Instructions & Version Number	UL Environment General Program Instructions v2.5, March 2020
Location of Explanatory Material	For any explanatory material, regarding this EPD, please contact Tony Bouquot (tbouquot@thomasamc.com)
Declaration Holder & Address	Metal Building Manufacturers Association 1300 Sumner Avenue Cleveland, OH 44115-2851
Declaration Number	4789771662.103.1
Declared Product & Functional Unit	Roll Formed Metal Wall and Roof Panels – 100 m^2
Product Definition	Roll-formed metal wall and roof panels (claddings) used in a metal building system CSI code: 074213.13 Formed Metal Wall Panels CSI code: 074113.13 Formed Metal Roof Panels
Reference PCR & Version Number	Part A: Product Category Rules for Building Related Products and Services (UL Environment, 2018, v3.2) Part B: Insulated Metal Panels, Metal Composite Panels, and Metal Cladding: Roof and Wall Panels (UL Environment, 2018, v2.0)
Markets of Applicability	USA – business-to-business focus
Date of Issue	April 01, 2021
Period of Validity	5 years
EPD Type	Industry-average
EPD Scope	Cradle-to-gate (modules A1 to A3)
Year(s) of Reported Manufacturer Primary Data	2019
LCA Software & Version Number	Sima Pro v9.1.1.1, 2021
LCI Database(s) & Version Number	ecoinvent 3.6, December 2019
LCIA Methodology & Version Number	US EPA TRACI v2.1+ IPCC 2013 (AR5)
The PCR Review was conducted by:	Thomas P. Gloria, PhD (Chair), t.gloria@industrial-ecology.com Ms. Brandie Sebastien, JBE Consultants Mr. James Littlefield, Independent Consultant

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

This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v3.2 (September 2018), based on ISO 21930:2017 and EN 15804 + A1:2013, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017) ☐ INTERNAL X EXTERNAL	Grant R. Martin, UL Environment
This life cycle assessment was conducted in accordance with ISO 14044:2006 and the reference PCR by:	Athena Sustainable Materials Institute
This life cycle assessment was independently verified in accordance with ISO 14044:2006 and the reference PCR by:	Tom Gloria, Industrial Ecology Consultant

LIMITATIONS
The environmental impact results of steel products in this document are based on a declared unit and therefore do not provide sufficient information to establish comparisons. The results shall not be used for comparisons without knowledge of how the physical properties of the steel product impact the precise function at the construction level. The environmental impact results shall be converted to a functional unit basis before any comparison is attempted. See Section 3.10 for additional EPD comparability guidelines.

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

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025:2006 and ISO 21930:2017. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. 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, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

ENVIRONMENTAL PRODUCT DECLARATION

Roll Formed Metal Wall and Roof Panels
Industry-Wide EPD

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

Metal Building Manufacturers Association

The Metal Building Manufacturers Association (www.mbma.com) is a trade association established in 1956. The mission of the MBMA is to promote the design and construction of metal building systems in the low-rise, non-residential building marketplace. Metal building systems are commonly used to provide warehouses, manufacturing, office, retail, community, and religious buildings. The popularity of metal building systems has been driven by the design and aesthetic flexibility, the consistency and the speed of construction. MBMA building systems members fabricate the primary rigid frames, secondary framing, and component products such as metal roof and wall panel cladding systems.

Ownership of Industry Wide EPD

This EPD was developed for use by MBMA member companies, a complete list of whom can be found here: https://www.mbma.com/System_Members.html.

Product Description

Roll formed metal wall and roof panels covered by this EPD and commonly used on a metal building system includes:

- Cold-formed single skin metal roofs supported and attached to purlins that spans to the primary rigid framed rafters. The metal roofs may be classified as standing seam roofs that are attached to the purlins via concealed clips or a through fastened roof with exposed fasteners attached to the purlins. These roof panels are custom roll formed from either cold rolled coils or hot dip galvanized coils and may be either bare steel or painted steel. Additionally, the metal roof panels may be formed from aluminum/zinc coated products that may also be bare steel or painted steel.
- Cold-formed single skin metal walls are attached to the girts that spans to the primary rigid framed columns. The metal wall panels are custom roll formed from either cold rolled coils or hot dip galvanized coils and may be either bare steel or painted steel. Additionally, the metal wall panels may be formed from aluminum/zinc coated products that may also be bare steel or painted steel.

Example of metal roof and wall panels on a building under construction.

Flexible Design

Metal building manufacturers custom design the secondary structural steel frame components, along with the primary structural steel framing and the metal roof and wall cladding, in accordance with the order documents. Order documents are based on the specified building code, loading conditions, and serviceability requirements.

