

## ENVIRONMENTAL PRODUCT DECLARATION

# STEEL SLAB

STRUCTURAL STEEL



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.



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Steel Slab  
Structural Steel

According to ISO 14025  
EN 15804: 2012+A2:2019

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Solutions	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	4791707177.101.1		
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Steel Slab Structural Steel, 1 metric ton		
REFERENCE PCR AND VERSION NUMBER	CEN standard EN 15804 serves as the core PCR 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	Steel Slabs are intermediate products that serve as the base material for various steel products. These slabs are further processed (typically through rolling) to produce finished products such as hot rolled coil, checkered coil, and other structural steel forms. The finished products derived from these slabs are 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	Europe		
DATE OF ISSUE	June 3rd, 2025		
PERIOD OF VALIDITY	5 Years		
EPD TYPE	Manufacturer Specific		
EPD SCOPE	Cradle to gate with modules C1-C4 and module D		
YEAR(S) OF REPORTED PRIMARY DATA	April 2022 and March 2023		
LCA SOFTWARE & VERSION NUMBER	Microsoft Excel calculation tool with Ecoinvent database		
LCI DATABASE(S) & VERSION NUMBER	Ecoinvent v3.10 (EN15804 system) database (2023), ecoinvent		
LCIA METHODOLOGY & VERSION NUMBER	EF 3.1 EN 15804		

Independent verification of the declaration and data, according to EN ISO 14025:2010 (ISO 14025:2006)

This declaration was independently verified in accordance with ISO 14025: 2006.

INTERNAL       EXTERNAL

Cooper McCollum, UL Solutions

Third Party Verifier

James 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.

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## Product information

### Product description

The product declared is "Steel Slab", which is an intermediate product used in the production of various steel products, including structural steel. Steel slabs are typically further processed by rolling to produce products such as floor plates, which are classified in 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 to produce structural steel, is based on the direct melting of scrap with an Electric Arc Furnace. The molten steel is then cast into slabs. These slabs are the intermediate products that can be subsequently processed in rolling mills to obtain finished products such as hot-rolled coils. The steel slab itself does not have any metallic or organic coating. It serves as a raw material for further processing.



The product is provided for the Japanese market and other export markets. The slabs serve as the base material for various steel products. These finished products, manufactured either by our company or by companies that purchase our slabs, can comply with various standards including JIS G 3101, JIS G 3106, JIS G 3136, JIS G3113, JIS G3125, JIS G3132, JIS G 3131 (Regional designation code: JIS), and similar international standards like EN10025, EN10149, EN10111, SAE J403, ASTM series, etc. The quality of our slabs ensures that the final products can meet these stringent standards after appropriate processing.

### Application

Steel Slabs are intermediate products that serve as the base material for various steel products. These slabs are further processed (typically through rolling) to produce finished products such as hot rolled coil, checkered coil, and other structural steel forms. The finished products derived from these slabs are 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

The steel slabs produced are designed to meet the requirements for manufacturing finished products that comply with various national and international standards. While the slabs themselves are intermediate products and may not directly fall under these standards, the steel used in their production is formulated to ensure that the final products can meet the specifications of: JIS G 3101, JIS G 3106, JIS G 3136, JIS G3113, JIS G3125, JIS G3132, JIS G 3131, and similar international standards like EN10025, EN10149, EN10111, SAE J403, ASTM series, etc. The exact chemical composition and mechanical properties of the slabs can be tailored to meet the specific requirements of the intended final products. This flexibility allows for the production of a wide range of steel grades suitable for various applications in construction, automotive, and other industries.



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## Delivery status

The delivery conditions may vary according to the intended application.

## Base materials / Ancillary materials

Structural steel "Steel Slab" is a low-alloy steel product. The typical content of carbon is lower than 0.18%. 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.

Any packaging materials are not used for this product. So, the packaging mass weight is zero.

