

SECTION SHAPE STEEL

STRUCTURAL STEEL



With cross-sectional shape of 'H', 'L', 'C', 'I', 'U' this is a typical section widely used frame of large structures or engineering work. The product characteristically boast excellent strength, as it registers uniform inner quality compared to the welded sections made by welding hot rolled or thick steel plates.



Hyundai Steel, a 70-year-old company with both electric arc and blast furnace facilities has a steel production capacity of 24 million tonnes. Especially, the electric arc furnace process offers advantages in reducing carbon emissions due to its process characteristics compared to the blast furnace. Hyundai Steel has been utilizing its electric arc furnace capacity to produce a diverse range of products, including steel bars, sections, and hot rolled sheets, even before the introduction of blast furnace operations. Additionally, in 2010, the company successfully entered the blast furnace integrated steelworks business and swiftly established itself as a global automotive steel sheet specialist in the short term. Leveraging the operating experience of both blast furnace and electric arc furnace processes, Hyundai Steel is committed to actively addressing climate change by drawing out the optimal solution for low-carbon production system transition.



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According to ISO 14025
and ISO 21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Solutions 333 Pfingsten Rd, Northbrook IL, 60062	www.ul.com www.spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	Program Operator Rules v 2.7 2022	
MANUFACTURER NAME AND ADDRESS	Hyundai Steel Company 63, Jungbong-daero, Dong-gu, Incheon, Republic of Korea	
DECLARATION NUMBER	4791231634.102.1	
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	1 metric ton of Section shape steel	
REFERENCE PCR AND VERSION NUMBER	ISO 21930(2017), UL PCR for Building-Related Products and Services Part A : Life Cycle assessment Calculation Rules and Report Requirements V4.0(2022) Part B : Designated Steel Construction product EPD Requirements (2020)	
DESCRIPTION OF PRODUCT APPLICATION/USE	Construction, Building	
PRODUCT RSL DESCRIPTION (IF APPL.)	N/A	
MARKETS OF APPLICABILITY	North America	
DATE OF ISSUE	September 20, 2024	
PERIOD OF VALIDITY	5 Years	
EPD TYPE	Product-Specific	
EPD SCOPE	Cradle to gate	
YEAR(S) OF REPORTED PRIMARY DATA	2023	
LCA SOFTWARE & VERSION NUMBER	GaBi software v10.7.1.28	
LCI DATABASE(S) & VERSION NUMBER	Ecoinvent 2022. Swiss Centre for Life Cycle Assessment, v3.9.1, Sphera 2021	
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1, CML2001	
The PCR review was conducted by:		UL Solutions
		PCR Peer Review Panel
		Dr. Tom Gloria, Chair Industrial Ecology Associates
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL		Skye Tang, UL Solutions <i>Skye Tang.</i>
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:		Hyundai Steel Company
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:		YeonSung Mo, H.I.Pathway Co., LTD. <i>YeonSung Mo</i>



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LIMITATIONS

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible*. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.



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1. Product Definition and Information

1.1. Description of Organization

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 various product portfolio that includes reinforcing bars, sections, hot rolled sheets/coils, cold rolled sheets/coils, plates, special steel, and automotive parts. With 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 (Bundangnaegok-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), and the Suncheon Works (Indeok-no, Haeryong-myeon, Suncheon City, Jeollanam-do), and our headquarters is in Jungbongdae-ro Dong-gu, Incheon Metropolitan City.

Globally, we have 19 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.

1.2. Product Description

Product Identification

Section shape steel comprises the structure of a building as one of the main steel products. Section shape steel have outstanding welding performance and impact resistance and its advantage is in reducing volume of steel materials used in comparison to other steel materials and can shorten the construction period. Hyundai Steel's section shape steels are manufactured at Incheon and Pohang worksites. And the production volumes and percent for each worksite that produces section shape steel are as follows.

Table 1. Production volumes and percent for each worksite that produces section shape steel

WORKSITE	PRODUCTION PERCENT
Incheon	59.1%
Pohang	40.9%

Product Specification

- Product name : Section shape steel
- Product identification
 - Complies with The Korean Industrial Standard (KS D 3502, KS D 3515, KS D 3866, KS F 4603, KS F 4604)
 - Complies with The Japan Industrial Standard (JIS G 3192)
 - Complies with The American Society for Testing Materials (ASTM A6)
 - Complies with The Australian Standard & New Zealand Standard (AS/NZS 3679)
 - Complies with The European Standard (EN 10025)
- Standard for Major Products : KS D 3502, JIS G 3192, ASTM A6, AS/NZS 3679, EN 10025