Less Material

Most often, the weight of steel used in a metal building framing system is significantly less than hot-rolled steel framed buildings due to the structural optimization of the tapered web design and the cold formed secondary structural steel frame components. By tapering the primary structural steel framing web, material is used where it is needed for strength and stability. Traditional hot-rolled steel frame designs and other competing materials do not take advantage of this material optimization. Similarly for the cold formed secondary framing members, the weight of steel used is less than the traditional bar joist type systems. The metal roof and wall panels used in this EPD are single skin systems that includes less weight per square foot then traditional exterior cladding products and the underlying support structure. This weight savings inherently reduces the environmental impact of metal buildings when compared to traditional framing systems.

Metal Building System - EPD Family

A complete metal building system is made up of primary structural steel frames (covered by the Primary Structural Steel Frame Components EPD), a secondary framing system (covered by the Secondary Structural Steel Frame Components EPD) and metal roof and wall panel cladding (covered by this EPD). All three EPDs may be found on the UL Environmental website available here: https://spot.ul.com/.

Quality Control

Metal building primary structural steel frames, secondary framing and metal wall and roof cladding are all custom fabricated in a factory following strict quality assurance standards. Quality control is a major focus for all MBMA metal building manufacturers. MBMA worked with the International Accreditation Services (IAS), a subsidiary of the International Code Council (ICC), to develop the Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems (AC472). This comprehensive, third-party accreditation program is based on the special inspection requirements in the International Building Code (IBC) Chapter 17. This program provides code officials with a means to approve the inspection programs of manufacturers involved in the fabrication of a metal building system. It provides building owners and specifiers with an extra level of assurance the metal building system manufacturer's engineering, order, design and fabrication process all conform to high-standards. All MBMA member companies are committed to quality control and they adhere to the strict criteria of the AC472 program.

Product Average

Primary gate-to-gate LCI manufacturing and input/output transportation data were collected for roll formed metal wall and roof panels for the reference year 2019. These data were collected from 14 MBMA member facilities from three discrete regions (East, Midwest, and Western US), to represent the US industry average geographic mix. These 14 plants were deemed representative of the specific processes and the MBMA's membership. The MBMA represents 41 different production facilities; as a result, the plant sample represents about 25% of all establishments. The 14 plants were combined on a production weighted basis to provide a weighted average profile for US production of each product of interest.

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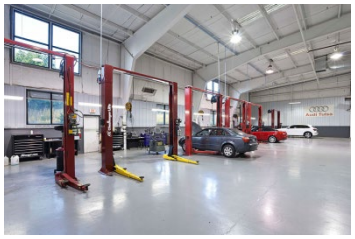
Range of Applications

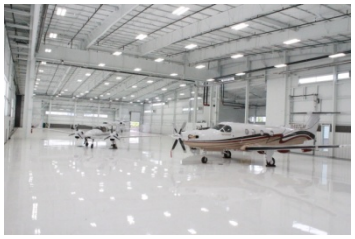
Metal buildings are used for low rise, non-residential construction end uses. This includes smaller building designs for health care, religious, office, education and retail facilities, up to larger building designs for warehouses, aircraft hangars, manufacturing and sports facilities. These and other building end uses are shown below.


Healthcare


Automotive


Recreation


Religious


Aviation


Retail


Office


Agriculture


Storage / Warehouse

Product Codes, Specifications and Standards

The products considered in this EPD meet or exceed one or more of the following codes, specifications, and standards:

Model Codes and Standards
International Building Code
State or Locally Adopted Code
ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures
UL - Building Material Directory
UL - Fire Resistance Directory
Common Industry Standards
MBMA Metal Building Systems Manual
MBMA Metal Roofing Systems Design Manual
International Accreditation Services (IAS)

Accreditation Criteria 472 (AC472) - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems
Specifications and Standards
American Institute for Steel Construction (AISC)
AISC 303 - Code of Standard Practice for Steel Buildings and Bridges
AISC Design Guide 3 - Serviceability for Steel Buildings
American Iron and Steel Institute (AISI)
AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members
American Society for Testing and Materials (ASTM)
ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zink-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A792/A792M - Standard Specifications for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM E72 - Standard Test Methods for Conducting Strength Tests of Panels for Building Construction
ASTM E1592 - Standard Test Methods for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
ASTM E1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems
ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
American Welding Society (AWS)
AWS D1.3 / D1.3M - Structural Welding Code - Sheet Steel

Material Composition

Table 1 lists the material inputs used in the production of metal wall and roof panels.

MBMA member production of wall panels (cladding) use five different semi-finished steel inputs with bare and pre-painted Galvalume® coated coil accounting for 77% of the input. Roof panel production is weighted more heavily towards Galvalume® coated coil use (95%). Steel substrate inputs used to produce wall panels were sourced from both BOF (59%) and EAF (41%) production plants and varied in thickness from 29 to 18 gauge. Steel substrate inputs used to produce roof panels were sourced from both BOF (58%) and EAF (42%) production plants and varied in thickness from 29 to 18 gauge. The most common thickness for both wall and roof panel production is 26-gauge steel.

