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JINDAL STEEL & POWER

Environmental Product Declaration

Average Plate & Coil Steel Product

ISO 14020:2000, ISO 14025:2006, ISO 14040:2006, ISO 14044:2006, EN 15804:2012+A2:2019/AC:2021

EPD Registration Number	Publication Date	Validity Date	Geographical Scope
S-P-09806	23-09-05	28-09-04	Global

ECO PLATFORM EPD VERIFIED

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1. Introduction

Jindal Steel and Power is an Indian steel company which is a part of OP Jindal Group. In terms of tonnage, it is the third largest private steel producer in India and only private player in India to produce rails. JSP is an industrial powerhouse with a dominant presence in steel, power, mining and infrastructure sectors. Part of the OP Jindal Group this young, agile and responsive company is constantly expanding its capabilities to fuel its fairy tale journey that has seen it grow to a US $ 7.6 billion business conglomerate. Led by Mr Naveen Jindal, the youngest son of the legendary Shri O.P. Jindal, the company produces economical and efficient steel and power through backward and forward integration. JSP's business operations span across the states of Chhattisgarh, Odisha and Jharkhand in India, where it operates some of India's most advanced steel manufacturing and power generation capacities of global scale. JSP has created cutting-edge capacities to produce up to 9.6 Million Tonne Per Annum (MTPA) crude steel through a judicious mix of Direct Reduced Iron (DRI) & Blast Furnace route catering to steelmaking facilities located at Angul with 6 MT & at Raigarh 3.6 MT plant capacity. All facilities at JSP are ISO 9001, ISO 14001 & ISO 45001 certified. In India, the company has a well spread out installed finished steel capacity of 6.65 MTPA prudently spread over Bar Mills, Wire rod Mills, Plate Mills, Rail Mill & Special Profile Mill with below breakup capacity :

Angul: Plate Mill (1.2MTPA) & Bar Mill (1.4MTPA)
Raigarh: Plate Mill (1MTPA), Rail Mill (0.75MTPA) & SPM (0.7MTPA)
Patratu: Bar Mill (1MTPA) & Wirerod Mill (0.6MTPA)

Plates & Coils are manufactured at Raigarh and Angul plants of JSP.

- Raigarh- Plates & Coils.
- Angul- Plates.

Alongside contributing to India's growth story, the company is driving an ambitious global expansion plan with its sights set on emerging as a leading transnational business group. The company continues to capitalise on opportunities in high growth markets, expanding its core areas and diversifying into new businesses. JSP's global operations include a 2 MTPA integrated steel complex at Sohar, Oman and 6.6 MTPA coal-mining operations spread across South Africa, Mozambique and Australia. The company's export portfolio is growing by the day with an existing export footprint in various countries.

Thinkstep Sustainability Solutions Pvt. Ltd, a Sphera Company (formerly thinkstep AG). has been entrusted to conduct Life Cycle Assessment for JSP Plate & Coils steel products as per the ISO 14040/44. The LCA model was created using the GaBi ts Software system for life cycle engineering, developed by Sphera (formerly thinkstep AG).

2. General Information

Environmental Product Declaration in accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021.

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 info@environdec.com	Indian Regional Hub www.environdecindia.com
Declaration holder[1]	Mr. Sanjay Nandanwar Jindal Steel & Power 2nd Floor, Tower-B, Plot No.2, Sector-32, Gurgaon-122001, Haryana, India Email: sanjay.nandanwar@jindalsteel.com Website: https://www.jindalsteelpower.com/	
Product	Steel Plate & Coil	
CPC Code	412 (Version 2.1)	
Geographical scope	Global	
Reference standards	ISO 14020:2001, ISO 14025:2006, EN 15804:2012+A2:2019	

Table 2. PCR Information

Reference PCR	'Construction Products and Construction Services' Version 1.2.5, 2019:14
Date of Issue	2022-07-08 (Version 1.2.5) (VALID UNTIL: 2024-12-20)

Table 3. Verification Information

Demonstration of verification	External, independent verification
Third party verifier	Dr. Hüdai Kara, Metsims Sustainability Consulting, 4 Clear Water Place, Oxford OX2 7NL, UK Email: hudai.kara@metsims.com

Table 4. LCA Information

Title	Environmental Product Declaration of Steel Plate & 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

[1] EPD owner has the sole ownership, liability, and responsibility for the EPD.

2.2 Reference Period of EPD Data

The reference period for the primary data (foreground data) used within this EPD is April 2021 – March 2022. 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 Global.

2.4 Additional Information about EPD

This EPD provides information for the Steel Plate & Coil product of JSP manufactured at Raigarh and Angul plants 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 Plate & Coil steel product 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 and Construction Services', Version 1.2.5, 2019:14.

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

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 characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

3. Product Description and System Boundaries

3.1 Product Identification and Usage

JSP Steel Plate & Coil have wide application across verticals due to its ultra-wide range and grades produced using state of the art technology in Angul and Raigarh plants. Plates are used in construction (Bridges, dams, highways, buildings & civil structures and for industrial fabrication work), windmill, boiler and pressure vessel, transportation (Ship building, railways & wagon builders), line pipes and offshore platforms, yellow goods and mining equipment, pre-engineered buildings and defence sector too.

The plates are manufactured through continuous casting and subsequent hot rolling of slabs. JSP is equipped with India's first state-of-the-art plate mill that produces plates and coils. These plates and coils are of premium quality in terms of dimensional adherence and internal soundness owing to its clean raw material, sound steel refining facilities and an efficient rolling mill.

Table 5: Content Declaration

Product Component Grade- ASTM A572 GR 50	Weight, %	Biogenic material, weight % and kg C/kg
Iron (Fe)	>97	-
C	0.23 Max	-
Si	0.40 Max	-
Mn	1.35 Max	-
Cr	-	-
P	0.030 Max	-
S	0.030 Max	-
Ni	-	
Cu	-	-
Mo	-	
Sum	100%	
Packaging Materials	**Weight, %**	**Biogenic material, weight % and kg C/kg**
Wooden box	22.93%	0.4
Plastic (Tarpaulin)	75.51%	-
Steel strap	1.56%	-
Sum	100%	

3.2 System boundary

Figure 1 given below represents system boundary diagram of the study.

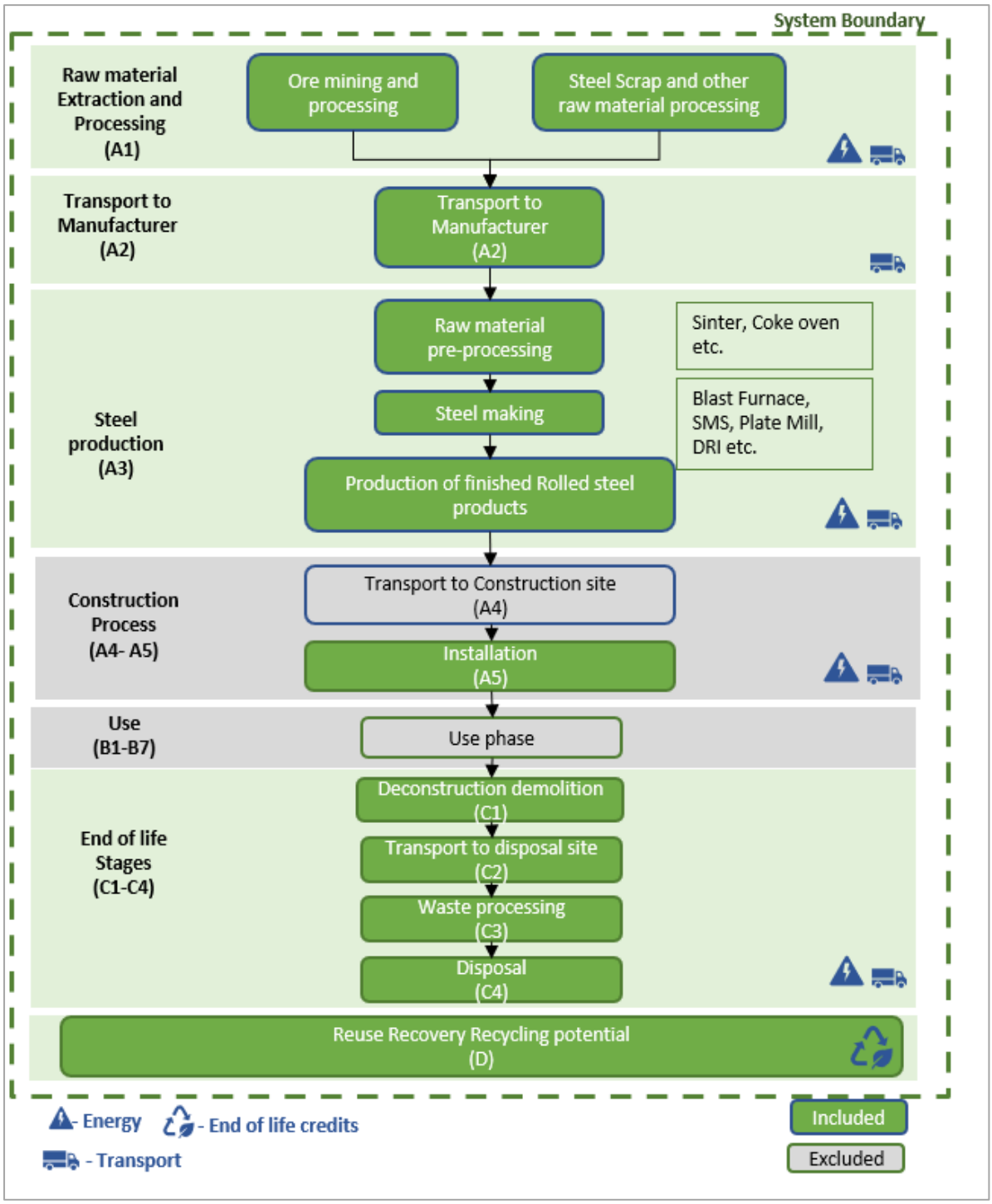


Figure 1: System Boundary for Steel Plate & Coil Production (Schematic)

3.3 Process Description

Products are manufactured using multiple technologies. JSP's steel plant has sinter plant, Coke ovens, Blast furnaces along with a SMS plant, Direct Reduced Iron (DRI). There are many auxiliary units such as

Raw material handling System (RMHS), Oxygen plant, Nitrogen plant, Producer gas plant & Coal Gasification plant. There is captive power plant on site. Further the surplus power generated is exported to the grid. Steel plant is a zero-discharge plant, and it also uses treated water from Sewage treatment plant.

Iron ore fines sintered into porous mass to make them as feed material for blast furnace iron making. The hot metal produced in the Blast furnace (BF) is transferred into the SMS/Basic Oxygen Furnace (BOF) / New Electric Oxygen Furnace (NEOF). In this vessel, the iron is converted into steel by lowering the carbon content of the iron by blowing oxygen into the melt (exothermic reaction). Refining (lowering of sulphur, phosphorous and other tramp elements) and alloying with micro-alloying elements is applied according to steel grade to give the requested characteristics for the steel. The production also includes the Electric Arc Furnace (EAF) route. The raw material input consists of Direct Reduced Iron (DRI), Hot metal, Ferro alloys along with allied materials. This raw material is charged to the electric arc furnace. Initially melting takes place by the addition of oxygen and/or fuels. In the oxidation phase, the slag is formed for removal of undesired materials by the addition of lime and coke. In the reduction phase, the slag is reduced for oxygen and sulphur removal. At the end of the steelmaking process, the liquid steel is transformed into a semi-finished product in a continuously casted steel slab.

The most common way that steel plates are manufactured is through hot rolling, where steel slabs are heated until they are more malleable. The steel is then run through a series of rollers that flatten and thin them out to the desired thickness. Then the product is sent for packaging.

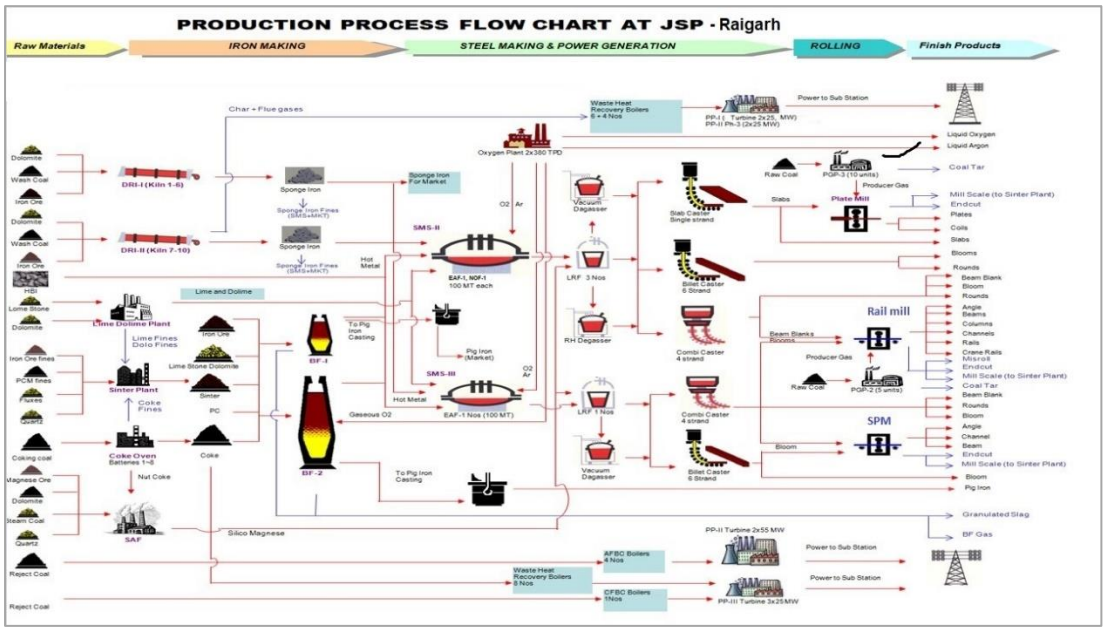


Figure 2: Manufacturing Process at Raigarh Plant, JSP

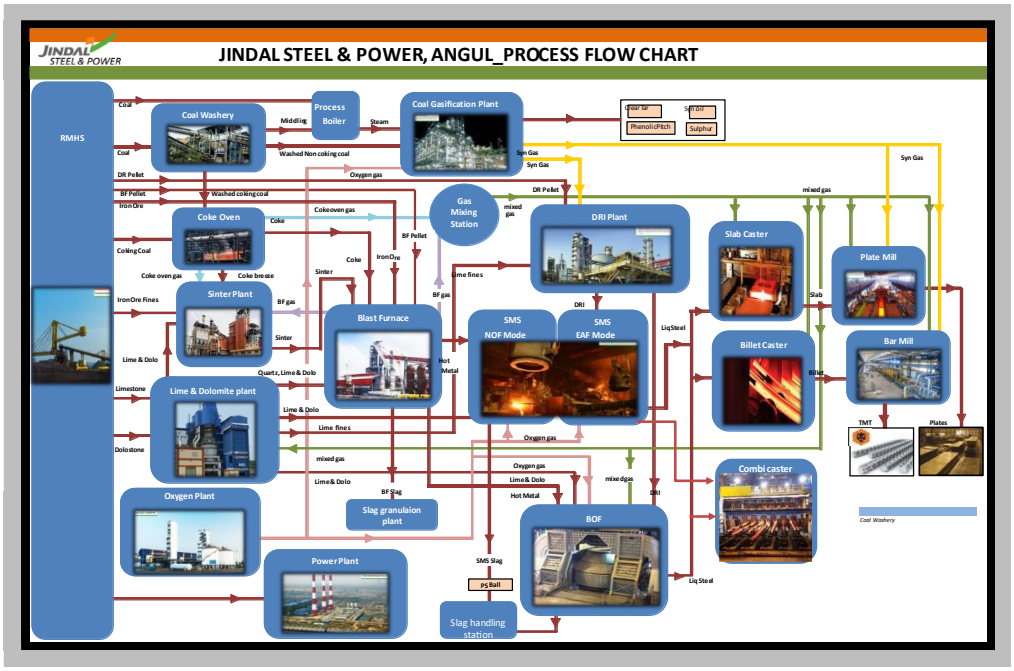


Figure 3: Manufacturing Process at Angul Plant, JSP

4. LCA

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 CUP 2023.1 Modelling database was used.

4.2 Methodological Details

4.2.1 Declared unit

The declared unit for the EPD is 1 tonne of Average Steel Plate & Coil manufactured at Raigarh and Angul plants at JSP, India.

4.2.2 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 in Table 6 and divided into Production, Installation, Use stage, End-of-Life module and Credits & charges outside system boundary (if included).

Table 6. 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 P 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[2]	Abiotic depletion potential for non-fossil resources (ADP- minerals & metals)	kg Sb eq.
Depletion of abiotic resources - fossil fuels[2]	Abiotic depletion for fossil resources potential (ADP-fossil)	MJ
Water use[2]	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	m^3 world eq.

The consumption of natural resources per declared or function unit is reported in the EPD. Input parameters, according with EN15804+A2, describing resource use are shown in Table 7.

Table 7. 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)	m^3

Table 8. 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 9. Additional parameters

Impact category	Indicator	Unit
Particulate matter emissions	Potential incidence of disease due to PM emissions (PM)	Disease incidences
Ionising radiation[1]	Potential Human exposure efficiency relative to U235 (IRP)	kBq U235 eq.
Eco-toxicity (freshwater)[2]	Potential Comparative Toxic Unit for ecosystems (ETP - fw)	CTUe
Human toxicity, cancer effects[2]	Potential Comparative Toxic Unit for humans (HTP - c)	CTUh
Human toxicity, non-cancer effects[2]	Potential Comparative Toxic Unit for humans (HTP - nc)	CTUh
Land use related impacts/ Soil quality potential[2]	Potential soil quality index (SQP)	Pt

**Disclaimer 1 – 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 2 – 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 experienced with the indicator.*

4.2.3 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 heating fuels and electricity.

2. The sum of the excluded material flows must not exceed 5% of mass, energy, or environmental relevance. However, in reality at least 99.9% of material inputs to each process stage were included.

3. Wastes representing less than 1% of total waste tonnage for given process stages were not recorded unless treated outside of the site.

4.3 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. The inventory for this product was provided so the allocation/apportion was not applied in terms of mass or production volume for any data points. However, the mass allocation has been applied as follows for the sub processes:

Table 10: Allocation Applied

Process Name	Product
Blast Furnaces	Hot metal
	BF slag
EAF	Liquid steel
	EAF Slag

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 the ecological information to be divided into raw material production (A1), inbound transportation (A2), Manufacturing (A3), treatment of packaging materials (A5), transport of dismantled product to EoL site (C2), waste processing (C3), disposal (C4) as well as the end of life stage recycling (D) considerations.

4.4.1 Geographic System Boundaries

The geographical coverage of this study covers the production of Plate & Coil steel product at JSP in India. 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 Raigarh and Angul plant of JSP in cooperation 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 April 2021 – March 2022. It is believed to be representative of steel production during this time frame.

4.4.3 Technology coverage

All models are representative of the technology used at each production site. Primary data is used for all gate-to-gate processes. Steel is produced predominantly by two process routes: the blast furnace/basic oxygen furnace route and the electric arc furnace route in Raigarh and Angul plants.

4.5 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, liquid 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 88% of steel (880 kg in 1 tonne of steel products).[2] The landfill is considered as 12% of steel (120 kg in 1 tonne of steel products).

4.6 Software and database

The LCA model was created using the GaBi CUP 2023.1 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/

4.7 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.

[2] Life cycle inventory (LCI) study (worldsteel.org)

4.8 Results

Modules of the life cycle included as per PCR is given in Table 11.

Table 11. Modules of the production life cycle included (X = declared module; MND = module not declared)

	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
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	MND	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X
Geography	Global																
Specific data used				-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation - products	NA																
Variation – Sites	Raigarh & Angul plants (India)																

4.8.1 LCIA results for 1 tonne of Steel Plate & Coil Product

The LCIA results for 1 tonne of Steel Plate & Coil are given in Table 12 - Table 16.

Table 12. Environmental impacts for 1 tonne of Steel Plate & Coil

1. Environmental impact indicators							
Parameters	A1-A3	A5	C1	C2	C3	C4	D
Climate Change - total [kg CO_2 eq.]	3.65E+03	2.14E+01	0.00E+00	5.24E+00	0.00E+00	1.82E+00	-1.54E+03
Climate Change, fossil [kg CO_2 eq.]	3.66E+03	1.43E+00	0.00E+00	5.06E+00	0.00E+00	1.80E+00	-1.54E+03
Climate Change, biogenic [kg CO_2 eq.]	-1.72E+01	2.00E+01	0.00E+00	1.76E-01	0.00E+00	6.76E-03	7.80E-01
Climate Change, land use and land use change [kg CO_2 eq.]	3.89E-01	2.31E-04	0.00E+00	6.49E-05	0.00E+00	5.60E-03	-3.81E-02
Ozone depletion [kg CFC-11 eq.]	4.05E-10	3.71E-12	0.00E+00	7.72E-14	0.00E+00	4.58E-12	-2.97E-11
Acidification [Mole of H+ eq.]	7.80E+00	7.87E-03	0.00E+00	2.54E-02	0.00E+00	1.28E-02	-3.40E+00
Eutrophication, freshwater [kg P eq.]	8.38E-04	1.94E-04	0.00E+00	9.86E-07	0.00E+00	3.63E-06	-2.82E-04
Eutrophication, marine [kg N eq.]	1.06E+00	2.07E-03	0.00E+00	9.17E-03	0.00E+00	3.30E-03	-5.91E-01
Eutrophication, terrestrial [Mole of N eq.]	1.16E+01	2.60E-02	0.00E+00	1.01E-01	0.00E+00	3.63E-02	-5.22E+00
Photochemical ozone formation, human health [kg NMVOC eq.]	3.18E+00	5.88E-03	0.00E+00	2.60E-02	0.00E+00	9.97E-03	-2.38E+00
Resource use, mineral and metals [kg Sb eq.]	4.41E-04	3.86E-08	0.00E+00	2.71E-08	0.00E+00	8.31E-08	-3.80E-03
Resource use, fossils [MJ]	3.71E+03	2.02E+01	0.00E+00	7.01E+01	0.00E+00	2.40E+01	-1.41E+04
Water use [m^3 world equiv.]	1.98E+01	2.21E+00	0.00E+00	5.73E-03	0.00E+00	1.98E-01	-2.84E+02

Table 13. Resource use indicators for 1 tonne of Steel Plate & Coil

2. Resource use indicators							
Parameters	A1-A3	A5	C1	C2	C3	C4	D
Use of renewable primary energy (PERE) [MJ]	6.11E+02	4.50E+01	0.00E+00	6.78E-02	0.00E+00	3.91E+00	8.63E+02
Primary energy resources used as raw materials (PERM) [MJ]	4.26E+01	-4.26E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of renewable primary energy resources (PERT) [MJ]	6.54E+02	2.44E+00	0.00E+00	6.78E-02	0.00E+00	3.91E+00	8.63E+02
Use of non-renewable primary energy (PENRE) [MJ]	3.55E+03	3.00E+02	0.00E+00	7.01E+01	0.00E+00	2.40E+01	-1.42E+04
Non-renewable primary energy resources used as raw material (PENRM) [MJ]	2.80E+02	-2.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources (PENRT) [MJ]	3.83E+03	2.02E+01	0.00E+00	7.01E+01	0.00E+00	2.40E+01	-1.42E+04
Secondary Material [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels (RSF) [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels (NRSF) [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water (FW) [m^3]	1.14E+00	5.27E-02	0.00E+00	1.82E-04	0.00E+00	6.06E+00	-6.43E+00

Table 14: Output flows and waste categories for 1 tonne of Steel Plate & Coil

3. Output flows and waste categories							
Parameters	A1-A3	A5	C1	C2	C3	C4	D
Hazardous waste disposed (HWD) [kg]	5.69E-08	8.03E-10	0.00E+00	6.12E-12	0.00E+00	5.23E-10	-1.10E-07
Non-hazardous waste disposed (NHWD) [kg]	1.32E+01	1.50E+01	0.00E+00	9.85E-04	0.00E+00	1.20E+02	2.12E+02
Radioactive waste disposed (RWD) [kg]	3.88E-02	3.74E-04	0.00E+00	7.73E-06	0.00E+00	2.73E-04	5.99E-04
Materials for Recycling (MFR) [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.80E+02	0.00E+00	0.00E+00
Materials for energy recovery (MER) [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy (EEE) [MJ]	0.00E+00	2.84E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy (EET) [MJ]	0.00E+00	5.11E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 15: Biogenic carbon content of product and packaging for 1 tonne of Steel Plate & Coil

4. Biogenic carbon content							
Parameters	A1-A3	A5	C1	C2	C3	C4	D
Biogenic carbon content in product [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Biogenic carbon content in packaging [kg]	4.71E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

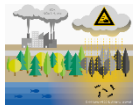
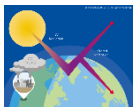
Table 16: Additional Environmental parameters for 1 tonne of Steel Plate & Coil

5. Optional indicators							
Parameters	A1-A3	A5	C1	C2	C3	C4	D
Particulate matter [Disease incidences]	6.65E-05	7.29E-08	0.00E+00	5.54E-07	0.00E+00	1.57E-07	-4.82E-05
Ionising radiation, human health [kBq U235	3.32E+00	5.51E-02	0.00E+00	7.03E-04	0.00E+00	3.16E-02	3.42E+01
Ecotoxicity, freshwater [CTUe]	2.14E+03	1.58E+01	0.00E+00	2.85E+01	0.00E+00	1.32E+01	-8.78E+02
Human toxicity, cancer [CTUh]	5.91E-08	8.21E-10	0.00E+00	4.74E-10	0.00E+00	2.02E-09	-6.25E-07
Human toxicity, non-cancer [CTUh]	1.91E-06	5.78E-08	0.00E+00	1.60E-08	0.00E+00	2.22E-07	-2.06E-05
Land Use [Pt]	3.26E+03	2.50E+00	0.00E+00	6.90E-02	0.00E+00	5.83E+00	1.55E+02

4.9 Interpretation

The interpretation of the results for 1 tonne of Steel Plate & Coil Product are presented in Table 17.

Table 17: Interpretation of most significant contributors to life cycle parameters (Steel Plate & Coil)

Parameter		Most significant contributor
Abiotic Depletion Potential (ADP) -Elements		The total cradle to gate impact is 4.41E-04 kg Sb eq. In A1 – A3 module more than 90% impact is coming from Ferro alloy. A total credit of 3.80E-03 kg Sb eq. is taken in module D.
Acidification Potential (AP)		The total cradle to gate impact is 7.80 Mole of H+ eq. In A1 – A3, major impact is coming from Process emission in Sinter (51.73%) and SMS (14.50%) followed by electricity (19.65%). A total credit of 3.40 Mole of H+ eq. is taken in module D.
Eutrophication Potential (EP)		The total cradle to gate impact is 8.38E-04 kg P eq. In A1 – A3, major impact is coming from pallet in DRI (71.99%) and BF (25.08%). A total credit of 2.82E-04 kg P eq. is taken in module D.
Climate Change - total [kg CO_2 eq.]		The total cradle to gate impact is 3646.242 kg CO_2 eq. In A1 – A3, DRI (36.52%) due to Syn gas & coal, BF (34.63%) due to coke & coal followed by SMS (19.41%) due to electricity, hot metal and lime. A total credit of -1536.08 kg CO_2 eq. is taken in the module D.
Ozone Layer Depletion Potential (ODP, steady state)		The total cradle to gate impact is 4.05E-10 kg CFC-11 eq. In module A1 – A3, major impact is coming from Pallet in DRI (47.07%) and Aluminium, Ferro alloys & graphite in SMS (51.42%). A total credit of 2.97E-11 kg CFC-11 eq. is taken in module D.
Photochemical Ozone Creation Potential (POCP)		The total cradle to gate impact is 3.18 kg NMVOC eq. In module A1 – A3, major impact is coming from Process emission in DRI (41.18%) and SMS (11.50%) followed by pallet (35.90%). A total credit of 2.38 kg NMVOC eq. is taken in module D.
Abiotic depletion potential (ADP) - Fossil		The total cradle to gate impact is 3711.54 MJ. In A1- A3 module, major impact is coming from Pallet in DRI (23.46%) and Aluminium, Ferro alloys & graphite in SMS (71.04%). A total credit of 14149.90 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), treatment of packaging materials (A5), 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.

5. 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.

6. 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.

7. References

- EN 15804: 2012+A2:2019, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.
- GaBi 2023: 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 - CO_2 Data Collection User Guide, Version 9 (May 2019).
- PCR 2019:14, Product Category Rules (PCR) for 'CONSTRUCTION PRODUCT' Version 1.2.5.