ENVIRONMENTAL PRODUCT DECLARATION

BILLET

(AVERAGE)

Billet

Semi-finished products pressed from steel.

WEI CHIH STEEL

Wei Chih Steel is actively engaging in international environmental advocacy efforts. As part of this commitment, we've launched the Environmental Product Declaration (EPD) project for all our products. By analyzing the entire product life cycle, we provide consumers with measurable and comparable environmental performance data, following ISO 14025 standards. Our goal is to enhance transparency by publicly sharing lifecycle assessments and environmental impact information. This empowers consumers to make informed choices about our products' environmental footprint. The data is independently verified. Purchasers can opt for our products based on the 'Type III Environmental Product Declaration,' which offers comprehensive environmental insights. This aligns with Sustainable Development Goals and promotes sustainable practices, corporate competitiveness, and the use of certified materials.

For more information visit:
http://www.weichih.com.tw/spic3.php?pid=7

or contact:
shj96012@weichih.com.tw

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

WEI CHIH STEEL

BILLET
Product Category Rules (PCR) Guidance for Building-Related Products and Services - Part A: Life Cycle Assessment Calculation Rules and Report Requirements and Part B: Designated Steel Construction Product EPD Requirements

According to ISO 14025, EN 15804 and ISO 21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Solutions www.ul.com 333 Pfingsten Rd, Northbrook IL, 60062 www.spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	Program Operator Rules v 2.7 2022
MANUFACTURER NAME AND ADDRESS	WEI CHIH STEEL INDUSTRIAL CO., Ltd./ KUANTIEN FACTORY NO.123, NanPu Village, KuanTien Distrect, Tainan City, Taiwan
DECLARATION NUMBER	4790852701.101.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	product per metric ton
REFERENCE PCR AND VERSION NUMBER	Product Category Rule (PCR) Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements Part B: Designated Steel Construction Product EPD Requirements
DESCRIPTION OF PRODUCT APPLICATION/USE	After rolling, small billets can be made into various steel products such as bar steel, wire rod, and spheroidized material. These include rebar, straight bar steel, coiled steel bar, and wire rod. The latter two are also commonly known as coil. Wire rods and spheroidized materials can be processed into basic bolts, hand tools, buckles, automobile parts, mechanical parts, polished rods, safety snap rings, and other products.
PRODUCT RSL DESCRIPTION (IF APPL.)	75 years
MARKETS OF APPLICABILITY	Hong Kong, Taiwan
DATE OF ISSUE	April 1, 2024
PERIOD OF VALIDITY	5 Years
EPD TYPE	Product specific
RANGE OF DATASET VARIABILITY	mean
EPD SCOPE	Cradle to gate with options (specify options)
YEAR(S) OF REPORTED PRIMARY DATA	2022
LCA SOFTWARE & VERSION NUMBER	SimaPro v9.4.0.2
LCI DATABASE(S) & VERSION NUMBER	SimaPro v9.4.0.2 Ecoinvent3.8, SimaPro v9.4.0.2 Industry data 2.0, SimaPro v9.4.0.2 USLCI, SimaPro v9.4.0.2 EU & DK Input Output Database, IPCC AR6 (2023): 7.SM Chapter 7: The Earth's energy budget, climate feedbacks, and climate sensitivity - Supplementary Material, Taiwan Ministry of Environment - GHG EF management table ver 6.0.4: Fugitive emission sources
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1: US-Canadian 2008, CML-IA baseline: EU25+3, 2000, EF 3.0 Method (adapted): EF 3.0 normalization and weighting

The PCR review was conducted by:	UL Solutions PCR Review Panel epd@ul.com
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Solutions
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WEI CHIH STEEL INDUSTRIAL CO., LTD.
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Sung Mo Yeon, H.I.P. Pathway

ENVIRONMENTAL PRODUCT DECLARATION

WEI CHIH STEEL

BILLET
Product Category Rules (PCR) Guidance for Building-Related Products and Services - Part A: Life Cycle Assessment Calculation Rules and Report Requirements and Part B: Designated Steel Construction Product EPD Requirements

According to ISO 14025, EN 15804 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.

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.

1. Product Definition and Information

1.1. Description of Company/Organization

Wei Chih Steel, established in 1982, initially focused on processing black iron wire and trading in coil elements. In 1991, the company set up a large integrated smelting and rolling plant in Guantian, Tainan. By 1994 and 1996, we successfully completed the construction and testing of the rolling and smelting steel plants, marking a new era of production. In December 1996, Wei Chih Steel went public, and it currently occupies approximately 140,000 square meters of land with around 350 employees. Their primary product range includes high-quality steel such as billets, reinforcing bars, straight bars, coil elements, and special alloy steel. With rigorous production process control and robust micro-techniques, Wei Chih Steel has emerged as a leading player in the steel industry. It holds the distinction of being Taiwan's steel reinforcement manufacturer with the most national export certifications. Between 2007 and 2020, they obtained product certifications from countries including Hong Kong, South Korea, Singapore, the United States, Australia, New Zealand, the Philippines, and Malaysia. During this period, we produced over 150,000 tons of special steel coil elements and more than 430,000 tons of special straight bars, which are marketed both domestically and internationally. The precision and strength of Wei Chih Steel's MIT steel have become a hallmark of quality worldwide.

