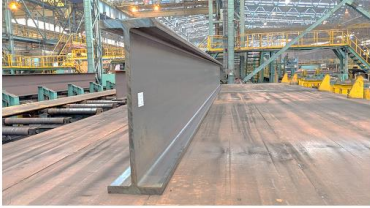





ENVIRONMENTAL PRODUCT DECLARATION

HOT ROLLED STRUCTURAL STEEL

<p>Photo 1-1 Hot Rolled H-beam</p> 	<p>Photo 1-2 Checkered H-Beam</p> 
<p>Photo 1-3 Beveled H-Beam</p> 	<p>Photo 2-1 Flat steel</p> 

Hot-rolled structural steel profiles are divided into two major types, H-Beam (include Hot rolled H-Beam, Checkered H-Beam, Beveled H-Beam) and Flat steel.



From its beginnings in “Kuei-Yi Industrial Co., Ltd” to “Dragon Steel Corporation” The company always upholds the values of teamwork, entrepreneurial approach, down-to-earthiness, and pursuit of innovation and is dedicated to technological improvement, intelligent manufacturing, continuous carbon reduction, environmental protection. Its vision is to become a world class steel manufacturing base.

DSC pays much attention to global warming issue and we established the "Energy Saving, Carbon Reduction, and Carbon Neutrality Task Force" in January 2022. In the future, DSC will continue to heighten the values of its products, promote green production, introduce the best production processes and technology, enhance the efficiency of energy utilization, integrate the needs of its customers, strengthen the advantage of quality services, be dedicated to environmental protection, fulfill its corporate social responsibility.



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025
, and ISO21930:2017

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	DRAGON STEEL CORPORATION No. 100, Longchang Rd., Longjing Dist., Taichung City 434, Taiwan(R.O.C.)	
DECLARATION NUMBER	4791193748.101.2	
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	HOT ROLLED STRUCTURAL STEEL SECTIONS Declared unit : 1 metric ton	
REFERENCE PCR AND VERSION NUMBER	Part B: Designated Steel Construction Product EPD Requirements, UL Environment, UL 10010-34, v2, 08/26/2020	
DESCRIPTION OF PRODUCT APPLICATION/USE	Steel structure and steel metrodeck	
PRODUCT RSL DESCRIPTION (IF APPL.)	N/A	
MARKETS OF APPLICABILITY	Global markets outside the EU	
DATE OF ISSUE	November 5, 2024	
PERIOD OF VALIDITY	5 Years	
EPD TYPE	product-specific	
RANGE OF DATASET VARIABILITY	N/A	
EPD SCOPE	Cradle to gate	
YEAR(S) OF REPORTED PRIMARY DATA	2021	
LCA SOFTWARE & VERSION NUMBER	SimaPro 9.5.0.2	
LCI DATABASE(S) & VERSION NUMBER	Ecoinvent v3.10(2023)	
LCIA METHODOLOGY & VERSION NUMBER	Ecoinvent v3.10-TRACI v2.1 and CMLv4.8 2016	
The PCR review was conducted by:	UL Solutions PCR Peer Review Panel Cara Vought, LCACP, Sustainable Solutions Corporatio	
This declaration was independently verified in accordance with ISO 14025: 2006. <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> 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:	Taiwan Green Productivity Foundation	
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Cara Vought, LCACP, Sustainable Solutions Corporatio <i>Cara M Vought</i>	

ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

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.

Statement that the LCIA results are relative expressions and do not predict impacts on category endpoints, exceeding of thresholds, safety margins or risks.

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, when they comply with all referenced standards, use the same sub-category Part B PCR, and use equivalent scenarios with respect to construction works. 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.

Comparison of the environmental performance of [Product category] using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR.

LCA life cycle assessments generally do not address the environmental impact of raw material extraction on a specific site, nor are they intended to assess human health toxicity, and LCIA for different products are not suitable for comparison.

ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

1. Product Definition and Information

1.1. Description of Company/Organization

Dragon Steel Corporation (DSC) was established in 1993. In 2004, the corporation, whose original name was Kuei-Yi Industrial Co., Ltd., was renamed "Dragon Steel Corporation" with a capital increase and became a 100% wholly-owned subsidiary of China Steel Corporation in 2008. DSC is located in Taichung. It upholds the values of teamwork, entrepreneurial approach, down-to-earthiness, and pursuit of innovation and is dedicated to technological improvement, intelligent manufacturing, continuous carbon reduction, environmental protection, and value creation. Its vision is to become a world class steel manufacturing base.

DSC is the only wholly integrated steel plant with both an electric arc furnace and two blast furnaces in Taiwan. Its main facilities were designed by adopting the latest, highly efficient, and environmentally-friendly designs. The types of steel which DSC's blast furnaces produce include general carbon steel, structural steel, high-strength low alloy steel, etc. It can also produce general structural steel with the specifications of the largest hot-rolled thickness and width in the CSC Group. The electric arc furnace produces flat steel and H beams with high strength, toughness, a low yield ratio, and seismic resistance. The specifications of DSC's H beams are the largest in Taiwan.

DSC will continue to heighten the values of its products, promote green production, introduce the best production processes and technology, enhance the efficiency of energy utilization, integrate the needs of its customers, strengthen the advantage of quality services, be dedicated to environmental protection, fulfill its corporate social responsibility, and propel the upgrade of the steel industry in Taiwan.



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

1.2. Product Description

Product Identification

Product name: H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

Production code is shown in the table below

number	HS CODE (6 code)	Product describe
1	721633	Hot Rolled H-Beam 、 Checkered H-Beam and Beveled H-Beam
2	720851 720890 721114	Flat steel

*Hot rolled H-Beam : Mainly applies to steel structure. The rolling H-beam, compares to BH, is a hot-rolled integrated product which can reduce welding, inspection, and shorten construction period. DSC can supply the H-beam with large section (H950X312X26/43.5 mm) in Taiwan market. The other hand, we have also developed the high strength H-Beams (CNS SM570) with YS higher than 450 MPa used for seismic-resistant structure, which currently have been successfully applied to DSC's warehouse with large span (142m) and newly constructed high-rise buildings domestically.

