Environmental Product Declaration

In accordance with ISO 14025:2006 and
EN 15804:2012+A2:2019/AC:2021 for:

Steel Bar

Programme
The International EPD® System,
www.environdec.com

EPD registered through the fully aligned regional hub
EPD Southeast Asia,
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PUTRA BAJA DELI
WORLD CLASS STEEL MILL

PT Putra Baja Deli

Kawasan Industri Terpadu Wilmar Bojonegara,
Teluk Terate, Kramatwatu, Kab. Serang,
Banten 42161, Indonesia

This EPD covers multiple products of Steel Bar, based on average result of the product group for deformed steel bar and round steel bar

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Programme information

Programme	**The International EPD ® System** EPD registered through the fully aligned regional hub: EPD Southeast Asia
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Accountabilities for PCR, LCA and independent, third-party verification	
Product category rules (PCR): CEN standard EN 15804+A2 serves as the Core Product Category Rules (PCR)	
Product Category Rules (PCR): Product Category Rules (PCR) of Construction Products (PCR 2019:14 Version 1.3.3) and UN CPC 41211	
PCR review was conducted by: The Technical Committee of the International EPD® System.	**Review chair:** Claudia A. Peña, PINDA LCT SpA The review panel may be contacted via the Secretariat www.environdec.com/contact.
Life Cycle Assessment (LCA) LCA accountability: PT Life Cycle Indonesia LCA practioner: Jessica Hanafi, Ph.D., Gloria FJ Kartikasari, Natalia Susanto Salim, Maria Gabriela Kristanti	
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Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☑ No	

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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.

Company information

Owner of the EPD

PT Putra Baja Deli

Contact

Mislan, S.T., M.T. (mislan@putrabajadeli.com)

Director of PT Putra Baja Deli

Description of the organisation

PT. Putra Baja Deli is one of the steel bar producer in Indonesia. Established since 2004, as a relatively new player, PT. Putra Baja Deli is in an advantageous position to choose the latest and most efficient technology, thereby enhancing our competitiveness as well as our ability to produce high quality steel products world-class steel bar with price and quality competitiveness.

Product-related or management system-related certifications

- ISO 9001:2015 Quality Management System;
- ISO 14001:2015 Environment Management System

Name and location of production site(s)

Putra Baja Deli,
Kawasan Industri Terpadu Wilmar,
Teluk Terate, Kramatwatu, Serang, Banten, Indonesia
42161

Product name

Steel Bar

Product identification

Country	Standard	Grade
Indonesia	SNI 2052:2017	BjTP 280
		BjTS 280
		BjTS 420A
		BjTS 420B
		BjTS 520
		BjTS 550
Australia	AS/NZS 4671:2019	250N
		300E
		500N
		600N
Malaysia	MS 146:2014	B500B
Singapore	SS560:2016	B500B
Canada	CSA G30.18-21	400W
		500W

Product description

Hot-rolled ribbed steel reinforcement bars, use in the reinforcement of concrete. Bars diameters from 8mm to 40mm. Length up to 18m. DELI deformed bars are certified under Indonesian Standard, Australian Standard, Malaysian Standard and Singapore Standard. All products are manufactured from various combinations of different recycled content of billets from qualified suppliers. The product have a chemical composition in compliance with national and international standard. All DELI product is intended for the domestic and international market.

The function of the products is offer reinforcement and enhance the tensile strength of concrete structures and integrated into the concrete matrix.

Product information

Technical Information

Standard Designation	Grade/Class	Yield Strength (MPa)	Tensile Strength (MPa)	Ratio	Size	Elongation min
SNI 2052:2017	BjTP 280	280-405	Min 350	-	8 – 10 mm	11.00%
					12 – 40 mm	12.00%
	BjTS 280	280-405	Min 350	Min 1.25	8 – 10 mm	11.00%
					13 – 40 mm	12.00%
	BjTS 420A	420-545	Min 525	Min 1.25	8 – 19 mm	9.00%
					22 – 25 mm	8.00%
					29 – 40 mm	7.00%
	BjTS 420B	420-545	Min 525	Min 1.25	8 – 19 mm	14.00%
					22 – 36 mm	12.00%
					40 mm	10.00%
	BjTS 520	520-645	Min 650	Min 1.25	8 – 25 mm	7.00%
					29 – 40 mm	6.00%
	BjTS 550	550-675	Min 687.5	Min 1.25	8 – 25 mm	7.00%
					29 – 40 mm	6.00%
AS/NZS 4671:2019	250N	Min 250	-	Min 1.08	10 – 12 mm	5.00%
	300E	300-380	-	1.15-1.50	10 – 16 mm	15.00%
	500N	500-650	-	Min 1.08	10 – 40 mm	5.00%
	600N	600-750	-	Min 1.08	10 – 32 mm	5.00%
MS 146:2014	B500B	Min 500	-	Min 1.08	10 – 40 mm	5.00%
SS560:2016	B500B	Min 500	-	Min 1.08	10 – 40 mm	5.00%
CSA G30.18-21	400W	400-525	Min 540	Min 1.15	10M	13.00%
					15M & 20M	13.00%
					25M	13.00%
					30M & 35M	12.00%
	500W	500-625	Min 625	Min 1.15	10M	13.00%
					15M & 20M	13.00%
					25M	13.00%
					30M & 35M	12.00%
					15M & 20M	13.00%
					25M	13.00%
					30M & 35M	12.00%

