TATA STEEL
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TATA

Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019 for

Steel Hot Rolled Coil

from Tata Steel Limited

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
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An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

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Introduction

Tata Steel Limited a flagship company of Tata Group is a multinational steel-making company headquartered in Mumbai (Maharashtra, India). The company is one of the world's most geographically diversified steel producing companies. It was established in India as Asia's first integrated private steel company in 1907 and today the company, together with its subsidiaries, associates and joint ventures, has its presence across five continents with key operations in India, the Netherlands and the United Kingdom. Tata Steel is among the top steel producing companies in the world with an annual crude steel capacity of 34 million tonnes per annum globally. The company's largest steel plant is located in Jamshedpur, Jharkhand (India). The company's operations in India are fully integrated from mining to finished steel production and it also has captive iron ore and coking coal mines in India.

Thinkstep Sustainability Solutions Pvt. Ltd, a Sphera Company (formerly thinkstep AG). has been entrusted to review the life cycle assessment study carried out by Tata Steel and to develop an Environmental Product Declaration document based on the Life Cycle Assessment study carried out by Tata Steel Limited as per ISO 14040/44.

The LCA model was created using the GaBi ts Software system for life cycle engineering, developed by Sphera (formerly thinkstep AG).

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General Information

2.1 EPD, PCR, LCA Information

Table 1 | EPD Information

Programme	The International EPD System www.environdec.com
Program operator	EPD International AB Box 210 60, SE-100 31 Stockholm, Sweden. Indian Regional Hub www.environdecindia.com
Declaration holder	Tata Steel Limited, 15th Floor, Tata Centre, 43 Jawaharlal Nehru Road, Kolkata - 700071
Product	Steel Hot Rolled Coil (HRC)
CPC Code	412 Products of iron or steel
EPD registration number	S-P-06474
Publication date	2023-02-10
Validity date	2028-02-10
Geographical scope	India
Reference standards	IS0 14020:2001, ISO 14025:2006, EN 15804:2012+A2:2019

Table 2 | PCR Information

Reference PCR	'Construction Products'2019:14, Version 1.2.5
Date of Issue	2022-11-01 (VALID UNTIL: 2024-12-20)

Table 3 | Verification Information

Demonstration of verification	External, independent verification
Third party verifier	Mr. Sunil Kumar CS, Founder and Principal Consultant, Chakra4 Sustainability Consulting Services, Ivory 501, HM World City, 9th Phase, J P Nagar, Bengaluru 560 108, Email: sunilkumar@chakra4.in

Table 4 | LCA Information

Title	Environmental Product Declaration of Hot Rolled Coil
Author	Dr. Rajesh Kumar Singh Thinkstep Sustainability Solutions Pvt. Ltd., a Sphera Company 707, Meadows, Sahar Plaza, Andheri Kurla Road, Andheri East, Mumbai, India - 400059 Email: rsingh@sphera.com
Reference standards	ISO 14040/44 standard

2.2 Reference Period of EPD Data

The reference period for the primary data (foreground data) used within this EPD is FY 2021-22. The background data used in the study have been applied through GaBi datasets which are less than 5 years old.

2.3 Geographical Scope of EPD Application

The geographical scope of this EPD is India.

2.4 Additional Information about EPD

This EPD provides information for the Steel Hot Rolled Coil manufactured by Tata Steel Limited at its Jamshedpur, Kalinganagar and Angul facilities in India. The EPD is in accordance with ISO 14025 and EN 15804+A2. EPD of construction products may not be comparable if they do not comply with EN 15804+A2. The Life Cycle Assessment (LCA) study carried out for developing this EPD for steel products is done as per ISO 14040 and ISO 14044 requirements.

Product Category Rules (PCR) for the assessment of the environmental performance of steel products is PCR for 'Construction Products' 2019:14, Version 1.2.5.

This PCR is applicable to the Steel Hot Rolled Coil Product complying with the applicable standard EN 15804+A2 (Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products).

3

Product Description and System Boundaries

3.1 Product Identification and Usage

1. Product Description

Steel slab (also known as crude steel) is the key raw material for hot rolled coil production and slabs are produced from slab caster which takes liquid steel produced from basic oxygen furnace as its raw material. Hot Rolled (HR) coils are produced at Tata Steel Limited at its Hot Strip Mills (HSM). Hot Rolled Coils are used in a variety of applications like Automobiles, Boiler and Pressure Vessels, Ship Building, Railways, Transmission Towers, Oil and Petrochemicals, Coal and Mining, General and Heavy Engineering.