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- Other standard for product classification : BS 4360, IS 2063
- Density of product : 7,850 ~ 7,860 kg/m³
- Designation : KS D 3502(H100~ H900), ASTM A6/A6M(W4x4 ~ W36x12)

Flow Diagram

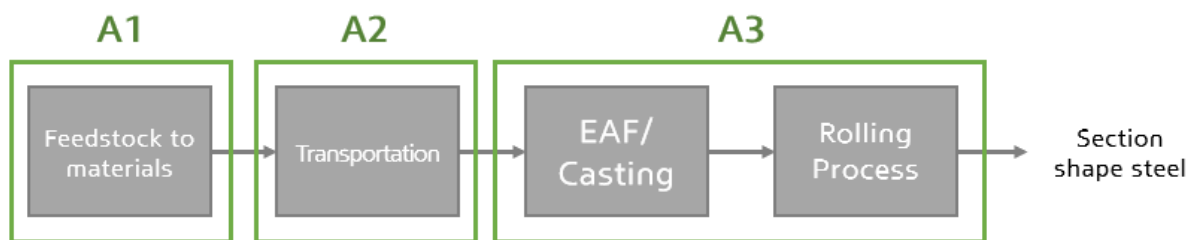


Figure 1. Flow diagram of section shape steel

1.3. Application

According to the shape of section, the shape 'H' is a typical section widely used for frame of large structures or engineering work. And shape 'L', is widely used as reinforcing material of steel structures such as iron tower materials, hull reinforcement material, and truss.

1.4. Declaration of Methodological Framework

This study has been conducted according to the requirements of UL EPD Product Category Rules for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements, PartB_Designated Steel Construction product EPD Requirements, ISO 21930:2017 and ISO 14025:2006. Hereinafter, the requirements are referred to as PCRs.

According to PCRs, average EPDs may be derived for similar products from one or more sites of one company or multiple companies using data specific to that product. And Hyundai Steel's the section shape steel are manufactured by electric arc funaces using steel scrap as main raw material at Incheon and Pohang worksites. The average EPD of Hyundai Steel's section shape steel was performed on a weighted average based on the 2023 production of the worksites.

Using GaBi v10.7.1.28 software, we derived LCI and LCIA results for A1-A3 input/output data weighted average with the section shape steel production ratio for each worksites.

LCIA results required for PCR PartA and environmental impacts for 7 impact categories were derived, through the TRACI 2.1 and CML2001 methodologies.

Secondary data is the most recent and representative data, sourced from Sphera(2021) and Ecoinvent 3.9.1(2022) LCI database.

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1.5. Technical Requirements

The section shape steel conforms to KS D 3502 or ASTM A6.

1.6. Material Composition

Steel products used inside the building envelope(e.g.,used in load-bearing applications present inside wall structures) do not include materials or substances which have any potential route of exposure to humans or flora/fauna in the environment.

Table 2. Material components of section shape steel

INGREDIENTS	CONTRIBUTION
Fe(Iron)	92.60~98.90%
C(Carbon)	~0.20%
Si(Silicon)	~0.40%
Mn(Manganese)	0.50~1.35%
P(Phosphorus)	~0.04%
S(Sulfur)	~0.05%
TOTAL	100.00%



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1.7. Manufacturing

Hyundai Steel’s electric arc furnace uses steel scrap to manufacture sections, reinforcing bars, and railway rails that are used for buildings, bridges and railways. After melting the steel scrap to make molten metal, it is then smelted to eliminate impurities before proceeding to the continuous casting process to manufacture half-finished products, such as blooms and billets. These half-finished products can be rolled after the reheating process to increase their size as finished products, such as sections and reinforcing bars, in various sizes and thickness.

