

Environmental Product Declaration

In accordance with ISO 14025:2006

Wire Rods



Owner of the declaration:
Hyundai Steel Company

Product name:
Wire Rods

Declared unit:
1 metric ton of Wire rods, including packaging

Product category /PCR:
PCR 2015:03. Basic iron or steel products & special steels, except construction steel products. Version 2.0, 2020-03-27

Program holder and publisher:
The Norwegian EPD foundation

Declaration number:
NEPD-5464-4770-EN

Registration Number:
NEPD-5464-4770-EN

Issue date: 29.11.2023

Valid to: 29.11.2028

General information

Product:

Wire Rods

Program holder:

The Norwegian EPD Foundation
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Declaration Number:

NEPD-5464-4770-EN

This declaration is based on Product Category Rules:

International EPD PCR 2015:03. Basic iron or steel products & special steels, except construction steel products. Version 2.0, 2020-03-27. According to ISO 14025, EPDs within the same product category but from different programmes may not be comparable.

Statements:

The owner of the declaration shall be liable for the underlying information and evidence. EPD Norway shall not be liable with respect to manufacturer, life cycle assessment data and evidences.

Declared unit:

1 metric ton of Wire rods

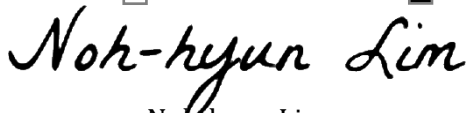
Functional unit:

-

Verification:

Independent verification of the declaration and data, according to ISO14025:2010

internal external



Noh-hyun Lim

Independent verifier approved by EPD Norway

Owner of the declaration:

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Manufacturer:

Hyundai Steel Company, 117, Bundangnaegok-ro, Bundang-gu, Seongnam-Si, Gyeonggi-do, 13529, South Korea

Place of production:

Dang-jin worksite, 1480, Bukbusaneop-ro, Songak-eup, Dangjin-si, Chungcheongnam-do, South Korea

Management system:

ISO 14001, ISO 50001

Organisation no:

121-81-10385

Issue date:

2023-11-29

Valid to:

2028-11-29

Year of study:

2022

Comparability:

EPDs from other programs than The Norwegian EPD Foundation may not be comparable.

The EPD has been worked out by:

