ENVIRONMENTAL PRODUCT DECLARATION

H BEAM

STRUCTURAL STEEL

TOKYO STEEL MANUFACTURING CO.,LTD.

TOKYO STEEL MANUFACTURING CO., LTD. started out as a small steel maker in Tokyo almost 80 years ago. It has since grown into Japan's leading electric-arc-furnace steelmaker with an annual production of several million tons.

Tokyo Steel prides itself as a recycler of steel scrap - its primary raw material - letting it protect the environment and thus contribute to society. Recycling of steel products with the electric arc furnace process is truly the most effective in terms of achieving a recycling-based society and low-carbon society at the same time. To contribute to Japan's target of reducing greenhouse gas (GHG) emissions by 80% by 2050 while making advanced use of steel scrap that, in aggregate, amounts to several decades' worth of domestic steel demand, Tokyo Steel will work, with strong determination, to provide even more diverse customers with a wide range of products.

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

Environmental Product Declaration

TOKYO STEEL MANUFACTURING CO.,LTD.

H BEAM
Structural Steel

According to ISO 14025
ISO21930:2017

EPD Program and Program Operator Name, Address, Logo, and Website	UL Solutions 333 Pfingsten Rd, Northbrook IL, 60062 www.ul.com www.spot.ul.com
General Program Instructions and Version	Program Operator Rules v.2.7 2022
Manufacturer Name and Address	Tokyo Steel Manufacturing Co. Ltd. Kasumigaseki Tokyu Bldg. 15F 3-7-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-0013 Japan
Declaration Number	4791119516.101.1
Declared Product & Functional Unit or Declared Unit	H BEAM Structural Steel, 1 metric ton
Reference PCR and Version Number	Product Category Rules for Building-Related Products and Services, Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL Environment, Standard 10010, Version 4.0 Part B: Designated Steel Construction Product EPD Requirements Second Edition, Dated August 26, 2020)
Description of Product Application/Use	Structural steel “H BEAM” is mostly used in buildings and civil works, mainly in structural steel constructions. In addition to the construction sector there are numerous applications in very diverse sectors.
Product RSL Description (if Appl.)	The Reference service life is not specified
Markets of Applicability	Japan
Date of Issue	April 1, 2024
Period of Validity	5 Years
EPD Type	Manufacturer Specific
EPD Scope	Cradle to gate
Year(s) of Reported Primary Data	April 2022 and March 2023
LCA Software & Version Number	Microsoft Excel calculation tool with IDEA database
LCI Database(s) & Version Number	IDEAv3.1 database (2021)
LCIA Methodology & Version Number	LIME2

The PCR review was conducted by	UL Solutions PCR Review Panel epd@ul.com
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Solutions
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Jim Mellentine, Thrive ESG

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.

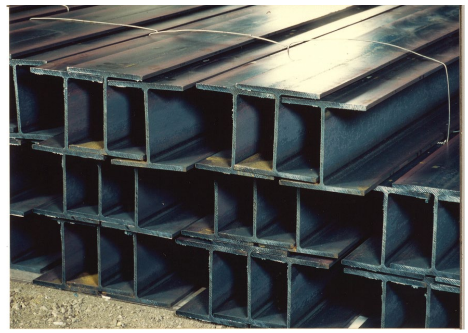
Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: comparison of the environmental performance of construction works and construction products using EPD information shall be based on the product’s use and impacts at the construction works level. In general, EPDs may not be used for comparability purposes when not considered in a construction works context.

Product information

Product description

The product declared is structural steel "H beam", which is classified as "Stock Materials" in the Section 2, Classification of Material of the AISC 303 - 10 Code of Standard Practice for Steel Buildings and Bridges. The production process used is the Electric Arc Furnace. This route, used by TOKYO STEEL for the production of structural steel, is based on the direct melting of scrap with an Electric Arc Furnace, which is subsequently processed in rolling mills in order to obtain the finished products. The steel section is hot rolled into structural steel in H shape. Technical property (yield strength level) is 235 to 365N/mm2. No metallic or organic coating.