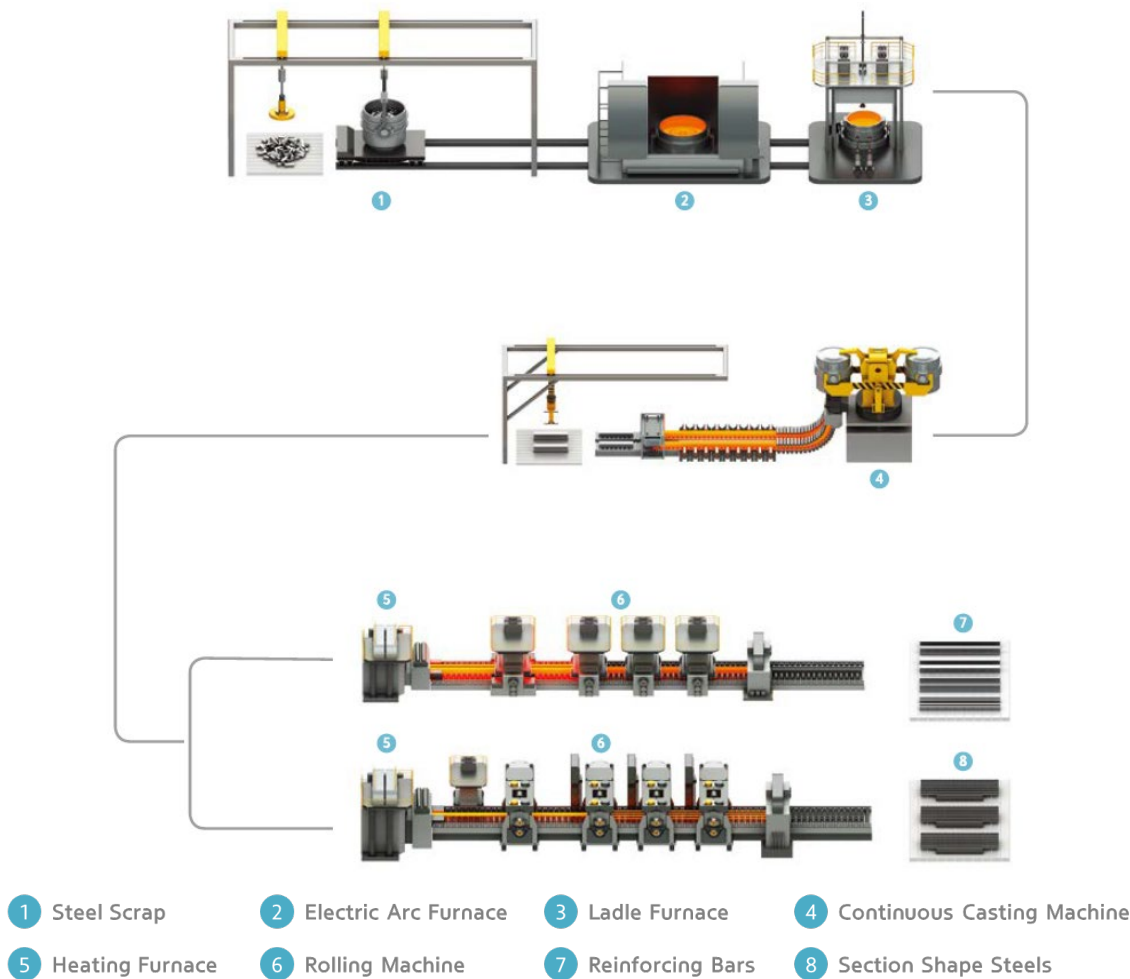


Figure 2. Main production processes of reinforcing bars and section shape steels



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2. Life Cycle Assessment Background Information

2.1. Declared Unit

According to PCR, since reinforcing bars have wide usage and different functions, they cannot be defined as a single function. Reinforcing bars were calculated based on the declared unit, one metric ton - their unit of sale. (※ Density of reinforcing bars : $7.85\text{ton}/\text{m}^3$).

2.2. System Boundary

This study includes the cradle-to-gate life cycle assessment of the section shape steel.

The system boundaries of this report follow the modular structure in line with PCRs.

According to PCR PartA 2.8, this report considers modules A1-A3; section shape steels are not replaced as they are a structure of the building, end of life with the building's life cycle.

Table 3. Description of the system boundary modules

EPD Type	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Extraction and upstream production	Transport to factory	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
	Mandatory			MND													

According to PCRs, the product stage includes A1 Extraction and upstream production, A2 Transport to the factory and A3 Manufacturing.

A1, Extraction and upstream production

- Extraction and processing of raw materials and auxiliary materials.
- The electricity from the grid and LNG generated from primary energy sources are used in the manufacturing.

A2, Transport to factory

- Transport of raw materials to the manufacturing worksites.

A3, Manufacturing



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- The energy and utilities used for the manufacturing process.
- Emissions from the combustion of LNG used in the manufacturing process.
- Transport of co-products from the manufacturing worksites to the recycling factories.

2.3. Estimates and Assumptions

For domestic transportation, the distance was calculated equivalent to 70% of suppliers because raw materials are purchased from various companies. For overseas transportation, the distance from the export ports to our worksites were considered because it was difficult to figure out the current status of road transportation of the region.

2.4. Cut-off Criteria

All inputs for which data were available were included. Material inputs greater than 1% (based on total input mass) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion and/or the material input was thought to have significant environmental impact. No known flows were excluded from this LCA.

