

HOT ROLLED COIL / CHECKERED COIL

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.



ENVIRONMENTAL PRODUCT DECLARATION



Hot Rolled Coil/Checkered Coil
Structural Steel


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

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	4791119526.101.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Hot Rolled Coil/Checkered Coil 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	Structural steel "Hot Rolled Coil/Checkered Coil" 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	Europe
DATE OF ISSUE	December 12 th , 2024
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 structural steel “Hot Rolled Coil/Checkered Coil”, which is classified as “Floor plates” 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 to produce structural steel, is based on the direct melting of scrap with an Electric Arc Furnace, which is subsequently processed in rolling mills to obtain the finished products. The steel section is hot rolled into structural steel sheet in coil. No metallic or organic coating.

The product is provided for Japan market and other export markets. The products comply with JIS G 3101, JIS G 3106, JIS G 3136, JIS G 3113, JIS G 3125, JIS G 3132, JIS G 3131 (Regional designation code: JIS), and similar international standards like EN10025, EN10149, EN10111, SAE J403, ASTM series, etc.

Application

Structural steel “Hot Rolled Coil/Checkered Coil” 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

The technical data of the products is based on JIS G 3101, JIS G 3106, JIS G 3136, JIS G 3113, JIS G 3125, JIS G 3132, JIS G 3131, and similar international standards like EN10025, EN10149, EN10111, SAE J403, ASTM series, etc.



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Delivery status

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

Base materials / Ancillary materials

Structural steel "Hot Rolled Coil/Checkered Coil" 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.

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. The semis are then rolled to the desired size.

TOKYO STEEL MFG produces the structural steel "Hot Rolled Coil/Checkered Coil" at one factory (Tahara factory).

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



ENVIRONMENTAL PRODUCT DECLARATION

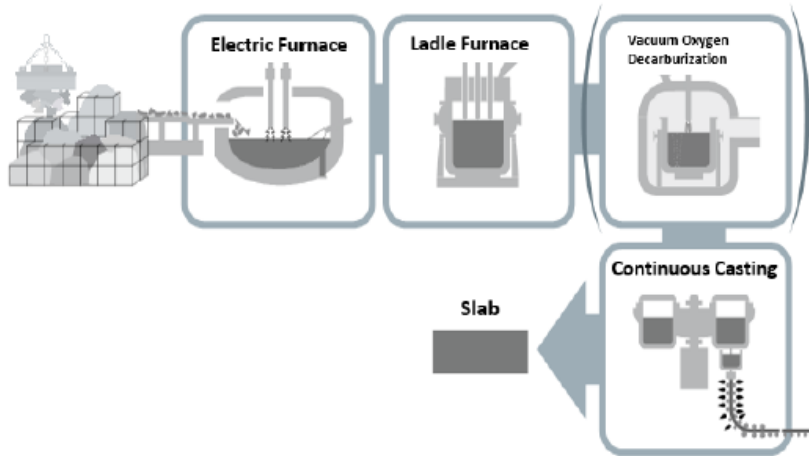


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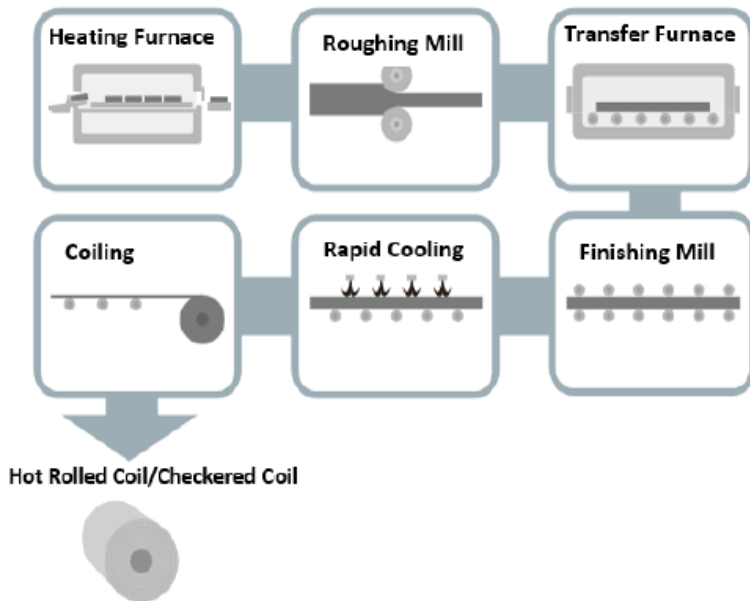
According to EN 15804 2012+A2:2019

Manufacturing process flow

Steelmaking Process



Rolling Process



Quality Management System

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

More information can be found at

Environment



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<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.

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

Packaging

Structural steel "Hot Rolled Coil/Checkered Coil" is secured with strapping bands.