Figure 1 Steel Hot Rolled Coil Product from Tata Steel Limited

2.Specifications of Tata Steel Hot Rolled Coil:

Parameter	Range
Thickness	1.6 - 25 mm
Width	900 – 2050 mm

The above product does not contain any substance whatsoever that can be included in the "Candidate List of Substances of Very High Concern for Authorization".

3.2 System boundary

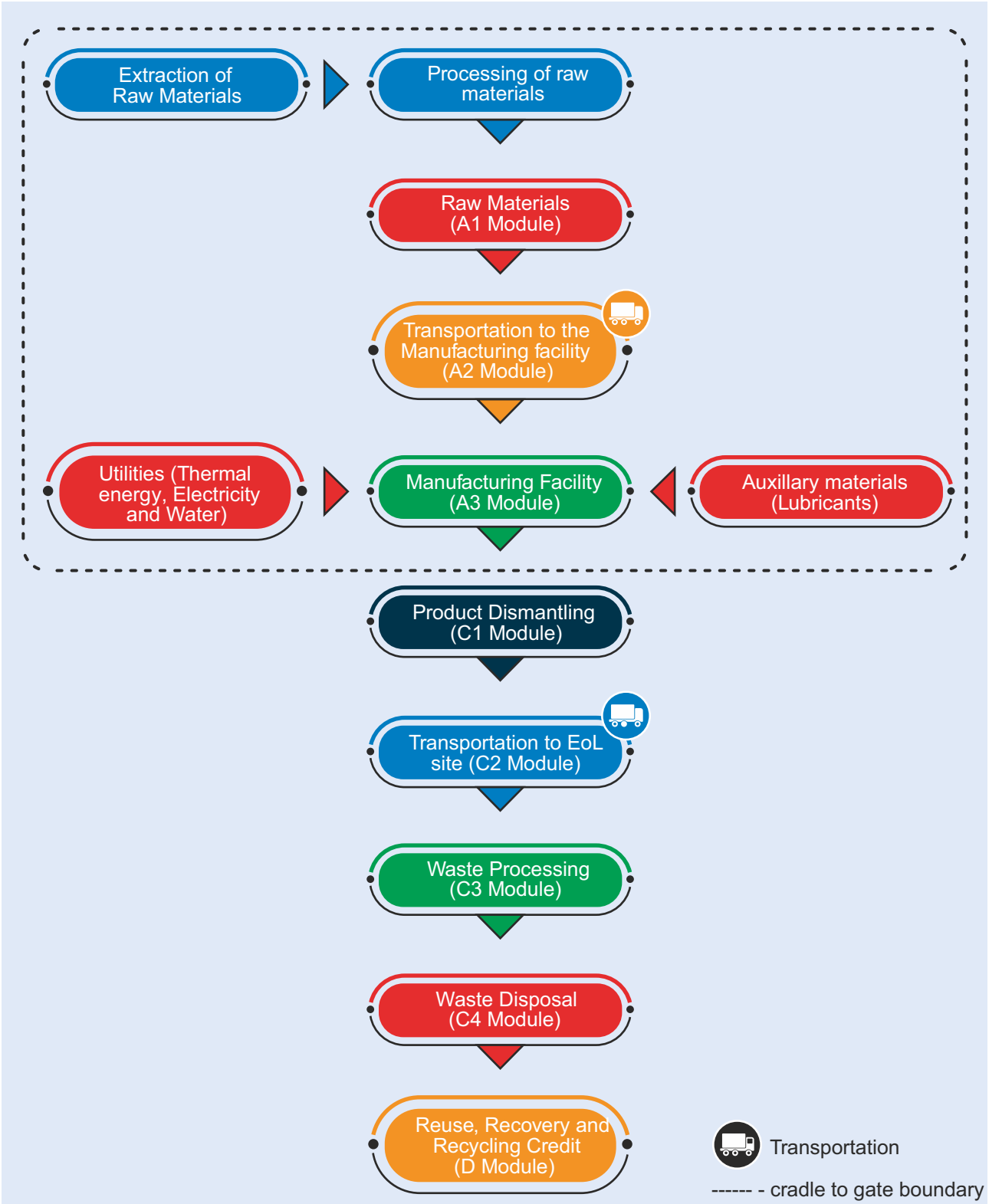

Figure 2 System boundary diagram (Cradle to gate with options)