2.5. Data Sources

Input/output data for the section shape steels production was derived from data which is managed by SAP system in Hyundai Steel. Upstream data for the inputs for the section shape steels production - raw materials, energy and purchased utilities - were utilized from the Sphera, and Ecoinvent LCI database as recent and representative data.

2.6. Data Quality

Time Related Coverage

- Primary data from on-site was collected during the fiscal year of 2023.
- For primary data, year 2023 – which is the most recent year – was used for calculation. Secondary data was used for upstream data of the raw materials which were difficult to collect (recent LCI DB was applied – Sphera, Ecoinvent etc). The data satisfies the requirements of ISO 21930 – 5 years for primary data, 10 years for secondary data.

Geographical Coverage

- The data used in the analysis is the most recent and representative data available.
- For secondary data, if there is DB representing Korea (ex. electricity), it was used as priority. If not, GLO DB was used. Due to sufficient similarities of global data and the actual process, it was determined that GLO DB has representativeness.
- Although the production plants are divided into 2, each worksite's data is managed by the SAP system. The results were weighted average after each calculation.

Technology Coverage

- Although the worksites are located in different regions, the same database was applied in report since the EAF production processes are the same.

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- For the secondary data, the most similar one was applied.

Completeness

- Hyundai Steel's section shape steels are manufactured at Incheon and Pohang worksites. Because this report is considering all 2 worksite's product manufacturing data, the data covers all productions of section shape steels produced by Hyundai Steel Company - which the completeness is satisfied.

2.7. Allocation

Allocation procedures for co-products were addressed according to ISO 14044:2006. Physical allocation methods such as mass, energy are not suitable since the co-products are mostly composed of minerals and low-economic value materials. According to PCR PartA section 3.3, allocation based on economic values is allowed if the difference in revenue is more than 25% between co-products and produced products.

The economic value of the co-products is assessed by considering the proportion of revenue generated by each co-product and the section shape steels. We calculated each revenue ratio of the product and the co-products in Incheon and Pohang worksites, and allocated the inputs and outputs of the A1-A3 process by applying the revenue ratio of section shape steels.

3. Life Cycle Assessment Results

Using GaBi software, the environmental impacts of 7 impact categories were derived as shown in Table 4 through the TRACI 2.1 and CML2001 methodologies. The inventory flow results were calculated using GaBi model and summarized for the declared unit from CtoG. Secondary data is sourced from the Sphera, and Ecoinvent LCI database with recent and representative data.

3.1. Life Cycle Impact Assessment Results

Table 4. Life cycle impact assessment results of section shape steel (per one metric ton)

IMPACT CATEGORY	UNIT	A1	A2	A3	TOTAL	METHODOLOGY
Global Warming Potential (GWP 100), IPCC 2013	kg CO ₂ eq.	1.14E+02	1.44E+01	5.19E+02	6.47E+02	TRACI 2.1
Ozone Depletion Potential (ODP)	kg CFC-11 eq.	6.31E-07	2.37E-07	1.66E-08	8.85E-07	TRACI 2.1
Acidification Potential (AP)	kg SO ₂ eq.	1.83E-01	7.81E-02	5.36E-01	7.98E-01	TRACI 2.1
Eutrophication Potential (EP)	kg N eq.	6.66E-01	1.25E-02	5.51E-02	7.34E-01	TRACI 2.1
Smog Formation Potential (SFP)	kg O ₃ eq.	2.39E+00	1.37E+00	1.26E+01	1.64E+01	TRACI 2.1
Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources sources (ADP _{fossil})	MJ, LHV	1.34E+03	1.99E+02	6.63E+03	8.16E+03	CML2001
Abiotic Resource Depletion Potential of Non-renewable (non-fossil) resources (ADP _{resources})	kg Sb eq.	8.69E-04	4.26E-05	3.74E-05	9.49E-04	CML2001

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3.2. Life Cycle Inventory Results

Table 5. Resource use for section shape steel (per one metric ton)

PARAMETER	UNIT	A1	A2	A3	TOTAL
Renewable primary resources used as energy carrier (fuel) (RPR _E)	MJ, LHV	7.13E-01	5.05E-02	8.51E-03	7.72E-01
Renewable primary resources with energy content used as material (RPR _M)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable primary resources total (RPR _T)	MJ, LHV	7.13E-01	5.05E-02	8.51E-03	7.72E-01
Non-renewable primary resources used as an energy carrier (fuel) (NRPR _E)	MJ, LHV	8.42E-01	0.00E+00	1.92E+02	1.93E+02
Non-renewable primary resources with energy content used as material (NRPR _M)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable primary resources total (NRPR _T)	MJ, LHV	8.42E-01	0.00E+00	1.92E+02	1.93E+02
Secondary materials (SM)	kg	0.00E+00	0.00E+00	1.14E+03	1.14E+03
Renewable secondary fuels (RSF)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuels (NRSF)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered energy (RE)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water resources (FW)	m ³	8.76E-01	6.01E-02	6.30E-02	9.99E-01