*Checkered H-Beam : During section steel production, we imprint the outer side of the flange with a checkerboard pattern, thus increases its surface friction and gives good resistance against slipping. This product mainly applies to Metrodeck's assembly, which are used in excavation construction supporting structure for transporting people, vehicles and construction equipment.

*Beveled H-Beam : We have successfully developed beveled H-beam (patent M492923) via production process and equipment adjustments. Beveled H-beam is directly chamfered on the edge of flange during its hot-rolled production process, so when it applies to Metrodeck production, it can replace the grooving process on the edge of the flange and proceed to assembly welding directly, therefore it has the advantage of both time and cost saving.

*Flat steel : Customized sizes to reduce the time and cost needs of width slitting. Currently we have successfully developed the grade of CSC SM570M , which combines the SN material seismic requirement with high strength advantage of SM570; it is particularly suitable for high rise buildings with advantages in material saving, weight reducing and optimize available spaces.

Product Specification

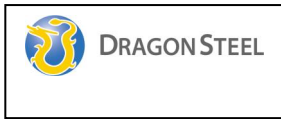
DSC has always adhered to product quality as the core of business operations and carefully controlled the quality in every stage of production. DSC is certified to many standards, such as in the table. Please visit

https://www.dragonsteel.com.tw/en/pro/pro_h.html.

Item	Standard	Serial number
1	Chinese National Standards (CNS)	CNS 2473 、 CNS 2947 、 CNS 13812 、 CNS 5083 、
2	Japanese Industrial Standards (JIS)	JIS G 3101 、 JIS G 3136 、 JIS G 3106 、



ENVIRONMENTAL PRODUCT DECLARATION

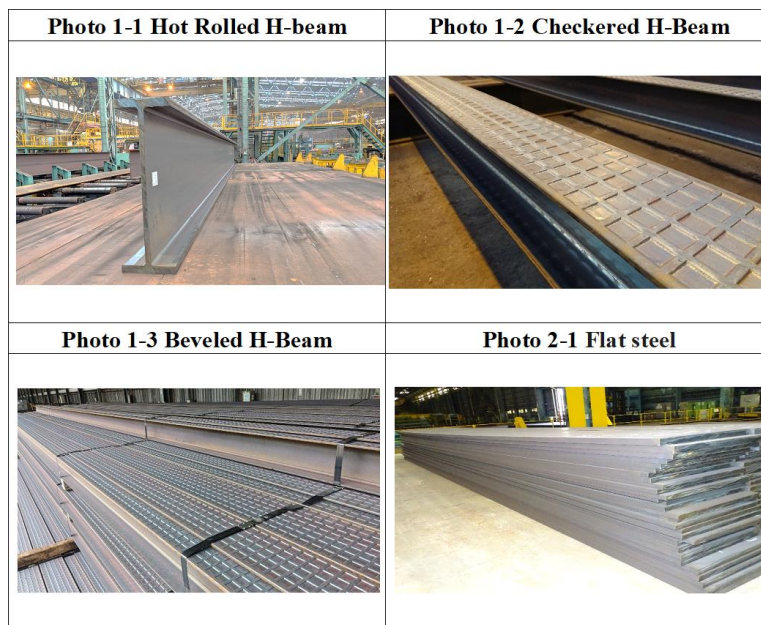


HOT ROLLED STRUCTURAL STEEL

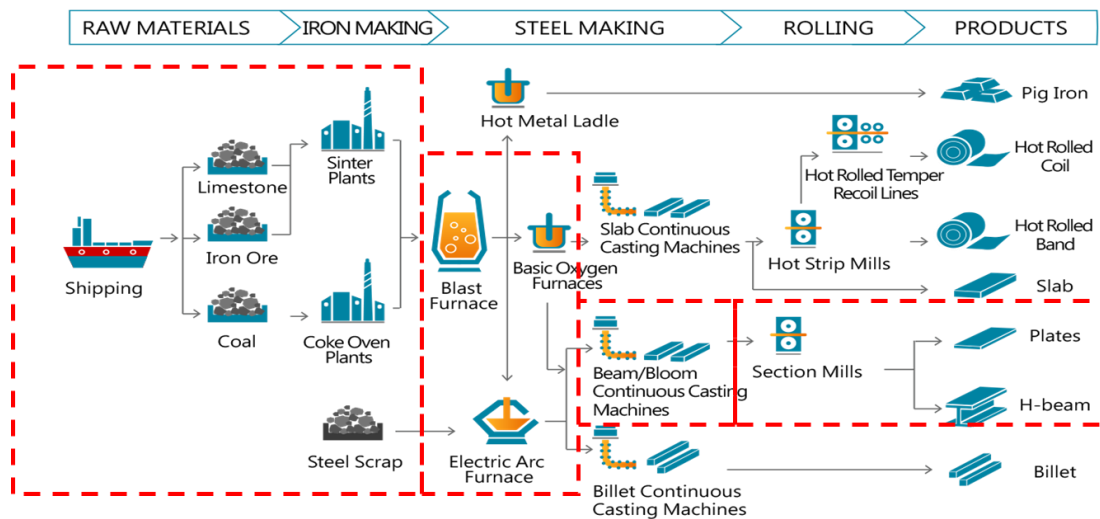
Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

3	American Society for Testing and Materials (ASTM)	ASTM A36 、 ASTM A709 、 ASTM A572 、 ASTM A992
4	British Standard European Norm (BS EN)	BS EN 10025-2/BS EN 10025-3
5	Australian Standard & New Zealand Standard (AS/NZS)	AS/NZS 3679.1
6	Korean Standards (KS)	KS D3503 、 KS D3515 、 KS D3866



Flow Diagram



EPD process boundaries (within the dotted line range)



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

1.3. Application

H-Beam and flat steel are mainly used in buildings, car bodies, bridges, etc.