Youngseok Lee and Yunyoung Hwang, Tres Works

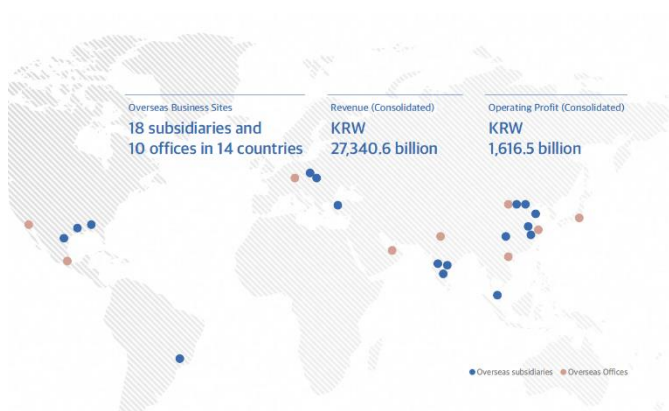
Approved



CEO of EPD Norway

About Hyundai Steel

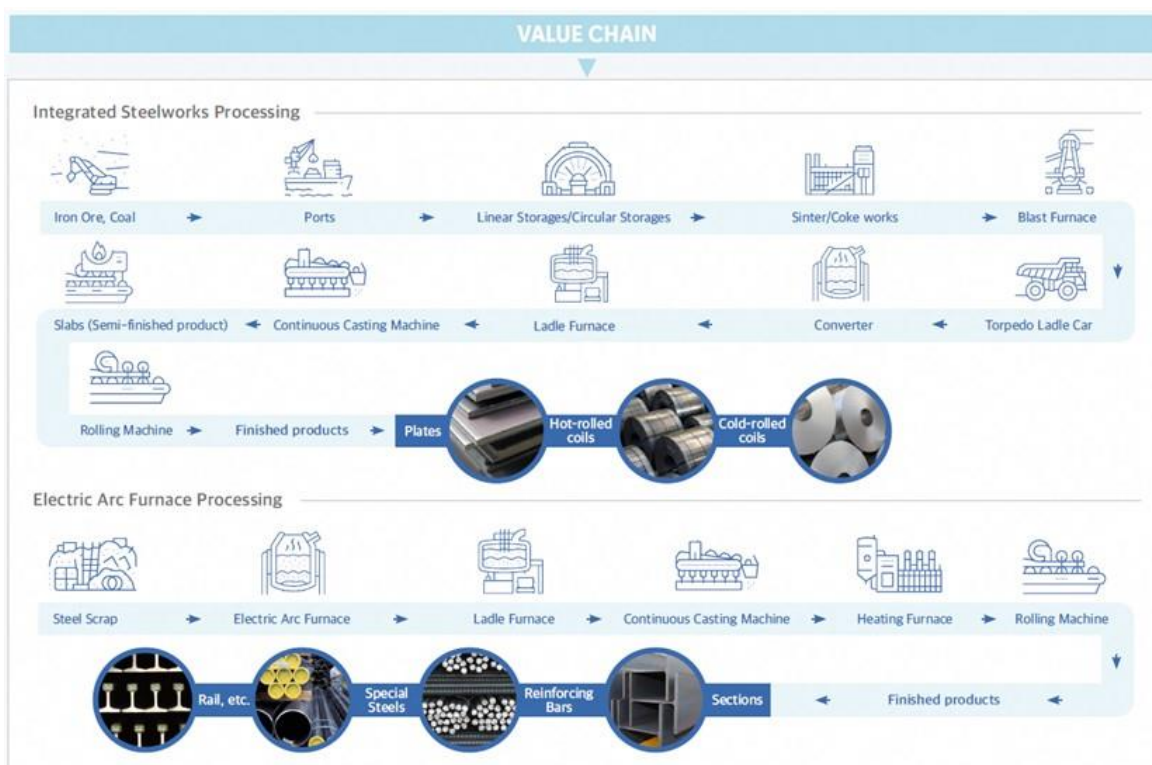
Hyundai Steel is at the forefront of driving the modernization of the steel industry by creating new possibilities and values of steel, contributing to the national economic development. We have grown into a global steelmaker with a world-class product portfolio that includes reinforcing bars, sections, hot rolled sheets/coils, cold rolled sheets/coils, plates, special steel, and automotive parts. With the



the completion of the resource circulation model spans from electric arc furnaces to blast furnaces, we are creating greater sustainable corporate value together with our customers and society.

In Korea, our offices include Pangyo Office (Bundangnagok-ro, Bundang-gu, Seongnam-si, Gyeonggi-do), the Incheon Works(Jungbongdae-ro Dong-gu, Incheon Metropolitan City), the Pohang Works(Donghaean-ro, Nam-gu, Pohang City, Gyeongsangbuk-do), the Dangjin Integrated Steelworks(Bukbusaneopno, Songak-eup, Dangjin City, Chungcheongnam-do), the Suncheon Works(Indeok-no, Haeryong-myeon, Suncheon City, Jeollanam-do), and the Ulsan Works(Yeompo-ro, Buk-gu, Ulsan Metropolitan City), and our headquartered is situated in Jungbongdae-ro Dong-gu, Incheon Metropolitan City.

Globally, we have a total of 18 overseas subsidiaries and 10 offices in 14 major countries, including the United States, China, and India. The overseas subsidiaries and offices located in various parts of the world serve as bridgeheads for Hyundai's global business.



Manufacturing Process

Under our vision of “Engineering the Value beyond Steel,” Hyundai Steel is committed to engaging in meaningful communication with various stakeholders, including customers, shareholders, employees, suppliers, and local communities, and generating new values from a different approach beyond traditional approaches.



Description of Processes

- EAF : Process for producing molten steel by melting scrap and molten iron
- LF : Heating of molten steel from the electric furnace and addition of iron alloy and subsidiary raw materials to adjust the composition of ingredients
- RH : Reflux of molten steel from the LF process in a vacuum to remove oxygen and hydrogen
- CCM : Process whereby molten metal is passed through a tundish and mold and solidified into blooms
- Large bar rolling : Production of large steel bars and billets by rolling blooms 2
- Small bar rolling : Production of wire rods and small steel bars with billets
- Conditioning & Inspection : Creation of steel with mechanical properties that meet customers' needs through heat treatment, and inspection

Product Information

The wire rods of Hyundai Steel is steel materials for automobile parts and other fasteners. It is a type of steel material that has a round cross section and is wound in a coil shape, with a cross section diameter of 5.5 to 42.0 mm. It is usually used in the form of secondary processed products that have undergone follow-up processes and is used for manufacturing various mechanical parts such as automobiles, assembled metal products, electrical and electronic products, general machinery, and construction. Also, depending on the purpose, it is divided into machine structure/piano/bearing steel/spring steel/free cutting steel, etc.

