Environmental Product Declaration

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

TMT Rebars - ARS Fe 550D

from

ARS Steels and Alloy International Private Ltd.

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

Programme Information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com, www.environdecindia.com
E-mail:	info@environdec.com

Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): PCR 2019:14 VERSION 1.3.3 , CPC, Version 2.1 Code 412
PCR review was conducted by: The Technical Committee of the International EPD System See hyperlink "http://www.environdec.com" for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat hyperlink "http://www.environdec.com/contact" www.environdec.com/contact.
Life Cycle Assessment (LCA)
LCA accountability: Conserve Consultants Private Limited
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier Third-party verifier: Mr. Prabodha Acharya ,Individual Verifier Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☒ Yes ☐ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

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: ARS Steels and Alloy International Private Ltd

Contact: Mr. Sumit Bhatia,
ARS Steels and Alloy International Private Ltd,
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About ARS: ARS Steels is one of the major integrated steel plants in India, located at GummidiPoondi, Tamil Nadu. ARS is certified with ISO 9001 and 14001 for its state-of-the-art production facility and the products are certified by SGS, a Swiss-based multinational inspection company that provides on-site inspection, verification, testing, and certification services for every batch and consignment. ARS has been producing MS billets from 1992 and TMT Rebars from 2005. The current M.S billet making capacity is 1,58,000 MT per annum and TMT rebar capacity is 1,80,000 MT per annum. Now in 2024, ARS is in the process of further increasing the billet and TMT Rebars production capacity. The total installed capacity of M.S Billets and TMT Rebars production after expansion will be 2,88,000 MT per annum and 2,50,000 MT per annum respectively. The company is quality-focused and produces best-in-class TMT Rebars.

Name and location of production site: ARS Steels and Alloy International Private Ltd, B-1/S, SIPCOT industrial complex, Gummidipoondi, Thiruvallur Dist., Tamil Nadu -601201.

Product Information

Product name: Reinforcement Steel Rebars

Product identification: TMT - ARS Fe 550D

Product description: Thermo Mechanically Treated Rebars or TMT Rebars are manufactured using a unique technique that leaves them with a tough outer area and a soft inner core – this makes the TMT Rebar strong but also flexible. TMT Rebars are widely used in reinforced concrete structures to provide support, resist tension forces, and ensure structural stability. By providing robust reinforcement, TMT Rebars help prevent cracks, increase load-bearing capacity, and improve the overall longevity of structures. Their ability to withstand seismic activity and extreme weather conditions makes them a preferred choice in areas prone to earthquakes and hurricanes. ARS Fe 550D TMT Rebars are produced in sizes from 8mm to 32 mm.

UN CPC code: CPC, Version 2.1 Code 412

Geographical Scope: India

LCA Information

Declared unit: 1 unit = 1000kg
Time Representativeness: Jan 2023 to Dec 2023
Description of system boundaries: Cradle to gate with modules C1–C4 and module D (A1–A3 + C + D)

Product Life - Cycle

Manufacturing and Packaging (A1-A3)

The environmental impacts considered for the product stage cover the manufacturing of raw materials used in the production as well as packaging materials and other ancillary materials. Also, fuels used by machines, and handling of waste formed in the production processes at the manufacturing facilities are included in this stage. The study also considers the material losses occurring during the manufacturing processes as well as losses during electricity transmission.

Raw materials like scrap steel and alloy, is collected in-house and also imported which are mostly recycled. 70% of local materials is collected within a radius of 200km from the manufacturing unit. Segregation of scrap is done at initial stage and shredded for further process. Induction furnace is used for melting the raw materials, alloying materials such as sponge iron are added to molten steel to achieve the desired properties of the TMT bars. Carbon test will be done for every heat to maintain quality and the value must be below 2%. The molten steel is casted into billets and passed through rolling mills to form the TMT bars. This process involves heating, rolling, and cooling the steel to the desired dimensions and properties. After rolling, the TMT bars undergo a heat treatment process known as quenching and self-tempering, which involves rapid cooling followed by controlled cooling to achieve the desired mechanical properties. After manufacturing, the TMT bars are bundled and packed for transportation and storage using iron straps and iron clips. Then the product transported from manufacturing unit to end user.

Transport and Installation (A4-A5)

Transportation impacts occurred from final products delivery to construction site (A4) cover fuel direct exhaust emissions, environmental impacts of fuel production, as well as related infrastructure emissions. Transport to building site cannot be determined as it may vary depending upon the customers.
Installation waste also cannot be determined as it will differ for each customer according to their need.