Hot Rolled H-beam : Mainly applies to steel structure. The rolling H-beam, compares to BH, is a hot-rolled integrated product which can reduce welding, inspection, and shorten construction period.

Checkered H-Beam : This product mainly applies to Metrodeck's assembly, which are used in excavation construction supporting structure for transporting people, vehicles and construction equipment.

Beveled H-Beam : It is directly chamfered on the edge of flange during its hot-rolled production process, so when it applies to Metrodeck production, it can replace the beveling process on the edge of the flange and proceed to assembly welding directly, therefore it has the advantage of both time and cost saving.

Flat steel : It combines the SN material seismic requirement with high strength advantage of SM570; it is particularly suitable for high rise buildings with advantages in material saving, weight reducing and optimize available spaces.

1.4. Declaration of Methodological Framework

The EPD specifies the following items according to ISO 21930:2017.

- Hot-rolled structural steel plates include H-beams (including H-beams (Hot Rolled H-Beam), checked H-Beams and Beveled H-Beams) and flat steel, Declared unit of 1 metric ton of H-Beam and 1 metric ton of flat steel as described in Section 2.1.
- The type of EPD with respect to life cycle stages is "cradle-to-gate". It means "Production stage" including A1: Extraction and upstream production, A2: Transport to factory (covers transport of raw materials and other inputs to the factory and internal transport), A3: Manufacturing, and moulding
- H-Beam and flat steel are manufactured within the boundaries of the factory, but come from different rolling and finishing processes, but are distributed using a weight-weighted average.
- Since the subject product is not directly sold to the final consumer, the scope of the overall environmental characteristics inventory is set as the product life cycle Cradle-to-gate. Its boundary only includes the evaluation before the product leaves the organization (that is, covering the two stages of raw material acquisition and manufacturing), excluding the use stage and final disposal stage.
- Allocation: weight is the main basis for allocation as described in Section 2.8.
- Cut-off criteria: according to the standard of ISO 21930:2017 as described in Section 2.4.
- The technical information and scenarios is described in Section 2 and Section 3. The LCA results based on the scenarios is described in Section 4.

1.5. Technical Requirements

Our company generally adopts CNS product specifications (similar to Japanese JIS specifications) for the production of structural projects, and the steel used for output structural projects complies with the verification standards related to the purchaser's product specifications. It includes general structural steel (SS), welded structural steel (SM) and building structural steel (SN) steel specifications. Among them, SN material has the most stringent control over its chemical composition and mechanical properties to ensure its weldability and earthquake resistance. performance, can provide better security for buildings. The H-Beam and flat steel products meet the requirements shown in Section 1.2 "Product Specification".

1.6. Properties of Declared Product as Delivered

ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

The hot-rolled structural steel plates produced by DSC include H-beam (including H-beam (Hot Rolled H-Beam), checkered H-Beam and Beveled H-Beam) and flat steel. Product features are described in the table.

Properties \ Product Category	H-Beam	Flat steel
	Value(Unit)	
Density	7850 kg/m ³	7850 kg/m ³
Modulus of elasticity	210 GPa	210 GPa
Coefficient of thermal expansion	11.6 x10 ⁻⁶ K ⁻¹	11.6 x10 ⁻⁶ K ⁻¹
Thermal conductivity	60.7 W/mK	60.7 W/mK
Melting	1493 °C	1493 °C
Electrical conductivity at 20°C	6.99x10 ⁶ S/m	6.99x10 ⁶ S/m
Minimum yield strength	345 N/mm ²	325 N/mm ²
Minimum tensile strength	490 N/mm ²	490 N/mm ²
Minimum elongation	17%	17%
Tensile strength	≥490 N/mm ²	≥490 N/mm ²

1.7. Material Composition

The hot-rolled structural steel plates produced by DSC include H-beam (including H-beam (Hot Rolled H-Beam), checkered H-Beam and Beveled H-Beam) and flat steel. Product features are described in the table.

Properties \ Product Category	H-Beam	Flat steel
	Value(%)	
Iron	98.31	98.08
Carbon	0.14	0.16
Manganese	1.03	1.30
Silicon	0.29	0.31
Phosphorus	0.016	0.015
Sulfur	0.006	0.004
Copper	0.07	0.02
Other(Sn, V, Nb, Al, B, Ni, Cr, Mo, Ti)	0.13	0.11



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

Total	100	100
-------	-----	-----

1.8. Manufacturing

The main manufacturing process of hot-rolled structural steel plates produced by DSC is described as follows:

1. Put sinter, coke, other materials and PCI coal into the blast furnace to produce hot metal.
2. Hot metal, scrap steel, other alloy materials and other materials are put into the basic oxygen furnace or electric arc furnace to be smelted into liquid steel.
3. The liquid steel is purified in the ladle refining furnace and then cast into Slab and H-Bloom through the continuous casting machine.
4. The Slab and H-Bloom are then rolled and conditioned in the steel factory to produce the size and size required by the customer.

1.9. Packaging

The hot-rolled structural steel plates produced by DSC are packed with steel belts or steel buckles, and they are recyclable resources after disassembly.

1.10. Product Installation

When the product is installed and used, it must be installed in accordance with the engineering construction outline specifications (or structural engineering calculations) and the manufacturer's recommendations. Additionally, standards of safety measures should be adopted during handling and use of the product.

1.11. Use

The use phase is not included in the product environmental declaration, and under normal use, the building or structure will not be replaced during its life cycle.