3.3 Process Description

The technology used by Tata Steel for steel hot rolled coil production follows the 100% Blast Furnace (BF) with Basic Oxygen Furnace (BOF) route [Peacey and Davenport 1979]. In the BF-BOF technology, Hematite iron ore in the form of Agglomerates namely Sinter & Pellets are reduced in BF through the addition of carbon sources namely Metallurgical coke (made from Coking coal in coke ovens) and Pulverized coal. Gangue or impurity in the form of Alumina and Silica present in the iron ore is removed as Blast Furnace slag by the addition of Fluxes namely Limestone, Pyroxenite and Quartz. Hot metal is the primary output of the Blast Furnace produced along with the generation of blast furnace slag and blast furnace gas. While BF slag is processed further externally to produce Ground Granulated Blast Furnace Slag (GGBS) that gets used in Cement production for construction applications, the BF gas generated at Tata Steel Jamshedpur (TSJ) steel works is predominantly used within the works for heating and power generation.

Hot metal produced from Blast Furnace is collected in Torpedo ladles and sent to LD shops for further processing. The Hot Metal is first desulphurised and then charged in LD vessel for steel making. In LD vessel, the Hot Metal is converted into liquid steel by lowering the carbon content through blowing oxygen into the melt (exothermic reaction); this is known as Primary steelmaking. For temperature control, scrap in certain ratio is added to the melt along with Phosphorous removal. Based on the chemistry of the steel grade, the steel may be routed to Secondary steelmaking of Ladle Furnace and RH Degasser for addition of micro-alloying elements, chemistry and removal of dissolved gases.

Finally the liquid steel is transformed (cast) into a semi-finished product (i.e. crude steel Slabs) in a Continuous Slab Caster. Then the hot slabs are reheated and rolled into Hot Rolled Coils (HRC) in a Hot Strip mill (HSM). The HRC are sent to either downstream Cold Rolling Mill (CRM) for production of Cold Rolled Coils (CRC) or sold in the market.

Tata Steel Jamshedpur Works has one LD shop that produces steel slabs which are subsequently rolled in a Hot Strip Mill. The second LD shop in Jamshedpur feeds molten steel from BOF+LF in a Compact Strip Plant (CSP) which casts Transfer Bars (lower thickness than Slabs) which are then rolled in Rolling stands to produce HR Coils. Tata Steel Kalinganagar has one LD shop and Slab Casters followed by HSM to produce HRC. Tata Steel Meramandali has one Steel Melt Shop (SMS) having two LD vessels and one CONARC producing liquid steel which is cast into Slabs in Slab Casters and rolled in Hot Strip Mill to produce Hot Rolled Coils (HRC).