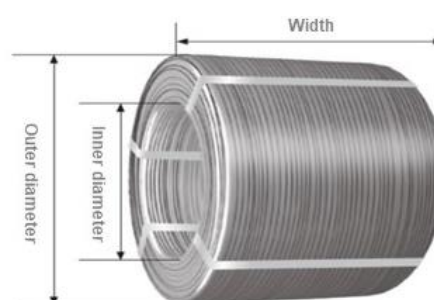
Typically, products are packed without wrapping. The use of wrapping is subject to negotiation, but this content is included the packaging for wire rods in the LCA study.



Table 1. Product components of wire rods

Steel Group	Grade	Application
Carbon Steel	SWRCH10A, SWRCH18A, SWRCH25K, SWRCH35K, SWRCH45K, SWRCH45CR, S20C, S25C, S35C, S45C	Bolt, Nut, Screw, Pin, Shaft
Alloy Steel	SCM415(H), SCM420(H), SCM420HB, SCM435(H), SCM440(H), SCR420H, SCR420HB	Bolt, Nut, Screw, Pin, Shaft
Spring Steel	SAE9254, SUPM125, SUPM12C, SUP9D	Coil Spring
Bearing Steel	SUJ2	Bearing, Pin
Free Cutting Steel	SUM22, SUM43	Worm Shaft, End Piece
Boron Steel	SAE10B38M1, SAE10B21, SAE51B20H	Bolt, Nut, Screw
Micro Alloyed Steel	SWRCH45VS2	Rack Bar

Inner diameter	Outer diameter	Width
850~1,150mm	1,250~1,550mm	1,800mm or less
Coil weight	Coiling direction	Binding
2 tons	Counter clockwise	Steel band (4 points)



Hyundai Steel's Dangjin worksite produces two grade types of wire rods, carbon steel rods and alloy steel rods, and in this study, an environmental evaluation was conducted based on the total data of the two grade product production processes. Table 2 and Table 3 show the product components of two grade types of wire rods.

Table 2. Product components of carbon steel wire rods

Ingredients	Concentration (%)	CAS No.	EINECS No.
Fe (Iron)	98.8 % ~ 99.9 %	7439-89-6	231-096-4
C (Carbon)	0.10 % ~ 1.20 %	7440-44-0	231-153-3

** Substances not listed in the ingredient list above are excluded because they are below the limit concentration.*

Table 3. Product components of alloy steel wire rods

Ingredients	Concentration (%)	CAS No.	EINECS No.
Fe (Iron)	86.0 % ~ 96.0 %	7439-89-6	231-096-4
Si (Silicon)	0.10 % ~ 2.50 %	7440-21-3	231-130-8
Mn (Manganese)	0.10 % ~ 2.50 %	7439-96-5	231-105-1
Ni (Nickel)	0.10 % ~ 4.50 %	7440-02-0	231-111-4
Cr (Chromium)	0.10 % ~ 4.50 %	7440-47-3	231-157-5

** Substances not listed in the ingredient list above are excluded because they are below the limit concentration.*

Table 4. Physicochemical characteristic of wire rods

Physical state	Boiling point	Melting point	Specific gravity
Solid	2,861 °C	1,538 °C	7.0 ~ 8.0 at 20 °C

Applications

Used to make parts that transmit power from the engine and powertrain to the drive shaft. High in strength and durability. Different alloying elements are added for different products, and parts are produced using heat treatment and back-end processing, such as heading and drawing.



LCA study

Declared unit

The declared unit is 1 tonne of steel wire-rod. It is thus a declared functional unit according to the definition and terminology of the Product Category Rules.

Data and LCA software

To compile life cycle inventory results, the LCI dataset from different sources, including GaBi professional database were applied.

GaBi LCA software (version 10.6.2.9) was used to measure life cycle inventory profile and life cycle impact results.

Cut-off criteria

The PCR says that data for elementary flows to and from the product system contributing to a minimum of 99% of the declared environmental impacts shall be included. To satisfy the PCR, we are considered more than 99% mass inputs.

Allocation

Physical allocation was applied according to the PCR, Section 4.5.1. The production is sequential processes of steelmaking continuous casting, large bar rolling, and small bar/wire rod rolling. We calculated the output ratio of the product and the co-products in each sequential processes, and allocated the inputs and outputs of the processes by applying the output ratio of the main product.