Reference Service Life and Estimated Building Service Life

The reference service life is not specified due to the variety in usage of the products. This LCA focuses only on the production stage.

1.12. Reuse, Recycling, and Energy Recovery

It is possible that the product is reused although depending on how it is installed. Unless reused, the product can be recycled since steel is 100% recyclable. In addition, the production process of this product will produce water-quenched slag, which can be used as a substitute material for cement, which has great carbon reduction and circular economic benefits.

1.13. Disposal

The end of life stage is not considered in this EPD. Because steel scrap has high value, it is usually reused or recycled



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

instead of disposed.

Waste code of the Basel Convention: A1010.

2. Life Cycle Assessment Background Information

2.1. Functional or Declared Unit

1 metric ton of H-Beam and 1 metric ton of flat steel are defined as declared unit according to ISO 21930:2017.

2.2. System Boundary

The system boundary of H-Beam and flat steel is “cradle-to-gate”. The stages included in “cradle-to-gate” correspond to A1 to A3 modules as defined in ISO 21930:2017.

	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
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During	Building Operational Water Use During	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type	x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

(MND : Module Not Declared)

A1: Extraction and upstream production

- Extraction and upstream production for raw materials including coal, iron, stone, ferroalloy, other auxiliary and scrap steels.

A2: Transport of factory

- Sea transportation of coal, iron, stone and ferroalloy in the country and from the foreign countries .
- Land transportation of ferroalloy, other auxiliary materials and scarp steels in home and abroad.
- In-plant processing and transportation process of raw materials.

A3: Manufacturing



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

- Production process utilities, including compressed air process, air separation plant, treated water, demineral water, recirculation water, process gases, etc.
- Supply of process utilities, including power house (electricity, steam), process water and natural gas
- Manufacturing process of H-Beam and flat steel products at the sintering factory, coal chemical plant, blast furnace, basic oxygen furnace or electric arc furnace, refining furnace, continuous casting machine, rolled steel factory.
- Burnt lime plant Calcination reaction of limestone
- In-plant processing waste recycling, Waste and waste water treatment, other

2.3. Estimates and Assumptions

For the transportation of raw materials (including coal, iron, stone, ferroalloy materials, carburizers, graphite electrode, etc.) from abroad to DSC by sea ships, the ship transportation distance is highly conservative, and the farthest method between ports is chosen. In addition, the railway or road transportation of foreign raw materials from manufacturers to ports is also relatively conservatively assessed. Except for the assumption that the transportation distance of foreign railway transportation in Russia and China is 1,000 kilometers, the rest are estimated based on relative distances from Google Map.

2.4. Cut-off Criteria

According to ISO 21930:2017, the sum of material flows excluded from the system (including energy, mass or environmental impacts) does not exceed 5% of the total input mass. Most of the relevant auxiliary materials are purchased domestically and account for less than 0.5% of the total procurement of raw materials and auxiliary materials, so the transportation part is excluded. In addition, waste that is disposed of through reuse and has low environmental impact and is difficult to quantify is also excluded.

2.5. Data Sources

The primary data of LCIA in this study are all from the cost accounting center of DSC, including the production and purchase of raw materials, the production and use of electricity, the transportation of raw materials, the energy and consumption of each unit of production and manufacturing process, etc. The primary data used for environmental impact assessment are all provided by DSC. The transportation distance is estimated using Google Map. Other secondary data used for life cycle environmental impact assessment come from the life cycle software SimaPro 9.5.0.2 and the database Ecoinvent v3.10.

2.6. Data Quality

For the products that are the subject of this study, product carbon footprint certificates have been obtained and all activity data have been verified by DNV. The primary information provided by DSC is consistent with LICA's temporal, geographical and technical criteria and covers all processes included in the LCIA system boundary. DSC has also obtained the ISO 9001 series and ISO 14001 series standards, and records and controls all data through the accounting cost center system to ensure the accuracy, completeness, consistency and reproducibility of the data.

The database of LICA in this study uses the life cycle software SimaPro 9.5.0.2 and the database Ecoinvent v3.10. It is also a high-quality database in LCIA and is also used for global LCA or carbon footprint assessment. The evaluation of



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

data quality is summarized in the table below.

Data quality items	Discussion
Time-Related Coverage	The inventory period of this research report is from January 1, 2021 to December 31, 2021. The data collected during the inventory are all written or electronic documents of various primary data provided by DSC during this period. In addition, the reference life cycle software SimaPro 9.5.0.2 is released in 2018 and the data database Ecoinvent v3.10 is released in 2023, both of which are suitable for use as background data for primary data.
Geographical Coverage	The subject product inventory location for this study is DSC (Address: No. 100, Longchang Rd., Longjing Dist., Taichung City, Taiwan(R.O.C.)) The raw materials required for steelmaking (including coal, iron ore and stone) are based on data from the actual mining areas purchased by DSC. The databases selected are also given priority when they are representative of the region.
Technological Coverage	The primary data provided by DSC includes the data used to cover the materials and production technology to produce the target product. The technical coverage cited in the database is appropriate for this study. Due to the particularity of the production technology of the conventional steelmaking plant, the distribution of self-produced gas (such as COG, BFG, LDG, etc.) and related resource materials must be considered. Establish self-factory power coefficients and steam coefficients.
Precision	DSC has obtained ISO 9001 and ISO 14001 certification, and the data are obtained from production operation information management systems or measurement values with accurate measurement basis and proper management. Relevant measuring instruments are regularly calibrated in accordance with the company's quality management regulations, striving to minimize numerical variability, which is in line with the objectives of this study.
Completeness	The primary data provided by DSC for this study include all data materials related to raw data, energy and water, exports to the atmosphere and water, and raw material procurement. Except for the transportation stage which accounts for less than 0.5% of the total weight of purchased raw materials, it is included in the excluded items and will not be calculated.
Representativeness	The primary data provided by DSC for this assessment all belong to 2021, covering the period from January 1, 2021 to December 31, 2021. The geographical scope of the inventory is located in DSC, and the inventory, allocation and calculation are carried out based on the site-specific processes for producing H-beams and narrow-width steel plates. The representative proportion of this inventory is more than 99%.
Consistency	DSC has obtained ISO 9001 and ISO 14001 certification and has implemented a strict document management system. Relevant data are collected and stored using consistent methods. The data provided by DSC for this study have been managed using appropriate and consistent methods.
Reproducibility	The primary data provided by DSC for this study are managed and output by the following institutions. The core system of the DSC, Cost Accounting Center, makes this research reproducible.
Sources of the Data	All primary data provided by DSC is recorded using DSC, Cost Accounting Center. All secondary data are quoted from the life cycle software SimaPro 9.5.0.2 and the data database Ecoinvent v3.10, and the data sources are clearly noted.
Uncertainty of the Information	The primary data provided by DSC for this study were obtained from the production process of the factory that produces the target product of this study. Data on raw materials and utilities are recorded through purchase/sales records and field data collection and managed by the