The product is provided for Japan market and complies with JIS G 3136, JIS G 3106, JIS G 3101 (Regional designation code: JIS).

Application

Structural steel "H beam" is mostly used in buildings and civil works, mainly in structural steel constructions. In addition to the construction sector there are numerous applications in very diverse sectors.

No specific product is needed to serve intended function in the construction work. Anticipated replacement cycle of product in the construction work will be about 20 years.

Technical data

Name	Value	Unit
Density	7,874	kg/m^3
Modulus of elasticity	2.1×10^5	N/mm^2
Coefficient of thermal expansion	11.7	$10^{-6}K^{-1}$
Thermal conductivity	48	W/(mK)
Melting point	1,522	°C
Electrical conductivity at 20C	1.0×10^7	$\Omega^{-1}m^{-1}$
Minimum yield strength	235	N/mm^2
Minimum tensile strength	400	N/mm^2
Minimum elongation	17	%
Tensile strength	400 - 490	N/mm^2
Compressive strength	235	N/mm^2
Grade of material according to the delivery standards	SS400	-

Delivery status

The delivery conditions and dimension may vary according to the intended application.

Base materials / Ancillary materials

Structural steel "H beam" is a low-alloy steel product. The typical content of carbon is lower than 0.24%. The share of other elements besides iron is typically around 1%. Steel scrap is a secondary raw material, defined in different qualities, depending on the composition (Fe content) and certain characteristics (plate, section steel, galvanized sheets, etc.).

The principal material is Steel and alloying elements are added on the form of ferroalloys and metals.

Any hazardous substances defined in Basel Convention and/or regulated by Japanese laws are not included in raw materials.