To gradually participate in international initiatives related to environmental climate, Wei Zhi Steel Industrial Co., Ltd. has promoted a project for all product Carbon Footprints (CFPs), including steel billets, rebar, round bar, and wire rod. Based on the characteristics of the product life cycle, we provide consumers with quantifiable and comparable environmental performance results in accordance with the ISO 14067 standard.

1.2. Product Description

Product Identification

The production of billet products is carried out according to standard specifications or customer requirements regarding their chemical composition.

Product Specification

Table 1. Product spec. description

Spec Description	Test Method and Standard	Chemical Composition
150mmx150mm, 5.5~12.5m	CNS 560 and customer needs	The chemical composition of the product is produced according to customer needs.
150mmx150mm, 5.5~12.5m	KS D 3504 and customer needs	
150mmx150mm, 5.5~12.5m	AS/NZS 4671 and customer needs	
150mmx150mm, 5.5~12.5m	MS 146 and customer needs	
150mmx150mm, 5.5~12.5m	BS 4449 and customer needs	
150mmx150mm, 5.5~12.5m	CS2 and customer needs	
150mmx150mm, 5.5~12.5m	JIS G3112 and customer needs	
150mmx150mm, 5.5~12.5m	ASTM A615 and customer needs	
150mmx150mm, 5.5~12.5m	ASTM A706 and customer needs	
130mmx130mm, 5.5~12.5m	JIS G3101 and customer needs	
130mmx130mm, 5.5~12.5m	JIS G3507 and customer needs	

SPEC DESCRIPTION	TEST METHOD AND STANDARD	CHEMICAL COMPOSITION
130mmx130mm, 5.5~12.5m	JIS G4051 and customer needs	The chemical composition of the product is produced according to customer needs.
130mmx130mm, 5.5~12.5m	JIS G4052 and customer needs	
130mmx130mm, 5.5~12.5m	JIS G4053 and customer needs	
130mmx130mm, 5.5~12.5m	ASTM A29 and customer needs	
130mmx130mm, 5.5~12.5m	ASTM A36 and customer needs	
130mmx130mm, 5.5~12.5m	ASTM A105 and customer needs	
130mmx130mm, 5.5~12.5m	ASTM A615 and customer needs	
130mmx130mm, 5.5~12.5m	SAE J403 and customer needs	
130mmx130mm, 5.5~12.5m	SAE J404 and customer needs	
130mmx130mm, 5.5~12.5m	CNS 2473 and customer needs	
130mmx130mm, 5.5~12.5m	CNS 3229 and customer needs	
130mmx130mm, 5.5~12.5m	CNS 3828 and customer needs	

Flow Diagram

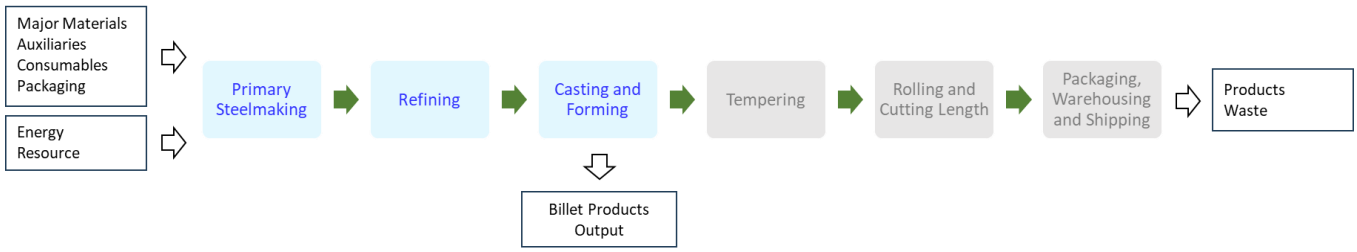

Figure 1. Production processes

Product Average

This EPD is a product-specific EPD. The declaration is for the billet nominated as the product manufactured by Wei Chih Steel.

While allocating energy, resource, waste and material usage within the production site, allocation was carried out based on the average annual mass.

1.3. Application

After rolling, small billets can be made into various steel products such as bar steel, wire rod, and spheroidized material. These include rebar, straight bar steel, coiled steel bar, and wire rod. The latter two are also commonly known as coil. Wire rods and spheroidized materials can be processed into basic bolts, hand tools, buckles, automobile parts, mechanical parts, polished rods, safety snap rings, and other products.

Table 2. Range of application, product standard or accreditation

COUNTRY/ REGION	TYPE	STANDARD
Taiwan	Chemical composition	CNS 560, CNS 2473, CNS 3229, CNS 3828
Korea	Chemical composition	KS D 3504
Australia	Chemical composition	AS/NZS 4671
Malaysian	Chemical composition	MS 146
UK	Chemical composition	BS 4449
Hong Kong	Chemical composition	CS2
Japan	Chemical composition	JIS G3101, JIS G3112, JIS G3507, JIS G4051, JIS G4052, JIS G4053
US	Chemical composition	ASTM A29, ASTM A36, ASTM A105, ASTM A615, ASTM A706
US	Chemical composition	SAE J403, SAE J404

1.4. Declaration of Methodological Framework

In this project, a full LCA approach was considered with some simplification on data modeling using generic data for most background systems. The EPD analysis uses a cradle-to-gate with options (specify options) system boundary.