UN CPC code

UN CPC 4124 - Bars and rods, hot-rolled, of iron or steel

Geographical Scope

Manufactured in Indonesia, supplied to Global (the biggest customers are Indonesia and Australia)

LCA information

Declared unit

1 tonne of steel bar to produce 269,819 tonnes steel bar (weighting average for all standards/grades)

Reference service life

Not applicable

Time representativeness

Specific data for the manufacturing collected from October 2022 – September 2023. The 10-year age requirement for generic data has been met.

Database(s) and LCA software used

Generic data for module A1-A2 and Module A4, C1-C4, D use Ecoinvent 3.9.1 database. All data and modelled by using SimaPro Developer software version 9.5.0.1. No datasets older than 10 years were used.

Description of system boundaries

The system boundary was chosen based on the goal and scope of the study and in accordance with EN 15804:2012+A2:2019, i.e. ”cradle-to-gate” with options (A1–A3 and additional module A4 on transport), plus modules C1-C4 and module D. Modules A5 and B1-B7 have not been included due to the inability to predict how the material will be used in the construction process and use stage. Infrastructure, construction, production equipment, and tools in module A3, not directly consumed in the production process, are excluded from the system boundary. Nonetheless, infrastructure included in the generic data for upstream modules A1-A2 and downstream modules C1-C4 and D remains accounted for in the system boundary.

Results from modules A1-A3 should not be used alone. Module C must be considered for a comprehensive assessment. Ignoring module C may lead to incomplete conclusions and errors in decision-making.

1

Upstream (A1-A2)

a. Production of raw materials (e.g., billet)
b. Production of auxiliary materials (e.g., oxygen, argon, oil engine, grease, blade, etc.)
c. Production of electricity and fuel gas (e.g., LNG, diesel, LPG, electricity)
d. Transportation of raw/ auxiliary materials from the supplier to manufacturing plant
e. Extraction of water (e.g., third party)

2

Core (A3)

a. Production of packaging (e.g., wire rod, galvanized wire, paint, label)
b. Reheating Furnace: heating the billets
c. Roughing Stands: hot rolling, shaping, and thinning process
d. Intermediate and Finishing Stands: refining steel bar to achieve the desired size, shape, and surface quality
e. Cooling Bed: cooling the steel bar
f. Quality Control Process: tensile tests, bend and rebend tests, dimension tests, and chemical composition tests
g. Packing: cutting, sorting, counting, tying, painting and labelling.
h. Maintenance: inspecting, repairing, servicing, and replacing machinery components
i. Utilities: genset and forklift
j. Co-product (i.e., steel scrap and mill scale) and economic waste (i.e., used blade and paint container) sold to the third party
k. Hazardous waste generated (used oil engine, used grease, used cloth rags, etc.) and non-hazardous waste generated (i.e., used grinding wheel) including waste treatment processing by a registered third party.
l. Direct emission to the environment
m. Land Use and Transformation