Data quality

For the data quality assessment, the following requirements are considered;

Time related coverage: Primary data from on-site was collected during the fiscal year of 2022,

Geographical coverage: Primary data was collected from Dangjin works,

Technology coverage: Primary data flow was collected from current steel making process.

Source of the data: All input and output data were collected in the enterprise resources planning (ERP) system where the data is sorted by product and process unit. So, the collected data are the primary data such as measurement, engineering calculations and purchasing records.

Precision: Measure of the variability of the data value for each data expressed.

Completeness: Percentage of flow that is measure or estimated.

Consistency: Quality assessment of the degree to which the data set reflects the true population of interest.

Reproducibility: Quality assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study.

Uncertainty of the information: Minimize uncertainty about data, models, etc.

Scope of Declaration

The system boundary on wire rods adapt cradle-to-gate(Upstream) and gate-to-gate(Core-stream). The following are the life cycle phases considered:

Upstream processes (from CtoG)

Raw material supply

- Extraction and processing of raw/auxiliary materials.

Transport

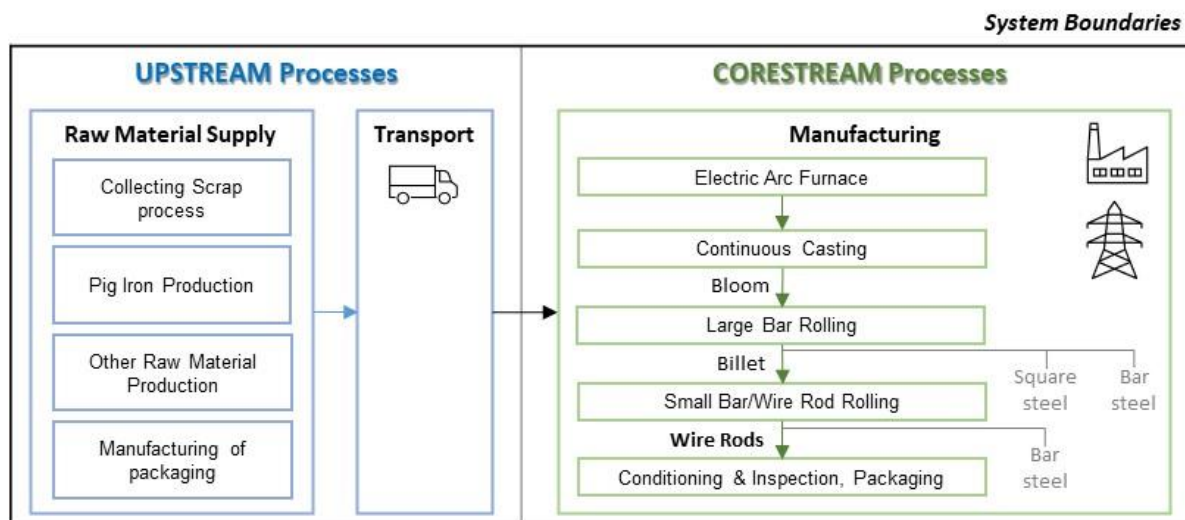
- Ocean transportation of raw/auxiliary materials and steel scrap.
- Road transportation of raw/auxiliary materials and steel scrap.

Core processes (from GtoG)

Manufacturing

- Producing process utilities.
- Supply of process utilities.
- Manufacturing wire-rods.
- Waste treatment of process wastes and emissions.

Scope of Declaration



Assumption and Limitations

Upstream processes (from CtoG)

Raw material supply

- Steel scrap : LCI database(LCI DB) is applied for the scraps and it's about the classification and stacking in the open air of steel scraps
- Pig iron : Pig iron was directly produced at the Dangjin worksite. We conducted research on it by collecting manufacturing process data

- Ferroalloy : There are 18 kind of ferroalloy inputs. Each of ferroalloy amount ratio is less than 1% of total inputs mass, and LCI DBs of top 6 (amount) ferroalloys are applied. The total ferroalloy amounts are considered.

Transport

- There are a large number of the raw and auxiliary material suppliers. The distances from suppliers to Dangjin worksite is not clearly, because the contract suppliers and the actual supplier work sites are different. So we consider the distances from a provincial government in same region with supplier to Dangjin worksite.
- When calculating the overseas transport distance of the steel scrap, the distance of road transportation is excluded since the products are imported through agencies after being collected or purchased across the country.