Additional details on assumptions, cut-offs and allocation procedures can be found in section 2.3, 2.4, and 2.8, respectively.

1.5. Properties of Declared Product as Delivered

This product is primarily sold in Taiwan. Some products are exported by sea, with the main destinations being Hong Kong. The total sales volume for the year 2022 was 90,511 metric ton.

1.6. Material Composition

1. Major materials: Scrap steel, Ferrosilicon, Ferromanganese-silicon, Ferromanganese, Ferromolybdenum, Ferrovanadium, Ferroniobium, Aluminum ingot.
2. Auxiliaries: Quicklime, CDQ, Anhydrous coke powder, Light calcined magnesia ball, Carburizing agent, Carbon wire, Aluminum wire, Calcium iron wire, Titanium wire, Artificial bauxite, Calcium aluminate, Boron wire, Carbonized rice husk, Calcium carbide, Argon, Nitrogen, Oxygen, EBT filling sand.
3. Consumables: Fluorite, Electrode bar, Tamping material, Magnesia carbon brick, Flexible freight bag, Magnesium oxide, Furnace material, Thermometer, Sampler, Refractory mortar, T/D dry covering material, T/D tamping material, Tamping material (L/D), Acetylene.

1.7. Manufacturing

To begin, scrap steel is sorted by grade after undergoing a radiation detection and weighing process. They are then melted in an electric arc furnace. The rapid melting process transforms the scrap steel into molten steel, which is then transferred to a refining furnace. In the refining furnace, the composition and casting temperature can be adjusted to improve the quality of the steel billet. Molten steel is cast into billets using a CONCAST five-way continuous casting machine and M-EMS electromagnetic stirring technology. Once the finished products pass quality inspection, they are stored in inventory for sale.

1.8. Packaging

The products does not use packaging materials.

1.9. Transportation

Only includes raw material transportation and final waste transportation.

1.10. Reference Service Life and Estimated Building Service Life

According to the “Product Category Rule (PCR) Guidance for Building-Related Products and Services - Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Chapter 7.1.4”, the default values for Reference Service Life and Estimated Building Service Life are both 75 years.

1.11. Reuse, Recycling, and Energy Recovery

For the LCA study, the disposal of the used products adopted a country- and region-based weighted average disposal mode following literature review and Ecoinvent database. End of life disposal treatment process (C4) from Ecoinvent was used in this LCA study. According to public information, we distinguish the final disposal as recyclable and non-recyclable parts.

In the recyclable sector, the rate of collected and recycled scrap steel is sourced from CSC Company Sustainability and the Statista Data Platform. The distance assumptions are based on data from the Statistics Department and Transport Department of Taiwan's MOTC, as well as the Government of the Hong Kong Special Administrative Region.

The recycling information of product dis-assembly instructions is described by sorting from International Universal Recycling Codes and European EWC codes. See the following table.

Table 3. Recycling information

Type	Items	International Universal Recycling Codes		European EWC Codes	
		Code	Description	Code	Description
product	Billet	#40 FE	Steel	# 17 04 09*	Metal waste contaminated with hazardous substances

1.12. Disposal

In non-recyclable part, the rate of sanitary landfill or incineration disposal we summarize recycling information and public data for statistics. See the following table.

Table 4. Recycling information

Module	Items	Treatment Assumptions		Distance Assumptions	
		Treatment	Ratio	Distance	Unit
Reuse, Recovery, Recycling Potential	Scrap steel in Taiwan	Recycling	94.10%	33.50	km
Waste processing, Disposal	Scrap steel in Taiwan	Disposal	5.90%	49.40	km
Reuse, Recovery, Recycling Potential	Scrap steel in Hong Kong	Recycling	21.90%	49.41	km
Waste processing, Disposal	Scrap steel in Hong Kong	Disposal	78.10%	49.41	km

2. Life Cycle Assessment Background Information

2.1. Functional or Declared Unit

Functional and declared unit both are defined as one metric ton of billet.

2.2. System Boundary

A full Life Cycle Assessment has been carried out according to ISO 14040 and ISO 14044. The following Life Cycle Stages are assessed:

- Product Stage(modules A1-A3)
- Construction Process Stage(modules A4-A5)
- Use Stage(modules B1-B7)
- End of life Stage(modules C1-C4)
- Benefits and Loads Beyond the System Boundary(module D)

The system boundaries of the LCA report, based on EPD-PCR rules, include the following study option: a) cradle to gate with modules C1–C4 and module D (modules A1–A3, + C + D).

1. Raw material supply and transport stages (modules A1-A2): including the relating information about energy use, transportation, waste disposal, etc., of the raw material acquisition process.
2. Manufacturing stage (module A3): including the relating information about energy use, transportation, waste disposal, etc., of the manufacturing process.
3. End of life stage, benefits and loads beyond the system boundary (modules C, D): to simulate local recycling and disposal information after the product discarded.