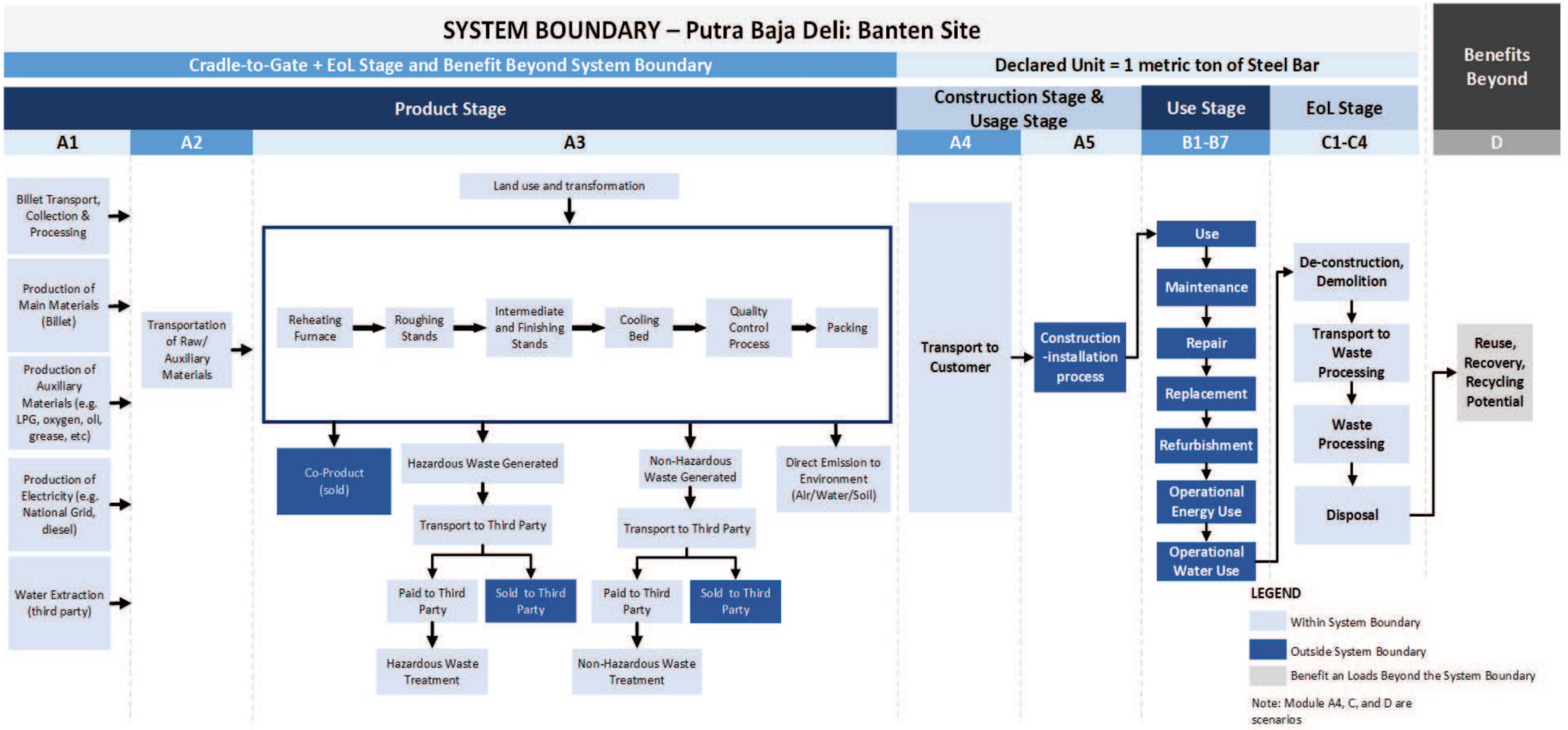
3

Downstream (A4, C1-C4, D)

a. Transport product to customer
b. Deconstruction & Demolition
c. Transport to waste processing unit
d. Waste processing including waste treatment process by a registered third party for hazardous waste
e. Disposal
f. Reuse/Recovery/ Recycling of the end of life of the products

System diagram

The processes below are identified for inclusion and exclusion in the product system to be studied:



More information

Relevant website for more information regarding the manufacturing process:
www.putrabajadeli.com