Table 1: Material Composition

MBMA Product
Roll Formed Metal Wall and Roof Panels
Input Materials
Pre-painted (Galvalume®, Cold Rolled Coil, Hot-Dipped Galvanized) and unpainted (Galvalume®, HDG) metal coils of varying thicknesses

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Manufacturing

The gate-to-gate processes in the production of wall and roof panels include coil slitting (if applicable), de-coiling, punching/shearing, roll forming, packaging, space conditioning and lighting, warehouse and loading, and pollution abatement equipment (as shown in Figures 1 and 2). The major process energy input is electricity followed by natural gas used for space conditioning only. For every metric ton of wall and roof panel produced, a total of 1.06 and 1.03 metric tons of steel input is required, which yields a 6% and 3% scrap rate, respectively. The resulting fabrication steel scrap is 100% recyclable. The average inbound transportation of input materials and fuels to production facilities by truck, rail, and ocean freighter as well as the outbound transportation of manufacturing wastes and waste disposal processes are included.

Packaging

Packaging materials consist of one-way wood pallets, steel banding, nails, protective slip-sheets, strippable film, and waterproof packaging paper.

Transportation

Product transportation to the customer or construction site is outside the scope of this EPD (see Table 4).

Technical data

Name	Typical Value	Unit
Thickness range	0.36 – 1.27 [29 – 18]	mm [ga.]
Width range	254 – 914 [10 – 36]	mm [inch]
Length range	1 – 15 [3 to 49]	m [ft.]
Profile depth range	≤102 [≤ 4]	mm [inch]

Table 2: Technical Data

Relevant technical data for this EPD can be found in Table 2. A variety of profiles are available for roll formed metal wall and roof panel applications. For additional technical data, please refer above to the applicable *product codes, specifications, and standards.*

Life Cycle Assessment Background Information

Declared Unit

Name	Quantity	Required Unit
Declared Unit	100	m^2
Density (wall panels)	417	kg/m^2
Density (roof panels)	473	kg/m^2

Table 3: Declared Unit

The declared unit for metal cladding is coverage of 100 square meters (1076.4 square feet) with metal product. 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, as shown in Table 3.

System Boundary

The underlying LCA product system boundary was limited to a cradle-to-gate analysis (as shown in Figures 1 and 2) of the production stage – Modules A1-A3 as depicted in Table 4 below. As per the scope of the PCR, construction, use and end-of-life stages are excluded from the product system boundary. The optional Module D is also excluded. No reference service life is specified for wall and roof panels.

Foreground data: Primary gate-to-gate LCI manufacturing and input transportation data were collected for wall and roof panels production for the reference year 2019. These data were collected from 14 MBMA member facilities from three discrete regions (East, Midwest and Western US), to represent the US industry average technology mix. These 14 plants produce wall and roof panels and were deemed representative of the specific processes and the MBMA's membership. The MBMA represents 41 different production facilities; as a result, the plant sample represents about 25% of all establishments. The 14 plants were combined on a production weighted basis to provide a weighted average profile for US production.

Background data: Background data to support the LCA of wall and roof panels were obtained from 2020 North American LCI profiles of semi-finished steel products and various proprietary and commercial databases as documented in the project background report. All background data are less than 10 years old.

Cut-off criteria: The cut-off criteria as per Part A, 2.9 and ISO 21930, 7.1.8 were followed for this EPD. All flow data reported by the participating MBMA facilities were included for the relevant process and product models. None of the reported flow data were excluded based on the cut-off criteria as specified in the PCR. No known flows are deliberately excluded from this EPD. This EPD excludes the following processes: (1) Capital goods and infrastructure required to produce MBMA products, and (2) Personnel related activity (travel, furniture, office operations and supplies).