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

	Cost Accounting Center. The data reference year is 2021, and business operations are normal. The uncertainty of primary data is low.
--	--

2.7. Period under Review

The period under review is calendar year 2021 including 1st January to 31st December 2021.

2.8. Allocation

In the manufacturing process of this subject product and other products, the distribution principle of input or output raw materials (materials, substances) and energy resource usage is as follows:

stage	activity data	principles for allocation
Raw material	Coal 、 iron 、 stone 、 ferroalloy 、 Scrap Steel	Transportation is distributed based on the company's steel product output.
manufacturing	Coking process	Allocation based on product (coke) weight
	Sintering process	Allocation based on product (sinter) weight
	Blast furnace plant	Allocation based on product (hot metal) weight
	Burnt lime plant	Allocation based on product (burnt lime) weight
	Steelmaking plant	1. Allocation based on product (liquid steel, Slab, Bloom) weight 2. The liquid steel produced by converters and electric furnaces will actually be customized to adjust the composition of the liquid steel. The compositions of section steel, flat steel and hot-rolled steel are slightly different, but the amount of process input is difficult to separate. Therefore, the emissions from the converter and electric furnace processes are evenly distributed to each ton of liquid steel.
	Section steel factory	Allocation based on product (H-Beam and flat steel) weight
	Other item	Allocation based on the company's steel product output.





HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

3. Life Cycle Assessment Results

Table 1. Description of the system boundary modules

	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
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Production Life	Building Operational Water Use During Production Life	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type	x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

(MND : Module Not Declared)

The impact categories assessed in the life cycle assessment include “Global Warming Potential (GWP100)”, “Ozone Depletion Potential (ODP)”, “Eutrophication Potential (EP)”, “Acidification Potential (AP)”, “Photochemical ozone creation potential(POCP)”, “Abiotic depletion potential for non-fossil resources (ADPE)” and “Abiotic depletion potential for fossil resources(ADPF)”, according to ISO 21930:2017. The results of life cycle assessment are shown for A1, A2, A3 and total of A1 to A3.

3.1. Life Cycle Impact Assessment Results

To conduct an impact assessment on the overall environmental characteristics of the product based on the inventory data, this study used the German life cycle analysis and assessment software SimaPro 9.5.0.2, and the database used Ecoinvent 3.10. In addition to the environmental impact of TRACI v2.1 and CMLv4.8 2016, the GHG impact of carbon-containing raw materials supplementation in conventional steelmaking operations is also considered. In addition, blast furnace gas, converter gas and coke oven gas are subsequently reused in the factory. The GHG impact must also be considered, so the carbon emission coefficient announced by the Ministry of Environment is used for evaluation.

Table 2. H-Beam Product Impact Assessment Results

IMPACT CATEGORIES	INDICATORS	A1	A2	A3	TOTAL OF A1 TO A3	METHODS
GWP (Global warming potential)	CO ₂ e emissions per unit steel product	3.60E+02	1.05E+01	1.40E+03	1.77E+03	Ecoinvent v3.10-TRACI v2.1 IPCC 2021, (GWP 100)



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

ODP (Depletion potential of the stratospheric ozone layer)	CFC11-eq. emissions per unit steel product	2.02E-06	1.06E-08	1.08E-06	3.11E-06	Ecoinvent v3.10-TRACI v2.1
AP (Acidification potential of land and water)	SO ₂ -eq. emissions per unit steel product	1.67E+00	9.76E-03	4.35E-01	2.12E+00	Ecoinvent v3.10-TRACI v2.1
EP (Eutrophication potential)	N-eq. emissions per unit steel product	2.02E+00	7.16E-03	4.15E-01	2.44E+00	Ecoinvent v3.10-TRACI v2.1
POCP (Formation potential of tropospheric ozone photochemical oxidants)	O ₃ -eq. emissions per unit steel product	2.19E+01	1.19E-01	4.82E+00	2.69E+01	Ecoinvent v3.10-TRACI v2.1
ADPE (Abiotic depletion potential for non-fossil resources)	Sb-eq. emissions per unit steel product	2.42E-03	1.46E+01	8.05E+02	8.20E+02	Ecoinvent v3.10-CMLv4.8 2016
ADPF (Abiotic depletion potential for fossil resources)	MJ(LHV) per unit steel product	1.04E+04	3.07E+00	4.25E+02	1.08E+04	Ecoinvent v3.10-CMLv4.8 2016