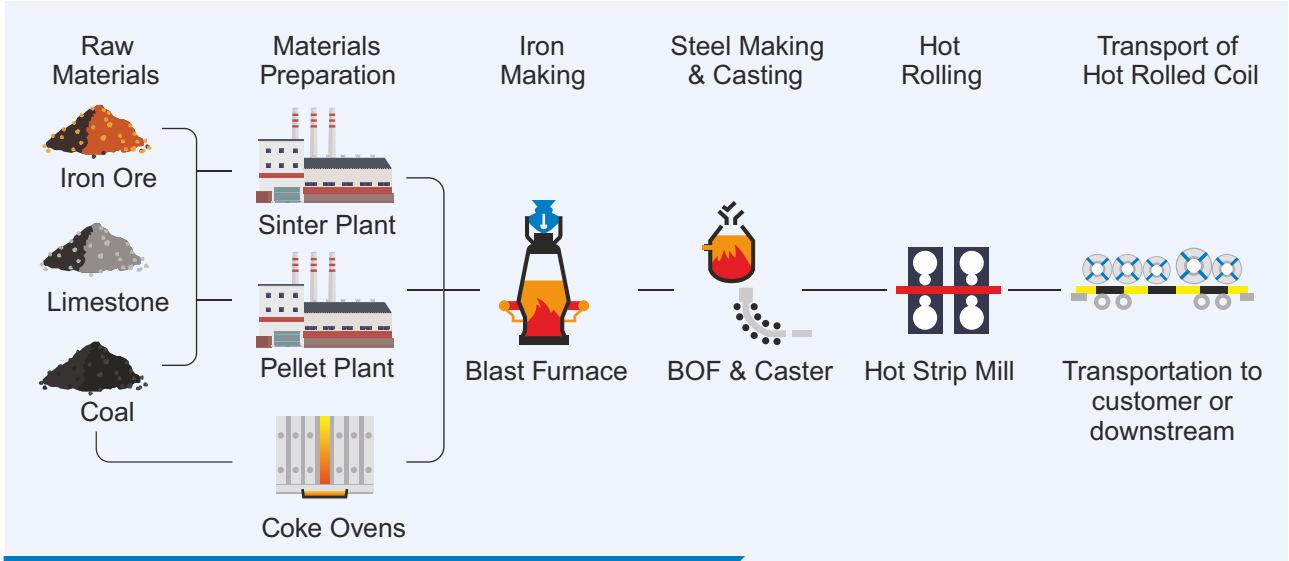

Figure 3 Process overview from raw materials to Hot Rolled Coil

4

Life Cycle Assessment

4.1 Information Sources and Data Quality

It is important that data quality is in accordance with the requirements of the LCA's goal and scope. This is essential to the reliability of LCA and achievement of the intended application. The quality of the LCI data for modelling the life cycle stages have been assessed according to ISO 14040:2006. Data quality is judged by its precision (measured, calculated or estimated), completeness (e.g. are there unreported emissions?), consistency (degree of uniformity of the methodology applied on an LCA serving as a data source) and representativeness (geographical, time period, technology). Primary data collected using data collection questionnaires was used for the study and for upstream processes GaBi 10.6 professional database 2021 was used.

4.2 Methodological Details

4.2.1 Co-Product Allocation

With any multi-product system, allocation rules are defined to relate the system inputs and outputs to each of the products. Several methods are documented in ISO 14040:2006 and ISO Technical Report 14049.

4.2.2 End-of-life phase

Steel is completely recyclable. Therefore, it is important to consider recycling in LCA studies involving steel, namely the steel scrap that is recycled from a final product at the end of its life. In addition, steel is a vital input to the steelmaking process, and this input of steel scrap should also be considered in LCA studies. Accounting for all these, the End-of -life credit for recycling is applied over 85% of steel (850 kg in 1 tonne of steel products).[1] The landfill is considered as 15% of steel (150 kg in 1 tonne of steel products).

4.2.3 Declared unit

The declared unit for the EPD is 1 tonne of Steel Hot Rolled Coil manufactured by Tata Steel Limited across its multiple facilities (Jamshedpur, Kalinganagar and Angul) in India.

4.2.4 Selection of application of LCIA categories

A list of relevant impact categories and category indicators is defined and associated with the inventory data. The environmental impact per declared unit for the following environmental impact categories were reported in the EPD according with EN15804+A2:2019 (Table 7), and divided into core, upstream (and downstream, if included) module

Table 5 | Environmental impacts indicators for EN15804+A2:2019

Impact category	Indicator	Unit
Climate change – total	Global Warming Potential total (GWP-total)	kg CO_2 eq.
Climate change - fossil	Global Warming Potential fossil fuels (GWP-fossil)	kg CO_2 eq.
Climate change - biogenic	Global Warming Potential biogenic (GWP-biogenic)	kg CO_2 eq.
Climate change - luluc	Global Warming Potential land use and land use change (GWP-luluc)	kg CO_2 eq.
Ozone Depletion	Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11 eq.
Acidification	Acidification potential, Accumulated Exceedance (AP)	Mole of H+ eq.
Eutrophication aquatic freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	kg PO_4 eq.
Eutrophication aquatic marine	Eutrophication potential, fraction of nutrients reaching marine end compartment (EP-marine)	kg N eq.
Eutrophication terrestrial	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	Mole of N eq.
Photochemical ozone formation	Formation potential of tropospheric ozone (POCP)	kg NMVOC eq.
Depletion of abiotic resources - minerals and metals	Abiotic depletion potential for non-fossil resources (ADP- minerals & metals)	kg Sb eq.
Depletion of abiotic resources - fossil fuels	Abiotic depletion for fossil resources potential (ADP-fossil)	MJ
Water use	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	m^3 world eq.