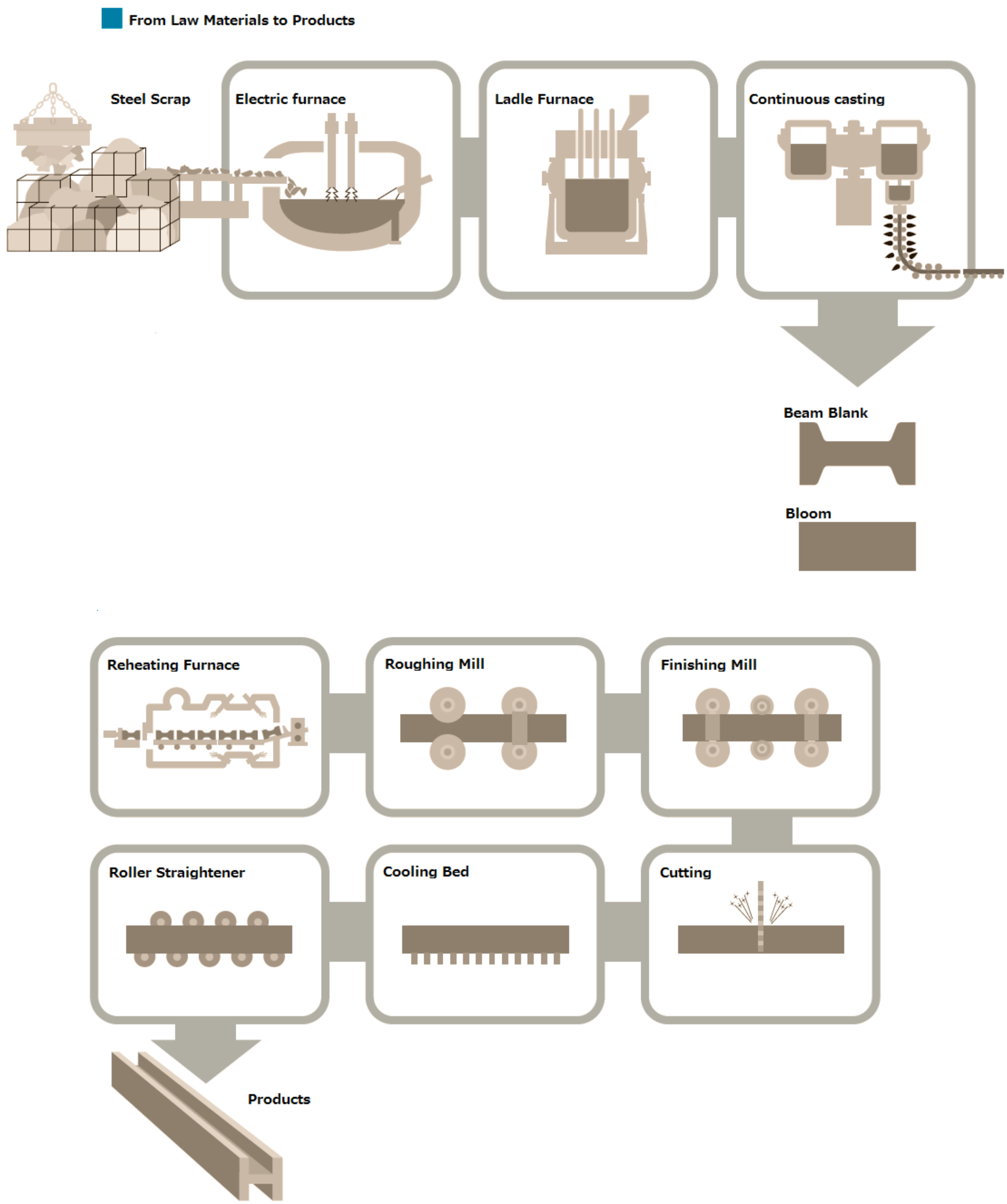
Manufacture

The steel scrap is melted in an electric arc furnace to obtain liquid steel, which is then refined in a ladle furnace with addition of ferroalloys and metals to obtain the required steel characteristics. The steel is then casted at a continuous caster to obtain semi-finished products as beam blanks. The semis are then hot-rolled through rolling mills to achieve the desired size, resulting in the finished product, which is a H-beam.

TOKYO STEEL MFG produces the structural steel "H beam" at three factories. However, this LCA study is only for H beam product which is produced at Utsunomiya Plant.

Factory	Address
TOKYO STEEL MFG Utsunomiya Plant	11-1, Kiyohara-kogyo-danchi, Utsunomiya-shi, Tochigi 321-3231, Japan

Manufacturing process flow



Quality Management System

TOKYO STEEL MFG Utsunomiya Plant is certified according to ISO9001 Quality Management System.

More information can be found at

https://www.tokyosteel.co.jp/company/about/

Environment and Health during manufacturing

TOKYO STEEL MFG Utsunomiya Plant is certified according to ISO14001 Environment Management System.

More information can be found at

https://www.tokyosteel.co.jp/company/about/

Product processing/Installation

Processing and proper use of steel products depends on the application and should be made in accordance with generally accepted practices, standards and manufacturers recommendations. National technical regulations apply to the design and construction of steel structures. They deal with requirements for performance, sustainability, durability and fire resistance of steel and steel structures.

When handling and using the products, no additional means to protect health are required beyond the usual occupational safety measures.

No environmental impacts occur when working with or using these products under normal conditions of use. No special measures are necessary for the protection of the environment.

Residual materials are separated for in-house recycling. The steel scrap can be recycled almost completely.

Packaging

Structural steel “H beam” is delivered unpacked.

Condition of use

During use no changes in material composition shall occur. Maintenance requirement will depend on specific design and application.

Environment and health during use

Steel products, under normal conditions of use, do not cause adverse health effects.

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According to ISO 14025

If the steel products are used according to their intended use, under normal conditions, there will be no significant environmental impact to water, air/atmosphere and soil.

Reference service life

The Reference service life is not specified. This LCA study covers only Module A1 to A3 and there are many different applications.