Table 3. Flat Steel Product Impact Assessment Results

IMPACT CATEGORIES	INDICATORS	A1	A2	A3	TOTAL OF A1 TO A3	METHODS
GWP (Global warming potential)	CO ₂ e emissions per unit steel product	4.22E+02	1.05E+01	1.52E+03	1.95E+03	Ecoinvent v3.10-TRACI v2.1 IPCC 2021, (GWP 100)
ODP (Depletion potential of the stratospheric ozone layer)	CFC11-eq. emissions per unit steel product	1.57E-06	1.06E-08	6.97E-07	2.28E-06	Ecoinvent v3.10-TRACI v2.1
AP (Acidification potential of land and water)	SO ₂ -eq. emissions per unit steel product	1.93E+00	9.76E-03	3.35E-01	2.28E+00	Ecoinvent v3.10-TRACI v2.1



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

EP (Eutrophication potential)	N-eq. emissions per unit steel product	2.62E+00	7.16E-03	3.28E-01	2.95E+00	Ecoinvent v3.10-TRACI v2.1
POCP (Formation potential of tropospheric ozone photochemical oxidants)	O ₃ -eq. emissions per unit steel product	2.46E+01	1.19E-01	3.54E+00	2.82E+01	Ecoinvent v3.10-TRACI v2.1
ADPE (Abiotic depletion potential for non-fossil resources)	Sb-eq. emissions per unit steel product	6.48E-03	1.46E+01	6.42E+02	6.56E+02	Ecoinvent v3.10-CMLv4.8 2016
ADPF (Abiotic depletion potential for fossil resources)	MJ(LHV) per unit steel product	1.40E+04	3.07E+00	3.43E+02	1.44E+04	Ecoinvent v3.10-CMLv4.8 2016

Comparability: Comparisons cannot be made between product-specific or industry average EPDs at the design stage of a project, before a building has been specified. Comparisons may be made between product-specific or industry average EPDs at the time of product purchase when product performance and specifications have been established and serve as a functional unit for comparison. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted.

Any comparison of EPDs shall be subject to the requirements of ISO 21930. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparison can be inaccurate and could lead to erroneous selection of materials or products which are higher-impact, at least in some impact categories.

3.2. Life Cycle Inventory Results

Table 4. Resource Use (for H-Beam Product)

Resource use flows	A1	A2	A3	TOTAL OF A1 TO A3
Renewable primary resources used as an energy carrier [MJ, net calorific value]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable primary resources with energy content used as material [MJ, net calorific value]	0.00E+00	0.00E+00	0.00E+00	0.00E+00



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

Non-renewable primary energy used as an energy carrier [MJ, net calorific value]	0.00E+00	0.00E+00	2.25E+03	2.25E+03
Non-renewable primary resources with energy content used as material [MJ, net calorific value]	9.12E+03	0.00E+00	0.00E+00	9.12E+03
Secondary material [metric kg]	5.14E+02	0.00E+00	0.00E+00	5.14E+02
Renewable secondary fuel [MJ, net calorific]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuel [MJ, net calorific]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered energy [MJ, net calorific]	0.00E+00	0.00E+00	4.69E-01	4.69E-01
Use of net fresh water [m ³]	3.31E+00	0.00E+00	0.00E+00	3.31E+00

Table 5. Resource Use(for Flat Steel Product)

Resource use flows	A1	A2	A3	TOTAL OF A1 TO A3
Renewable primary resources used as an energy carrier [MJ, net calorific value]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable primary resources with energy content used as material [MJ, net calorific value]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable primary energy used as an energy carrier [MJ, net calorific value]	0.00E+00	0.00E+00	3.10E+03	3.10E+03
Non-renewable primary resources with energy content used as material [MJ, net calorific value]	1.32E+04	0.00E+00	0.00E+00	1.32E+04
Secondary material [metric kg]	1.82E+02	0.00E+00	0.00E+00	1.82E+02
Renewable secondary fuel [MJ, net calorific]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuel [MJ, net calorific]	0.00E+00	0.00E+00	0.00E+00	0.00E+00



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

Recovered energy [MJ, net calorific]	0.00E+00	0.00E+00	6.79E-01	6.79E-01
Use of net fresh water [m ³]	3.31E+00	0.00E+00	0.00E+00	3.31E+00

Table 6. Output Flows and Waste Categories (for H-Beam and Flat Steel Product)

Waste and output flows		A1	A2	A3	TOTAL OF A1 TO A3
Non-hazardous waste disposed [metric kg]		0.00E+00	0.00E+00	1.75E+00	1.75E+00
Hazardous waste disposed [metric kg]		0.00E+00	0.00E+00	7.23E-05	7.23E-05
Radioactive waste disposed [metric kg]		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Components for re-use [metric kg]		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling [metric kg]	Nonhazardous	0.00E+00	0.00E+00	3.91E+01	3.91E+01
	Hazardous	0.00E+00	0.00E+00	4.16E+01	4.16E+01
Materials for energy recovery [metric kg]		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy [MJ per energy carrier]		0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy [MJ per energy carrier]		0.00E+00	0.00E+00	0.00E+00	0.00E+00

Note : The electricity consumption of the subject product accounts for about 5.30E-10 in Taiwan, which is a very low proportion, so this radioactive waste description is ignored, but it is not zero.

Table 7. Carbon Emissions and Removals (for H-Beam Product)

Additional CO ₂ emissions	A1	A2	A3	TOTAL OF A1 TO A3
Biogenic Carbon Emission from Product [kgCO ₂]	0.00E+00	0.00E+00	9.22E-01	9.22E-01
Calcination Carbon Emission [kgCO ₂]	0.00E+00	0.00E+00	3.63E+01	3.63E+01

Note: 1. the carbonation, and emissions from combustion of waste are not relevant to the product system.
2. Packaging data not relevant. 3. Waste categories are not relevant.