[1]World Steel Methodology Report, 2020

The consumption of natural resources per declared or function unit is reported in the EPD. Input parameters, in accordance with EN15804+A2, describing resource use are in Table 6.

Table 6 | Natural resources use parameters

Parameter	Unit
Renewable primary energy as energy carrier (PERE)	MJ
Renewable primary energy resources as material utilization (PERM)	MJ
Total use of renewable primary energy resources (PERT)	MJ
Non-renewable primary energy as energy carrier (PENRE)	MJ
Non-renewable primary energy as material utilization (PENRM)	MJ
Total use of non-renewable primary energy resources (PENRT)	MJ
Use of secondary material (SM)	kg
Use of renewable secondary fuels (RSF)	MJ
Use of non-renewable secondary fuels (NRSF)	MJ
Net freshwater Use (FW)	m3

Table 7 | Output flows and waste categories parameters

Parameter	Unit
Hazardous waste disposed (HWD)	kg
Non-hazardous waste disposed (NHWD)	kg
Radioactive waste disposed (RWD)	kg
Components for re-use (CRU)	kg
Materials for recycling (MFR)	kg
Materials for energy recovery (MER)	kg
Exported electrical energy (EEE)	MJ
Exported thermal energy (EET)	MJ

Table 8 | Additional parameters

Impact category	Indicator	Unit
Particulate matter emissions	Potential incidence of disease due to PM emissions (PM)	Disease incidences
Ionising radiation	Potential Human exposure efficiency relative to U235 (IRP)	kBq U235 eq.
Eco-toxicity (freshwater)	Potential Comparative Toxic Unit for ecosystems (ETP - fw)	CTUe
Human toxicity, cancer effects	Potential Comparative Toxic Unit for humans (HTP - c)	CTUh
Human toxicity, non-cancer effects	Potential Comparative Toxic Unit for humans (HTP - nc)	CTUh
Land use related impacts/ Soil quality potential	Potential soil quality index (SQP)	Pt

4.3 Cut-off Criteria

Criteria were set out in the original study for the recording of material flows and to avoid the need to pursue trivial inputs/outputs in the system. These are outlined below:

1. All energetic inputs to the process stages were recorded, including fuels, electricity, steam, and compressed air.
2. Each excluded material flow must not exceed 1% of mass, energy, or environmental relevance, for each unit process. Accordingly, 99% of the material flow were accounted.
3. The sum of the excluded material flows in the system must not exceed 5% of mass, energy, or environmental relevance and it has been complied.

4.4 System Boundaries

The study is a cradle-to-gate with additional modules LCA study. It covers the stages from production of raw materials to the End of Life of the product, excluding the use phase of the product. The scope covers raw material production (A1), inbound transportation (A2), manufacturing (A3), product dismantling (C1), transport of dismantled product to EoL site (C2), waste processing (C3), disposal (C4) as well as the end of life stage recycling (D) considerations. The scenarios included are currently in use and are representatives for one of the most likely scenario alternatives.

Table 9 | Details of system boundary included in the study

EPD Module	Life Cycle Stages	Life Cycle Sub-Stages	Definitions
A1	Materials	Primary raw materials Production	Extraction, production of the raw materials.
A2	Upstream Transport	-	Transport raw materials to the manufacturing unit
A3	Manufacturing	Ironmaking, steelmaking shop and utilities and packaging materials	Manufacturing of various grades of Hot rolled Steel coil and production of steel slab across various shops i.e. Sinter plant, pellet plant, coke palnt, Blast Furnace
C1	Product Dismantling	-	Dismantling of the steel hot rolled coil product
C2	Transport to EoL site	-	Transport of the dismantled product to the EoL site
C3	Waste Processing	-	Waste processing of the dismantled product (85% steel recycling)

C4	Disposal	-	Disposal of the dismantled products (i.e. landfill) 15% of steel product is send to landfill.
D	EoL Credit	-	Steel is a 100% recyclable material and as per World Steel Data 85% recoverability is observed. Thus 85% is considered for EoL credit.