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.

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 Module A1 to A3, C1 to C4, and D. There are many different applications.



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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

Reuse, recycle, and disposal

The product "Hot Rolled Coil/Checkered Coil" is used as a construction material. It can be reused after its recovery from deconstruction site, in particular when steel constructions are properly designed to facilitate disassembly and re-use 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.

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

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 ³
Conversion factor to 1kg	0.001	-
Thickness	1.45 - 25.0	mm

System boundary

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
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 Hot

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Rolled Coil / Checkered Coil 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.

In the calculation of the A1 module, strapping bands were excluded after confirming the impact was small. They were 0.0359% of the total resources on a weight basis as input flows for the A1 module calculation.

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.

These cut-offs are confirmed meeting the cut-off criteria mentioned above.

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 IDEAv3.1 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.

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	Primary/Foreground data	Secondary/Background data
Geography representativeness	Good 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.	Good 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.
Technical representativeness	Fair 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.	Fair 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.
Time representativeness	Good Primary data was collected at Tahara Plant between April 2022 and March 2023.	Good The reference years of secondary data varies, but all of them include 2023 in their time range.

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 ₂ eq	6.72E+02	6.27E+00	5.42E+00	6.83E+02	6.21E+01	1.08E+01	6.13E+01	8.08E-01	7.53E+01
GWP biogenic	kg-CO ₂ eq	1.39E-01	1.49E-04	1.65E-01	3.04E-01	6.20E-03	6.19E-03	1.27E-02	4.62E-04	8.90E-02
GWP fossil	kg-CO ₂ eq	6.71E+02	6.26E+00	5.26E+00	6.83E+02	6.21E+01	1.08E+01	6.13E+01	8.07E-01	7.52E+01
GWP luluc	kg-CO ₂ eq	3.06E-01	2.93E-03	2.65E-03	3.11E-01	5.40E-03	3.67E-03	8.59E-03	3.88E-04	1.90E-02
ODP	kg-CFC-11eq	7.83E-06	9.06E-08	2.65E-08	7.95E-06	9.50E-07	2.17E-07	9.16E-07	1.35E-08	3.36E-07
AP	mol H ⁺ -Eq	3.84E+00	6.78E-02	1.73E-02	3.93E+00	5.60E-01	4.86E-02	5.43E-01	6.64E-03	2.33E-01
EP freshwater	kg P-eq	1.90E-01	4.25E-04	3.47E-03	1.93E-01	1.81E-03	7.42E-04	2.89E-03	3.34E-05	3.45E-02
EP marine	kg N-eq	6.46E-01	1.87E-02	1.06E-02	6.75E-01	2.60E-01	1.91E-02	2.48E-01	3.00E-03	5.69E-02
EP terrestrial	mol N-eq	6.85E+00	2.06E-01	5.79E-02	7.11E+00	2.85E+00	2.08E-01	2.72E+00	3.28E-02	6.08E-01
POCP	kg NMVOC-eq	2.09E+00	6.27E-02	1.67E-02	2.17E+00	8.49E-01	7.46E-02	8.10E-01	1.00E-02	2.16E-01
ADP minerals & metals	kg Sb-eq	2.31E-03	1.64E-05	2.22E-05	2.34E-03	2.23E-05	3.43E-05	3.59E-05	7.02E-07	-1.02E-04
ADP fossil	MJ, net calorific value	7.86E+03	8.56E+01	3.25E+01	7.98E+03	8.12E+02	1.54E+02	8.01E+02	1.14E+01	7.55E+02
WDP	m3 world Eq deprived	1.18E+02	3.65E-01	3.58E-01	1.19E+02	1.99E+00	7.70E-01	2.46E+00	3.27E-02	2.00E+01

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	3.36E-05	4.83E-07	1.90E-07	3.43E-05	1.59E-05	1.05E-06	1.52E-05	1.82E-07	4.93E-06
IRP	kBq U235-Eq	3.70E+01	6.66E-02	6.23E-02	3.71E+01	3.63E-01	2.05E-01	6.94E-01	6.38E-03	2.07E+00
ETP-fw	CTUe	5.09E+03	2.09E+01	3.69E+01	5.15E+03	1.15E+02	4.02E+01	1.17E+02	2.09E+00	5.73E+03
HTP-c	CTUh	1.17E-05	3.18E-08	4.08E-08	1.18E-05	2.43E-07	7.30E-08	2.35E-07	3.42E-09	2.17E-05
HTP-nc	CTUh	5.41E-06	5.09E-08	7.10E-08	5.53E-06	1.10E-07	1.10E-07	1.29E-07	2.60E-09	5.72E-07
SQP	dimensionless	2.45E+03	4.96E+01	2.98E+01	2.53E+03	5.69E+01	1.16E+02	7.37E+01	4.89E+00	1.09E+02