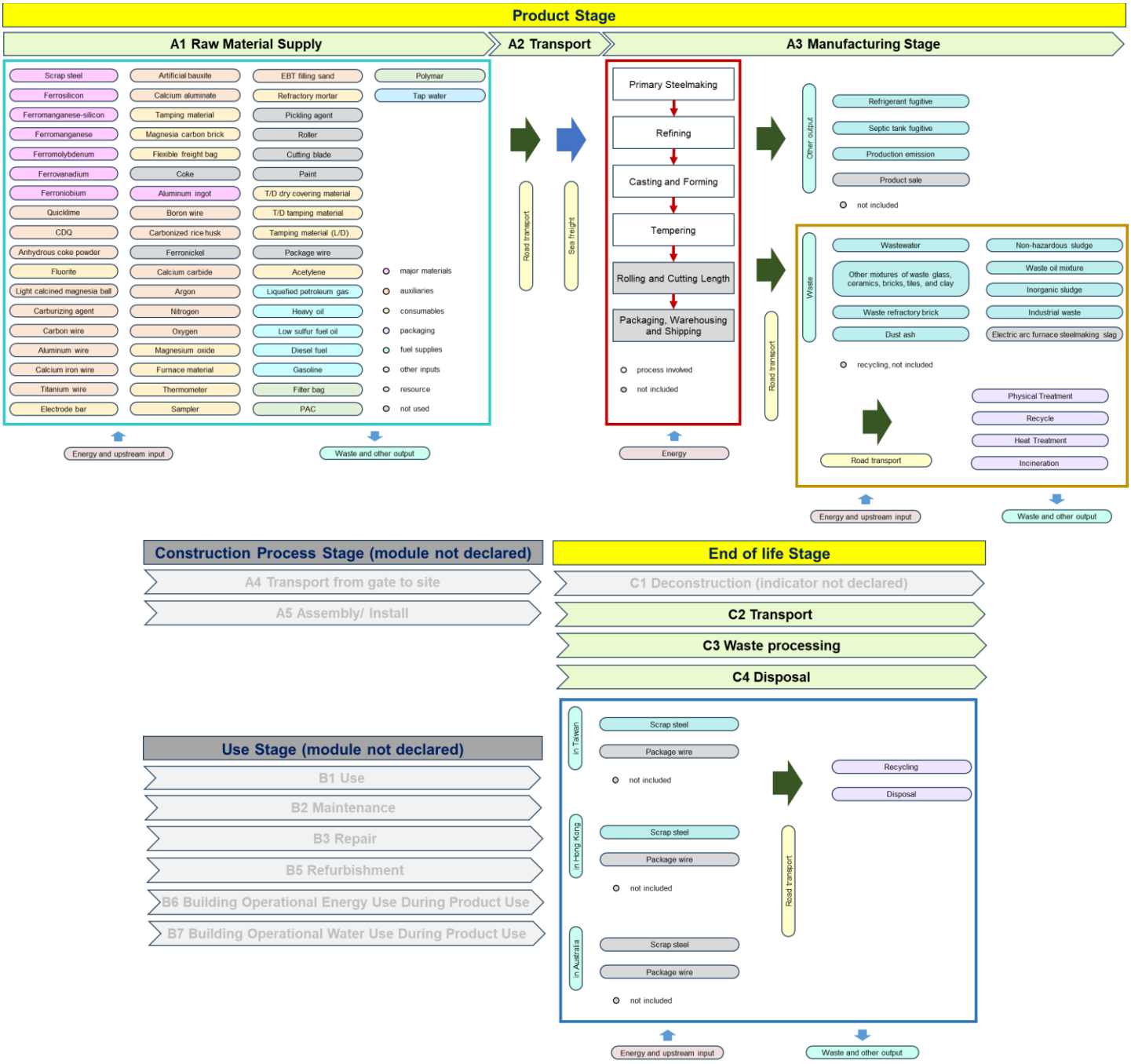

Figure 2. System boundary of EPD-PCR

2.3. Estimates and Assumptions

The assumptions and limitations of the study described as following:

1. The billet could be as a product for sale directly, or to be as raw materials to produce other products. In this inventory, the carbon emissions of billet products would be calculated only for the portion for sale. If billet used as raw material to produce other products, then the carbon emissions of the portion would be incorporated into the calculation of its corresponding product.
2. For the requirements of EPD-PCR, the study covered life cycle stages for modules A1-A3, C, D of the targeted product from cradle to grave, and the environmental impact of end of life stage was assessed by the regional situational criteria of the EPD-PCR.
3. The weight of raw materials was collected by sampling, and the results would be different for the sampling.
4. As for the activity data, the refrigerant and septic tank items are calculated with the default value of IPCC fugitive source.
5. At end of life stage, the study estimated the distance by the public data of waste treatment location.
6. The deconstruction stage (module C1) is not accessible, and its expected impact on environmental categories is minimal, so the system boundaries indicator is not declared.
7. Because there is no specific data available for activities in waste processing and disposal stages (module C3 and C4), the study estimated the emissions from the final disposal of the product by the official announcement data of waste disposal where the first-tier distribution sites located. The coefficients in the database already account for C3 and C4 processes, so the environmental impact results can only be displayed when these stages are combined. However, this decision will lead to a decrease in accuracy.
8. The values in reuse, recovery, recycling potential stage (module D) include a recognition of the benefits or impacts related to steel recycling which occur at the end of the product's service life. The rate of steel recycling and related processes will evolve over time. The results included in reuse, recovery, recycling potential stage (module D) attempt to capture future benefits, or impacts, but are based on a methodology that uses current industry-average data reflecting current processes.

2.4. Cut-off Criteria

For any impact category, if the sum of the impact from a specific process/activity is less than 1% of the impact equivalent, such a process/activity may be neglected during the inventory analysis. Nonetheless, the accumulated impact of neglected process/activity may not exceed 5%. Components and materials omitted from the LCA shall be documented.

The neglected items of the LCA study include:

1. Refrigerant's Fugitive: Air conditioner in the information room office on 4F of the office building (the equipment data plate cannot be read)
2. Refrigerant's Fugitive: Refrigerator in the container of the raw materials section of steelmaking department (R600a of IPCC GWP undisclosed)
3. Self-disposal: Waste flexible freight bag (low frequency of activity data, unable to calculate)
4. Self-disposal: Waste paint bucket (low frequency of activity data, unable to calculate)
5. Refrigerant (Raw Material)-R22 (no environmental factors of raw material, unable to calculate)
6. Refrigerant (Raw Material)-R407C (no environmental factors of raw material, unable to calculate)

7. Refrigerant (Raw Material)-R410a (no environmental factors of raw material, unable to calculate)
8. Refrigerant (Raw Material)-R134a (being consistency, do not perform calculations)

For lacking of statistical data or relevant coefficient information (such as the limitations in the database and the absence of similar or closely related types for calculation) for the activities mentioned above in the investigation process, and reasonably estimated its contribution to the environmental impact categories are also very small, they have been excluded. No known flows are deliberately excluded from this report.

2.5. Data Sources

Most of the raw data collected by actual activities and purchase records of Wei Chih Steel and partially reasonable assumptions.See the following table.

Data	Time Related Coverage	Geographical Coverage	Technological Coverage	Data Source	Measured/ Estimated
Data Quality Assessment (A1, A2)					
Major Materials, Auxiliaries, Consumables, Packaging and Other Inputs Consumption	2022	Taiwan	Modern	Wei Chih	Measured
Distance of Materials Transportation to Production Line	2022	Taiwan	Modern	Digital Map	Measured
Fuel and Resources Consumption	2022	Taiwan	Modern	Wei Chih	Measured
Data Quality Assessment (A3)					
Electricity Use	2022	Taiwan	Modern	Wei Chih	Measured
Effusion Sources	2022	Taiwan	Modern	Wei Chih	Estimated
Waste and Wastewater Generation	2022	Taiwan	Modern	Wei Chih	Measured
Distance of Waste Transportation to Disposal Site	2022	Taiwan	Modern	Digital Map	Measured
Data Quality Assessment (C, D)					
Scrap Steel Generation	2014~2023	Hong Kong, Taiwan	Unknown	Public Data	Estimated
Waste Paper Generation			Unknown	Public Data	Estimated
Waste Plastic Generation			Unknown	Public Data	Estimated
Distance of Waste Transportation to Disposal Site			Modern	Digital Map	Measured

2.6. Data Quality

Raw data of the report is based on 1 year averaged data (Year 2022). The date of the generic data used in the modelling typically covers information from the past ten years. For the requirement of boundaries regarding geographical coverage, waste generated by manufacturing process has to obey local regulation where the manufacturing processes located, to disclosure related information about recycling process of the product. Furthermore, for ease of comparison, no matter where the emissions are generated, the same environmental impact parameters should be used for life cycle impact assessment.

Data collection of the LCA study based on EPD-PCR rules, most of the data are actual measurement data in 2022 delivered by manufacturing plant, with regional and technical representation. The detailed data quality as shown in the table below.

2.7. Period under Review

1. The data inventory report is from 2022-01-01 to 2022-12-31.
2. LCA report review is from 2023-12-14 to 2024-03-12.

2.8. Allocation

Output

The allocation of outputs, such as refrigerant's fugitive, manufacturing waste and final waste derived from the system, would be based on actual production, IPCC emission factors, and data from local governmental investigation or public platform.

Input

The allocation of inputs, such as raw materials, energy and resources used in the production process, as well as upstream transportation, would be based on the actual production of the factory.

Therefore, all allocation factors are based on mass. The description of allocation rules in of this LCA report meets the requirements of the PCR. Detailed explanations can be found in the chapters below.

2.9. Comparability (Optional)

This report does not support to be used in comparative assertions intended to be disclosed to the public, and it is not applicable for measuring, comparing and analyzing the similar products.

3. Life Cycle Assessment Scenarios

Table 5. Reference Service Life

NAME	VALUE	UNIT
RSL	75	years
Declared product properties (at the gate) and finishes, etc.	1	metric ton

Table 6. End of life (C1-C4)

ITEMS	DESCRIPTION
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation)	The disposal information is from the product's sales data. It assumes the local waste disposal methods and transportation distances at the sales points based on publicly available information, and calculates the environmental impact assessment based on sales volume.

NAME		VALUE	UNIT
Collection process (specified by type)	Collected separately	1.00E+00	metric ton/per metric ton product
	Recycling	8.05E-01	metric ton/per metric ton product
	Mix of treatment (excluding recycling)	1.95E-01	metric ton/per metric ton product
Disposal (specified by type)	Product or material for final deposition	1.00E+00	metric ton/per metric ton product
Removals of biogenic carbon (excluding packaging)		8.76E-04	kg CO2 eq/per metric ton product

4. Life Cycle Assessment Results

Table 7. Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCT-ION 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 Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	IND	X	X	X	X

(X: included in LCA; MND: module not declared; IND: indicator not declared; MNR: module not relevant)

4.1. Life Cycle Impact Assessment Results

Table 8. North American Impact Assessment Results

TRACI v2.1	Unit	A1	A2	A3	A4-A5	B1-B7	C1	C2	C3-C4	Total	D
GWP	kg CO_2 eq	1.76E+02	5.54E+01	7.22E+02	MND	MND	IND	4.95E+00	1.62E+00	9.60E+02	-1.34E+03
ODP	kg CFC-11 eq	3.34E-05	1.19E-05	4.65E-05	MND	MND	IND	1.12E-06	5.63E-07	9.34E-05	-6.31E-05
AP	kg SO_2 eq	9.98E-01	1.25E+00	2.31E+00	MND	MND	IND	2.46E-02	1.20E-02	4.60E+00	-4.38E+00
EP	kg N eq	5.90E-01	7.78E-02	2.73E+00	MND	MND	IND	5.92E-03	2.61E-03	3.41E+00	-3.39E+00
SFP	kg O_3 eq	1.49E+01	2.35E+01	2.57E+01	MND	MND	IND	6.11E-01	3.00E-01	6.51E+01	-7.00E+01
ADPF	MJ surplus	3.04E+02	1.08E+02	7.37E+02	MND	MND	IND	1.05E+01	5.38E+00	1.16E+03	-4.69E+02

Table 9. EU Impact Assessment Results-CML

CML-IA	Unit	A1	A2	A3	A4-A5	B1-B7	C1	C2	C3-C4	Total	D
GWP	kg CO_2 eq	1.77E+02	5.54E+01	7.25E+02	MND	MND	IND	4.95E+00	1.62E+00	9.65E+02	-1.36E+03
ODP	kg CFC-11 eq	2.57E-05	8.90E-06	3.39E-05	MND	MND	IND	8.38E-07	4.23E-07	6.98E-05	-5.47E-05
AP	kg SO_2 eq	9.58E-01	1.18E+00	2.33E+00	MND	MND	IND	2.07E-02	1.02E-02	4.50E+00	-4.14E+00
EP	kg PO_4 eq	3.09E-01	1.38E-01	1.26E+00	MND	MND	IND	4.99E-03	2.32E-03	1.72E+00	-1.75E+00
POCP	kg C_2H_4 eq	5.98E-02	3.08E-02	9.35E-02	MND	MND	IND	7.26E-04	4.09E-04	1.85E-01	-7.19E-01
ADPE	kg Sb eq	1.06E-02	1.02E-04	3.43E-04	MND	MND	IND	1.70E-05	4.56E-06	1.11E-02	-1.37E-03
ADPF	MJ	2.97E+03	7.37E+02	7.39E+03	MND	MND	IND	7.41E+01	3.72E+01	1.12E+04	-1.14E-04

Table 10. EU Impact Assessment Results-EF

EF 3.0	Unit	A1	A2	A3	A4-A5	B1-B7	C1	C2	C3-C4	Total	D
GWP	kg CO_2 eq	1.83E+02	5.59E+01	7.35E+02	MND	MND	IND	5.03E+00	1.65E+00	9.81E+02	-1.43E+03
ODP	kg CFC-11 eq	3.08E-05	1.12E-05	4.26E-05	MND	MND	IND	1.06E-06	5.34E-07	8.62E-05	-5.18E-05
AP	mol H+ eq	1.18E+00	1.48E+00	2.75E+00	MND	MND	IND	2.75E-02	1.35E-02	5.45E+00	-5.15E+00
EP-freshwater	kg P eq	5.90E-01	7.78E-02	2.73E+00	MND	MND	IND	5.92E-03	2.61E-03	3.41E+00	-3.39E+00
EP-marine	kg N eq	2.46E-01	3.71E-01	4.81E-01	MND	MND	IND	9.83E-03	4.75E-03	1.11E+00	-1.21E+00
EP-terrestrial	mol N eq	2.67E+00	4.12E+00	4.50E+00	MND	MND	IND	1.06E-01	5.18E-02	1.14E+01	-1.28E+01
POCP	kg NMVOC eq	9.72E-01	1.08E+00	1.31E+00	MND	MND	IND	3.06E-02	1.50E-02	3.41E+00	-6.10E+00
ADPE	kg Sb eq	1.06E-02	1.02E-04	3.40E-04	MND	MND	IND	1.70E-05	4.56E-06	1.11E-02	-1.36E-03
ADPF	MJ	3.09E+03	7.40E+02	8.42E+03	MND	MND	IND	7.53E+01	3.76E+01	1.24E+04	-1.17E+04
WDP	m_3 depriv.	2.93E+02	1.69E+00	6.42E+01	MND	MND	IND	2.95E-01	1.31E+00	3.61E+02	-8.94E+01

4.2. Life Cycle Inventory Results

Table 11. Resource Use

Parameter	Unit	A1	A2	A3	A4-A5	B1-B7	C1	C2	C3-C4	Total	D
PERE	MJ	0.00E+00	6.95E+00	1.12E+02	MND	MND	IND	1.29E+00	4.37E-01	1.21E+02	-2.95E+02
PERM	MJ	2.16E+02	0.00E+00	0.00E+00	MND	MND	IND	0.00E+00	0.00E+00	2.16E+02	0.00E+00
PERT	MJ	2.16E+02	6.95E+00	1.12E+02	MND	MND	IND	1.29E+00	4.37E-01	3.37E+02	-2.95E+02
PENRE	MJ	0.00E+00	7.43E+02	8.42E+03	MND	MND	IND	7.54E+01	3.77E+01	9.28E+03	-1.17E+04
PENRM	MJ	3.06E+03	0.00E+00	0.00E+00	MND	MND	IND	0.00E+00	0.00E+00	3.06E+03	0.00E+00
PENRT	MJ	3.06E+03	7.43E+02	8.42E+03	MND	MND	IND	7.54E+01	3.77E+01	1.23E+04	-1.17E+04
SM	kg	0.00E+00	0.00E+00	0.00E+00	MND	MND	IND	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	MND	MND	IND	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	MND	MND	IND	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m_3 eq	2.93E+02	1.72E+00	6.49E+01	MND	MND	IND	2.96E-01	1.31E+00	3.61E+02	-8.78E+01

Table 12. Output Flows and Waste Categories

Parameter	Unit	A1	A2	A3	A4-A5	B1-B7	C1	C2	C3-C4	Total	D
HWD	kg	2.22E-03	1.00E-03	6.16E-03	MND	MND	IND	1.96E-04	6.72E-05	9.64E-03	-1.35E-01
NHWD	kg	6.47E+01	1.43E+01	2.75E+01	MND	MND	IND	5.22E+00	1.94E+02	3.06E+02	-2.66E+02
RWD	kg	1.41E-02	5.08E-03	3.30E-02	MND	MND	IND	4.95E-04	2.45E-04	5.29E-02	-3.17E-02
MFR	kg	0.00E+00	0.00E+00	2.18E-01	MND	MND	IND	0.00E+00	8.05E-01	1.02E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	3.62E-02	MND	MND	IND	0.00E+00	0.00E+00	3.62E-02	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	MND	MND	IND	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	MND	MND	IND	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	MND	MND	IND	0.00E+00	0.00E+00	0.00E+00	0.00E+00

5. LCA Interpretation

The highest proportion of GWP of the product is module A3 manufacturing: 75.22% in TRACI method, 75.18% in CML-IA method, and 74.93% in EF method. The highest proportion of ODP of the product is module A3 manufacturing: 49.75% in TRACI method, 48.59% in CML-IA method, and 49.43% in EF method. The highest proportion of AP of the product is module A3 manufacturing: 50.26% in TRACI method, 51.72% in CML-IA method, and 50.49% in EF method. The highest proportion of EP of the product is module A3 manufacturing: 80.16% in TRACI method, and 73.55% in CML-IA method. The highest proportion of EP-freshwater of the product is module A3 manufacturing: 80.16% in EF method. The highest proportion of EP-marine of the product is module A1 raw material supply: 43.20% in EF method. The highest proportion of EP-terrestrial of the product is module A1 raw material supply: 39.30% in EF method. The highest proportion of POCP of the product is module A1 raw material supply: 50.48% in CML-IA method, and 38.56% in EF method. The highest proportion of SFP of the product is module A3 manufacturing: 39.56% in TRACI method. The highest proportion of ADPE of the product is module A1 raw material supply: 95.78% in CML-IA method, and 95.81% in EF method. The highest proportion of ADPF of the product is module A3 raw material supply: 63.27% in TRACI method, 65.92% in CML-IA method, and 68.11% in EF method. The highest proportion of WDP of the product is module A1 raw material supply: 81.30% in EF method.

The significant emission hotspots:

- GWP: Electricity, Dust ash, Low sulfur fuel oil (process), Quicklime, CDQ (process), Sea Freight (raw materials);
- ODP: Electricity, Dust ash, Low sulfur fuel oil, Sea Freight (raw materials), Low sulfur fuel oil (process), Scrap steel;
- AP: Electricity, Sea Freight (raw materials), Low sulfur fuel oil (process), Scrap steel;
- EP: Electricity;
- POCP: Electricity, Sea Freight (raw materials), Low sulfur fuel oil (process), CDQ, Scrap steel, Ferromanganese-silicon;
- SFP: Sea Freight (raw materials), Electricity, Scrap steel, Ferromanganese-silicon;
- ADPE: Ferromolybdenum (high-carbon), Scrap steel;
- ADPF: Electricity, Dust ash, Low sulfur fuel oil, Low sulfur fuel oil (process), Sea Freight (raw materials);
- WDP: Aluminum ingot, Electricity.

6. Additional Environmental Information

RoHS

As specified by client, with reference to RoHS 2011/65/EU Annex Ⅱ and amending Directive (EU)2015/863 to determine Cadmium, Lead, Mercury, Cr (VI), PBBs, PBDEs, DBP, BBP, DEHP, DIBP contents in the submitted sample(s).

Based on the performed tests on submitted sample(s), the test results of Cadmium, Lead, Mercury, Cr (VI), PBBs, PBDEs, DBP, BBP, DEHP, DIBP comply with the limits as set by RoHS Directive (EU)2015/863 amending Annex Ⅱ to Directive 2011/65/EU.

REACH

As specified by client, the sample(s) was/were tested with reference to Regulation (EC) No 1907/2006 concerning the REACH.

According to the ruling of the Court of Justice of the European Union on the definition of an article under REACH, and the specified scope as well as analytical technique, the test results of the selected component article are ≦0.1%(w/w) in the submitted sample(s).

7. References

1. ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations
   International Organization for Standardization
2. ISO 14044:2006 Environmental management - Life cycle assessment
   International Organization for Standardization
3. ISO 21930: 2019 ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance
   International Organization for Standardization
4. CSN EN 15804+A2 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products, 2019
   European Committee for Standardization
5. Product Category Rule (PCR) Guidance for Building-Related Products and Services - Part A: Life Cycle Assessment Calculation Rules and Report Requirements, Version3.2
   UL Environment
6. Product Category Rule (PCR) Guidance for Building-Related Products and Services - Part B: Designated Steel Construction Product EPD Requirements, Version2.0
   UL Environment
7. SimaPro Database Manual Methods Library, Version4.15
   PRé, various authors
8. How to calculate EN 15804:A2 indicators in desktop SimaPro
   SimaPro Help Center. Website: https://support.simapro.com/s/article/How-to-calculate-EN-15804-A2-indicators-in-desktop-SimaPro
9. Database: Ecoinvent 3.8
   Ecoinvent teams. Website: https://ecoinvent.org/
10. Database: USLCI
    NREL. Website: https://www.nrel.gov/lci/
11. Database: Industry data 2.0
    PlasticsEurope, Worldsteel, ERASM, ACE, and IMOA. Website:
    https://plasticseurope.org/sustainability/circularity/life-cycle-thinking/eco-profiles-set/
    https://worldsteel.org/steel-topics/life-cycle-thinking/
    https://www.erasm.org/
12. Database: EU & DK Input Output Database
    EU FP6 project FORWAST. Website: http://forwast.brgm.fr/
13. 7.SM Chapter 7: The Earth's energy budget, climate feedbacks, and climate sensitivity - Supplementary Material, IPCC AR6 (2023)
    Intergovernmental Panel on Climate Change (IPCC)
14. Greenhouse Gas Emission Coefficient Management Table, Version6.0.4
    Taiwan Ministry of Environment
15. Environmental Protection - Materials and Energy
    CSC Company Sustainability. Website: https://www.csc.com.tw/csc_e/hr/csr/env/env2.htm
16. Reduce, Reuse and Recycle
    Australian Steel Institute. Website: https://www.steel.org.au/what-we-do/focus-areas/sustainability/reduce,-reuse-and-recycle/

17. Steel scrap to crude steel ratio in steel production in China from 2014 to 2021
Statista Data Platform. Website: https://www.statista.com/statistics/1071833/china-steel-scrap-recycling-rate/
18. 汽車貨運調查報告, 2021
Taiwan MOTC Statistics Department
19. Vehicles - Supply Chain Benchmarking Report, 2021
L.E.K. Consulting Australia Pty Ltd.
20. The Annual Traffic Census, 2017
Transport Department, The Government of the Hong Kong Special Administrative Region
21. Density: Coke
POLCARBOTRANS Sp. z o.o. Website: https://polcarbotrans.pl/en/offer/coal/4-coke
22. Density: LPG
ELGAS. Website: https://www.elgas.co.nz/elgas-knowledge-hub/
23. Density: Heavy oil
Genesis Group. Website: https://www.genesisny.net/Commodity/Oil/ODefinitions.html
24. Density: Diesel fuel
Innovation, Science and Economic Development. Website: https://www.ic.gc.ca/eic/site/mc-mc.nsf/vwapj/VCF_Diesel.pdf/$file/VCF_Diesel.pdf
25. Density: Gasoline
LGC Limited. Website: https://www.lgcstandards.com/PL/en/Density-Gasoline-Nominal-0-7429-g-mL-15-C-/p/ALK-CRM-DEGA
26. New From Old: The Global Potential for More Scrap Steel Recycling, 2021
Institute for Energy Economics and Financial Analysis
27. Scrap Metal 101: Types, Recycling, and Identification, 2023
Global Sourcing Sites. Website: https://www.globalsources.com/STM/knowledge/article/scrap-metal-101-types-recycling-and-identification/
28. UL General Program Instructions, v2.7, March 2022
UL Verification Services, Inc.