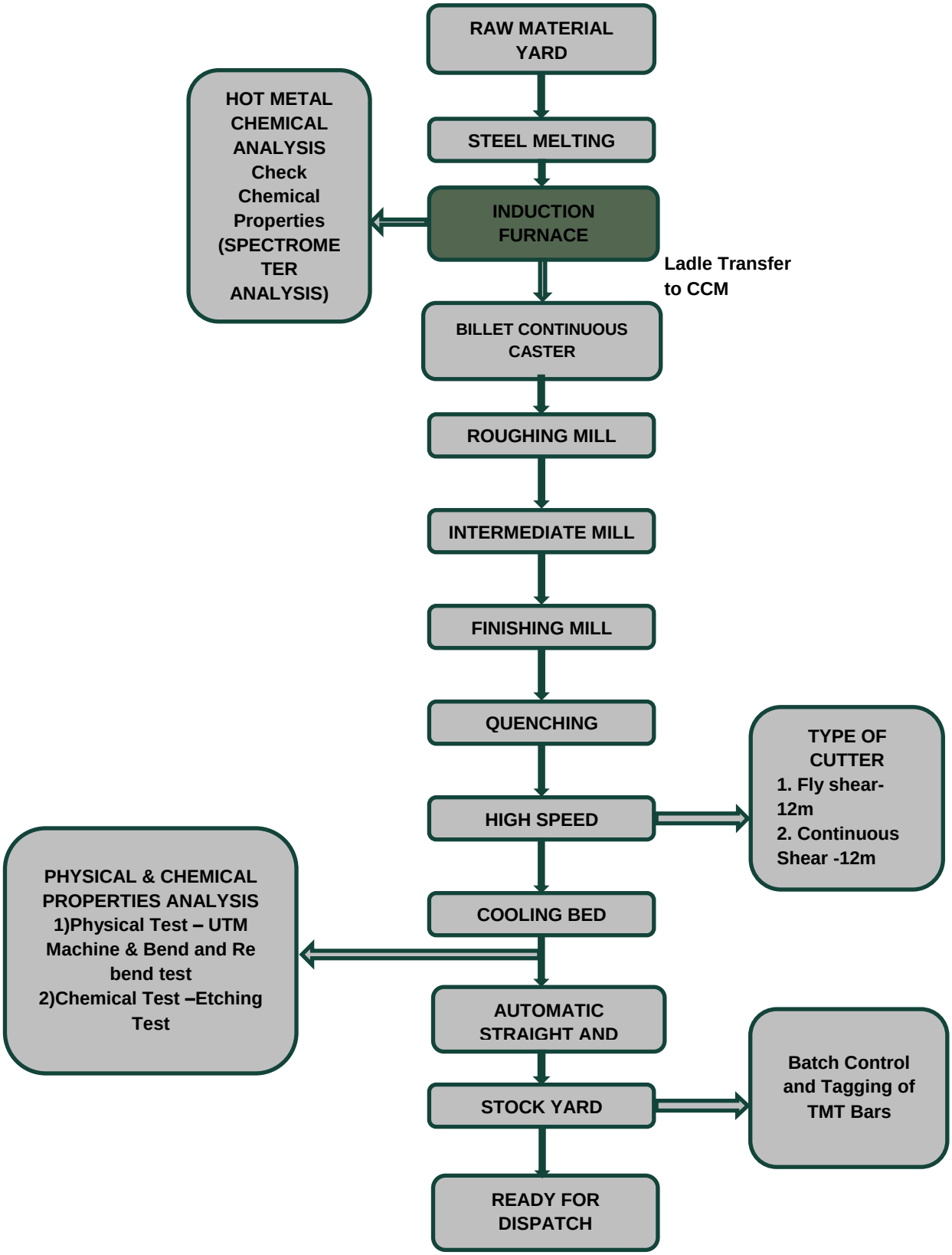
Product Use and Maintenance (B1-B7)

This EPD does not cover the use phase. Air, soil, and water impacts during the use phase have not been studied.

Product End of Life (C1-C4, D)

C1- Total emission due to demolition is assumed to be 0kg of CO2 for 1000kgs of TMT bars after demolition.
C2- Includes transportation of the demolished product to the recycling facility, distance of 80 km is considered.
C3-This stage includes sorting of iron scrap, 90% is recycled.
C4-This stage includes the treatment of 90% reinforced steel which comes under wastage and 10% is sent to landfill.
D- This stage includes the Benefits of recycling waste generated in module C3 are taken into account in module D.

Process Flow



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	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X
Geography	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN

Modules not declared = MND; IN=India

Content Information

Product Components	Weight, kg	Post-consumer material, weight-%	Biogenic material, weight-% and kg C/kg
MS Scrap -Local	971.7	100%	-
MS Scrap-Import	145.7	100%	-
TOTAL	1117.4	100%	-
Packaging materials	**Weight, kg**	**Weight-% (versus the product)**	**Weight biogenic carbon, kg C/kg**
Tag	0.066	100%	-
Iron strapping	1.24	100%	-
TOTAL	1.90	100%	-

Note: There is no production of biogenic carbon as the packaging material is not a source of biogenic carbon.

Chemical Properties of ARS Fe 550D

Properties	Unit	IS:1786 Fe-550D	ARS Fe 550D	BS:4449
C	%	0.25 Max	**0.25 Max**	0.25 Max
S	%	0.04 Max	**0.04 Max**	0.05 Max
P	%	0.04 Max	**0.04 Max**	0.05 Max
S+P	%	0.075 Max	**0.075 Max**	-
CE	%	0.42 Max	**0.42 Max**	0.51 Max

Physical Properties of ARS Fe 550D

Properties	Unit	IS:1786 Fe-550D	ARS Fe 550D	BS:4449
Yield Stress	N/mm2	550 Min	**550 Min**	460 Min
Tensile Strength	N/mm2	600 Min	**600 Min**	510 Min
TS/YS	Ratio	1.10Min	**1.10 Min**	-
Elongation	%	14.0 Min	**16.0 Min**	14.0 Min

Production Process

Raw Material Processing

ARS 550D TMT Bars are manufactured using Billets. Billets are produced in-house by melting 100% MS scraps. Different types of MS scraps are procured domestically and internationally. The scrap is stored in a very large raw material yard. The scrap is processed using hydraulic bundling machine, scrap shredder, shearing etc. Hydraulic bundle machine is used to compress the scraps to create dense blocks. The scrap is compressed to increase the density of scrap. The use of processed scrap reduces the storage and makes it easy to handle and charge in the furnace, thereby leading to increase the production and reduction in electricity consumption (Kwh) per ton.

Steel Melting Shop (SMS)

The scrap will be lifted and charged into Induction Furnace for melting using electromagnets, Grabs attached to Electric Overhead Cranes. In an induction furnace, the scrap charge material is placed in an alternating magnetic field, high current will be generated. As current flows it's dissipate energy in heat form, so the scraps will get melted. In the Induction Melting Furnace the scrap melts at temperature of about 1560 Deg C. After melting, the furnace is tilted to remove slag and other impurities that come to the surface of molten metal.

Addition of Micro Alloying Elements

Ferro Alloys are added for refining the molten metal to achieve the desired level of chemical composition. The molten metal is fully killed by adding ferro alloys such as silico manganese, aluminum. Throughout the melting process and micro alloying elements addition process, samples are chemically analyzed to ensure accurate and desired chemical composition.

Ladle Pouring

Upon achieving the desired chemical composition, molten metal is poured into Ladle. Purging is done to the molten metal tapped to the ladle to achieve homogenous chemistry and temperature throughout the ladle. In order to avoid thermal stratification that leads to undesirable varying steel compositions, nitrogen gas purging is done. Purging is conducted by generating bath turbulence to retain thermal homogeneity. This process also helps in removing excessive non-metallic inclusions

Continuous Casting

After purging, the ladle is taken to Continuous Casting set up where it is placed on the tundish. The material then passes from ladle to tundish and tundish to Copper moulds. Liquid steel is continuously poured into the mould to replenish the withdrawn steel at an equal rate. The copper moulds covered with water cooling jackets. This will reduce the temperature and form the shape. The withdrawal rate depends on the cross section grade and quality of steel is being produced. Casting time is typically 45 – 60 minutes per heat to avoid excessive ladle heat losses. This area preserves cast shape integrity and product quality.

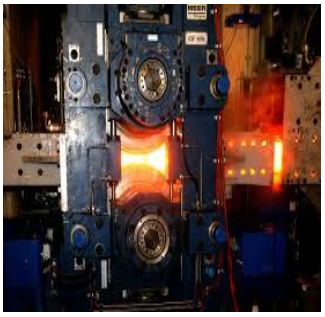
Hot Charging

After the Casting, the hot billets are cut into lengths as per rolling requirements. Post the cut, the red hot billets are straight away transferred from continuous casting to the roughing mill for rolling using conveyors

Rolling Mill Roughing Mills

The Hot billets will be transferred to rolling mill by the rolling conveyors. In Rolling mill there will be three stage process, i.e., Roughing, Intermediate and Finishing. The hot billet will enter first to Roughing Mill. This Mill first stand consists of 3rolls which will be located top, Middle and Bottom, in these rolls 5passes with different shapes are provided. The hot billet passes through these passes and the size will be reduced to 80 percentage. Again it is transferred to another four roughing stand passes and size will be reduced further.

Intermediate and Finishing Mills



After Roughing process mill is separated into two lines as main and bypass lines. Before entering into further stages, the billets front and back edges will be cut's automatically with the help of cobble shear, to enter free in the other stages. In each line the material will be further processed through intermediate and finishing stands. In these stands odd mill passes output will be oval size and even mill stand output will be round size. During rolling process material pass through grooved roll with the help of entry guides to get the perfect shape. In Intermediate mill billet size will reduce further 10-20 percentage. Then the material moves to finishing mill, where we get the final required size.

Quenching System

In the final stand, the finishing size of bar with lug impression of 925 Deg C (+/-25) will enter into the Quenching System. In Thermo mechanical Treatment (TMT) process, where the rebars are rapidly cooled to obtain required mechanical properties, by using a special water spray system (high pressure RO water) and compressed air in the quenching box. Where we can achieve a grade from Fe 500 to Fe 600 as per requirement. Quenching of the rolled bar is imparted in thermex process through a proprietary system and this results in a harden periphery. After the box the Bars are cut into the required sizes by the high speed continuous/ rotary shear.

Self-Tempering & Cooling

At the cooling bed, the TMT bar will be cooled further in atmosphere temperature. In the cooling process, a thermal exchange (Thermex) occurs between the core and cooled outside martensite surface. Whereby the resultant bar structure is a distinct tempered martensite at periphery and fine grained Ferrite – Pearlite structure in central zone. Tempered Martensite, which has more strength. Quenching as well as self-tempering leads to typical micro-structure of TMT bar.The TMT samples will be collected and Grade, weight, quality will be tested in UTM in front of SGS engineer (international testing agency). In this they will check, yield stress, Tensile strength, Martensite ring test, elongation and bend test.

Storage and Dispatches

Once the bars are cooled and packed into bundles they are stored in covered indoor shed according to their Sizes, lot numbers and/or any other distinguishing factors. Having covered and controlled shed keeps material always fresh and rust free. The TMT bars will be bended and bundled as per the customer requirements and made ready for dispatches.

Results of the Environmental Performance Indicators

Mandatory impact category indicators according to EN 15804

Results per Declared Unit									
Indicator	**Unit**	**A1 - A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
GWP - Fossil	kg CO_2 eq.	8.50E+02	0	0	0	0	5.70E+01	5.76E-01	-5.76E-01
GWP - Biogenic	kg CO_2 eq.	0	0	0	0	0	0	0	0
GWP - Luluc	kg CO_2 eq.	9.07E-02	0	0	0	0	5.67E-03	5.73E-05	-5.73E-05
GWP - Total	kg CO_2 eq.	8.50E+02	0	0	0	0	5.70E+01	5.76E-01	-5.76E-01
ODP	kg CFC 11 eq.	9.29E-06	0	0	0	0	1.22E-05	1.23E-07	-1.23E-07
AP	mol H^+ eq.	4.29E+00	0	0	0	0	5.92E-01	5.98E-03	-5.98E-03
EP- Fresh Water	kg P eq.	5.35E-02	0	0	0	0	1.89E-04	1.91E-06	-1.91E-06
EP - Marine	kg N eq.	7.79E-01	0	0	0	0	2.62E-01	2.65E-03	-2.65E-03
EP - Terrestrial	mol N eq.	9.09E+00	0	0	0	0	2.87E+00	2.90E-02	-2.90E-02
POCP	kg NMVOC eq.	2.37E+00	0	0	0	0	7.90E-01	7.98E-03	-7.98E-03
ADP –Minerals & Metals*	kg Sb eq.	2.74E-03	0	0	0	0	2.89E-05	2.92E-07	-2.92E-07
ADP - Fossil*	MJ	1.03E+04	0	0	0	0	7.67E+02	7.74E+00	-7.74E+00
WDP*	m^3	1.39E+02	0	0	0	0	2.06E+00	2.08E-02	-2.08E-02
Acronyms	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								

** 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 Mandatory and Voluntary Impact Category Indicators

Indicator	Unit	A1 - A3	A4	A5	C1	C2	C3	C4	D
GWP - GHG[1]	kg CO_2 eq.	8.50E+02	0	0	0	0	5.70E+01	5.76E-01	-5.76E-01

[1] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO_2 is set to zero.

Resource Use Indicators

Results per Declared Unit									
Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ	9.42E+02	0	0	0	0	4.38E+00	4.43E-02	-4.43E-02
PERM	MJ	0	0	0	0	0	0	0	0
PERT	MJ	9.42E+02	0	0	0	0	4.38E+00	4.43E-02	-4.43E-02
PENRE	MJ	1.03E+04	0	0	0	0	7.67E+02	7.74E+00	-7.74E+00
PENRM	MJ	0	0	0	0	0	0	0	0
PENRT	MJ	1.03E+04	0	0	0	0	7.67E+02	7.74E+00	-7.74E+00
SM	kg	8.67E-01	0	0	0	0	3.00E-01	3.03E-03	-3.03E-03
RSF	MJ	2.05E-02	0	0	0	0	9.80E-04	9.90E-06	-9.90E-06
NRSF	MJ	1.27E-07	0	0	0	0	0	0	0
FW	m^3	3.09E+00	0	0	0	0	4.66E-02	4.70E-04	-4.70E-04
Acronyms	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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water								

** 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.*

Waste Indicators

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous Waste Disposed	kg	7.03E+01	0	0	0	0	0	1.04E-02	-1.04E-02
Non - Hazardous Waste Disposed	kg	2.12E+03	0	0	0	0	0	7.28E-02	-7.28E-02
Radioactive Waste Disposed	kg	8.13E-03	0	0	0	0	0	5.45E-05	-5.45E-05

Output Flow Indicators

Indicator	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Components for Re-use	kg	0	0	0	0	0	0	0	0
Material for Recycling	kg	0	0	0	0	0	0	0	0
Materials for Energy Recovery	kg	0	0	0	0	0	0	0	0
Exported Energy	MJ	2.52E-03	0	0	0	0	0	0	0

Other Environmental Performance Indicators

Impact Category	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Pot.	kg CO_2e	8.41E+02	0	0	0	0	5.63E+01	5.69E-01	-5.69E-01
Ozone depletion Pot.	kg CFC_{-11}e	7.86E-06	0	0	0	0	9.64E-06	9.74E-08	-9.74E-08
Acidification	kg SO_2e	3.52E+00	0	0	0	0	4.22E-01	4.26E-03	-4.26E-03
Eutrophication	kg PO_4^3e	1.70E+00	0	0	0	0	9.79E-02	9.89E-04	-9.89E-04
POCP (“smog”)	kg C_2H_4e	1.31E-01	0	0	0	0	9.23E-03	9.33E-05	-9.33E-05
ADP - Elements	kg Sbe	2.78E-03	0	0	0	0	2.84E-05	2.87E-07	-2.87E-07
ADP - Fossil	MJ	1.03E+04	0	0	0	0	7.67E+02	7.74E+00	-7.74E+00

Allocation, Estimates and Assumptions

Allocation is required if some material, energy, and waste data cannot be measured separately for the product under investigation. In this study, as per EN 15804, allocation is conducted in the following order;

1. Allocation should be avoided.
2. Allocation should be based on physical properties (e.g. mass, volume) when the difference in revenue is small.
3. Allocation should be based on economic values.

The allocations in the Ecoinvent 3.8 datasets used in this study followed the mass basis allocation from total consumption for co-products.

Averages and Variability

The International EPD System additional data requirements.
Data specificity and GWP-GHG variability for GWP-GHG for A1-A3.

Supply-chain specific data for GWP-GHG	**100%**
Variation in GWP-GHG between products	>10 %
Variation in GWP-GHG between sites	-

Scenario Documentation

The intensity of the scrap is 24kg CO_2 eq /tonne.

Manufacturing Energy Scenario Documentation

Scenario parameter	Value
Electricity data source and quality	Ecoinvent 3.8
Electricity CO_2e / kWh	1.06 CO_2 e/KWh
District heating data source and quality	-
District heating CO_2e / kWh	-

References

1. ISO 14025:2010 Environmental labels and declarations – Type III environmental declarations. Principles and procedures.
2. ISO 14040:2006 Environmental management. Life cycle assessment. Principles and frameworks.
3. ISO 14044:2006 Environmental management. Life cycle assessment. Requirements and guidelines.
4. Ecoinvent database v3.8 (2021) and One Click LCA database.
5. EN 15804:2012+A2:2019 Sustainability in construction works – Environmental product declarations – Core rules for the product category of construction products.
6. Int´l EPD System PCR 2019:14 Construction products, version 1.3.3
7. CPC, Version 2.1 Code 412
8. EPD International (2021). General Programme Instructions of the international EPD® system. Version 4.0. www.environdec.com
9. TMT - ARS 550D LCA background report 14.03.2024

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