Table 6. Output flows and waste categories for section shape steel (per one metric ton)

PARAMETER	UNIT	A1	A2	A3	TOTAL
Hazardous waste disposed (HWD)	kg	1.41E-08	0.00E+00	7.02E-07	7.16E-07
Non-hazardous waste disposed (NHWD)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
High-level radioactive waste, conditioned, to final repository (HLRW)	kg or m ³	2.14E-06	0.00E+00	8.99E-04	9.01E-04
Intermediate- and low-level radioactive waste, conditioned, to final repository (ILLRW)	kg or m ³	4.82E-05	0.00E+00	2.03E-02	2.03E-02
Components for re-use (CRU)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (MR)	kg	0.00E+00	0.00E+00	2.47E+02	2.47E+02
Materials for energy recovery (MER)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered energy exported from the product system (EE)	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00



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4. LCA Interpretation

Results were summarized by life cycle phase for a CtoG assessment of the Hyundai Steel's section shape steels product systems.

A Life Cycle Impact Assessment of the Hyundai Steel's section shape steels product was conducted to ISO 21930:2017, UL PCR for Building-related products and services PartA V4.0:2022 and PartB:2020, ISO 14044:2006 and ISO 14025:2006. Results are reported using the indicators prescribed by the PCRs based on the TRACI 2.1 and CML2011 characterization methodologies. Impact category indicator results for the product systems considered are presented in section 3.

Impact category indicator results are summarized by life cycle phase including raw material extraction and processing; transport to manufacturer; product manufacturing and packaging. Results are evaluated using process contribution analyses.

In GWP100, AP, SFP and ADP fossil impact categories, the contributions to the most impact indicator results are dominated by the A3 manufacturing stage of the assessment. And as a result of inventory analysis, the impact categories are emitted by electricity production. In ODP, EP and ADP resource impact categories, the contributions to the most impact indicator results are dominated by the A1 extraction and upstream production stage of the assessment.

4.1. Assumptions and limitations associated with the interpretation

The assessment relied on a number of assumptions and limitations, the most relevant of which are discussed in this report. Most of the upstream raw materials extraction and processing could not be modeled with actual process information. Representative data from Sphera and Ecoinvent life cycle inventory databases were utilized as appropriate.

It is noted that the LCIA results presented in this report are relative expressions and do not predict impacts on category endpoints, exceedance of thresholds, safety margins, or risks associated with the product system. Impact indicators rely on the use of generic models and potential impacts, and therefore are not able to measure actual environmental impacts. Additionally, the indicators prescribed by the PCR do not represent all categories of potential environmental and human health impacts associated with the life cycle of the assessed products, and this represents a general limitation of the LCA study.

4.2. Data quality assessment

Completeness check

- Life cycle inventory results were reviewed for completeness, consistency and representativeness. Overall, the inventory was considered consistent and generally representative of the product system, with respect to the impact categories assessed. The primary source of data used during the assessment was from the manufacturer, with the remaining derived from the Sphera and Ecoinvent life cycle inventory database.

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Consistency check

- Methodological choices and practices were consistent with the PCR PartA, PartB, ISO 21930, ISO 14044 and ISO 14025:2006. Overall, the inventory was considered consistent with respect to the processes and impact categories assessed.

5. Additional Environmental Information

5.1. Mandatory Environmental Information

Regulated hazardous substances

- REACH, SVHC information : There aren't any dangerous substances about REACH and SVHC in the section shape steels production of Incheon and Pohang worksites.

Dangerous substances

- Indoor air quality : There aren't relevant impact on the indoor environment.

6. References

- 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 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 21930:2017 – Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services
- UL Product Category Rules for Building-Related Products and Services PartA V4.0 2022, Product Category Guidance for Building-Related Products and Services PartB 2020
- The GaBi LCA Software (GaBi version 10.7.1.28)
- Ecoinvent, 2022. Swiss Centre for Life Cycle Assessment, v3.9.1 (www.ecoinvent.org)
- Sphera, 2021. (<https://lcadatabase.sphera.com/>)



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7. Contact Information

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