Extraordinary effect

Fire: Structural steels are classified as incombustible materials according to Notification No. 1400 by Ministry of Construction Japan

Water: Not relevant

Mechanical destruction: Not relevant

Re-use phase

H beam can be reused after its recovery, in particular when steel constructions are properly designed to facilitate disassembly and re-use at the end of their useful lives.

Steel is 100% recyclable and scrap can be converted to the same (or higher or lower) quality of steel depending upon the metallurgy and processing of the recycling route.

Disposal

Due to its high value as a resource, steel scrap is not disposed of, but instead in a well-established cycle fed to reuse or recycling. Disposal is not included in the study.

The disposal pathway in Japan: Recycling (99%), Landfill (1%), Incineration (0%)

Waste code according to Basel convention is

A1010: Metal wastes

And Waste classification according to Japanese national law “Waste Management Law” is

Industrial Waste: 1210 Steel scrap

Industrial Waste shall be collected by a licensed collector.

Further information

Additional information can be obtained from http://www.tokyosteel.co.jp/

LCA Rules

Declared unit

Name	Value	Unit
Declared unit	1	metric ton
Density	7,874	kg/m^3
Conversion factor to 1kg	0.001	-
Thickness	4.5 - 24.0	mm

System boundary

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-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

This is an EPD based on a cradle-to-gate life cycle assessment. The selected system boundaries of this study encompass the following steps and this LCA study is not comparative assertion.
A1: Production of raw materials and energy
A2: Transport of resources to the production site
A3: Production of the product

No known flows are deliberately excluded from this EPD.
Capital goods and infrastructure flows are excluded from the product system boundary.

Estimates and Assumptions

Regarding the transportation of materials, it is assumed:

- All of steel scraps are procured in Japan and transported from places within 62.7 km to the plant.
- Coal cokes are procured from Taiwan (37%) or in Japan (63%). As for the procurement from Taiwan, it was transported from Taiwan port to Yokohama port by container ships (2309km), then transported from Yokohama port to Furukawa (125km), and Furukawa to the plant (50km). Regarding the procurement in Japan, it was transported from Kimitsu to the plant (215km).
- All of calcium alminate are procured from Toyama prefecture in Japan and transported to the plant (439km). The size and the loading rate of the truck used in this transportation is unknown and they are assumed as 10t truck and 50%, respectively.
- All of calcium oxides are procured in Japan and transported from places within 50 km to the plant.
- Internal circulation waste were transported inside the plant from where they were produced to the H beam production zone (1km)

IDEA database provides the data from every electricity power company. Tokyo Steel is using the average power mix data from 10 major electric power companies in Japan.

Slag is recycled mainly for base layer of roads. Slag is considered as remiderflow in this study and the transportation for recycling is not considered in this study.

Cut-off rules

The transportations of primary resources for the H beam production (Steel scrap, Coal coke, Calcium oxide, and Internal circulation waste) and Calcium aluminate were included as input flows in the calculation of the A2 module.

On the other hand, the transportations of the other resources were excluded as input flows in the calculation of the A2 module due to the lack of data availability, after confirming their impacts were small. The total excluded resources were 0.93% of the total included resources on a weight basis as input flows for the A2 module calculation. The estimated energy usage and environmental impacts of the excluded input flows were explained in detail in Interpretation Completeness.

The cut-off criteria are 1 % of renewable primary resource (energy), 1 % nonrenewable primary resource (energy) usage, 1 % of the total mass input of that unit process and 1 % of environmental impacts. Tthe total of neglected input flows per module are a maximum of 5 % of energy usage, mass and environmental impacts. These cut-off criteria align with ISO 21930.

Except the above cut-offs, all information from the data collection process has been considered, covering all used and registered materials, thermal energy, electrical energy and diesel consumption.

Data quality

Principally the inventory data include material, energy, auxiliary, water consumption (foreground data). The foreground data are derived from the Utsunomiya Plant.

Further, LCA data sets (background data) linked to the foreground data of various stages of the life cycle (cradle to gate) were obtained from IDEAv3.1 database (2021).