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	7.58E+02	1.05E+00	1.42E+00	7.61E+02	4.97E+00	2.67E+00	9.37E+00	9.02E-02	2.43E+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	7.58E+02	1.05E+00	1.42E+00	7.61E+02	4.97E+00	2.67E+00	9.37E+00	9.02E-02	2.43E+01
PENRE	MJ	7.39E+03	8.56E+01	3.25E+01	7.51E+03	8.12E+02	1.54E+02	8.01E+02	1.14E+01	7.55E+02
PENRM	MJ	4.73E+02	0.00E+00	0.00E+00	4.73E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	7.86E+03	8.56E+01	3.25E+01	7.98E+03	8.12E+02	1.54E+02	8.01E+02	1.14E+01	7.55E+02
SM	kg	1.27E+00	4.04E-02	9.61E-03	1.32E+00	3.37E-01	7.00E-02	3.26E-01	4.72E-03	1.03E+01
RSF	MJ	2.45E-02	3.87E-04	1.71E-04	2.50E-02	8.81E-04	8.58E-04	8.65E-04	2.66E-05	9.51E-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	2.87E+00	1.04E-02	-2.83E-01	2.59E+00	5.28E-02	2.17E-02	6.64E-02	2.37E-03	4.33E-01

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	7.10E+01	1.45E-01	2.78E+01	9.89E+01	9.07E-01	2.23E-01	1.09E+00	1.38E-02	1.46E+01
NHWD	kg	9.69E+02	2.56E+00	3.02E+02	1.27E+03	1.24E+01	4.72E+00	1.74E+01	3.37E-01	1.92E+02



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RWD	kg	8.23E-03	1.63E-05	1.54E-05	8.27E-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	1.58E+02	1.58E+02	0.00E+00	0.00E+00	9.35E+02	0.00E+00	0.00E+00
MER	kg	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
EE	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

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	5.28E-09
BCAP	kg C	0.00E+00

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



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Interpretation

Completeness

As mentioned before, strapping bands were excluded for the A1 module calculation in the section Cut-off rule. The total excluded resources were 0.0359% of the total included resources on a weight basis as input flows for the A1 module calculation.

The estimated impacts of the exclusion on core environmental impact indicators are lower than 0.04% of any of them.

The estimated impacts of the exclusion on indicators of energy use are lower than 0.04% of any of them.

Indicators	Units	Ratio of A1 to A1-A3 Total	Estimated exclusion impact on A1-A3 Total
GWP-total	%	98.29	0.035
GWP-biogenic	%	45.62	0.016
GWP-fossil	%	98.31	0.035
GWP-luluc	%	98.21	0.035
ODP	%	98.53	0.035
AP	%	97.83	0.035
EP-freshwater	%	97.99	0.035
EP-marine	%	95.66	0.034
EP-terrestrial	%	96.29	0.035
POCP	%	96.34	0.035
ADP-minerals & metals	%	98.35	0.035
ADP-fossil	%	98.52	0.035
WDP	%	99.39	0.036

Indicators	Units	Ratio of A1 to A1-A3 Total	Estimated exclusion impact on A1-A3 Total
PERE	%	99.68	0.036
PERM	%	0.00	0.000

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PERT	%	99.68	0.036
PENRE	%	98.43	0.035
PENRM	%	100.00	0.036
PENRT	%	98.52	0.035

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	%	0.92	0.005
GWP-biogenic	%	0.05	0.000
GWP-fossil	%	0.92	0.005
GWP-luluc	%	0.94	0.005
ODP	%	1.14	0.006
AP	%	1.73	0.009
EP-freshwater	%	0.22	0.001
EP-marine	%	2.77	0.015
EP-terrestrial	%	2.90	0.015
POCP	%	2.89	0.015
ADP-minerals & metals	%	0.70	0.004
ADP-fossil	%	1.07	0.006
WDP	%	0.31	0.002

Indicators	Units	Ratio of A2 to A1-A3 Total	Estimated exclusion impact on A1-A3 Total
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PERE	%	0.138	0.001
PERM	%	0.000	0.000
PERT	%	0.138	0.001
PENRE	%	1.141	0.006
PENRM	%	0.000	0.000
PENRT	%	1.073	0.006

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	%	0.013	0.001
GWP-biogenic	%	0.009	0.001
GWP-fossil	%	0.013	0.001

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GWP-luluc	%	0.018	0.002
ODP	%	0.004	0.000
AP	%	0.012	0.001
EP-freshwater	%	0.011	0.001
EP-marine	%	0.014	0.001
EP-terrestrial	%	0.014	0.001
POCP	%	0.013	0.001
ADP-minerals & metals	%	0.044	0.004
ADP-fossil	%	0.012	0.001
WDP	%	0.010	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 Structural steel “Hot Rolled Coil/Checkered Coil”. 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

