ENVIRONMENTAL PRODUCT DECLARATION

Primary Structural Steel Frame Components

Metal Building Manufacturers Association

Industry-Wide EPD

Illustration of primary structural steel framing (columns/beams) supporting secondary structural steel framing members (girts/purlins) with metal roof panel (standing seam or through fastened) and metal wall panel (through fastened) cladding.

Note: Primary structural steel framing featured in illustration above.

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 Primary Structural Steel Frame components used in metal building systems. These components serve as the load carrying columns and beams of a metal building system.

Separate EPDs are available that address the secondary structural steel framing, and the exterior metal roof and wall panel cladding 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 https://www.mbma.com/System_Members.html

ENVIRONMENTAL PRODUCT DECLARATION

Primary Structural Steel Frame Components
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	4789771662.101.1
Declared Product & Functional Unit	Primary Structural Steel Frame Components-1 metric ton
Product Definition	A built-up structural steel component (column/beam) used in a metal building system (*CSI code: 051200 Structural Steel Framing).*
Reference PCR & Version Number	Part A: Product Category Rules for Building Related Products and Services (UL Environment, 2018, v3.2) Part B: Designated Steel Construction Product EPD Requirements (UL Environment, 2020, 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

ENVIRONMENTAL PRODUCT DECLARATION

METAL BUILDING MANUFACTURERS ASSOCIATION®

CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION

Primary Structural Steel Frame Components
Industry-Wide EPD

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 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:	Thomas Gloria 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.

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

Primary Structural Steel Frame Components
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

Primary structural steel frames used in a metal building system are built-up using three welded steel plates to form an "I" section. The three plates include the uniform width of the two flanges (commonly derived from bar stock) and one tapered web section (commonly derived from hot rolled steel plate). The flanges are welded to the tapered web to form the tapered web I-section for the beam and columns, typically by an automatic welder. End plates with bolt holes are welded to the ends of the individual frame sections by a certified welder, along with other weldaments and accessories. The primary frames are often coated with a rust-inhibiting primer or painted to meet project specifications. Once the columns and roof beams have been fabricated, completed with holes in webs and flanges for attachment of secondary structural members and bracing, the products are delivered to the jobsite.

Flexible Design

Metal building manufacturers custom design the primary structural steel frame components in accordance with the order documents. Order documents are based on the specified building code, loading conditions, and serviceability requirements. The primary frame will consist of two exterior columns and a rafter spanning the width of the building. Primary frames can also feature straight columns when the end use warrants such a design (for example in office or retail spaces with finished drywall interiors). Primary frame rafters can clear span over 61 m (200 ft), with a height that can exceed 18.3 m (60 ft) with frames commonly spaced from 6.1 m (20 ft) to 12.2 m (40 ft) apart. Interior columns can be used to support rafters for buildings wider than 200 feet, or to create a more economical design where the interior building layout allows.

Certified welder adding metal accessories to primary structural steel frame.

ENVIRONMENTAL PRODUCT DECLARATION

Primary Structural Steel Frame Components
Industry-Wide EPD

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

Less Material

Most often, the weight of steel used in a metal building framing system is significantly less than hot-rolled steel frames due to the structural optimization of the tapered web design. By tapering the 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. This weight savings inherently reduces the environmental impact of metal buildings when compared to traditional framing systems. Life cycle assessment software, such as the Athena Impact Estimator, can be used to confirm the environmental and material savings.

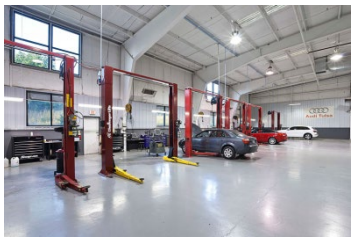
Metal Building System - EPD Family

A complete metal building system is made up of primary structural steel frames (covered by this EPD), a secondary framing system (covered by Secondary Structural Steel Frame Component EPD), and metal roof and wall panel cladding (covered by the Rolled Formed Roof and Wall Panels EPD). All three EPDs may be found on the UL Environmental website available here: http://productguide.ulenvironment.com.

Range of Applications

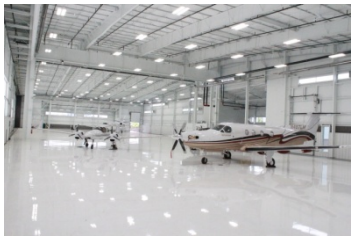
Metal buildings are used for low rise, non-residential construction end uses. This includes smaller building designs for health care, religious, office, education and retail facilities, up to larger building designs for warehouses, aircraft hangars, manufacturing and sports facilities. These and other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


Healthcare


Automotive


Recreation


Religious


Aviation


Retail


Office


Agriculture


Storage / Warehouse

ENVIRONMENTAL PRODUCT DECLARATION

METAL BUILDING MANUFACTURERS ASSOCIATION®

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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 primary structural steel frame components 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 primary structural steel frame components.