Figure 1: Cradle-to-Gate System Boundary- Wall Panels

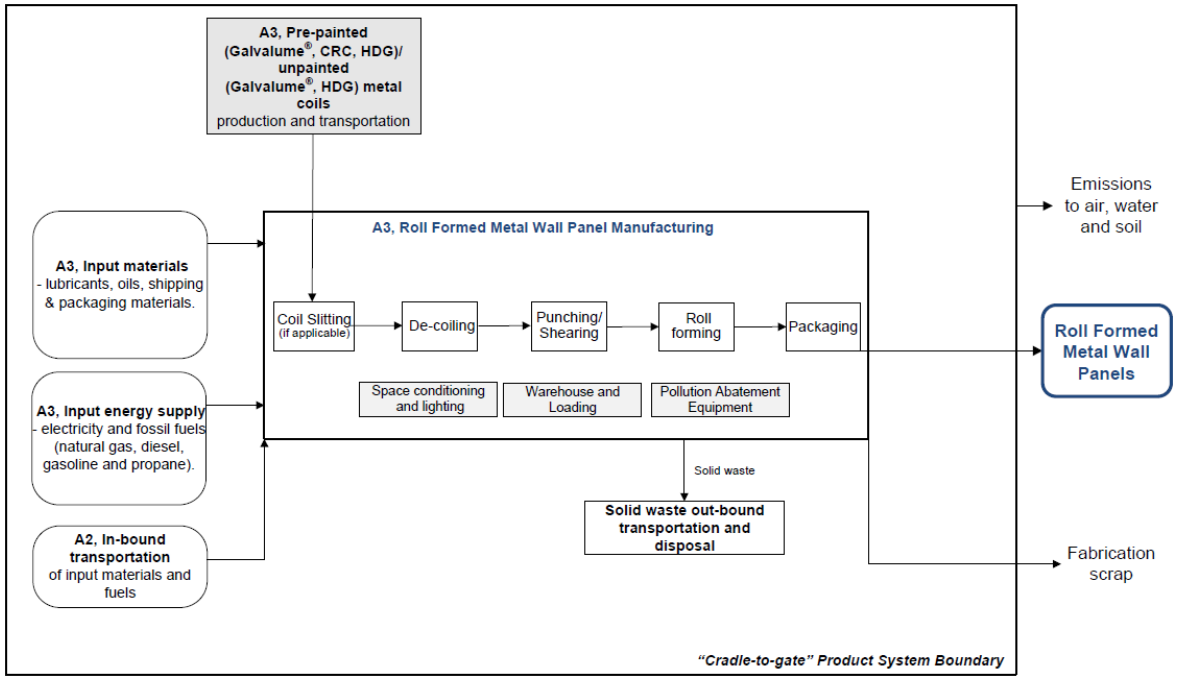

Figure 2: Cradle-to-Gate System Boundary- Roof Panel

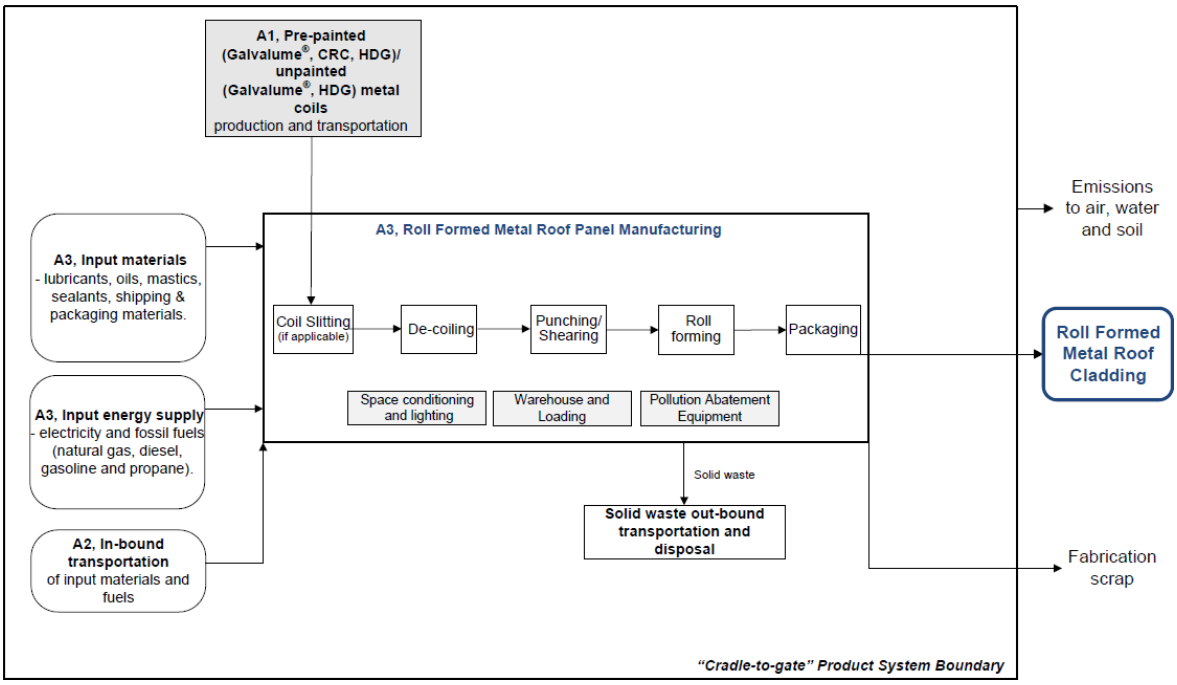

Table 4: Systems Boundaries

Production Stage			Construction Stage		Use Stage					End-of-Life Stage				Optional supplementary information beyond the system boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	De-construction	Transport to waste processing or disposal	Waste processing	Disposal of waste	Potential net benefits from reuse, recycling and/or energy recovery beyond the system boundary
X	X	X	MND		MND					MND				MND
X = Included in LCA; **MND** = Module is not declared														