4.4.1 Geographic System Boundaries

The geographical coverage of this study covers the production of Hot rolled steel coil by Tata Steel in its Jamshedpur, Kalinganagar and Angul works facilities. Indian specific datasets wherever possible have been adapted and others dataset were chosen from EU if no Indian datasets were available. In addition, imported raw materials are considered along with transport. All the primary data has been collected from Tata Steel Limited in co-operation with experts from Sphera (formerly Thinkstep AG).

4.4.2 Temporal System Boundaries

The data collection is related to one year of operation and the year of the data is indicated in the questionnaire for each data point. The data was derived for the FY 2021 - 2022. It is believed to be representative of steel production during this time frame.

4.4.3 Technology coverage

In the present study, steel slab is the major raw material in the production of the steel hot rolled coil.

4.5 Software and database

The LCA model was created using the GaBi 10.6 Software system for life cycle engineering, developed by Sphera Solutions Inc. The GaBi database provides the life cycle inventory data for several of the raw and process materials obtained from the upstream system. Detailed database documentation for GaBi datasets can be accessed at:

https://sphera.com/product-sustainability-gabi-data-search/.

4.6 Comparability

According to the standards, EPDs do not compare the environmental performance of products in the sector. Any comparison of the declared environmental performance of products lies outside the scope of these standards and is suggested to be feasible only if all compared declarations follow equal standard provisions.

“EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterization factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025."

4.7 Results

Modules of the life cycle included as per PCR is given in.

4.7 Results

Modules of the life cycle included as per PCR is given in Table 10.

Table 10 | Modules of the production life cycle included (X = declared module; MNA = module not applicable)

Production			Installation		Use stage							End-of-Life				Credits & charges outside system boundary
Raw material supply	Transport to manufacturer	Manufacturing	Transport to building site	Installation into building	Use / application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to EoL	Waste processing for reuse, recovery, recycle	Disposal	Reuse, recovery, or recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	X	X	X	X	X

4.7.1 LCIA results for 1 tonne of Steel Hot Rolled Coil

The LCIA results for 1 tonne of Steel Hot Rolled Coil is given in Table 11 to Table 15. The estimated results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.

Table 11 | Environmental impacts for 1 tonne of Steel Hot Rolled Coil

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
GWP - total	kg CO2 eq.	3.24E+02	9.56E+01	2.44E+03	6.10E+00	4.08E+00	0.00E+00	7.18E+00	-1.48E+03
GWP - fossil	kg CO2 eq.	3.25E+02	9.56E+01	2.44E+03	6.11E+00	4.08E+00	0.00E+00	7.40E+00	-1.48E+03
GWP - biogenic	kg CO2 eq.	-5.46E-01	-2.01E-03	-7.11E-02	-3.80E-03	8.14E-07	0.00E+00	1.59E-01	-2.12E+00
GWP - luluc	kg CO2 eq.	2.38E-01	3.28E-02	4.93E-01	3.16E-04	2.11E-04	0.00E+00	7.20E-03	4.22E-02
ODP	kg CFC-11 eq.	1.69E-09	3.57E-14	7.29E-11	3.03E-16	2.02E-16	0.00E+00	1.64E-14	3.23E-12
AP	Mole of H+ eq.	1.45E+00	2.44E+00	5.72E+00	7.26E-03	3.47E-02	0.00E+00	2.38E-02	-3.30E+00
EP - freshwater	kg P eq.	1.27E-04	3.12E-05	2.38E-04	1.29E-06	8.59E-07	0.00E+00	5.67E-06	-8.38E-04
EP - marine	kg N eq.	3.61E-01	6.43E-01	7.27E-01	8.39E-04	1.57E-02	0.00E+00	5.78E-03	-6.01E-01
EP - terrestrial	Mole of N eq.	3.97E+00	7.05E+00	7.96E+00	9.27E-03	1.72E-01	0.00E+00	6.34E-02	-6.09E+00
POCP	kg NMVOC eq.	1.07E+00	1.75E+00	2.18E+00	3.84E-03	2.99E-02	0.00E+00	1.83E-02	-2.48E+00
ADPE	kg Sb eq.	1.84E-03	9.28E-06	1.58E-05	6.33E-08	4.22E-08	0.00E+00	5.00E-07	-2.40E-02
ADPF	MJ	2.36E+04	1.16E+03	5.49E+03	8.14E+01	5.43E+01	0.00E+00	1.06E+02	-1.27E+04
WDP	m³ world equiv.	2.83E+01	1.85E+00	1.24E+02	1.88E-02	1.26E-02	0.00E+00	-7.97E-02	-1.12E+02