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

Table 8. Carbon Emissions and Removals(for Flat Steel Product)

Additional CO ₂ emissions	A1	A2	A3	TOTAL OF A1 TO A3
Biogenic Carbon Emission from Product [kgCO ₂]	0.00E+00	0.00E+00	1.43E+00	1.43E+00
Calcination Carbon Emission [kgCO ₂]	0.00E+00	0.00E+00	3.01E+01	3.01E+01

Note: 1. the carbonation, and emissions from combustion of waste are not relevant to the product system.
 2. Packaging data not relevant. 3. Waste categories are not relevant.

4. LCA Interpretation

LCA Interpretation

Description of the environmental impact of the two target products, such as figure 1 & 2. With the exception of GWP and ADPE, for all categories and the two target products, A1: Extraction and upstream production was the module with the highest contribution. This is due to the mining of raw materials such as coal, iron, and stone requires a large amount of energy. Additionally, The main raw materials of module A3 are iron ore, metallurgical coal, coke and sinter, etc., the environmental impact of the two target products on GWP and ADPE is relatively large. Compared with the A2 module, the impact of the environment on the two target products is low.

The highest proportion of GWP(Global warming potential) impact of the H-Beam product is module A3(manufacturing), 79.05%. The highest proportion of ODP(Depletion potential of the stratospheric ozone layer) impact of the H-Beam product is module A1(Extraction and upstream production), 64.99%. The highest proportion of AP(Acidification potential of land and water) impact of the H-Beam product is module A1(Extraction and upstream production), 79.01%. The highest proportion of EP(Eutrophication potential) impact of the H-Beam product is module A1(Extraction and upstream production), 82.67%. The highest proportion of POCP(Formation potential of tropospheric ozone photochemical oxidants) impact of the H-Beam product is module A1(Extraction and upstream production), 81.63%. The highest proportion of ADPE(Abiotic depletion potential for nonfossil resources) of the H-Beam product is module A3(manufacturing), 98.22%. The highest proportion of ADPF(Abiotic depletion potential for fossil resources) impact of the H-Beam product is module A1(Extraction and upstream production), 96.05%.

The highest proportion of GWP(Global warming potential) impact of the flat steel product is module A3(manufacturing), 77.85%. The highest proportion of ODP(Depletion potential of the stratospheric ozone layer) impact of the flat steel product is module A1(Extraction and upstream production), 68.98%. The highest proportion of AP(Acidification potential of land and water) impact of the flat steel product is module A1(Extraction and upstream production), 84.88%. The highest proportion of EP(Eutrophication potential) impact of the flat steel product is module A1(Extraction and upstream production), 88.65%. The highest proportion of POCP(Formation potential of tropospheric ozone photochemical oxidants) impact of the flat steel product is module A1(Extraction and upstream production), 87.04%. The highest proportion of ADPE(Abiotic depletion potential for nonfossil resources) of the flat steel product is module A3(manufacturing), 97.78%. The highest proportion of ADPF(Abiotic depletion potential for fossil resources) impact of the flat steel product is module A1(Extraction and upstream production), 97.59%.