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
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 360 - Specification for Structural Steel Buildings
AISC 341 - Seismic Provisions for Structural Steel Buildings (when appropriate)
AISC 303 - Code of Standard Practice for Steel Buildings and Bridges
AISC Design Guide 3 - Serviceability for Steel Buildings

American Welding Society (AWS)
AWS D1.1 / D1.1M - Structural Welding Code - Steel
AWS D1.3 / D1.3M - Structural Welding Code - Sheet Steel
ASTM International (ASTM)
ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A36/A36M – Standard Specification for Carbon Structural Steel
ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A500/A500M – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A992/A992M - Standard Specification for Structural Steel Shapes
ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
ASTM A1018/A1018M - Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawings, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F3125 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
Research Council on Structural Connections (RCSC)
Specification for Structural Joints Using High-Strength Bolts
The Society for Protective Coatings (SPSC)
SSPC Paint-15 – Steel Joist Shop Primer / Metal Building Primer

Material Composition

Table 1 lists the material inputs used in the production of primary structural steel frame components.

Table 1: Material Composition

MBMA Product
Primary Structural Steel Frame Components
Input Materials
Hot rolled plate, hot rolled bar and sections of varying thicknesses

Hot rolled plate or bar is commonly used for flanges, webs, end plates and base plates. The typical product thickness used in a metal building manufacturing plate is between 3 mm (0.125 in) to 50 mm (2.0 in). Steel sections, such as pipe, angles, structural channels, and wide flange beams, are pre-formed or shapped prior to arriving at the metal building manufacturing plant in order to be cut to size. Interior columns may be either pipe columns or made out of wide flange I-beams. Bracing may utilize angle irons connected to the structure and structural channels may be used for spandrels.

For the production of primary structural frame components, the primary semi-finished steel inputs are hot-rolled plate (38%), bar (44%), and sections (19%). The semi-finished steel input is sourced from both the Electric Arc Furnace (EAF) and Basic Oxygen Furnace (BOF) routes, 88% and 12%, respectively and varies in thickness from 1.8 mm (0.071 in) to 38.1 mm (1.5 in).

Manufacturing

The gate-to-gate processes in the production of primary steel frame components include plate/bar/sections shearing, punching, splicing, tack welding, flange welding, finish welding and grinding, painting, touch up painting (if applicable), packaging, space conditioning and lighting, warehouse and loading, and pollution abatement equipment (as shown in Figure 1). The major process energy input is electricity followed by natural gas used for space conditioning and in the paint process. For every metric ton of primary frame component produced, a total of 1.066 metric tons of steel is required; this yields a 6.6% scrap rate for the processes leading to the production of primary structural frame components. 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 and steel banding.

Transportation

Product transportation to the customer or construction site is outside the scope of this EPD (see Table 3).

Life Cycle Assessment Background Information

Declared Unit

Name	Quantity	Required Unit
Declared Unit	1	metric ton
Density	7,833	kg/m^3

Table 2: Declared Unit

The declared unit is one metric ton (1,000 kg) of the primary structural steel frame components, as shown in Table 2.

System Boundary

The underlying LCA product system boundary was limited to a cradle-to-gate analysis (as shown in Figure 1) or the production stage – Modules A1-A3 as depicted in Table 3 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 primary structural steel frames.

Estimates and Assumptions

Primary gate-to-gate LCI manufacturing and input transportation data were collected for primary structural steel frames production for the reference year 2019. Background data to support the LCA of primary frames were obtained from 2020 North American LCI profiles of semi-finished steel products (hot rolled plate, hot rolled bar and sections) and various proprietary and commercial databases as documented in the project background report. All background data are less than 10 years old. When selected background datasets, a conservative approach was applied in that datasets associated with higher impacts are used when there are multiple possible options.

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

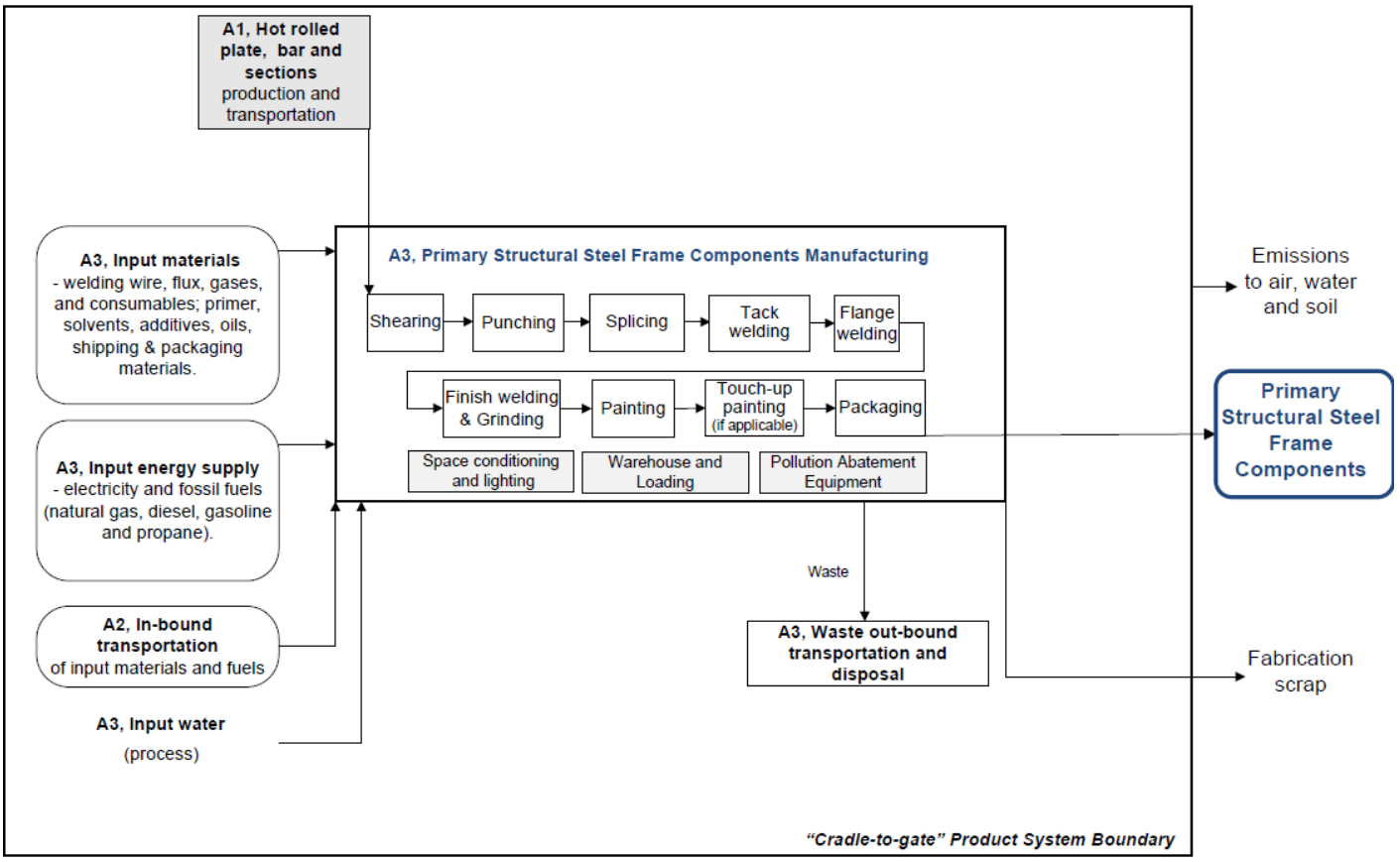

Table 3: Systems Boundaries

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 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. As per the PCR and where necessary, "Mass" was used as the primary basis 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 4 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 primary structural frame. 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 4: EPD Results Per Metric Ton of Primary Structural Steel Frame Components

Impact category and inventory indicators	Unit	A1	A2	A3	Total
Global warming potential, GWP-100[1] (IPCC 2013)	kg CO_2 eq	1,231.2	99.6	137.2	**1,468**
Ozone depletion potential, ODP[2]	kg CFC-11 eq	3.9E-12	6.8E-07	1.7E-05	**1.8E-05**
Smog formation potential, SFP[2]	kg O_3 eq	42.4	33.3	9.3	**84.9**
Acidification potential, AP[2]	kg SO_2 eq	2.8	1.3	0.4	**4.5**
Eutrophication potential, EP[2]	kg N eq	0.13	0.08	0.61	**0.82**
Abiotic depletion potential, elements ADPe[3]	kg Sb eq	7.9E-03	1.9E-07	9.6E-04	**8.9E-03**
Abiotic depletion potential, fossil ADPf[3]	MJ LHV	13,956	1,355	1,773	**17,084**
Renewable primary resources used as an energy carrier (fuel), RPR_E	MJ LHV	893	0	690	**1,583**
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	15,662	1,370	2,150	**19,182**

ENVIRONMENTAL PRODUCT DECLARATION

Primary Structural Steel Frame Components
Industry-Wide EPD

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

Impact category and inventory indicators	Unit	A1	A2	A3	Total
Non-renewable primary resources with energy content used as material, $NRPR_M$ [4)]	MJ LHV	0	0	0	**0**
Secondary materials, SM [4)]	kg	974	0	0	**974**
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	6.7	0	0.02	**6.7**
Hazardous waste disposed, HWD [4)]	kg	0.001	0	0	**0.136**
Non-hazardous waste disposed, NHWD [4)]	kg	8.7E-04	0.0	2.7	**2.7**
High-level radioactive waste, conditioned, to final repository, HLRW [4)]	m^3	1.5E-07	3.1E-11	2.3E-07	**3.8E-07**
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW [4)]	m^3	2.7E-04	2.3E-07	4.4E-06	**2.7E-04**
Components for re-use, CRU [4)]	kg	0	0	0	**0**
Materials for recycling, MR [4)]	kg	0.0	0.0	66.4	**66.4**
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 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.

It is also noted that comparisons cannot be made between product-specific or industry average EPDs at the design stage of a project, before a building has been specified. Comparisons may be made between product-specific or industry average EPDs at the time of product purchase when product performance and specifications have been established and serve as a functional unit for comparison. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted.
Any comparison of EPDs shall be subject to the requirements of ISO 21930. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparison can be inaccurate and could lead to erroneous selection of materials or products which are higher-impact, at least in some impact categories.

Interpretation

Figure 2 below provides a percent contribution summary by information module (A1 – extraction and upstream production, A2 – transport to factory and A3 – manufacturing) for the LCIA indicators and energy resource use metrics. A contribution analysis revealed that the A3 Manufacturing accounted for 14% of the total primary energy use and 9% of the GWP-100 of the total cradle-to-gate product system. Potential environmental impacts for primary steel frame components are driven by the A1 semi-finished steel inputs. 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 82%. Similarly, semi-finished steel input accounts for 84% of the cradle-to-gate global warming potential (GWP).

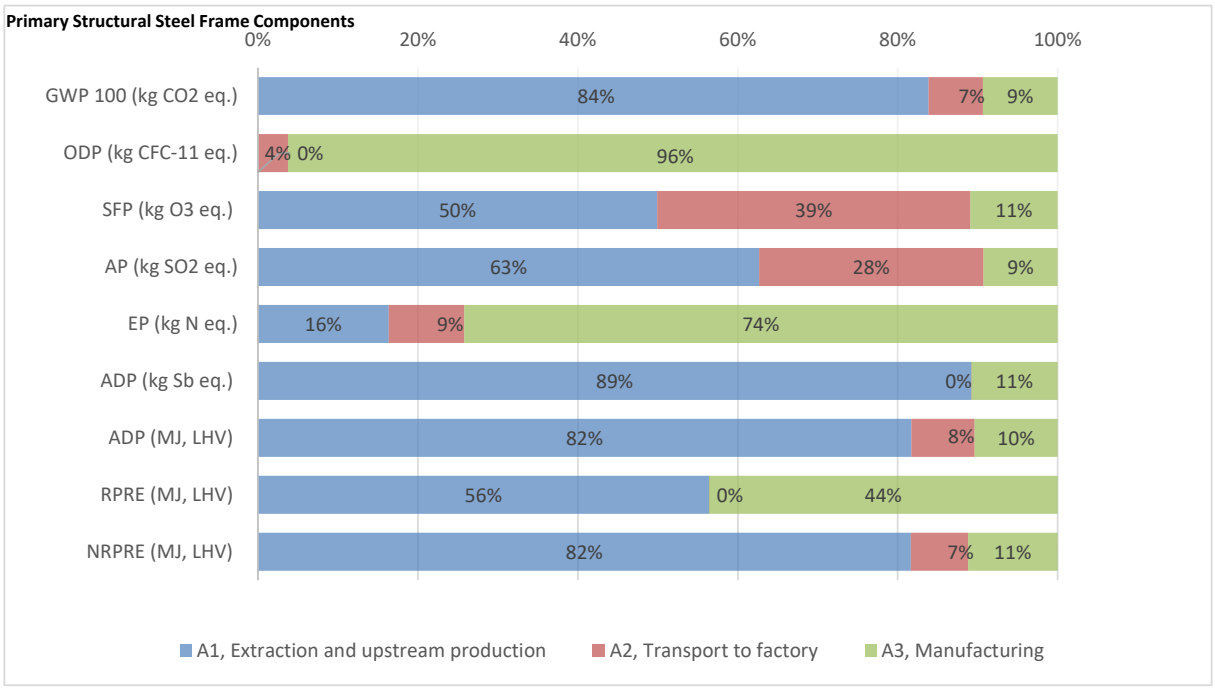

Figure 2: Percent Contribution by Production Stage Information Modules (A1, A2 and A3)

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 primary structural steel frame components. 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 primary structural steel frame components is [+31%, -39%]. 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 primary structural steel frames.

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.

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