Data Quality

Representativeness:

- Time related coverage of the MBMA *primary* data: 2019.
- *Secondary* data: American Iron and Steel Institute North American LCI data for semi-finished steel products (2020) – cradle to gate, excluding end-of-life recycling, ecoinvent v.3.6 datasets, December 2019, US LCI datasets, September 2015, SimaPro 9.1.1.1, 2021. No Secondary data sources are more than 10 years old.
- Geographical coverage: the geographical coverage is the US.
- Technological coverage: typical or average reflecting MBMA's membership.

The LCI data is deemed representative for the production year and the industry and adequately reflects North American conditions and prevailing technologies.

Consistency: To ensure data consistency, all primary data were collected with the same level of detail, while all background data were consistently applied.

Reproducibility: Through disclosure of input and output flow data, selected datasets, and methodological approaches as described in the project background report, a third-party should be able to demonstrate results similar to this EPD using similar and consistent data sources and modeling approaches.

Uncertainty: A sensitivity check was conducted to assess the reliability of the EPD results and conclusions by determining how they are affected by uncertainties in the data or assumptions on calculation of LCIA and energy indicator results. The sensitivity check includes the results of the sensitivity analysis and Monte Carlo uncertainty analysis as documented in the project report.

Allocation

Multiple product output: The MBMA plant participants produce an array of products used in the structure and envelope of metal buildings and, as such, allocation across shared processes was applied. "Mass" was deemed as the most appropriate physical parameter for allocation of the total inputs/outputs of the plant production system between primary frames, secondary frames, and roof and wall panel manufacturing lines. Data collection participants provided input and output data specific to each of four selected manufacturing processes. Then inputs/outputs were allocated over the total outputs of panel or framing on a mass basis.

Semi-finished steel products are integral commodities used in the production of upstream and the primary MBMA metal building products. As a result, 2020 peer-reviewed North American LCI data, according to the ISO 14040 series for these metal products, as generated by the American Iron and Steel Institute were applied in this LCA study. Semi-finished steel product LCIA results and LCI data based on physical allocation approach are used. The physical allocation approach follows the partitioning methodology developed by worldsteel.

Life Cycle Assessment Results

Table 5 and Table 6 presents the life cycle impact assessment (LCIA), resource use and waste output flow results for the production stage (A1 to A3) per metric ton of wall and roof panels, respectively. US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), version 2.1, 2012 impact categories are used as they provide a North American context for the mandatory category indicators to be included in this EPD. *It should be noted that LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.*

In addition to the impact results, this LCA supports several metrics related to resource consumption and waste generation. These data are informational as they do not provide a measure of impact on the environment.

Table 5: EPD Results Per 100 m^2 of Wall Panels

Impact category and inventory indicators	Unit	A1	A2	A3	Total
Global warming potential, GWP-100[1] (IPCC 2013)	kg CO_2 eq	1,173.6	29.8	29.6	**1,233**
Ozone depletion potential, ODP[2]	kg CFC-11 eq	2.1E-05	5.6E-07	3.5E-06	**2.5E-05**
Smog formation potential, SFP[2]	kg O_3 eq	49.3	10.2	1.61	**61.1**
Acidification potential, AP[2]	kg SO_2 eq	9.24	0.39	0.09	**9.7**
Eutrophication potential, EP[2]	kg N eq	1.271	0.024	0.141	**1.44**
Abiotic depletion potential, elements ADPe[3]	kg Sb eq	4.5E-01	1.4E-07	1.0E-04	**4.5E-01**
Abiotic depletion potential, fossil ADPf[3]	MJ LHV	12,704	411	371	**13,486**
Renewable primary resources used as an energy carrier (fuel), RPR_E	MJ LHV	990.9	0.0	363.4	**1,354**
Renewable primary resources with energy content used as material, RPR_M[4]	MJ LHV	0	0	0	**0**
Non-renewable primary resources used as an energy carrier (fuel), $NRPR_E$	MJ LHV	13,819	415	465	**14,699**
Non-renewable primary resources with energy content used as material, $NRPR_M$[4]	MJ LHV	0	0	0	**0**
Secondary materials, SM[4]	kg	159	0	0	**159**
Renewable secondary fuels, RSF[4]	MJ LHV	0	0	0	**0**
Non-renewable secondary fuels, NRSF[4]	MJ LHV	0	0	0	**0**
Recovered energy, RE[4]	MJ LHV	0	0	0	**0**
Consumption of freshwater, FW[4]	m^3	2.1	0.0	0.0	**2.1**
Hazardous waste disposed, HWD[4]	kg	1	0	0	**0.646**
Non-hazardous waste disposed, NHWD[4]	kg	0.00	0.00	0.45	**0.5**
High-level radioactive waste, conditioned, to final repository, HLRW[4]	m^3	6.3E-08	2.7E-11	5.8E-08	**1.2E-07**

Impact category and inventory indicators	Unit	A1	A2	A3	Total
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW[4)]	m^3	1.1E-04	1.9E-07	1.0E-06	**1.2E-04**
Components for re-use, CRU[4)]	kg	0	0	0	**0**
Materials for recycling, MR[4)]	kg	16.1	0.0	25.6	**41.7**
Materials for energy recovery, MER[4)]	kg	0	0	0	**0**
Recovered energy exported from the product system, EE[4)]	MJ LHV	0	0	0	**0**

Table 6: EPD Results Per 100 m^2 of Roof Panels

Impact category and inventory indicators	Unit	A1	A2	A3	Total
Global warming potential, GWP-100[1)] (IPCC 2013)	kg CO_2 eq	1,260.3	31.4	34.6	**1,326**
Ozone depletion potential, ODP[2)]	kg CFC-11 eq	2.4E-05	4.3E-07	5.1E-06	**2.9E-05**
Smog formation potential, SFP[2)]	kg O_3 eq	54.0	10.5	1.85	**66.4**
Acidification potential, AP[2)]	kg SO_2 eq	4.57	0.41	0.11	**5.1**
Eutrophication potential, EP[2)]	kg N eq	1.500	0.025	0.154	**1.68**
Abiotic depletion potential, elements ADPe[3)]	kg Sb eq	6.0E-01	1.1E-07	9.9E-05	**6.0E-01**
Abiotic depletion potential, fossil ADPf[3)]	MJ LHV	13,615	422	544	**14,580**
Renewable primary resources used as an energy carrier (fuel), RPR_E	MJ LHV	1,111.5	0.0	367.4	**1,479**
Renewable primary resources with energy content used as material, RPR_M[4)]	MJ LHV	0	0	0	**0**
Non-renewable primary resources used as an energy carrier (fuel), $NRPR_E$	MJ LHV	14,744	426	648	**15,819**
Non-renewable primary resources with energy content used as material, $NRPR_M$[4)]	MJ LHV	0	0	0	**0**
Secondary materials, SM[4)]	kg	172	0	0	**172**
Renewable secondary fuels, RSF[4)]	MJ LHV	0	0	0	**0**
Non-renewable secondary fuels, NRSF[4)]	MJ LHV	0	0	0	**0**
Recovered energy, RE[4)]	MJ LHV	0	0	0	**0**
Consumption of freshwater, FW[4)]	m^3	2.3	0.0	0.0	**2.3**
Hazardous waste disposed, HWD[4)]	kg	0	0	0	**0.346**
Non-hazardous waste disposed, NHWD[4)]	kg	0.00	0.00	0.42	**0.4**

Impact category and inventory indicators	Unit	A1	A2	A3	Total
High-level radioactive waste, conditioned, to final repository, HLRW[4)]	m^3	6.4E-08	2.1E-11	6.3E-08	**1.3E-07**
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW[4)]	m^3	1.2E-04	1.5E-07	1.5E-06	**1.2E-04**
Components for re-use, CRU[4)]	kg	0	0	0	**0**
Materials for recycling, MR[4)]	kg	12.8	0.0	16.0	**28.8**
Materials for energy recovery, MER[4)]	kg	0	0	0	**0**
Recovered energy exported from the product system, EE[4)]	MJ LHV	0	0	0	**0**

Tables 5 and 6 Notes:

[1)] Calculated as per U.S EPA TRACI v2.1, with IPCC 2013 (AR 5), SimaPro v 9.1.1.1.
GWP 100, excludes biogenic CO_2 removals and emissions associated with biobased products; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5), TRACI v2.1 with AR5, v1.05.

[2)] Calculated as per U.S EPA TRACI v2.1, SimaPro v 9.1.1.1.

[3)] ADPe and ADPf are calculated as per CML-IA Baseline v3.05, SimaPro v 9.1.1.1.

[4)] Calculated as per ACLCA ISO 21930 Guidance.