## Manufacture

The steel scrap is melted in an electric arc furnace to obtain liquid steel, which is then refined in a ladle furnace with the addition of ferroalloys and metals to obtain the required steel characteristics. The steel is then cast in a continuous caster to obtain semi-finished products known as steel slabs.

The manufacturing process for steel slabs ends at this point. Subsequent processes, such as rolling to desired sizes, are typically performed on these slabs to produce various finished products, but these processes are not included in the scope of this EPD.

Factory	Address
TOKYO STEEL MFG Tahara Plant	2-1-3, Shirahama, Tahara-shi, Aichi 441-3436, Japan



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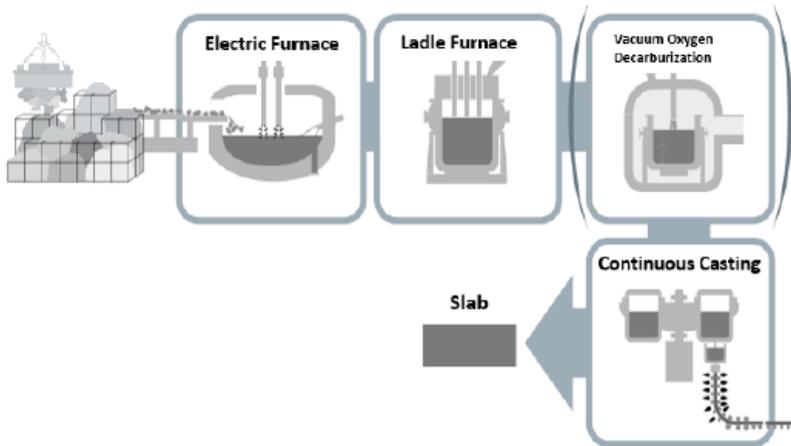


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## Manufacturing process flow

### Steelmaking Process



## Quality Management System

TOKYO STEEL MFG Tahara 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 Tahara 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 depend 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.



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

## Packaging

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Structural steel "Steel Slab" is delivered unpacked.

## Condition of use

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

## Environment and health during use

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

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

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The Reference service life is not specified. This LCA study covers Module A1 to A3, C1 to C4, and D. There are many different applications.

## Extraordinary effect

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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

## Reuse, recycle, and disposal

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Steel slabs are intermediate products in the steel manufacturing process. While the slabs themselves are not directly reused, they are processed into various finished steel products, many of which are used as construction materials.

The finished products derived from these slabs can often be reused or recycled after their recovery from deconstruction sites, particularly when steel constructions are properly designed to facilitate disassembly at the end of their useful lives.

The product which is recovered from deconstruction site but not reused is 100% recyclable as steel scrap. The steel scrap can be converted to the same (or higher or lower) quality of steel depending upon the metallurgy and processing of the recycling route.



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Only fraction of the product is not recovered from deconstruction site due to being mixed up with other construction waste, which is disposed (landfilled).

The product is expected to be sold and used in Europe. This LCA study uses the scenario to assume reuse rate, recycle rate and landfill rate of used products in buildings in Europe for the calculation of End-of-life stage (Module C1-C4) and Module D, based on research of the end-of-life stage of construction materials in Europe.

Waste code according to Basel convention is:

“A1010: Metal wastes”

## Further information

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



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## LCA Rules

### Declared unit

Name	Value	Unit
Declared unit	1	metric ton
Density	7,874	kg/m <sup>3</sup>
Conversion factor to 1kg	0.001	-
Thickness	210	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	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X

This is an EPD based on a cradle to gate with modules C1-C4 and module D life cycle assessment. The selected system boundaries of this study encompass the following steps and this LCA study is not comparative assertion.

#### Module A1 to A3

The product stage includes provision of all materials, products, and energy, as well as waste processing up to the end-of waste state or disposal of final residues during the product stage. Impacts on raw material transportation, including external scrap, and intermediate products are included with some exceptions that fall under the cut-off threshold.