Key Assumptions and Limitations

- Data collected from all processing areas are cumulative from all product specifications produced by the company (i.e., round and deformed steel bar). The calculation of the manufacturing process will be calculated as aggregated total data for all specifications produced. The inventory data was not analyzed per sub-process. The whole manufacturing process (A3), which consists of the reheating furnace, roughing stands, intermediate and finishing stands, cooling bed, quality control process, and packing, will be aggregated so that all the production processes are modeled as a process system, not a process unit.
- Production process of materials in upstream (module A1) taken from Ecoinvent database reflects average or generic production and therefore does not correspond to actual suppliers. For raw material production i.e. billets, the Ecoinvent database is used where some data are modified to available Putra Baja Deli's specific supplier countries (Indonesia, Malaysia, China, Oman, United Arab Emirates, and Saudi Arabia) databases, i.e. for input water, hard coal, heavy fuel oil, LPG, natural gas, electricity, and wastewater. The content of billets also has been modified based on the suppliers. The modification method is by adjusting the % virgin material (pig iron) and % recycled material (iron scraps).
- The impact of transportation for raw materials, supporting materials, and products to customers are calculated based on the amount of load, distance, and transportation type by using generic data from Ecoinvent. Due to limited information, there is no adjustment made as the suppliers mostly use another third party to transport the products to Putra Baja Deli.
- There are several specifications following several standards for the steel bar product. The differentiation is on the mechanical die process (equipment), where there is no variation on the material or energy input Consequently, there is no variation in the environmental results, so that the results are grouped per product. This study covers multiple products of Steel Bar based on weighted average results of the product group for the types of round steel bar and deformed steel bar.
- Air emissions generated from reheating furnace are based on one sampling done in February 2024 and then extrapolated to obtain the total emissions for one year based on the flow rate of the stack, stack cross-sectional area, and running hour of the stack in October 2022-September 2023.
- The Indonesian Environment Minister Regulation only requires opacity measurement for diesel-fuelled mobile source emissions, therefore Putra Baja Deli measures only the opacity of diesel burned emissions in forklifts semi-annually. Emissions from the forklift, specifically those resulting from the combustion of diesel in the forklift, are determined using the dataset in the Ecoinvent database. The calculation is based on the amount of the diesel consumption.
- In this study period, the generator set status is standby condition, therefore Putra Baja Deli did not measure the emission. However, diesel was occasionally used for warm-up maintenance. Emissions from the generator set, specifically those resulting from the combustion of diesel for generator set heating, are determined using the dataset in the Ecoinvent database. The calculation is based on the amount of the diesel consumption. In the future study, it can be a recommendation for the company to do direct measurement for generator set when they are used.
- The water consumption was counted from the amount of makeup water to compensate the losses due to water evaporation.
- Data measured for electricity consumption are cumulative from all processes and machines.
- Data for oil, grease, blade and grinding wheel usage for maintenance are cumulative from all machines and processes
- The impact of land use changes are considered immaterial and have not been included because the land use change was done more than 7 years ago.

Cut-off rules

In case of insufficient input data or data gaps for a unit process, the cut-off criteria shall be 1 % of renewable and non-renewable primary energy usage and 1 % of the total mass input of that unit process. The total of neglected input flows per module, e.g., per module A1-A3, A4, C1-C4 and module D shall be a maximum of 5 % of energy usage and mass. In this study, all data in the product system is included. If there is missing specific data, generic data from the database or literature will be used.

LCA information

Data Quality

- Time related coverage: specific data were collected from 2022-10-01 to 2023-09-30, and generic data are representative of the year 2023.
- Geographic coverage: specific data were collected from the area under study, i.e., Serang, Banten, Indonesia. Electricity production as a key input are sourced from national grid network. Another key input is that no specific data was available for raw material production (steel billet). Therefore, rest-of-world data with some adjustments to the available Indonesia, Malaysia, China, Oman, United Arab Emirates, and Saudi Arabia Ecoinvent databases was used.
- Technological coverage: specific data were collected from current steel making process under study. There is no specific data for module A1-A2 and module A4, therefore generic data from the global average was used with similar technology aspects to describe the process under study. Module A3, detailed data based on the production process in Indonesia has been integrated. Modules C1-C4 now include specific data reflecting the end-of-life stage as Indonesia and Australia is the primary customer countries.

Allocation Rules

Data quality for both specific and generic data were sufficient to conduct life cycle assessment in accordance with the defined goal and scope. Allocation was applied to allocate the main product, steel scrap, and mill scale coming out of the steel bar production process. For the end-of-life of waste generated in the manufacturing process, the disposal scenarios principle is applied for each type of waste. This means that Putra Baja Deli will carry the full environmental impact until the end-of-waste state is reached. Multi-input allocation is relevant for the end of life of waste generated in manufacturing process, disposal scenarios are applied for each type of waste.

In this study, the closed-loop process is applied. When the scrap is used in the manufacture of a new product, there is an allocation (or debit) associated with the scrap input. Meanwhile the recovered steel scrap for recycling is allocated a credit (or benefit) associated with the avoided impacts of the virgin material. If the amount of recovered steel scrap for recycling is less than what the product system requires/steel scrap needed in the manufacture, then the environmental burdens associated with meeting the raw material demand are included in this closed-loop model. If, however, the amount of recovered steel scrap for recycling is larger than what the product system requires/steel scrap needed in the manufacture, then the product system receives a net credit, equivalent to the net amount of virgin material avoided.

The recovered steel scrap that is not looped back to the manufacture (leaving product system that have passed the end-of-waste state), goes to module D, except those which have been allocated as co-product. The end-of-waste state of the steel scrap is reached when the steel scrap is processed in the waste processing (Module C3). The steel scrap is sorted and pressed into blocks and ready to be used for other specific purposes. After the point of end-of-waste, the downstream emissions related to transportation process from recycler to manufacture is attributed to the processing unit that uses the secondary material.

The impacts assigned to the credit or burden that comes from module D are calculated by adding impact connected to secondary steel production from EAF plant (beyond system boundary) and subtracting the impacts resulting from primary steel production at BOS plant. The difference between 100% primary steel production (BOS plant) and 100% secondary steel production (EAF plant) is the result of the module D.

The benefit beyond system boundary (module D) is a credit estimation resulted from the system because in real-life there is a trans-continent boundary of the market of each customers' country Indonesia/ Australia/Papua New Guinea/Vanuatu/Solomon Island/Tonga/American Samoa/New Zealand and producers in Indonesia which do not share the recycled material market. The assessed products are exported to 8 countries spread out all over the world In this study, applying the Pareto rules on the end-of-life of the products, only countries that are within 80% market share were taken into account i.e. Indonesia and Australia. Therefore, the recovery rate for recycling is adjusted to the rate in each country and the steel scrap that is considered as material losses will go to landfills.

LCA Scenarios and Additional Technical Information

1. Electricity grid in module A3 was based on Ecoinvent database for Indonesia electricity network whic is highly reliant on coal (63%), combined cycle power plant (15%), conventional power plant (11 %), hydro (6%), oil (3%), geothermal (2%), and biogas (1%). The climate impact of the electricity is 1.18 kg CO_2 eq./kWh (GWP-GHG Indicator, IPCC 2021).

2. The steel billet raw materials in Putra Baja Deli are sources from 6 suppliers in 6 countries (Indonesia, Malaysia, China, Oman, United Arab Emirates, Saudi Arabia). Therefore, the Ecoinvent database is used based on specific supplier countries. Each supplier has its own product specification, which in this study were differentiated based on the recycled content in the raw materials they produce. The recycled content average was used for the dataset modification. In the dataset, it only affects the raw material production with electrical arc furnace technology that is implemented for the production of steel products with recycled materials. Furthermore, the recycled content percentage is used to modify the composition of pig iron and recycled iron materials.

3. The mass of diesel and oil engine use the generic density conversion value of respectively 0.85 kg per litre and 0.866 kg per litre.

4. The gas conversion of Oxygen is 1.43 kg per m^3 and for argon is 1.78 kg per m^3.

5. For the purposes of calculating the transportation load, the weight data of argon, oxygen, and LPG cylinders in kg are respectively 40, 50, and 40.

6. The characterisation factor (CF) for water use is modified to describe the watershed level where the unit process withdraws water, i.e., Teluk Terate, Kramatwatu, Serang, Banten, Indonesia. The CF data is documented by AWARE through a Google Layer Document that provides CF up to watershed level in the region. The CF ranges from 0.1 up to 100 with the annual average is 0.3. Therefore, the CF for water is modified to 17.3 m^3/m^3 from average Indonesia 23.6 m^3/m^3.

7. Transportation using trucks in Indonesia, supplier countries, and customer countries was adjusted to its EURO level to represent the current condition. In Indonesia, EURO3 is used. Malaysia, Oman, and Saudi Arabia use EURO 4. Australia and the United Arab Emirates use EURO5. Meanwhile, in China, EURO 6 is used as a standard emission.

8. Transport distance was calculated by Google Maps from Putra Baja Deli to Indonesia's Port (Merak Port, 99.4 km) and Indonesia's Port to destination port (Sydney Harbour, Australia = 5 590 km; Pago-pago Harbour, America Samoa = 9 110 km; Auckland Port, New Zealand = 7 730 km; Moresby Port, Papua New Guinea = 4 540 km; Solomon Island Port, Solomon Island = 5 940 km; Tonga Port, Tonga = 8 600 km; and Port Villa, Vanuatu = 6 870 km).

9. Transportation using truck in overseas customer countries is calculated only countries that are within 80.00% market share based on the average truck travelled per day (Australia = 57.8 km).

10. Local transportation to Indonesian customers (module A4) is calculated based on a weighted average of specific market data (i.e. 104 km for ships and 33.9 km for trucks). Meanwhile, the transportation to the waste processing and disposal area (Module C) is calculated based on the average truck travelled per day in Indonesia (i.e.134 km).

11. Amount of diesel used for demolition process was modelled using Ecoinvent database (Waste reinforcement steel {RoW}| treatment of waste reinforcement steel, recycling | Cut-off, U) for global data, i.e., 0.626 MJ diesel/kg steel.

12. Amount of diesel and electricity consumption for waste processing was modelled using Ecoinvent database for global data on sorting and pressing iron scrap, i.e., 0.1 MJ diesel/kg steel and 0.01 kWh/kg steel.

13. Electricity was modelled using Ecoinvent database for Australia and Thailand.

14. Average recycling rate for steel is 90% in Australia according to UTS (2020) and in Indonesia it is around 15% according to Ministry of National Development Planning of the Republic of Indonesia (2021). Around 65.78% of the steel scrap was considered as material losses that will go to landfill.

15. Putra Baja Deli uses 23.70% external scrap in its steel production, consisting of 96.98% sorted scrap and 3.02% unsorted scrap. The climate impact of the sorted scrap is 0.0697 kg CO_2 eq. per kg sorted scrap (GWP-GHG Indicator, IPCC 2021). Net scrap was calculated by excluding the amount of internal scrap (home scrap). The potential environmental benefit calculated for the end-of-life stage (Module D) was based on the net amount of scrap left in the system.

Modules declared, geographical scope, share of specific data (in GWP-GHG results) and data variation (in GWP-GHG results):

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Trans-port	Manu-facturing	Trans-port	Con-struction installa-tion	Use	Mainte-nance	Repair	Replace-ment	Refur-bish-ment	Opera-tional energy use	Opera-tional water use	De-con-struction demoli-tion	Trans-port	Waste process-ing	Disposal	Reuse-Recovery-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	X	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	ID, MY, CN, OM, SA, AE	ID, MY, CN, OM, SA, AE	ID	ID, AU	-	-	-	-	-	-	-	-	ID, AU	ID, AU	ID, AU	ID, AU	ID, AU, VN, TW, KR, JP, IN, BD
Specific data used	>90%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	<10%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

Abrevation:
ID: Indonesia ; MY: Malaysia ; CN : China ; OM : Oman ; SA : Saudi Arabia ; AE : United Arab Emirates ; AU: Australia ; VN: Vietnam ; TW: Taiwan : KR: South Korea ; JP: Japan ; IN: India ; BD: Bangladesh

Content declaration

Steel Bar manufactured by Putra Baja Deli is made of low alloy steels with pig iron and approximately 23.70% scrap-based material. Putra Baja Deli followed the chemical range of Steel Bar as per spec, therefore, our typical chemical composition can be seen below.

Product content	Weight, kg	Post-consumer material, weight-%	Biogenic material, weight-% and kg C/kg
Iron	2 100	23.70	0

Chemical composition, %	Standard, %	
	Range	Average*
Carbon (C)	0.18 – 0.35	0.22
Manganese (Mn)	0.60 – 1.00	1.65
Silicon (Si)	0.15 – 0.40	0.55
Phosphorus (P)	Max. 0.05	0.05
Sulphur (S)	Max. 0.05	0.05
Nitrogen (N)	Max. 0.012	0.012
Carbon equivalent (Ceq)	0.44 – 0.60	0.50

Packaging materials	Weight, kg	Weight-% (versus the product)	Weight biogenic carbon, kg C/kg
Wire Rod	0.65	0.065	0
Galvanized Wire	0.02	0.002	0
Label	0.002	0.0002	0
TOTAL	0.672	0.672	0

Dangerous substances from the candidate list of SVHC for Authorisation
No dangerous substances

*Disclaimer: average value is the average for all standards/grades

Environmental performance

Mandatory impact category indicators according to EN 15804:2012+A2:2019 (EF 3.1 package)

Results for 1 tonne to of Steel Bar								
Impact Indicator	Unit	Total A1-A3	A4	C1	C2	C3	C4	D
GWP-fossil	kg CO_2 eq.	2.61E+03	2.21E+01	6.21E+01	1.24E+01	3.03E+01	1.31E+01	-1.11E+02
GWP-biogenic	kg CO_2 eq.	5.78E+00	4.78E-03	8.64E-03	3.71E-03	-2.47E+00	-1.74E-02	5.25E-01
GWP-luluc	kg CO_2 eq.	1.72E+00	1.59E-02	6.99E-03	6.07E-03	3.19E-02	6.82E-03	-7.50E-03
GWP-total	kg CO_2 eq.	2.61E+03	2.21E+01	6.21E+01	1.24E+01	2.79E+01	1.30E+01	-1.10E+02
ODP	kg CFC 11 eq.	3.91E-05	3.36E-07	9.88E-07	1.95E-07	3.48E-07	2.56E-07	-2.85E-06
AP	mol H^+ eq.	1.15E+01	5.59E-01	5.76E-01	7.07E-02	3.10E-01	8.42E-02	-3.44E-01
EP-freshwater	kg P eq.	2.41E-01	1.09E-04	2.24E-04	1.16E-04	2.86E-03	1.24E-04	3.38E-03
EP-marine	kg N eq.	2.58E+00	1.42E-01	2.67E-01	2.83E-02	6.76E-02	3.35E-02	-6.04E-02
EP-terrestrial	mol N eq.	2.72E+01	1.57E+00	2.90E+00	3.07E-01	7.73E-01	3.63E-01	-8.71E-01
POCP	kg NMVOC eq.	1.14E+01	4.31E-01	8.59E-01	1.00E-01	2.26E-01	1.20E-01	-5.57E-01
ADP-minerals & metals*	kg Sb eq.	1.19E-02	2.82E-05	2.17E-05	3.33E-05	1.59E-03	3.00E-05	-9.62E-04
ADP-fossil*	MJ	2.68E+04	2.80E+02	8.14E+02	1.82E+02	3.38E+02	2.31E+02	-1.01E+03
WDP*	m^3	4.38E+02	7.94E-01	1.75E+00	9.18E-01	4.45E+00	4.91E+00	8.18E+00

* Disclaimer: **The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.**

Additional impact category indicators according to EN 15804:2012+A2:2019 (EF 3.1 package)

Results for 1 tonne to of Steel Bar								
Impact Indicator	Unit	Total A1-A3	A4	C1	C2	C3	C4	D
PM	Disease incidence	2.14E-04	9.91E-07	1.61E-05	1.51E-06	4.30E-06	1.78E-06	-7.56E-06
IRP**	kBq U235 eq.	1.63E+01	6.80E-02	1.66E-01	6.78E-02	1.83E-01	7.56E-02	-3.32E-01
ETP-fw*	CTUe	1.60E+04	1.41E+02	3.89E+02	9.79E+01	2.67E+02	1.18E+02	2.25E+02
HTP-c*	CTUh	1.96E-05	9.98E-09	1.90E-08	7.24E-09	4.01E-08	7.21E-09	2.71E-07
HTP-nc*	CTUh	6.55E-05	1.11E-07	1.32E-07	1.53E-07	1.81E-06	1.36E-07	4.73E-06
SQP*	dimensionless	6.52E+03	7.50E+01	5.48E+01	1.81E+02	5.94E+02	3.25E+02	-3.30E+02

* Disclaimer 1: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

** Disclaimer 2: 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 random and from some construction materials is also not measured by this indicator.

Climate impact (GWP-GHG) – according to PCR

Results for 1 tonne to of Steel Bar								
Indicator	Unit	Total A1-A3	A4	C1	C2	C3	C4	D
GWP-GHG	kg CO_2 eq.	2.61E+03	2.21E+01	6.21E+01	1.24E+01	3.05E+01	1.31E+01	-1.11E+02

Additional voluntary indicators e.g. the voluntary indicators from EN 15804 or the global indicators according to ISO 21930:2017

Notes:

1. The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.
2. Variability of standards/grades in impact results is not significant. The nitrogen content in steel, which controled/measured by the Malaysia and Singapore standards, shows minimal variation (0.012%) among types. Whereas, carbon equivalent (Ceq), which indicates strength, hardness, and other properties in alloys, varies within a narrow range (0.195%), affecting properties by less than 10%.

- **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 marine end compartment
- **EP-terrestrial** : Eutrophication potential, Accumulated Exceedance
- **POCP** : Formation potential of tropospheric ozone
- **ADP-minerals&metals** : Abiotic depletion potential for non-fossil resources
- **ADP-fossil** : Abiotic depletion for fossil resources potential
- **WDP** : Water (user) deprivation potential, deprivation-weighted water consumption
- **PM** : Particulate Matter emissions
- **IRP** : Ionizing radiation - human healt
- **ETP-fw** : Eco-toxicity – freshwater
- **HTP-c** : Human toxicity - cancer effects
- **HTP-nc** : Human toxicity - non-cancer effects
- **SQP** : Land use related impacts / soil quality

Waste production and output flows

Resource use indicators

Results for 1 tonne of Steel Bar								
Indicator	Unit	Total A1-A3	A4	C1	C2	C3	C4	D
PERE	MJ	1.64E+03	2.31E+00	4.64E+00	2.28E+00	4.30E+01	2.51E+00	-1.07E+02
PERM	MJ	0	0	0	0	0	0	0
PERT	MJ	1.64E+03	2.31E+00	4.64E+00	2.28E+00	4.30E+01	2.51E+00	-1.07E+02
PENRE	MJ	2.68E+04	2.80E+02	8.14E+02	1.82E+02	3.38E+02	2.31E+02	-1.01E+03
PENRM	MJ	0	0	0	0	0	0	0
PENRT	MJ	2.68E+04	2.80E+02	8.14E+02	1.82E+02	3.38E+02	2.31E+02	-1.01E+03
SM	kg	2.46E+02	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0
FW	m^3	9.79E+01	1.60E-01	4.23E-01	1.68E-01	1.09E+00	2.75E-01	1.80E+00

- **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
- **PENRE** : Use of non-renewable primary energy excluding non-renewable 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
- **SM** : Use of secondary material
- **RSF** : Use of renewable secondary fuels
- **NRSF** : Use of non-renewable secondary fuels
- **FW** : Use of net fresh water

Waste production

Results for 1 tonne of Steel Bar								
Indicator	Unit	Total A1-A3	A4	C1	C2	C3	C4	D
Hazardous waste disposed	kg	2.31E+00	0	3.22E-01	0	5.14E-02	0	-2.66E-01
Non-hazardous waste disposed	kg	1.61E+02	0	0	0	0	6.32E+02	-6.71E+00
Radioactive waste disposed	kg	0	0	0	0	0	0	0

Output flow indicators

Results for 1 tonne of Steel Bar								
Parameter	Unit	Total A1-A3	A4	C1	C2	C3	C4	D
Components for re-use	kg	0	0	0	0	0	0	0
Material for recycling	kg	0	0	0	0	3.42E+02	0	0
Materials for energy recovery	kg	0	0	0	0	0	0	0
Exported energy, electricity	MJ	0	0	0	0	0	0	0
Exported energy, thermal	MJ	0	0	0	0	0	0	0

Interpretation of results

1

From overall life cycle stages, module A1 contributes significantly to the impact generated by the whole life cycle.

2

The production process of billets with no recycled content from Oman supplier is the largest contributor to the majority of the potential impacts followed by the production process of billets with 50.50% recycled content from Indonesia supplier.

3

In terms of material transportation (module A2), transportation of materials by ship from overseas to Indonesia contributes to 2 impact categories: acidification potential and photochemical ozone creation potential.

4

From the production activities carried out in the Putra Baja Deli area (module A3), there is no significant impact on the production activities process.

5

In terms of product distribution (module A4), transportation of products by ship from Indonesia to overseas sea contributes to 2 impact categories: eutrophication marine and eutrophication terrestrial.

6

Activities carried out on the end-of-life of the steel life cycle (module C1-C4) did not have a significant impact on the overall steel life cycle studied. However, steel bar de-construction and demolition (module C1) emerges as contributor for 5 impact categories: acidification potential, eutrophication potential in marine and terrestrial, photochemical ozone creation potential, and particulate matter < 2.5 µm. Meanwhile, waste processing (module C3) becomes hotspot for abiotic depletion potential-minerals and metals and the land use and transformation.

Additional Information

Additional environmental information

To fulfill our commitment to environmental sustainability, we are planting 1 000 mango trees around the factory area for reforestation.

Additional social and economic information

As a form of social and economic responsibility and recognizing that industrial growth cannot be separated from the obligation to build local communities, Putra Baja Deli is actively involved in various socio-economic initiatives. Some of the activities we undertake include:

1. Financial support for the Independence Day event in the Kramatwatu Military Command.
2. Financial support for the Independence Day event to Teluk Terate Subdistrict, Kramatwatu Subdistrict, and Tonjong Subdistrict.
3. Master degree scholarship for employee.
4. Educational scholarship for employee's outstanding children.

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Environmental Product Declaration

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