Core processes (from GtoG)

Manufacturing

- Dangjin works produces and uses industrial oxygen, nitrogen argon, compressed air, and steam. Therefore, the data on the utility production facilities are collected and calculated and reflected in the environmental impact results of the products.
- Influent : In corestream stage, the influent from lake nearby Dangjin works is used. There are not any water resource pretreatment, then only the impact of inflow electricity for influent is considered except water production.
- Slag, Mill scale, Steam, Particulate matter : They are reused in Dangjin works except particulate matter. It is reused in external facility, then the road transportation is considered.
- Vapor : The vapor is (the sum of influent and flocculating agent) minus (the sum of effluent and waste water sludge).
- COG combustion emission: COG caloric value and COG combustion impact factor from Hyundai-Steel are applied.

Result of Life Cycle Assessment

Using GaBi software, the environmental impacts of 13 impact categories were derived as shown in Table 5 through the EF3.1 methodology. The inventory flow results were calculated using GaBi model and summarized for the functional unit from CtoG. Secondary data are sourced from the Sphera, and Ecoinvent LCI database with a bias towards recent and representative data.

Table 5. Environmental Impacts of wire rods (per 1,000 kg)

Parameter	Unit	Upstream		Corestream	Total	
		Raw material	Transportation	Manufacturing		
Global Warming Potential (GWP)	Total	kg CO ₂ eq.	1.06E+03	1.51E+01	6.67E+02	1.74E+03
	Biogenic	kg CO ₂ eq.	7.44E-01	3.95E-03	5.93E-01	1.34E+00
	Fossil	kg CO ₂ eq.	1.06E+03	1.51E+01	6.66E+02	1.74E+03
	LULUC	kg CO ₂ eq.	3.10E-01	8.16E-03	4.48E-02	3.63E-01
Acidification Potential (AP)		Mole of H ⁺ eq.	1.36E+00	6.47E-02	9.55E-01	2.38E+00
Eutrophication Potential (EP)	Freshwater	kg P eq.	9.29E-01	1.16E-03	5.35E-04	9.31E-01
	Marine	kg N eq.	4.86E-01	1.52E-02	3.82E-01	8.84E-01
	Terrestrial	Mole of N eq.	3.45E+00	1.61E-01	4.18E+00	7.80E+00
Ozone layer Depletion Potential (ODP)		kg CFC ₁₁ eq.	2.16E-06	2.31E-07	5.02E-08	2.44E-06
Photochemical Ozone Creation Potential (POCP)		kg NMVOC eq.	1.07E+00	6.56E-02	1.03E+00	2.17E+00
Abiotic Depletion Potential	Fossil (ADPF)	MJ	8.56E+03	2.11E+02	8.97E+03	1.78E+04
	Elements (ADPE)	kg Sb eq.	2.90E-02	4.52E-05	2.23E-05	2.91E-02
Water Deprivation Potential (WDP)		m ³	6.44E+01	1.18E+00	6.14E+00	7.17E+01