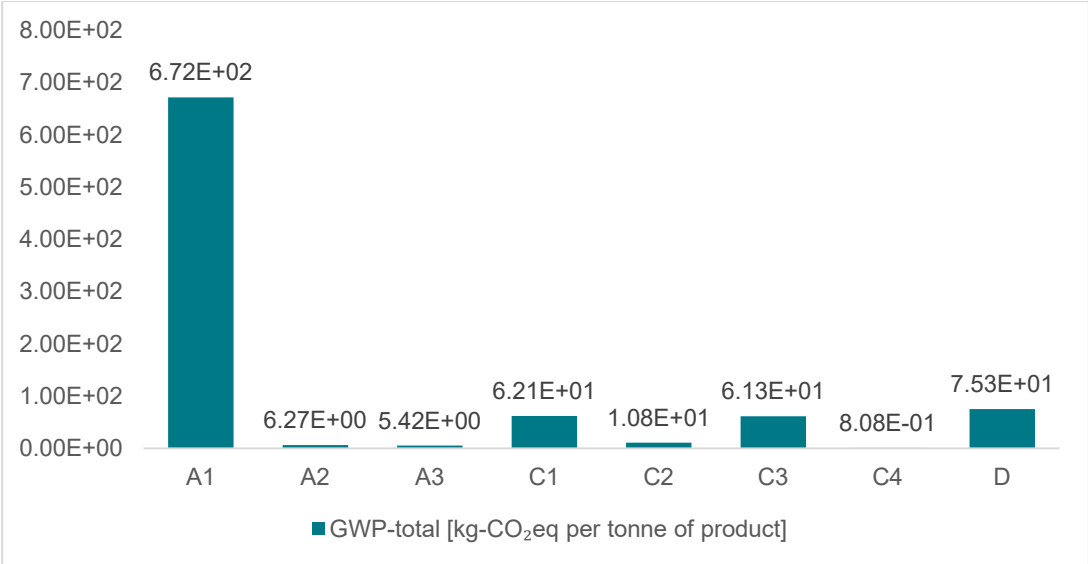
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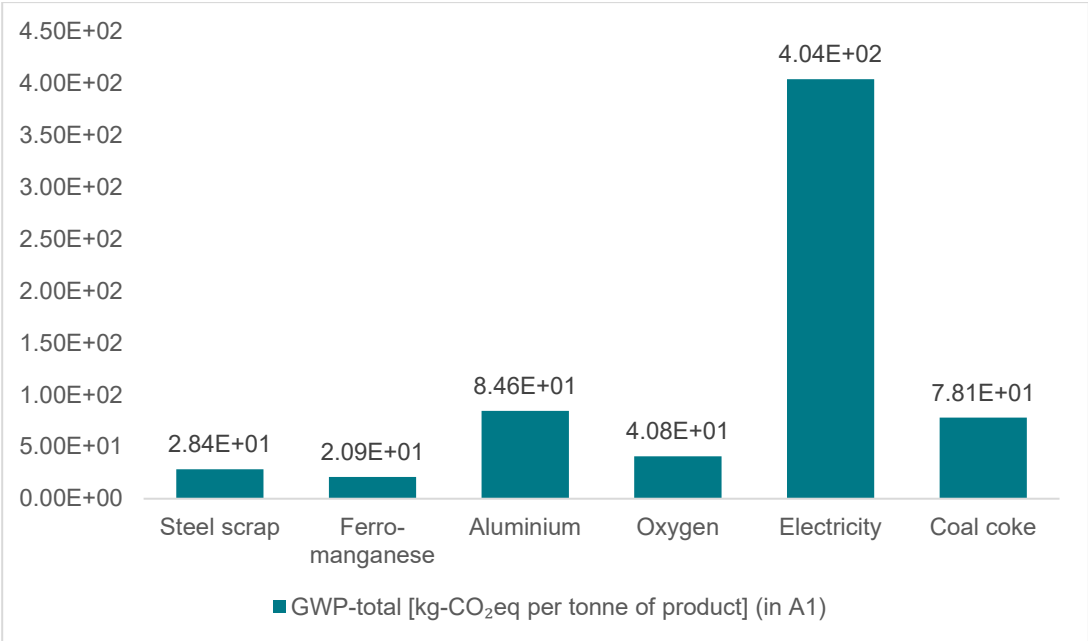
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A1 module accounts for the largest impact at the GWP-total indicator. Tokyo steel uses the Electric Arc Furnace production process to utilize steel scrap as secondary material. This process can save raw materials to input, but it needs electricity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



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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According to EN 15804 2012+A2:2019

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