#### Module C1 to C4



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These modules consider the dismantling of the considered product (C1), the transportation of the dismantled components to their End of Life (EoL) destinations (C2), the waste processing for recovery or recycling (C3) as well as the disposal (C4).

The end-of-life scenario used for calculating C1-C4 is described in the below table.

Processes		Quantity	Unit (per tonne of product)
Collection process specified by type	Collected separately	1000	kg
	Collected with mixed construction waste	0	kg
Recovery system specified by type	Re-use	55	kg
	Recycling	935	kg
	Energy recovery	0	kg
Disposal specified by type	Product or material for final deposition	10	kg
Assumptions for scenario development (transportation)	Deconstruction site to plant for sorting and shredding	75	km
	Deconstruction site to final disposal site	50	km

## Module D

Module D includes declared benefits and loads resulting from the net flow of secondary fuels or materials exiting the product system. This excludes flows that have been allocated as co-products. Metals are assumed to reach the end of waste state after they have gone through a sorting and shredding process. The treatment as well as net benefits and loads of reuse or recycling potentials (for the net scrap amount only) are grouped to module D.

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 raw materials, it is assumed:

- The distances of the transportation for 6% of Coal cokes were unknown. It was assumed that the distance of land transportation was 587.2km with truck and the distance of marine transportation was 450.0 km with ferry respectively.
- Internal circulation steel scraps were transported inside the plant from where they were produced to the Steel



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Slab production zone, and the distance of the transportation is assumed 2.9km.

The emission factor of electricity supplied for the production is assumed to be the emission factor of electricity of the average mixes of technologies in Japan.

Slag is produced as by-products in the production stage (A3 module). It is eventually recycled mainly for base layer of roads. It is considered as reminderflow in this study and the transportation for the recycling for slag is not considered in this study.

## Cut-off rules

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. The 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 EN15804:2012+A2:2019.

The transportations of primary raw materials (Steel scrap, Coal coke, Calcium oxide, Ferro-manganese, and Internal circulation steel scrap) to the production site were included as input flows in the calculation of the A2 module. On the other hand, the transportations of the other raw materials 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 0.532% of the total 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 the subsection Completeness. These cut-offs met the criteria.

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 Tahara Plant.

Further, LCA data sets (background data) linked to the foreground data of various stages of the life cycle (cradle to gate with modules C1-C4 and module D) were obtained from Ecoinvent v3.10 (EN15804 system) database (2023).

Time coverage: Primary data was collected at Tahara Plant between April 2022 and March 2023. Secondary data comes from Ecoinvent v3.10 (EN15804 system) database (2023). The data referenced year varies.

Geographical coverage: This product is produced in Japan and provided in Europe. Primary data was collected in Japan and secondary data was referred by Ecoinvent database.

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

The results of data quality assessment

Data quality assessment was done based on Data quality level and criteria from the Product Environmental Footprint Category Rules, according to Annex E of EN 15804:2012+A2:2019. The results are shown below.

	Primary/Foreground data	Secondary/Background data
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Geography representativeness	<p><b>Good</b></p> <p>The processes included in the data set are well representative for the geography stated in the "location". Primary data was collected at Tahara Plant in Japan. Raw materials are procured mainly from inside Japan, but some of them are purchased from other countries such as Vietnam and India. The product is produced at the plant and expected to be sold and used in Europe.</p>	<p><b>Good</b></p> <p>The processes included in the data set are well representative for the geography stated in the "location" as secondary data from Ecoinvent v3.10 database is chosen to suit the geographical information of the primary data.</p>
Technical representativeness	<p><b>Fair</b></p> <p>Technology aspects are similar to what described in the title and metadata but merits improvements. Some of the relevant processes are not modelled with specific data but using proxies.</p>	<p><b>Fair</b></p> <p>Technology aspects are similar to what described in the title and metadata but merits improvements. Some of the relevant processes are not modelled with specific data but using proxies.</p>
Time representativeness	<p><b>Good</b></p> <p>Primary data was collected at Tahara Plant between April 2022 and March 2023.</p>	<p><b>Good</b></p> <p>The reference years of secondary data varies, but all of them include 2023 in their time range.</p>

## Allocation

The manufacturing process generates by-products, slag, and internal circulation steel scrap. All environmental impacts are allocated to the steel product (i.e., they are not allocated to any of by-products and slag). All internal circulation steel scrap outputs are input to this main product.

Most of energy such as Electricity, 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 EN 15804 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.



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Environment Impact										
Impact Category	Units	A1	A2	A3	A Total	C1	C2	C3	C4	D
GWP total	kg-CO <sub>2</sub> eq	5.83E+02	6.02E+00	5.11E+00	5.94E+02	6.21E+01	1.08E+01	6.13E+01	8.08E-01	3.40E+00
GWP biogenic	kg-CO <sub>2</sub> eq	1.26E-01	1.43E-04	1.07E-01	2.33E-01	6.20E-03	6.19E-03	1.27E-02	4.62E-04	5.32E-03
GWP fossil	kg-CO <sub>2</sub> eq	5.83E+02	6.01E+00	5.00E+00	5.94E+02	6.21E+01	1.08E+01	6.13E+01	8.07E-01	3.39E+00
GWP luluc	kg-CO <sub>2</sub> eq	2.88E-01	2.82E-03	2.49E-03	2.94E-01	5.40E-03	3.67E-03	8.59E-03	3.88E-04	-1.16E-04
ODP	kg-CFC-11eq	6.48E-06	8.70E-08	2.51E-08	6.60E-06	9.50E-07	2.17E-07	9.16E-07	1.35E-08	6.43E-09
AP	mol H <sup>+</sup> -Eq	3.40E+00	6.51E-02	1.63E-02	3.48E+00	5.60E-01	4.86E-02	5.43E-01	6.64E-03	-9.57E-05
EP freshwater	kg P-eq	1.70E-01	4.08E-04	3.10E-03	1.73E-01	1.81E-03	7.42E-04	2.89E-03	3.34E-05	1.44E-03
EP marine	kg N-eq	5.70E-01	1.79E-02	7.84E-03	5.96E-01	2.60E-01	1.91E-02	2.48E-01	3.00E-03	3.02E-04
EP terrestrial	mol N-eq	6.05E+00	1.98E-01	5.47E-02	6.30E+00	2.85E+00	2.08E-01	2.72E+00	3.28E-02	1.26E-03
POCP	kg NMVOC-eq	1.84E+00	6.02E-02	1.58E-02	1.92E+00	8.49E-01	7.46E-02	8.10E-01	1.00E-02	2.72E-03
ADP minerals & metals	kg Sb-eq	2.19E-03	1.57E-05	2.11E-05	2.22E-03	2.23E-05	3.43E-05	3.59E-05	7.02E-07	-8.90E-05
ADP fossil	MJ, net calorific value	6.75E+03	8.22E+01	3.06E+01	6.87E+03	8.12E+02	1.54E+02	8.01E+02	1.14E+01	3.16E+01
WDP	m <sup>3</sup> world Eq deprived	1.06E+02	3.50E-01	3.28E-01	1.07E+02	1.99E+00	7.70E-01	2.46E+00	3.27E-02	1.03E+00

Disclaimer (associated with ADP-minerals & metals, ADP-fossil, WDP) – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

GWP-total	Global Warming Potential total
GWP-fossil	Global Warming Potential fossil fuels
GWP-biogenic	Global Warming Potential biogenic
GWP-luluc	Global Warming Potential land use and land use change
ODP	Depletion potential of the stratospheric ozone layer
AP	Acidification potential, Accumulated Exceedance
EP-freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment
EP-marine	Eutrophication potential, fraction of nutrients reaching freshwater end compartment
EP-terrestrial	Eutrophication potential, Accumulated Exceedance
POCP	Formation potential of tropospheric ozone
ADP minerals & metals	Abiotic depletion potential for non-fossil resources



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ADP-fossil                      Abiotic depletion potential for fossil resources  
WDP                                Water (user) deprivation potential, deprivation weighted water consumption

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 EN 15804. 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.

Additional Impact										
Impact Category	Units	A1	A2	A3	A Total	C1	C2	C3	C4	D
PM	disease incidence	3.16E-05	4.64E-07	1.78E-07	3.22E-05	1.59E-05	1.05E-06	1.52E-05	1.82E-07	1.06E-07
IRP	kBq U235-Eq	3.10E+01	6.40E-02	5.67E-02	3.11E+01	3.63E-01	2.05E-01	6.94E-01	6.38E-03	7.21E-02
ETP-fw	CTUe	4.78E+03	2.01E+01	3.08E+01	4.83E+03	1.15E+02	4.02E+01	1.17E+02	2.09E+00	3.54E+02
HTP-c	CTUh	1.12E-05	3.05E-08	3.89E-08	1.12E-05	2.43E-07	7.30E-08	2.35E-07	3.42E-09	1.38E-06
HTP-nc	CTUh	4.94E-06	4.88E-08	6.00E-08	5.04E-06	1.10E-07	1.10E-07	1.29E-07	2.60E-09	-3.54E-08
SQP	dimensionless	2.15E+03	4.76E+01	2.84E+01	2.22E+03	5.69E+01	1.16E+02	7.37E+01	4.89E+00	-2.43E+01

Disclaimer (associated with IRP indicator) – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Disclaimer (associated with ETP-fw, HTP-c, HTP-nc, and SQP) – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

PM                                Particulate matter emissions  
IRP                                Ionising radiation, human health  
ETP-fw                         Ecotoxicity (freshwater)  
HTP-c                         Human toxicity, cancer effects  
HTP-nc                        Human toxicity, noncancer effects  
SQP                               Land use related impacts / soil quality



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Resource Use										
Parameter	Units	A1	A2	A3	A Total	C1	C2	C3	C4	D
PERE	MJ	6.47E+02	1.01E+00	1.32E+00	6.49E+02	4.97E+00	2.67E+00	9.37E+00	9.02E-02	-9.54E-01
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	6.47E+02	1.01E+00	1.32E+00	6.49E+02	4.97E+00	2.67E+00	9.37E+00	9.02E-02	-9.54E-01
PENRE	MJ	6.30E+03	8.22E+01	3.06E+01	6.41E+03	8.12E+02	1.54E+02	8.01E+02	1.14E+01	3.16E+01
PENRM	MJ	4.54E+02	0.00E+00	0.00E+00	4.54E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	6.75E+03	8.22E+01	3.06E+01	6.87E+03	8.12E+02	1.54E+02	8.01E+02	1.14E+01	3.16E+01
SM	kg	1.13E+00	3.88E-02	8.87E-03	1.17E+00	3.37E-01	7.00E-02	3.26E-01	4.72E-03	6.40E-01
RSF	MJ	2.32E-02	3.71E-04	1.63E-04	2.37E-02	8.81E-04	8.58E-04	8.65E-04	2.66E-05	-8.08E-04
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	2.58E+00	9.96E-03	-1.47E-01	2.44E+00	5.28E-02	2.17E-02	6.64E-02	2.37E-03	2.07E-02

- PERE Use of renewable primary energy excluding renewable primary energy resources used as raw materials
- PERM Use of renewable primary energy resources used as raw materials
- PERT Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)
- PENRE Use of non-renewable primary energy excluding nonrenewable primary energy resources used as raw materials
- PENRM Use of non-renewable primary energy resources used as raw materials
- PENRT Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)
- SM Use of secondary material
- RSF Use of renewable secondary fuels
- NRSF Use of non-renewable secondary fuels
- FW Net use of fresh water

Waste Categories										
Parameter	Units	A1	A2	A3	A Total	C1	C2	C3	C4	D
HWD	kg	6.48E+01	1.40E-01	2.67E+01	9.16E+01	9.07E-01	2.23E-01	1.09E+00	1.38E-02	8.05E-01
NHWD	kg	8.68E+02	2.46E+00	1.64E+02	1.04E+03	1.24E+01	4.72E+00	1.74E+01	3.37E-01	8.60E+00



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RWD	kg	6.92E-03	1.57E-05	1.41E-05	6.95E-03	8.92E-05	5.08E-05	1.70E-04	1.56E-06	0.00E+00
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HWD Hazardous waste disposed  
NHWD Non-hazardous waste disposed  
RWD Radioactive waste disposed

Output Flows										
Parameter	Units	A1	A2	A3	A Total	C1	C2	C3	C4	D
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	1.12E+02	1.12E+02	0.00E+00	0.00E+00	9.35E+02	0.00E+00	0.00E+00
MER	kg	0.00E+00								
EE	MJ	0.00E+00								

CRU Components for re-use  
MFR Materials for recycling  
MER Materials for energy recovery  
EE Exported energy

Biogenic carbon content		
Parameter	Units	Content
BCP	kg C	2.85E-09
BCAP	kg C	0.00E+00

BCP Biogenic carbon content in product  
BCAP Biogenic carbon content in accompanying packaging

## Interpretation

## Completeness



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The transportation of non-primary resources for the production were excluded from input flows for the A2 module calculation as explained in the section Cut-off rule. The total excluded resources were 0.532% of the total included resources on a weight basis as input flows for the A2 module calculation.

The estimated impacts of the exclusion on core environmental impact indicators are lower than 0.05% of any of them.

The estimated impacts of the exclusion on indicators of energy use are lower than 0.01% of any of them.

Indicators	Units	Ratio of A2 to A1-A3 Total	Estimated exclusion impact on A1-A3 Total
GWP-total	%	1.01	0.005
GWP-biogenic	%	0.06	0.000
GWP-fossil	%	1.01	0.005
GWP-luluc	%	0.96	0.005
ODP	%	1.32	0.007
AP	%	1.87	0.010
EP-freshwater	%	0.24	0.001
EP-marine	%	3.01	0.016
EP-terrestrial	%	3.14	0.017
POCP	%	3.14	0.017
ADP-minerals & metals	%	0.71	0.004
ADP-fossil	%	1.20	0.006
WDP	%	0.33	0.002

Indicators	Units	Ratio of A2 to A1-A3 Total	Estimated exclusion impact on A1-A3 Total
PERE	%	0.16	0.001
PERM	%	0.00	0.000
PERT	%	0.16	0.001
PENRE	%	1.28	0.007
PENRM	%	0.00	0.000



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PENRT	%	1.20	0.006
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## Sensitivity

Precise emission factors for some of raw materials in A1 module do not exist in Ecoinvent v3.10 (EN15804 system) database. Therefore, proxies of emission factors in the database were used for this study. The proxies used are shown in the below Table.

Module	Name of Material	Proxy data	
		Data code	Activity name
A1	Calcium aluminate	4336307b-03dd-566e-9367-fb5b740460d9_9c78fb2b-13ba-46ab-8e5c-7996d9526938	aluminum alloy production, metallic matrix composite
	Calcium Ferro Cored Wire	4c901683-5f2e-5d67-a0d5-eee13f71951e_1e87e7db-557d-490d-b0bf-946d78833e56	ferrosilicon production
	Ferro-boron	4c901683-5f2e-5d67-a0d5-eee13f71951e_1e87e7db-557d-490d-b0bf-946d78833e56	ferrosilicon production
	Industry water	76e63b8d-541f-59bc-8510-7842d74f774b_c5adb1fb-872e-4446-a3bb-c4b61aa4bd45	tap water production, conventional treatment

To assess the sensitivity of the results on these proxy choices, we calculated the following results if the proxy impact factors were increased by 10%. The results change very little and are clearly not very sensitive to these proxy data choices.

Indicators	Units	Ratio of A1-A3 (with proxies only) to A1-A3 Total	Estimated impact of the use of proxies on A1-A3 Total
GWP-total	%	0.014	0.001
GWP-biogenic	%	0.011	0.001
GWP-fossil	%	0.014	0.001
GWP-luluc	%	0.019	0.002
ODP	%	0.004	0.000
AP	%	0.013	0.001
EP-freshwater	%	0.012	0.001



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EP-marine	%	0.015	0.001
EP-terrestrial	%	0.015	0.002
POCP	%	0.014	0.001
ADP-minerals & metals	%	0.044	0.004
ADP-fossil	%	0.014	0.001
WDP	%	0.011	0.001

## Consistency

All foreground data was gathered with the same level of detail and all background data (emission factors) were sourced from Ecoinvent v3.10 (EN15804 system) database, selecting the most appropriate geographical characteristics of the data available.

## Representativeness

Tahara Plant produces "Steel Slab". All foreground data used was gathered from Tahara Plant.

## Limitation

The products are expected to be sold to processing companies and to be used in the buildings in Europe eventually. However, it might not be necessarily true in some cases. In that case, the LCA results might be different. These are considered as limitations.

This LCA study uses EcoINVENT as a secondary dataset. However, we Tokyo Steel used IDEA for all products (including the same product) on previous LCA studies. IDEA and EcoINVENT have different emission factors and the gaps are big on some emission factors. And IDEA database misses some emission data. So, we cannot have some comparison studies between the previous LCA and this LCA even on the same product.

## Conclusion

A1 module accounts for the largest impact at the GWP-total indicator. Tokyo steel uses the Electric Arc Furnace production process to utilize steel scrap as secondary material. This process can save raw materials to input, but it needs electricity in the production process.