Time coverage: Primary data was collected at Utsunomiya Plant between April 2022 and March 2023. The representativeness of Utsunomiya Plant was reviewed in the section of Interpretation. Secondary data comes from IDEAv3.1 database (2021). The data referenced year is 2015.

Geographical coverage:This product is produced and provided in Japan. Primary data was collected in Japan and secondary data was referred by Japan industry inventory from IDEA.

Technology coverage: State-of-the-art at the time when the data was developed.

Allocation

The manufacturing process generates by-products, slag, and internal circulation waste. All internal circulation waste outputs are input to this main product.

Most of energy as Electrictiy, Gas was measured at individual meter at each line. So there is no energy allocation except industrial water. Only industrial water volume was measured at a factory level so the industrial water volume was allocated based on the product manufacturing mass volume.

Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to ISO 21930 and the building context, respectively the product-specific characteristics of performance, are taken into account.

Life Cycle Assessment Results

LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Environment Impact (Assessment Method: LIME2)					
Impact Category	Units	Total	A1	A2	A3
Global warming (GWP)	kg-CO_2eq	7.54E+02	1.80E+02	7.05E+00	5.67E+02
Acidification (AP)	kg-SO_2eq	5.70E-01	1.40E-01	1.85E-02	4.12E-01
Eutrophication (EP)	kgPO_4^{3-}-eq	2.03E-02	6.44E-03	3.51E-05	1.39E-02
Ozone depletion (ODP)	kg-CFC-11eq	2.19E-04	2.01E-05	9.36E-11	1.99E-04
Photo Chemical Ozone Creation (POCP)	kg-C_2H_4eq	1.68E-02	7.07E-03	4.10E-05	9.68E-03

Comparability: 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.

Carbon dioxide emissions and removals from biogenic sources, carbonation, and combustion of waste are not relevant to this product system and were not included in the calculation of GWP.

Resource Use					
Parameter	Units	Total	A1	A2	A3
Renewable primary resources used as energy carrier	MJ	7.46E+02	3.92E+02	2.42E-03	3.54E+02
Renewable primary resources with energy content used as material	MJ	-	-	-	-
Non-renewable primary resources used as an energy carrier	MJ	1.12E+04	2.54E+03	1.17E+02	8.50E+03
Non-renewable primary resources with energy content used as material	MJ	-	-	-	-
Secondary materials	kg	1.12E+03	1.12E+03	-	-
Renewable secondary fuels	MJ	-	-	-	-
Non-renewable secondary fuels	MJ	-	-	-	-
Recovered energy	MJ	-	-	-	-
Use of net fresh water resources	m^3	6.92E+02	1.01E+02	2.66E-02	5.91E+02
Abiotic depletion potential for fossil resources	MJ	1.12E+04	2.54E+03	1.17E+02	8.50E+03

Output Flows and Waste Categories					
Parameter	Units	Total	A1	A2	A3
Hazardous waste disposed	kg	4.01E+00	2.06E+00	6.06E-08	1.94E+00
Nonhazardous waste disposed	kg	2.67E-10	2.66E-10	9.81E-17	3.33E-13
High-level radioactive waste, conditioned, to final repository (*)	kg	-	-	-	-
Intermediate- and low-level radioactive waste, conditioned, to final repository (*)	kg	-	-	-	-
Components for reuse	kg	-	-	-	-
Materials for recycling	kg	1.69E+02	-	-	1.69E+02

Materials for energy recovery	kg	-	-	-	-
Recovered energy exported from the product system	MJ	-	-	-	-

(*) Radioactive waste data is not available in IDEA database.

Carbon Emissions					
Parameter	Units	Total	A1	A2	A3
Calcination Carbon Emissions	kg-CO_2	1.96E+01	1.96E+01	-	-

Interpretation

Completeness

A2 module calculation as explained in the cut-off rule. The total excluded resources were 0.93% of the total included resources on a weight basis as input flows for the A2 module calculation.

The estimated environmental impacts of the excluded input flows accounts for 0.01% for GWP and 0.03% for AP of the total, respectively.

Environment Impact (Assessment Method: LIME2)					
Impact Category	Units	A1-A3	A2	A2 impact of total	A2 impact
GWP	kg-CO_2eq	7.54E+02	7.05E+00	0.93%	0.01%
AP	kg-SO_2eq	5.70E-01	1.85E-02	3.24%	0.03%
EP	kgPO_4^{3-}-eq	2.03E-02	3.51E-05	0.17%	0.00%
ODP	kg-CFC-11eq	2.19E-04	9.36E-11	0.00%	0.00%
POCP	kg-C_2H_4eq	1.68E-02	4.10E-05	0.24%	0.00%

The estimated energy usage of the excluded input flows accounts for 0.00% of RPRE, 0.01% of NRPRE of the total, respectively.

Environment Impact (Assessment Method: LIME2)					
Parameter	Units	A1-A3	A2	A2 impact of total	A2 impact
RPRE	MJ	7.46E+02	2.42E-03	0.00%	0.00%
NRPRE	MJ	1.12E+04	1.17E+02	1.05%	0.01%

Sensitivity

Proxies of emission factors were used for a few materials and activities because precise emission factors for them were not available in IDEA v3.1 database.

Environment Impact (Assessment Method: LIME2)				
Impact Category	Units	A1-A3	Impact of proxies	10% of proxies impact
GWP	kg-CO_2eq	7.54E+02	4.25%	0.43%
AP	kg-SO_2eq	5.70E-01	7.06%	0.71%
EP	kgPO_4^{3}-eq	2.03E-02	19.94%	1.99%
ODP	kg-CFC-11eq	2.19E-04	2.24%	0.22%
POCP	kg-C_2H_4eq	1.68E-02	36.31%	3.63%

Steel scrap processing impacts are based on an environmentally extended economic input/output (EEIO) data set using the amount spent on scrap as the quantity. Since EEIO data sets are generally considered to have lower accuracy compared to data sets based on physical flows, the EEIO data impact has been evaluated as below.

Environment Impact (Assessment Method: LIME2)						
Impact Category	Units	A1-A3	A1	EEIO data	EEIO data in A1	EEIO data in total
GWP	kg-CO_2eq	7.54E+02	1.80E+02	4.89E+01	27%	6%
AP	kg-SO_2eq	5.70E-01	1.40E-01	3.82E-02	27%	7%
EP	kgPO_4^{3}-eq	2.03E-02	6.44E-03	1.57E-03	24%	8%
ODP	kg-CFC-11eq	2.19E-04	2.01E-05	9.47E-06	47%	4%
POCP	kg-C_2H_4eq	1.68E-02	7.07E-03	4.85E-04	7%	3%

Consistency

All manufacturing data was gathered with the same level of detail and all background data were sourced from IDEA database selecting most appropriate geography.

Representativeness

There are three factories to produce Structural steel “H beam”. However, this study and LCA data is only for H beam products which are produced at Utsunomiya Plant.

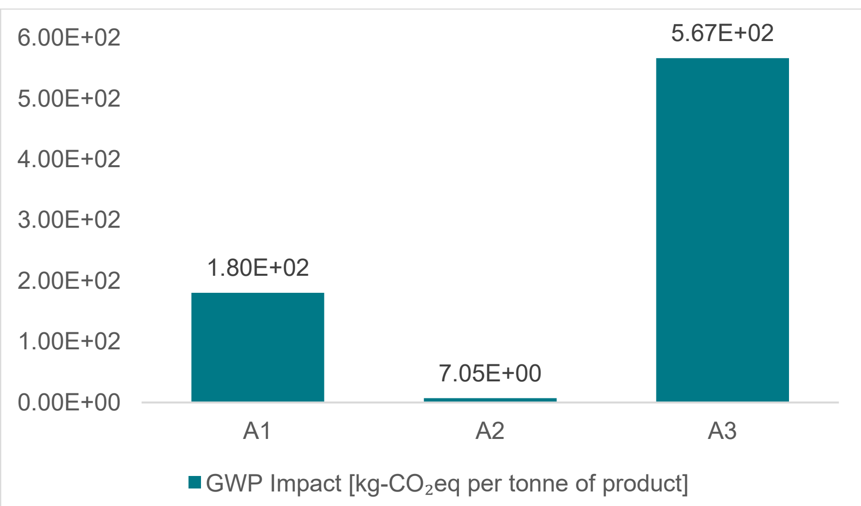
Limitation

LIME characteristic methodology and IDEA database are used in the study. These are specific to Japan market so these are considered as limitations when the data will be used in other countries.

And some data are not available in IDEA database. Radioactive waste data for nuclear power plant electricity is not covered.

Conclusion

Tokyo steel uses the Electric Arc Furnacee production process to utilize steel scrap. This process can save material impact instead use more energy. A3 is the biggest portion in GWP.



And in A3, Elecricity impact is the biggest item. So the electricity usage will be a challenge to reduce the environmental impact.

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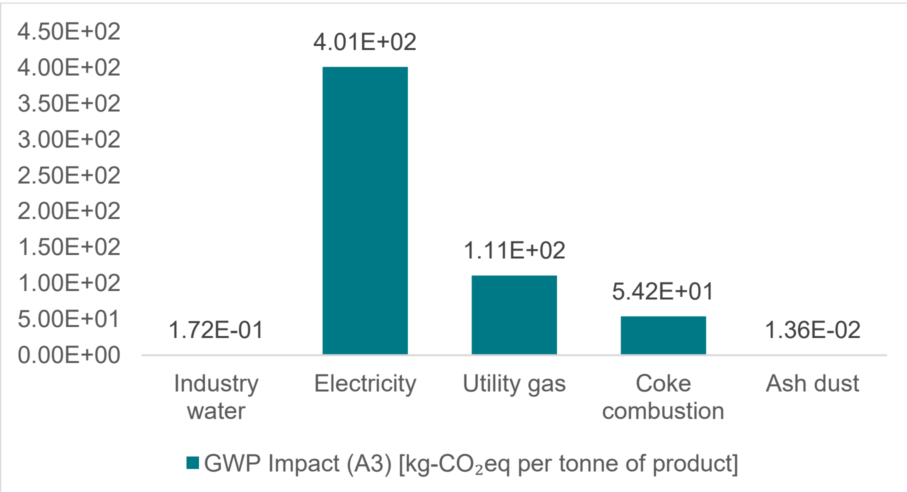
According to ISO 14025



References

DIN EN /ISO 14025:201110: Environmental labels and declarations - Type III environmental declarations - Principles and procedures

ISO 14040:2006 - Environmental management – Life cycle assessment – Principles and framework

ISO 14044:2006 - Environmental management – Life cycle assessment – Requirements and guidelines

ISO 21930:2017 - Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services

ISO 14001:2015 - Environmental management systems -- Requirements with guidance for use

ISO 9001:2015 - Quality management systems – Requirements

JIS G 3101: Rolled steels for general structure

JIG G 3106: Rolled steels for welded structure

JIG G 3136: Rolled steels for building structure

Notification No. 1400 by Ministry of Construction Japan: Classification of incombustible materials

Product Category Rules for Building-Related Products and Services, Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL Environment, Standard 10010, Version 4.0

Part B: Designated Steel Construction Product EPD Requirements Second Edition, Dated August 26, 2020

Secondary dataset

IDEAv3.1 database (2021).

National Institute of Advanced Industrial Science and Technology

Japan Environmental Management Association for Industry

National Greenhouse Gas Inventory Report of Japan 2022, Ministry of the Environment, Japan, Greenhouse Gas Inventory Office of Japan, Center for Global Environmental Research, National Institute for Environmental Studies, Japan