Interpretation

Figure 3 and Figure 4 below provide a percent contribution summary by information module (A1 – extraction and upstream production, A2 – transport to factory and A3 – manufacturing) for wall and roof panels, respectively. A contribution analysis revealed that the A3 Manufacturing generally accounted for 5% to 6% of the total primary energy use and 2% to 3% of the GWP-100 of the total cradle-to-gate product system. Upstream semi-finished steel production (A1) is the single and most significant input driving the potential environmental burden of both products. A3 Manufacturing is the second largest contributor to the Production stage EPD results, followed by the A2 Transportation. About 92% of the product system energy use (A1 to A3) is derived from fossil fuels, of which semi-finished steel input contribution is 94%. Similarly, semi-finished steel accounts for 95% of the cradle-to-gate global warming potential (GWP).

A Monte Carlo uncertainty analysis was also conducted to assess the combined uncertainty effect of the data variability on the LCIA and energy indicator results. As a statistical method, Monte Carlo analysis establishes the uncertainty range, which expresses the variance between the upper and lower confidence limit [97.5%, 2.5%], in the calculated EPD results. Based on the industry sample data, [minimum; maximum] range data was calculated per each input/output flow for the two selected MBMA products. These data are used in the Monte Carlo uncertainty analysis. This uncertainty analysis assesses the combined uncertainty effect of the inventory data (both foreground and background). It should be noted that U.S. EPA TRACI v2.1 methodology has not specified any uncertainty information of the characterization factors per impact category. With a confidence level of 95%, the confidence interval of cradle-to-gate GWP-100 of the MBMA products (wall panels and roof panels), are [+45%, -46%], and [+48%, -45%], respectively. Based on 1,000 runs, such information provides a quantitative indication of the range of results that are likely for the manufacturer's specific products covered by the industry average EPD for these two selected MBMA products.

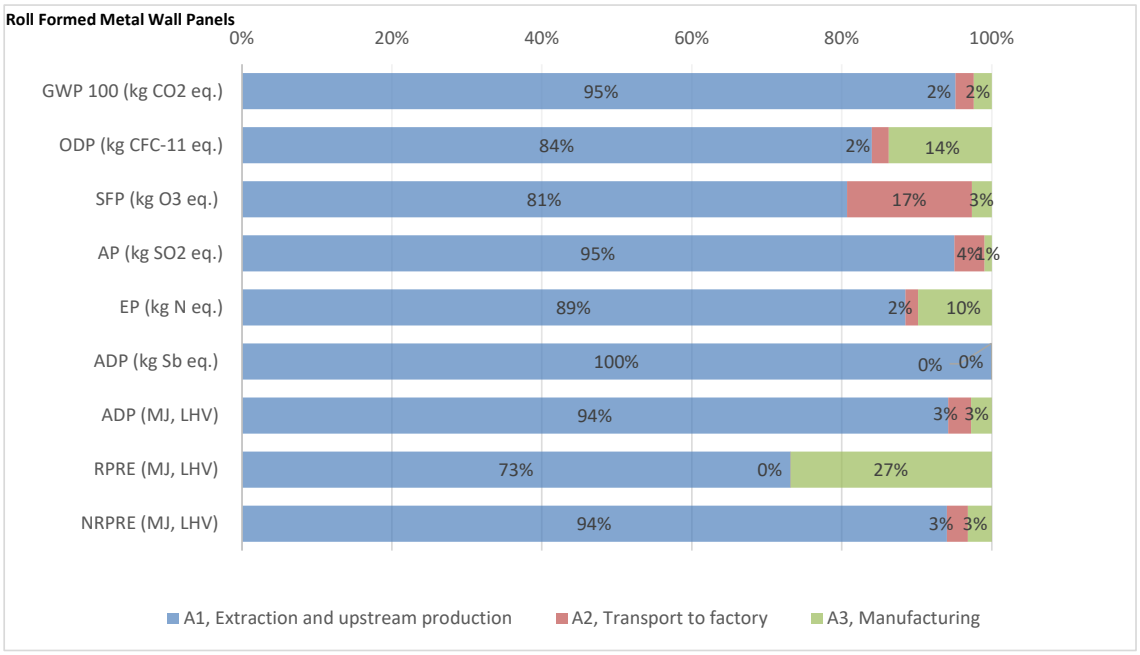

Figure 3: Percent Contribution by Production Stage Information Modules (A1, A2 and A3) for Wall Panels

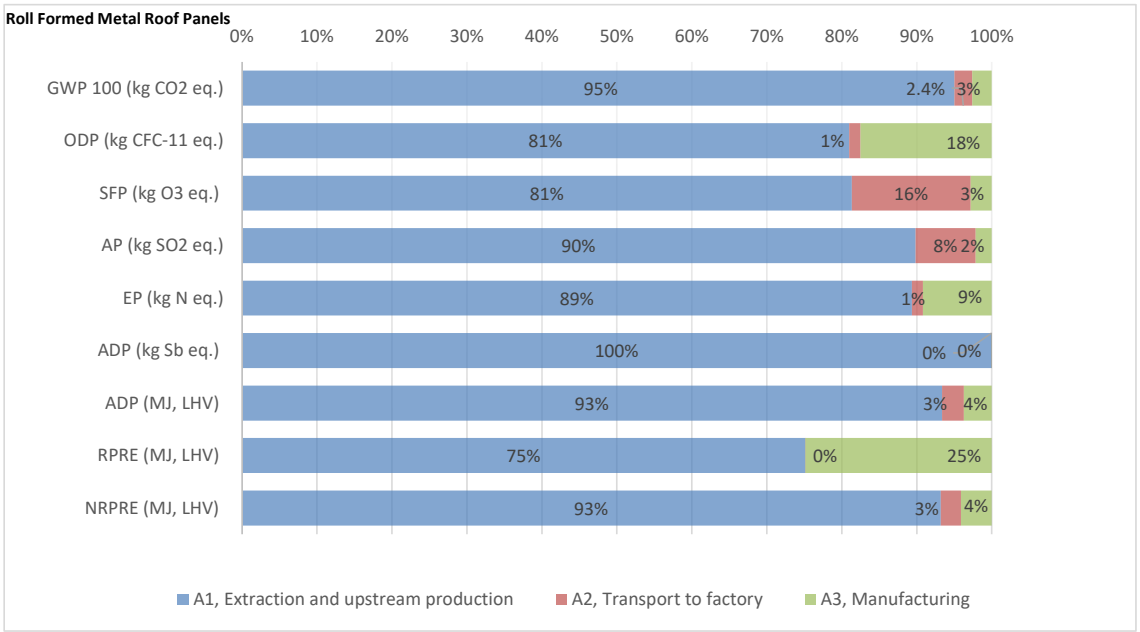

Figure 4: Percent Contribution by Production Stage Information Modules (A1, A2 and A3) for Roof Panels

Additional Environmental Information

All 14 MBMA member facilities participating in the study are ISO 9001 and ISO 14001 certified or follow other company specific environmental management systems. Pollution abatement equipment typically used in the MBMA manufacturing facilities consist of fabric filter– low temperature (baghouse), dry filters and cartridge filters. No substances of high concern were identified in the framework of this EPD.

Disclaimer

This Environmental Product Declaration (EPD) conforms to ISO 14025, ISO 14040, ISO 14044, and ISO 21930.

Scope of Results Reported: The PCR requires the reporting of a limited set of LCIA indicators and resource use metrics; therefore, there may be relevant environmental impacts beyond those disclosed by this EPD. The EPD does not indicate that any environmental or social performance benchmarks are met nor thresholds exceeded.

Accuracy of Results: This EPD has been developed in accordance with the PCR applicable for the identified product following the principles, requirements and guidelines of the ISO 14025, ISO 14040, ISO 14044, and ISO 21930 standards as well as ULE's general program instructions. The results in this EPD are estimations of potential impacts. The accuracy of results in different EPDs may vary as a result of value choices, background data assumptions and quality of data collected.

References

ACLCA. (2019). *ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017.*
Athena Sustainable Materials Institute. (March 2021). *Life Cycle Assessment of MBMA Primary and Secondary Structural Steel Components and Roll Formed Metal Wall and Roof Panel Products, Final Report. Prepared by: Lindita Bushi, PhD, Mr. Jamie Meil, and Mr. Grant Finlayson, Prepared for: The Metal Buildings Manufacturers Association (MBMA).*
Bare, J. (2012). *Tool for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI) – Software Name and Version Number: TRACI version 2.1 - User's Manual. Washington, D.C.: U.S. EPA.*
IPCC. (2013). *Climate Change 2013: The Physical Science Basis. Geneva, Schweiz.*
ISO. (2006). *ISO 14025: Environmental labeling and declarations - Type III environmental declarations - Principles and procedures*
ISO. (2006/Amd 1:2020). *ISO 14040: Environmental management – Life cycle assessment – Principles and framework. Geneva:* International Organization for Standardization.
ISO. (2006/Amd1:2017/Amd2:2020). ISO 14044: *Environmental management – Life cycle assessment – Requirements and guidelines. Geneva: International Organization for Standardization.*
ISO. (2017). *ISO 21930 Sustainability in building construction – Environmental declaration of building products.*
PRé (2021). *SimaPro LCA Software v9.1.1.1, 2021.*
UL Environment. (2018). *Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version 3.2.*
UL Environment. (2020). *Part B: PCR for Insulated Metal Panels, Metal Composite Panels, and Metal Cladding: Roof and Wall Panels, v2.0.*
UL Environment. (2020). General Program Instructions, version 2.5, March 2020.
worldsteel and EUROFER. (2014). A methodology to determine the LCI of steel industry co-products.