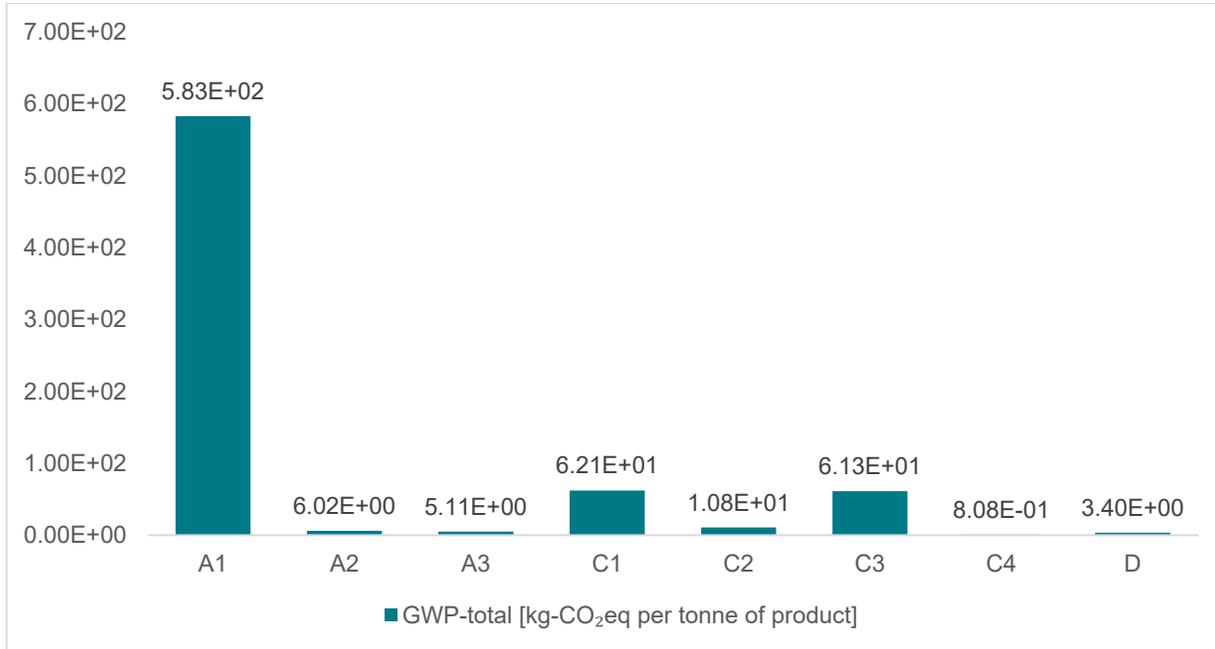


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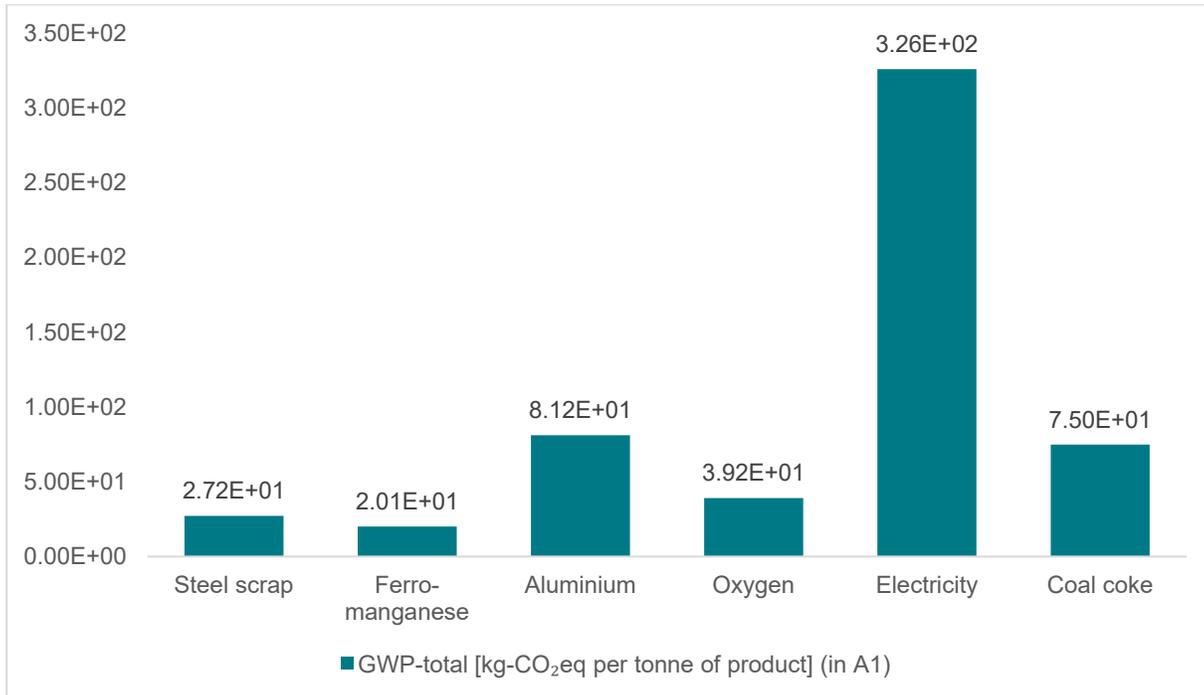


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The use of electricity accounts for the largest impact at the GWP-total indicator in A1 module. In conclusion, the electricity usage will be a challenge to reduce the global warming potential.



Note: Only items with 1% or higher in GWP for Module A1 are shown in the above figure.



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