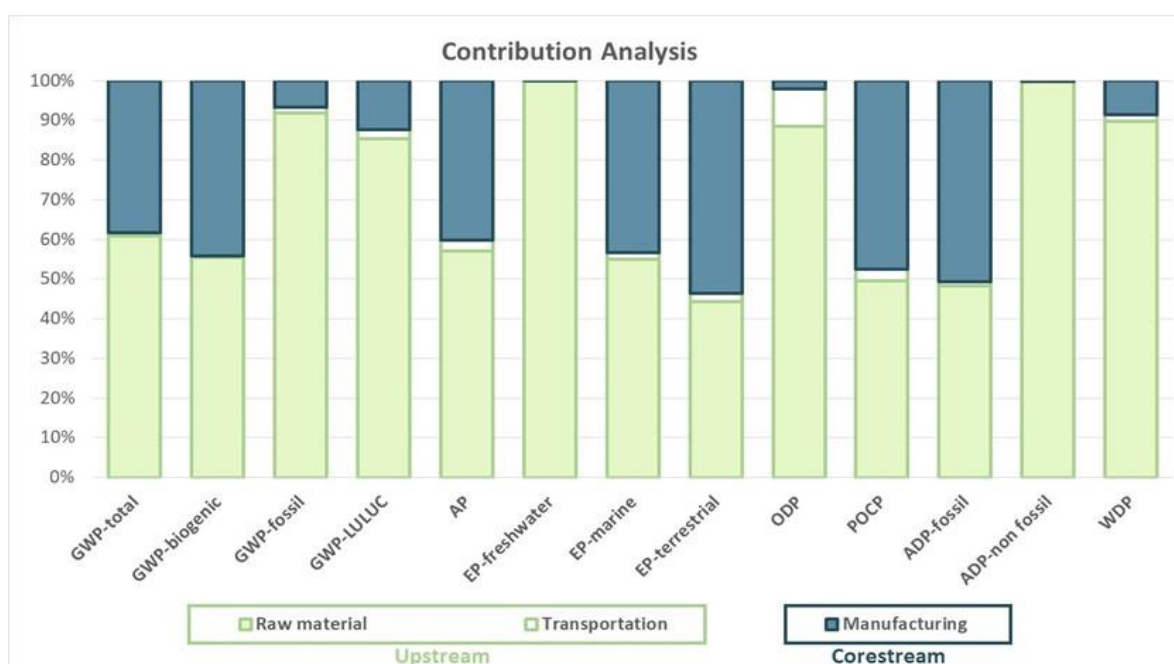


Table 6. Resource use for wire rods (per 1,000 kg)

Parameter		Unit	Upstream		Corestream	Total
			Raw material	Transportation	Manufacturing	
Renewable Primary Energy Resources	excluding renewable primary energy used as raw materials (PERE)	MJ	3.82E+00	5.41E-02	7.12E-03	3.88E+00
	raw materials (PERM)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total (PERT)	MJ	3.82E+00	5.41E-02	7.12E-03	3.88E+00
Non-renewable Primary Energy Resources	excluding non-renewable primary energy used as raw materials (PENRE)	MJ	2.22E+01	0.00E+00	2.04E+02	2.27E+02
	raw materials (PENRM)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total (PENRT)	MJ	2.22E+01	0.00E+00	2.04E+02	2.27E+02
Secondary Material (SM)		kg	0.00E+00	0.00E+00	6.69E+02	6.69E+02
Renewable Secondary Fuels (RSF)		MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable Secondary Fuels (NRSF)		MJ	8.00E+03	0.00E+00	6.65E+03	1.47E+04
Net Fresh Water (FW)		m ³	4.06E+00	6.47E-02	2.48E-01	4.38E+00

Table 7. Waste production and output flows of wire rods (per 1,000 kg)

Parameter		Unit	Upstream		Corestream	Total
			Raw material	Transportation	Manufacturing	
Hazardous Waste Disposed		kg	2.72E-08	0.00E+00	3.24E-07	3.51E-07
Non-hazardous Waste Disposed		kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radioactive Waste Disposed		kg	8.55E-02	0.00E+00	8.19E-01	9.04E-01
Components for Re-use		kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for Recycling		kg	0.00E+00	0.00E+00	6.69E+02	6.69E+02
Materials for Energy Recovery		kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported Energy Electricity		MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported Energy Thermal		MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Additional Norwegian requirements

Greenhouse gas emission from the use of electricity in the manufacturing phase

National production mix from import, low voltage (production of electricity without own electricity transformers, which use electricity directly from the grid) of applied electricity for the manufacturing process

Table 8. Carbon emission factor of electricity

Electricity	Data source	Amount	Unit
Electricity grid mix, KR	Sphera	6.04E-01	kg CO ₂ eq./kWh

Dangerous substances

There aren't any dangerous substances about REACH and SVHC in the wire rods production of Dangjin worksite.

indoor environment result

No tests have been carried out on the product concerning indoor climate - not relevant.

Carbon footprint

Carbon footprint has been worked out for the product.

Parameter	Unit	Upstream		Corestream	Total
		Raw material	Trans- portation		
GWP-TOTAL	kg CO ₂ eq	1.06E+03	1.51E+01	6.67E+02	1.74E+03

Bibliography

ISO 14025:2010 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 14047:2012 Environmental management – Life cycle assessment – Illustrative examples on how to apply ISO 14044 to impact assessment situations

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

ISO 20915:2018 Life cycle inventory calculation methodology for steel products






EPD PCR 2015:03 Basic iron or steel products & special steels, except construction steel products. Version 2.0, 2020-03-27

General Programme Instructions for The Norwegian EPD Foundation 2019:05

The GaBi LCA Software (GaBi version 10.6.2.9).

Ecoinvent, 2022. Swiss Centre for Life Cycle Assessment, v3.9.1 (www.ecoinvent.ch)

Sphera, 2020. Software GaBi version 10.7.0.183. (www.gabi.sphera.com)

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