GWP - total = global warming potential; GWP - fossil = global warming potential (fossil fuel only); GWP - biogenic = global warming potential (biogenic); GWP - luluc = global warming potential (land use only); ODP = ozone depletion; AP = acidification terrestrial and freshwater; EP - freshwater = eutrophication potential (freshwater); EP - marine = eutrophication potential (marine); EP- terrestric = eutrophication potential (terrestrial); POCP = photochemical ozone formation; ADPE = abiotic depletion potential (element), ADPF = abiotic depletion potential (fossil) WDP = water scarcity.

Table 12 | Resource use for 1-tonne of Steel Hot Rolled Coil

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
PERE	MJ	1.04E+02	2.75E+01	3.87E+02	2.91E-01	1.94E-01	0.00E+00	7.41E+00	9.87E+02
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
PERT	MJ	1.04E+02	2.75E+01	3.87E+02	2.91E-01	1.94E-01	0.00E+00	7.41E+00	9.87E+02
PENRE	MJ	1.65E+04	1.21E+03	1.25E+04	8.14E+01	5.43E+01	0.00E+00	1.06E+02	-1.27E+04
PENRM	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
PENRT	MJ	1.65E+04	1.21E+03	1.25E+04	8.14E+01	5.43E+01	0.00E+00	1.06E+02	-1.27E+04
SM	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
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+0	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+0	0.00E+00	0.00E+00	0.00E+00
FW	m3	7.23E-01	6.54E-02	4.33E+00	6.46E-04	4.31E-04	0.00E+00	1.41E-03	-2.61E+00

PERE = Use of renewable primary energy as energy; PERM = Use of renewable primary energy as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy as raw materials; PENRM = Use of non-renewable primary energy d as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

Table 13 | Output flows and waste categories for 1-tonne of Steel Hot Rolled Coil

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
HWD	kg	4.07E-05	3.60E-07	3.32E-06	4.34E-09	2.89E-09	0.00E+00	4.80E-07	-1.63E-03
NHWD	kg	2.17E+00	7.84E-02	9.11E-01	1.01E-03	6.77E-04	0.00E+00	1.50E+02	1.52E+02
RWD	kg	1.55E-02	3.13E-03	2.85E-02	1.69E-05	1.13E-05	0.00E+00	1.25E-03	4.53E-04
CRU	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
MFR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.50E+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
EEE	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
EET	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

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

Table 14 | Biogenic carbon content of product and packaging for 1-tonne of Steel Hot Rolled Coil

Parameter	A1	A2	A3	C1	C2	C3	C4	D
Biog. C in product [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
Biog. C in packaging [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

Biog. C in packaging = Biogenic carbon content in packaging; Biog. C in product = Biogenic carbon content in product

Table 15 | Additional Environmental parameters for 1-tonne of Steel Hot Rolled Coil

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D
PM	Disease incidences	1.95E-05	3.99E-05	6.71E-05	6.14E-08	2.23E-07	0.00E+00	2.56E-07	-4.96E-05
IR	kBq U235 eq.	1.00E+00	2.77E-01	2.68E+00	1.61E-03	1.07E-03	0.00E+00	1.78E-01	2.74E+01
ETF-fw	CTUe	2.18E+03	1.03E+03	6.79E+02	2.80E+01	1.87E+01	0.00E+00	3.15E+01	-7.55E+01
HTP-c	CTUh	1.98E-08	1.70E-08	3.42E-08	4.74E-10	3.21E-10	0.00E+00	3.62E-09	4.54E-07
HTP-nc	CTUh	1.81E-06	5.95E-07	2.66E-06	1.52E-08	1.55E-08	0.00E+00	3.64E-07	-1.53E-05
SQP	Pt	4.24E+02	3.85E+01	5.89E+02	3.51E-01	2.34E-01	0.00E+00	8.02E+00	3.43E+02

PM = Particulate matter emissions; IR = Ionising radiation, human health; ETF= Eco-toxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects; SQP = Soil quality potential/Land use related impacts

4.8 Interpretation

The interpretation of the results for 1 tonne of Steel Hot Rolled Coil are presented in Table 16.

Table 16 | Interpretation of most significant contributors to life cycle parameters (Steel Hot Rolled Coil)

Parameter		Most significant contributor
Abiotic Depletion Potential (ADP) -Elements		The total cradle to gate impact is 1.87E-03 kg Sb eq. In A1 – A3 module around 99% of the impact is from manufacturing of steel slab. A total credit of 2.40E-02 kg Sb eq is taken in module D.
Acidification Potential (AP)		The total cradle to gate impact is 9.61E+00 Mole of H+ eq. In A1 – A3, steel slab manufacturing (90.3%) followed by electricity (7.1%) has the highest impact. A total credit of 3.30E+00 Mole of H+ eq is taken in module D.
Eutrophication Potential (EP)		The total cradle to gate impact is 3.96E-04 kg P eq. In A1 – A3, steel slab manufacturing (87.3%) followed by electricity (10.23%) has the highest impact. A total credit of 8.38E-04 kg P eq is taken in module D.
Global Warming Potential (GWP 100 years)		The total cradle to gate impact is 2859.60 kg CO2 eq. In A1 – A3, steel slab manufacturing (88.6%) followed by electricity (4.3%) has the highest impact A total credit of 1.48E+03 kg CO2 eq is taken in the module D.
Ozone Layer Depletion Potential (ODP, steady state)		The total cradle to gate impact is 1.76E-09 kg CFC eq. In module A1 – A3, around 99% of the impact is from manufacturing of steel slab. A total credit of 3.23E-12 kg CFC-11 eq is taken in module D.
Photochemical Ozone Creation Potential (POCP)		The total cradle to gate impact is 5.00E+00 kg NMVOC eq In A1 – A3, , steel slab manufacturing (92.6%) followed by electricity (5.1%) has the highest impact. A total credit of 2.48E+00 kg NMVOC eq is taken in module D.
Abiotic depletion potential (ADP) - Fossil		The total cradle to gate impact is 3.03E+04 MJ. In A1 – A3, around 96% of the impact is from manufacturing of steel slab. A total credit of 1.27E+04 MJ is taken in module D.

Concluding, the study provides fair understanding of environmental impacts during the various life cycle stages of steel production. It also identifies the hot spots in the value chain where improvement activities can be prioritised and accordingly investment can be planned. The scope covers the ecological information to be divided into raw material production (A1), transportation (A2), manufacturing (A3), product dismantling (C1), transport of dismantled product to EoL site (C2), waste processing (C3), waste disposal (C4)as well as the end of life stage recycling (D) considerations.

4.9 LCA Terminology

Cradle to Gate	Scope of study extends from mining of natural resources to the completed product ready for shipping from the manufacturing dispatch “gate”, known as Modules A1-A3.
Cradle to Grave	Scope of study extends from mining of natural resources to manufacture, use and disposal of products at End of Life, including all Modules A-D.
End of life	Post-use phase life cycle stages involving collection and processing of materials (e.g. scrap) and recycling or disposal, known as Modules C and D.

5 Other Environmental Information

The constituent materials used within our products are responsibly sourced and we apply the principles of Sustainable Development and of Environmental Stewardship as a standard business practice in our operations. Protecting the environment by preserving non-renewable natural resources, increasing energy efficiency, reducing the environmental emissions, limiting the impact of materials transportation to and from our operations is part of our way in doing business.

6 References

- EN 15804: 2012+A2:2019, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
- GaBi 10 2021: Dokumentation der GaBi-Datensätze der Datenbank zur Ganzheitlichen Bilanzierung. LBP, Universität Stuttgart und PE International, 2012
- GaBi 10 2021: Software und Datenbank zur Ganzheitlichen Bilanzierung. LBP, Universität Stuttgart und PE International, 2012
- ISO 14020:2000 Environmental labels and declarations - General principles
- ISO 14025:2006 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/TR 14049:2012 Environmental management — Life cycle assessment — Illustrative examples on how to apply ISO 14044 to goal and scope definition and inventory analysis.
- WSI and Eurofer’s Co-product Allocation Methodology 2014 - A methodology to determine the LCI of Steel industry Co-products.
- World Steel Association - CO2 Data Collection User Guide, Version 9 (May 2019)
- World Steel Association – Life Cycle Inventory Methodology Report for Steel Products 2017