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

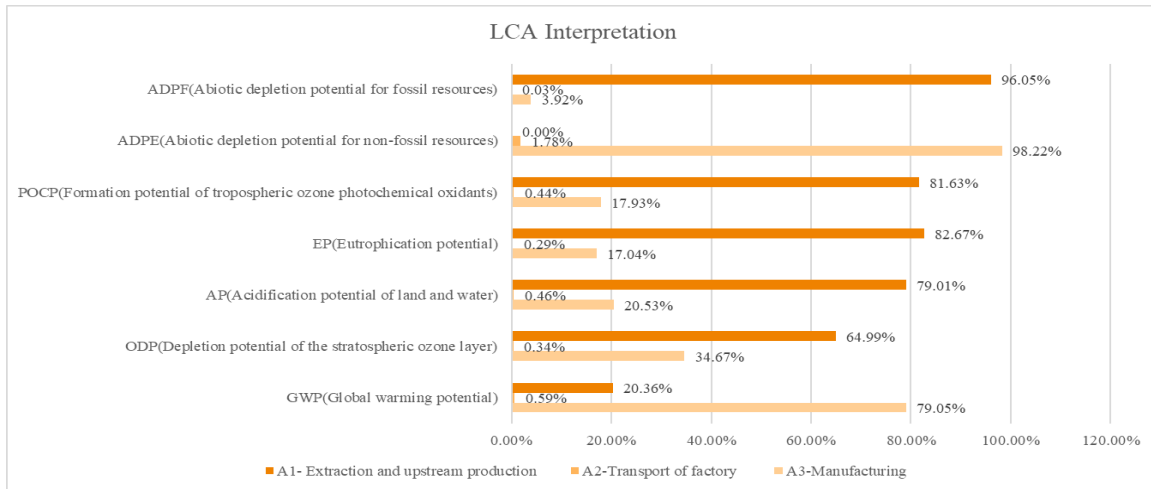


Figure 1. H-Beam products LCA Interpretation

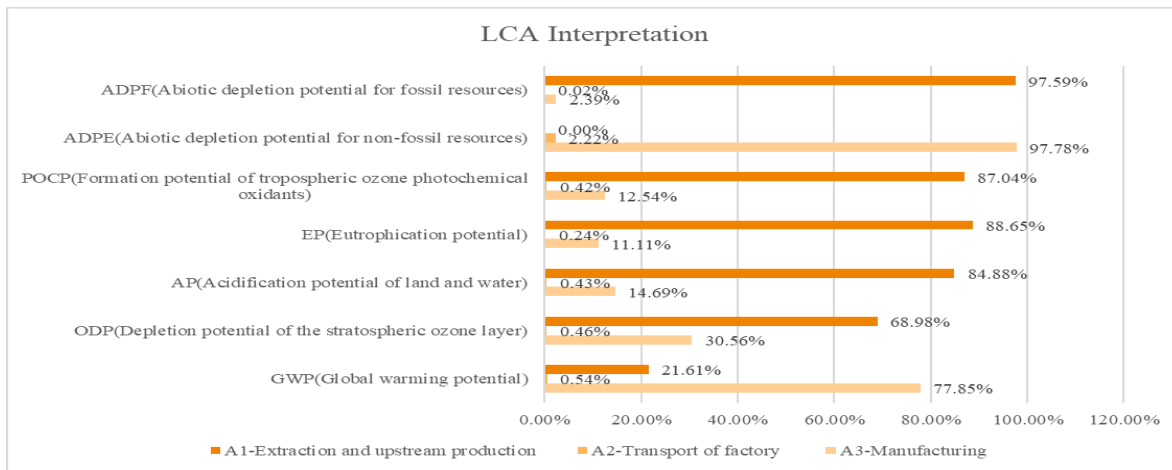


Figure 2. Flat steel product LCA Interpretation

Sensitivity analysis

For the two targets of products in this study (H-Beam and flat steel), the GWP values of the front-end process are the same, accounting for 88.8% and 80.1% respectively, which has the greatest impact. Therefore, sensitivity analysis is performed on the front-end process.

The study considered sensitivities of most uncertain and significant aspects of the data set, including “MB Coke”, “MB Coke(redox)” and “MB Graded Sinter”. After adjusting 20% on each item and check the changes of each LCA result, the results of sensitivity check are as shown on the tables below. All sensitivities of each LCA results are under 17%.

Table 9. MB Coke Emission Coefficient



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

Impact Category	Item of Sensitivity Check	The current LCA result	The LCA result after adjusting 20% on impact of MB Coke	Sensitivity
GWP (Global warming potential)	MB Coke	1.10E+09	1.32E+09	16.67%
ODP (Depletion potential of the stratospheric ozone layer)	MB Coke	5.71E-01	6.85E-01	16.67%
AP (Acidification potential of land and water)	MB Coke	1.79E+06	2.15E+06	16.67%
EP (Eutrophication potential)	MB Coke	3.81E+06	4.57E+06	16.67%
POCP (Formation potential of tropospheric ozone photochemical oxidants)	MB Coke	1.77E+07	2.13E+07	16.67%
ADPE (Abiotic depletion potential for non-fossil resources)	MB Coke	5.69E+07	6.83E+07	16.67%
ADPF (Abiotic depletion potential for fossil resources)	MB Coke	2.52E+10	3.02E+10	16.67%

Table 10. MB Coke(redox) Emission Coefficient

Impact Category	Item of Sensitivity Check	The current LCA result	The LCA result after adjusting 20% on impact of MB Coke(redox)	Sensitivity
GWP (Global warming potential)	MB Coke (redox)	2.83E+09	3.39E+09	16.67%

Table 11. MB Graded Sinter Emission Coefficient



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

Impact Category	Item of Sensitivity Check	The current LCA result	The LCA result after adjusting 20% on impact of MB Graded Sinter	Sensitivity
GWP (Global warming potential)	MB Graded Sinter	9.61E+08	1.15E+09	16.67%
ODP (Depletion potential of the stratospheric ozone layer)	MB Graded Sinter	4.25E-01	5.11E-01	16.67%
AP (Acidification potential of land and water)	MB Graded Sinter	6.82E+05	8.19E+05	16.67%
EP (Eutrophication potential)	MB Graded Sinter	7.06E+05	8.47E+05	16.67%
POCP (Formation potential of tropospheric ozone photochemical oxidants)	MB Graded Sinter	1.17E+07	1.40E+07	16.67%
ADPE (Abiotic depletion potential for non-fossil resources)	MB Graded Sinter	1.62E+08	1.94E+08	16.67%
ADPF (Abiotic depletion potential for fossil resources)	MB Graded Sinter	3.94E+09	4.73E+09	16.67%

5. Additional Environmental Information

5.1. Environment and Health During Manufacturing

DSC has obtained ISO 9001, ISO 14001, ISO 45001, ISO 50001 and other management system certifications, and has inherited organizational culture, strengthened competency development, building LOHAS environment and delivered corporate image marketing.

DSC implementing occupational safety management, ensuring work safety, advancing energy saving and environmental protection, determining recycling economy, fulfilling corporate social responsibility.

5.2. Environmental Activities and Certifications

The 2021 carbon footprint inventory report of the target products H-Beam and flat steel was verified by DNV on



ENVIRONMENTAL PRODUCT DECLARATION



HOT ROLLED STRUCTURAL STEEL

Product categories include H-Beam (include hot rolled H-Beam, checkered H-Beam, Beveled H-Beam) and Flat steel.

According to ISO 14025 and ISO 21930:2017

January 18, 2023 and a verification statement was obtained.

6. Further Information

Dragon Steel Corporation website: <https://www.dragonsteel.com.tw/en/index.html>.

7. References

UL 10010 Version 4.0 : Product Category Rules for Building-Related Products and Services : Part A Life Cycle Assessment Calculation Rules and Report Requirements.

UL 10010-34 Version 2.0 : PCR Guidance for Building-Related Products and Services: Part B Designated Steel Construction Product EPD Requirements, UL Environment, UL 10010-34, v2, 08/26/2020.

ACLCA-ISO-21930:2017-Guidance.

EN 15804:2012+A1:2013 (Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products).

ISO 21930 , "Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services", 2017-07.

ISO 14025 , "Environmental labels and declarations—Type III environmental declarations Principles and procedures", 2006-07.

ISO 14040, "Environmental management — Life cycle assessment — Principles and framework", second edition, 2006-07-01.

ISO 14044, "Environmental management — Life cycle assessment — Requirements and guidelines", first edition, 2006-07-01.

ISO 14067:2018 Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification.