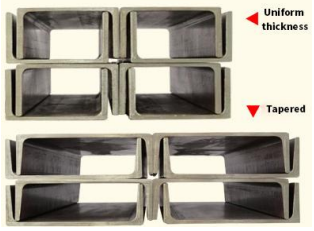
ENVIRONMENTAL PRODUCT DECLARATION

# HOT ROLLED STRUCTURAL STEEL SECTIONS

EPD REPORT

| Hot rolled structural steel sections | |
|---|---|
|  |  |
| Hot Rolled H-Beam | Checkered H-Beam |
|  |  |
| I-Beam | Channel Beam |

TUNG HO STEEL ENTERPRISE CORP.

From its beginnings in "Tung Ho Hang" to today's Tung Ho Steel Enterprise Corporation, the company has always made trustworthiness the company's spiritual essence in its business. The company's core business values and objectives are embodied in the pursuit of exceptional contributions to society.

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# ENVIRONMENTAL PRODUCT DECLARATION

TUNG HO STEEL ENTERPRISE CORP

## HOT ROLLED STRUCTURAL STEEL SECTIONS

Hot rolled structural steel sections include “Hot Rolled H-Beam”, “Checkered H-Beam”, “I-Beam” and “Channel Beam”

**According to ISO 14025 and EN 15804**

| | |
|---|---|
| EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE | UL ENVIRONMENT<br>333 PFINGSTEN ROAD HTTPS://WWW.UL.COM/<br>NORTHBROOK, IL 60611 HTTPS://SPOT.UL.COM/ |
| GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER | PROGRAM OPERATOR RULES V2.7 2022 |
| MANUFACTURER NAME AND ADDRESS | TUNG HO STEEL ENTERPRISE CORP.<br>Headquater<br>6F., No.9, Sec. 1, Chang-an E. Rd.,<br>Taipei City 10441, Taiwan<br>https://www.tunghosteel.com/EN/HomeEg/Index<br><br>Site for which this EPD is representative: Kaohsiung Works<br>Address: No.8, Jiaxing St., Xiaogang Dist.,Kaohsiung City 81257, Taiwan<br>Contact person: L. U. Yang<br>k01@tunghosteel.com |
| DECLARATION NUMBER | 4791874414.101.1 |
| DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT | Hot rolled structural steel sections<br>Declared Unit: 1 metric ton of hot rolled structural steel sections |
| REFERENCE PCR AND VERSION NUMBER | Construction Products, PCR 2019:14 version 2.0.1 |
| DESCRIPTION OF PRODUCT APPLICATION/USE | Hot rolled structural steel sections include “Hot Rolled H-Beam” , “Checkered H-Beam”, “I-Beam” and “Channel Beam”.<br>*Hot Rolled H-Beam is broadly applied in large-scale buildings with major load-bearing capabilities and stable cross-section performance, as well as in bridges, ships, cranes, equipment foundations, support frames, and foundation piles.<br>*Checkered H-Beam is suitable for cover plates involving applications in temporary steel bridges, rapid transit, and other civil engineering projects.<br>*I-Beam is broadly applied in industrial buildings and metal structures such as factories, bridges, ships, agricultural vehicle manufacturing, and power transmission towers.<br>*Channel beam is widely applied in building structure and vehicle production, as well as other industrial structures. |
| PRODUCT RSL DESCRIPTION (IF APPL.) | - |
| MARKETS OF APPLICABILITY | Local and international |
| DATE OF ISSUE | December 30, 2025 |
| PERIOD OF VALIDITY | December 30, 2030 |
| EPD TYPE | Product-specific |
| RANGE OF DATASET VARIABILITY | Mean |
| EPD SCOPE | Cradle to gate |
| YEAR(S) OF REPORTED PRIMARY DATA | 2024 |
| LCA SOFTWARE & VERSION NUMBER | SimaPro 10.2.0.0 |
| LCI DATABASE(S) & VERSION NUMBER | Ecoinvent 3.8, Ecoinvent system processes, EF database 3.1, USLCI, USLCI+, AGRIBALYSE 3, EU & DK Input Output Database |
| LCIA METHODOLOGY & VERSION NUMBER | EN 15804 + A2 (adapted) V1.03, Cumulative Exergy Demand V1.09, AWARE V1.07, EDIP 2003 V1.07 |
| The PCR review was conducted by: | The International EPD System<br>LCA-lab srl, SAPI srl<br>info@environdec.com |
| This declaration was independently verified in accordance with ISO 14025: 2006.<br>☐ INTERNAL ☒ EXTERNAL | Skye Tang, UL Solutions |

# ENVIRONMENTAL PRODUCT DECLARATION

TUNG HO STEEL ENTERPRISE CORP.

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## HOT ROLLED STRUCTURAL STEEL SECTIONS

Hot rolled structural steel sections include “Hot Rolled H-Beam” , “Checkered H-Beam”, “I-Beam” and “Channel Beam”

**According to ISO 14025 and EN 15804**

| | |
|---|---|
| This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by: | C.C.Sustain ESG Solution Co., Ltd. |
| This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by: | Ik-Kim, Smart-Eco |

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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**HOT ROLLED STRUCTURAL STEEL SECTIONS**
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**According to ISO 14025 and EN 15804**

# 1. Product Definition and Information

## 1.1. Description of Company/Organization

From its beginnings in“Tung Ho Hang”to today's Tung Ho Steel Enterprise Corporation, the company has always made trustworthiness the company's spiritual essence in its business. The company's core business values and objectives are embodied in the pursuit of exceptional contributions to society.

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## 1.2. Product Description

**Product Identification**

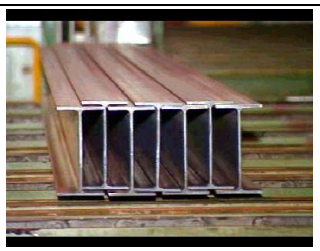
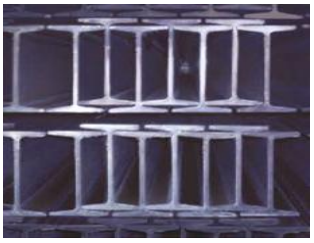
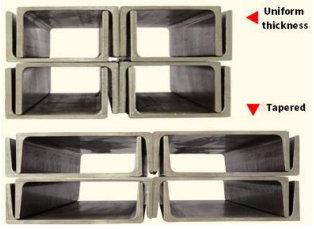
Hot rolled structural steel sections include “Hot Rolled H-Beam”, “Checkered H-Beam”, “I-Beam” and “Channel Beam”.

*Hot Rolled H-Beam is broadly applied in large-scale buildings with major load-bearing capabilities and stable cross-section performance, as well as in bridges, ships, cranes, equipment foundations, support frames, and foundation piles.

*Checkered H-Beam is suitable for cover plates involving applications in temporary steel bridges, rapid transit, and other civil engineering projects.

*I-Beam is broadly applied in industrial buildings and metal structures such as factories, bridges, ships, agricultural vehicle manufacturing, and power transmission towers.

*Channel beam is widely applied in building structure and vehicle production, as well as other industrial structures.

| Hot rolled structural steel sections | |
|---|---|
|  |  |
| Hot Rolled H-Beam | Checkered H-Beam |
|  |  |
| I-Beam | Channel Beam |

**Product Specification**

The products own CE MARK for LRV, and can be customized in accordance with Chinese National Standard(CNS), Australian Standard(AS), Japanese Industrial Standard(JIS), European Standard(EN), British Standard(BS) and American Society for Testing and Materials Standard(ASTM). For more details of technical specifications such as: dimensions, properties and steel grade of steel sections, please visit:
https://www.tunghosteel.com/EN/HomeEg/Product/Intro/2

**Manufacturing Process**

The manufacturing process includes two major parts, the first is electric arc furnace steelmaking process ,and the second is hot rolling process. The quality management system is ISO 9001. The environmental management system is ISO 14001. The occupational safety management system is ISO 45001.

**Flow Diagram**

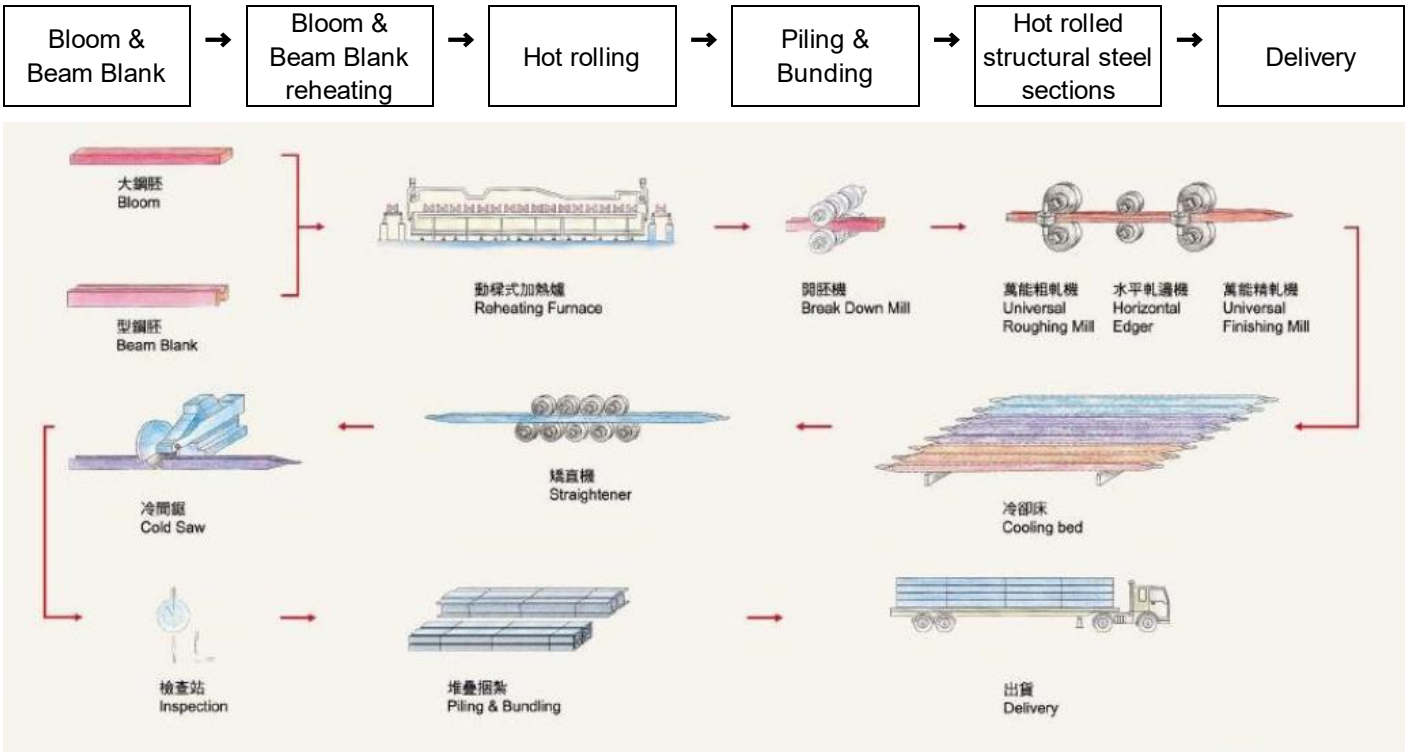



**Figure 1. Flow diagram of HOT ROLLED STRUCTURAL STEEL SECTIONS manufacturing process**

## 1.3. Application

Hot rolled structural steel sections include “Hot Rolled H-Beam”, “Checkered H-Beam”, “I-Beam” and “Channel Beam”.

*Hot Rolled H-Beam is broadly applied in large-scale buildings with major load-bearing capabilities and stable cross-section performance, as well as in bridges, ships, cranes, equipment foundations, support frames, and foundation piles.

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*Channel beam is widely applied in building structure and vehicle production, as well as other industrial structures.

## 1.4. Declaration of Methodological Framework

This EPD follows the Product Category Rules (PCR) in accordance with EN 15804+A2. The declared boundary is

cradle-to-gate (Modules A1–A3), covering raw material extraction and processing, upstream transport, and manufacturing. Use-stage (B modules) and end-of-life modules (C, D) are excluded in this declaration.

## 1.5. Technical Requirements

### Technical Data

**Table 1. Technical data for product**

| NAME | VALUE | UNIT |
|---|---|---|
| Density | 7,850 | kg/m3 |
| Modulus of elasticity | 2.1 | N/mm2 |
| Coefficient of thermal expansion | 11.6 | 10-6K-1 |
| Thermal conductivity | 80.2 | W/(mK) |
| Melting point | 1,493 | °C |
| Electrical conductivity at 20°C | 1,030 | Ω-1m-1 |
| Minimum yield strength (für Bleche) | 345 | N/mm2 |
| Minimum tensile strength (für Bleche) | 450 | N/mm2 |
| Minimum elongation (für Bleche) | ≧18 | % |
| Tensile strength | ≧450 | N/mm2 |

## 1.6. Properties of Declared Product as Delivered

The products are delivered at the factory gate and may be supplied directly to construction sites or processing plants for fabrication. For detailed product specifications and dimensions, please refer to the *Specification of Main Products of Tung Ho Steel Enterprise Corporation* available at: https://www.tunghosteel.com/EN/HomeEg/Product/Intro/2

## 1.7. Material Composition

The typical composition of the low alloyed is presented in the following table.

**Table 2. Typical composition of the low alloyed**

| ELEMENT | TYPICAL CONTENT |
|---|---|
| Iron | 98.5% |
| Carbon | 0.12% |
| Manganese | 0.18% |
| Silicon | 0.65% |
| Phosphorus | 0.01% |
| Sulfur | 0.01% |
| Copper | 0.02% |
| Others (Sn, V, Nb, Al, B, Ni, Cr, Mo, Ti) | 0.51% |
| Total | 100% |

The products do not contain any hazardous substances listed in the "Candidate List of Substances of Very High Concern for Authorisation" (SVHC) exceeding 0.1% of the weight of the product.

### 1.8. Manufacturing

The hot rolled structural steel sections production flow is: Bloom & Beam Blank → Bloom & Beam Blank reheating → Hot rolling →Piling & Bunding → Hot rolled structural steel sections → Delivery

### 1.9. Packaging

The hot rolled structural steel sections are packaged by rod-carbon steel for delivery.

### 1.10. Transportation

Raw materials are delivered to Kaohsiung Works via land and sea, with transportation distances modeled based on supplier and manufacturing locations. Waste materials are transported solely by land.

### 1.11. Product Installation

This inventory calculation covers stages A1 to A3, and the scope of the inventory does not include Product Installation.

### 1.12. Use

This inventory calculation covers stages A1 to A3, and the scope of the inventory does not include Use.

### 1.13. Reference Service Life and Estimated Building Service Life

This inventory calculation covers stages A1 to A3, and the scope of the inventory does not include Reference Service Life and Estimated Building Service Life.

### 1.14. Reuse, Recycling, and Energy Recovery

Hot rolled structural steel sections is easy to recycling, but it is not suggested to be re-used as structural elements.

### 1.15. Disposal

The European Waste Index code for hot rolled structural steel sections is ewc-code-17-04-05– iron and steel.

## 2. Life Cycle Assessment Background Information

### 2.1. Functional or Declared Unit

Declared Unit: 1 metric ton of Hot rolled structural steel sections

**Table 3. Declared unit**

| NAME | VALUE | UNIT |
|---|---|---|
| Declared unit | 1 | ton |
| Thickness (des Bleches) | 4.3 ~ 24 | mm |
| Density | 7,850 | kg/m3 |
| Conversion factor to 1 kg | 1,000 | kg/ton |

## 2.2. System Boundary

This is a cradle to gate EPD. The following life cycle stages were considered:

A1 – Raw material supply.

A2 – Transport.

A3 – Manufacturing.

*Not including "CONSTRUCTION PROCESS STAGE", "USE STAGE" and "END OF LIFE STAGE".

## 2.3. Estimates and Assumptions

The life cycle assessment does not include estimates and assumptions.

## 2.4. Cut-off Criteria

Life Cycle Inventory data for 100% of total inflows (mass and energy) to the upstream and core module have been included. Company infrastructure, employee's transportation and administrative activities were kept out of the scope of this study.

## 2.5. Data Sources

The material, energy, transportation, waste treatment and air emission data colleted are from the year 2024, and the major data source is from the ERP system of Kaohsiung Works. The LCA software used for this study is SimaPro 10.2.0.0, the LCI databases include Ecoinvent 3.8, Ecoinvent system processes, EF database 3.1, USLCI, USLCI+, AGRIBALYSE 3, EU & DK Input Output Database.

## 2.6. Data Quality

The collected data were checked for plausibility and consistancy. Good data quality can be assumed. Data quality assessment per information module is provided in the following table.

**Table 4. Raw material supply module data quality assessment**

| DATA | TIME RELATED COVERAGE | GEOGRAPHICAL COVERAGE | TECHNOLOGICAL COVEGARE | DATA SOURCE | MEASURED OR ESTIMATED |
|---|---|---|---|---|---|
| Raw materials consumption | 2024 | Taiwan | Modern | Tung Ho | M |
| Distance of Waste transportation | 2024 | Taiwan | Modern | Tung Ho | M |

| | | | | | |
|---|---|---|---|---|---|
| to disposal site | | | | | |
| Energy and materials consumption of waste processing in disposal site, as well as waste and generated emissions | 2024 | Taiwan | Modern | Tung Ho | M&E |
| Fuels consumption and emissions related to electricity generation and distribution in Taiwan | 2024 | Taiwan | Modern | Tung Ho | M&E |
| Energy consumption and generation of emissions related to natural gas production in Taiwan | 2024 | Taiwan | Modern | Tung Ho | M&E |
| Energy and materials consumption to raw materials production for tne Manufacturing | 2024 | Taiwan | Modern | Tung Ho | M&E |

**Table 5. Transportation module data quality assessment**

| DATA | TIME RELATED COVERAGE | GEOGRAPHICAL COVERAGE | TECHNOLOGICAL COVEGARE | DATA SOURCE | MEASURED OR ESTIMATED |
|---|---|---|---|---|---|
| Distance of waste and others raw materials transportation | 2024 | Taiwan | Not Applicable | Tung Ho | M |
| Distance of auxiliary items transportation | 2024 | Taiwan | Not Applicable | Tung Ho | M |
| Consumption of materials and energy and emissions related to the transport requirements of raw materials and auxiliary inputs | 2024 | Taiwan | World average | Ecoinvent | M&E |

**Table 6. Manufacture module data quality assessment**

| DATA | TIME RELATED COVERAGE | GEOGRAPHICAL COVERAGE | TECHNOLOGICAL COVEGARE | DATA SOURCE | MEASURED OR ESTIMATED |
|---|---|---|---|---|---|
| Consumption of auxiliary items | 2024 | Taiwan | Modern | Tung Ho | M&E |
| Energy and materials consumption of auxiliary items production | 2024 | Taiwan | Modern | Tung Ho | M&E |
| Waste generation | 2024 | Taiwan | Modern | Tung Ho | M |
| Waste treatment process | 2024 | Taiwan | Modern | Tung Ho | M&E |
| Air emissions and waste water generation | 2024 | Taiwan | Modern | Tung Ho | M&E |
| Distance of waste transportation | 2024 | Taiwan | Modern | Tung Ho | M&E |
| Requirements of waste transportation | 2024 | Taiwan | Modern | Tung Ho | M&E |

## 2.7. Period under Review

From January 1st to December 31st, 2024.

## 2.8. Allocation

There are no credits from recycling or energy recovery of packaging materials and production waste. On the other hand, this is a "cradle to gate" study, so there are no credits from recycling or energy recovery from the end of life of the product.

**Table 7. Allocation principles**

| STYLE FOR DISTRIBUTION | ALLOCATION (%) | REMARK |
|---|---|---|
| Hot rolled structural steel sections/Hot rolled structural steel sections+Small billets (toll rolling) | 96.53% | section process |
| Hot rolled structural steel sections/Hot rolled structural steel sections+Small billets (toll rolling)+Steel bars (straight-length and formed) | 54.49% | total plant |
| Employees (structural steel process)/Employees (production dept.) | 62.24% | total plant |

# 3. Life Cycle Assessment Results

**Table 8. 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 | MND | MND | MND | MND | MND |

(X = included in LCA; MND = Module Not Declared).

## 3.1. Life Cycle Impact Assessment Results

**Table 9. Impact Assessment Results**

| EN 15804 + A2 (ADAPTED) V1.03 | UNIT (PER TON) | A1 | A2 | A3 | A1-A3 |
|---|---|---|---|---|---|
| Global warming potential - total (GWP-total) | kg CO2 eq. | 3.94E+02 | 3.63E+01 | 9.12E+01 | 5.22E+02 |
| Global warming potential - fossil fuels (GWP-fossil) | kg CO2 eq. | 3.58E+02 | 3.63E+01 | 9.11E+01 | 4.85E+02 |
| Global warming potential - biogenic (GWP-biogenic) | kg CO2 eq. | 3.56E+01 | 1.12E-01 | 5.84E-02 | 3.58E+01 |
| Global warming potential - land use and land use change (GWP-luluc) | kg CO2 eq. | 3.75E-01 | 1.38E-02 | 8.23E-02 | 4.71E-01 |
| Depletion potential of the stratospheric ozone layer (ODP) | kg CFC-11 eq. | 2.00E-07 | 4.77E-08 | 5.97E-08 | 3.07E-07 |
| Acidification potential, accumulated exceedance (AP) | mol H+ eq. | 1.31E+00 | 1.15E-01 | 3.62E-01 | 1.79E+00 |
| Eutrophication potential - freshwater (EP-freshwater) | kg P eq. | 6.61E-04 | 2.50E-03 | 6.99E-02 | 7.31E-02 |
| Eutrophication potential - marine (EP-marine) | kg N eq. | 2.63E-01 | 2.43E-02 | 7.37E-02 | 3.61E-01 |
| Eutrophication potential - terrestrial (EP-terrestrial) | mol N eq. | 2.83E+00 | 2.65E-01 | 6.37E-01 | 3.73E+00 |
| Photochemical ozone creation potential (POCP) | kg NMVOC eq. | 8.46E-01 | 1.00E-01 | 1.85E-01 | 1.13E+00 |
| Abiotic depletion potential - non-fossil resources (ADPE) | kg Sb eq. | 1.13E-04 | 1.16E-04 | 5.69E-05 | 2.86E-04 |
| Abiotic depletion potential - fossil resources (ADPF) | MJ, net calorific value | 6.31E+03 | 5.67E+02 | 1.22E+03 | 8.10E+03 |
| Water (user) deprivation potential (WDP) | m3 world eq. deprived | 5.18E+02 | 1.96E+00 | 1.02E+01 | 5.30E+02 |

**Table 10. Additional voluntary environmental impact indicators (OPTIONAL)**

| PARAMETER | UNIT (PER TON) | A1 | A2 | A3 | A1-A3 |
|---|---|---|---|---|---|
| Particulate matter emissions (PM) | Disease incidence | 1.67E-05 | 3.34E-06 | 1.26E-06 | 2.13E-05 |
| Ionizing radiation, human health (IRP) | kBq U235 eq. | 2.31E+05 | 2.96E+00 | 1.43E+01 | 2.31E+05 |
| Eco-toxicity - freshwater (ETP-fw) | CTUe | 1.42E+03 | 1.64E+02 | 2.26E+02 | 1.81E+03 |
| Human toxicity, cancer effect (HTP-c) | CTUh | 1.13E-07 | 5.16E-09 | 2.86E-09 | 1.21E-07 |
| Human toxicity, non-cancer effects (HTP-nc) | CTUh | 1.57E-06 | 1.62E-08 | 1.31E-08 | 1.60E-06 |
| Land use related impacts/Soil quality (SQP) | dimensionless | 4.27E+02 | 4.81E+02 | 1.14E+02 | 1.02E+03 |

## 3.2. Life Cycle Inventory Results

**Table 11. Resource Use**

| PARAMETER | UNIT (PER TON) | A1 | A2 | A3 | A1-A3 |
|---|---|---|---|---|---|
| Use of renewable primary energy as energy carrier (PERE) | MJ, net calorific value | 1.37E+03 | 8.50E+00 | 4.30E+01 | 1.42E+03 |
| Use of renewable primary energy resources used as raw materials (PERM) | MJ, net calorific value | 2.62E+03 | 3.59E+00 | 1.11E+01 | 2.64E+03 |
| Total use of renewable primary energy (PERT) | MJ, net calorific value | 4.00E+03 | 1.21E+01 | 5.41E+01 | 4.06E+03 |
| Use of non renewable primary energy as energy carrier (PENRE) | MJ, net calorific value | 6.26E+03 | 6.07E+02 | 1.30E+03 | 8.16E+03 |
| Use of non renewable primary energy resources used as raw materials (PENRM) | MJ, net calorific value | 1.56E+02 | 8.05E+00 | 3.20E+00 | 1.68E+02 |
| Total use of non renewable primary energy resource (PENRT) | MJ, net calorific value | 6.41E+03 | 6.15E+02 | 1.02E+02 | 7.13E+03 |
| Use of secondary material (SM) | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Use of renewable secondary fuels (RSF) | MJ, net calorific value | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Use of non-renewable secondary fuels (NRSF) | MJ, net calorific value | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| RE (recovered energy) | [MJ, LHV] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Net use of fresh water (FW) | m3 | 5.16E+02 | 2.00E+00 | 1.04E+01 | 5.29E+02 |

**Table 12. Output Flows and Waste Categories**

| PARAMETER | UNIT (PER TON) | A1 | A2 | A3 | A1-A3 |
|---|---|---|---|---|---|
| Hazardous waste disposed (HWD) | kg | 4.24E-05 | 1.43E-03 | 7.17E-04 | 2.18E-03 |
| Non-hazardous waste disposed (NHWD) | kg | 3.90E-02 | 3.78E+01 | 5.91E+00 | 4.38E+01 |
| HLRW(High-level radioactive waste, conditioned,to final repository | [kg] or [m3] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| ILLRW(Intermediate- and low-level radioactive waste, conditioned,to final repository | [kg] or [m3] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Radioactive waste disposed (RWD) | kg | 9.74E-05 | 3.83E-03 | 3.87E-03 | 7.79E-03 |
| Components for re-use (CRU) | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for recycling (MFR) | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for energy recovery (MER) | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported electrical energy (EEE) | MJ, net calorific value | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported thermal energy (EET) | MJ, net calorific value | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

**Table 13. Carbon Emissions and Removals**

| PARAMETER | UNIT (PER TON) | A1 | A2 | A3 | A1-A3 |
|---|---|---|---|---|---|
| BCRP( Biogenic Carbon Removal from Product) | kg CO2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| BCEP (Biogenic Carbon Emission from Product) | kg CO2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| BCRK (Biogenic Carbon Removal from Packaging) | kg CO2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| BCEK (Biogenic Carbon Emission from Packaging) | kg CO2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| BCEW(Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes) | kg CO2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| CCE (Calcination Carbon Emissions) | kg CO2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| CCR (Carbonation Carbon Removals) | kg CO2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| CWNR (Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes) | kg CO2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

## 4. LCA Interpretation

The highest proportion of GWP-total(Global warming potential total) impact of the product is module A1(raw material supply), 75.57%. The highest proportion of GWP-fossil(Global warming potential fossil fuels) impact of the product is module A1(raw material supply), 73.75%. The highest proportion of GWP-biogenic(Global warming potential biogenic) impact of the product is module A1(raw material supply), 99.52%. The highest proportion of GWP-luluc(GWP from land use and land use change) impact of the product is module A1(raw material supply), 79.60%. The highest proportion of ODP(Depletion potential of the stratospheric ozone layer) impact of the product is module A1(raw material supply), 65.09%. The highest proportion of AP(Acidification potential of land and water) impact of the product is module A1(raw material supply), 73.37%. The highest proportion of EP-freshwater(Eutrophication, fraction of nutrients reaching freshwater end compartment) impact of the product is module A3 (Manufacturing), 95.68%. The highest proportion of EP-marine(Eutrophication, fraction of nutrients reaching marine end compartment) impact of the product is module A1(raw material supply), 72.88%. The highest proportion of EP-terrestrial(Eutrophication, accumulated exceedance) impact of the product is module A1(raw material supply), 75.82%. The highest proportion of POCP(Formation potential of tropospheric ozone photochemical oxidants) impact of the product is module A1(raw material supply), 74.82%. The highest proportion of ADP- minerals & metals(Abiotic depletion potential for non-fossil resources) of the product is module A2(transportation), 40.66%. The highest proportion of ADP-fossil(Abiotic depletion potential for fossil resources) of the product is module A1(raw material supply), 77.97%. The highest proportion of WDP(Water (user) deprivation potential, deprivation weighted water consumption) impact of the product is module A1(raw material supply), 97.70%.

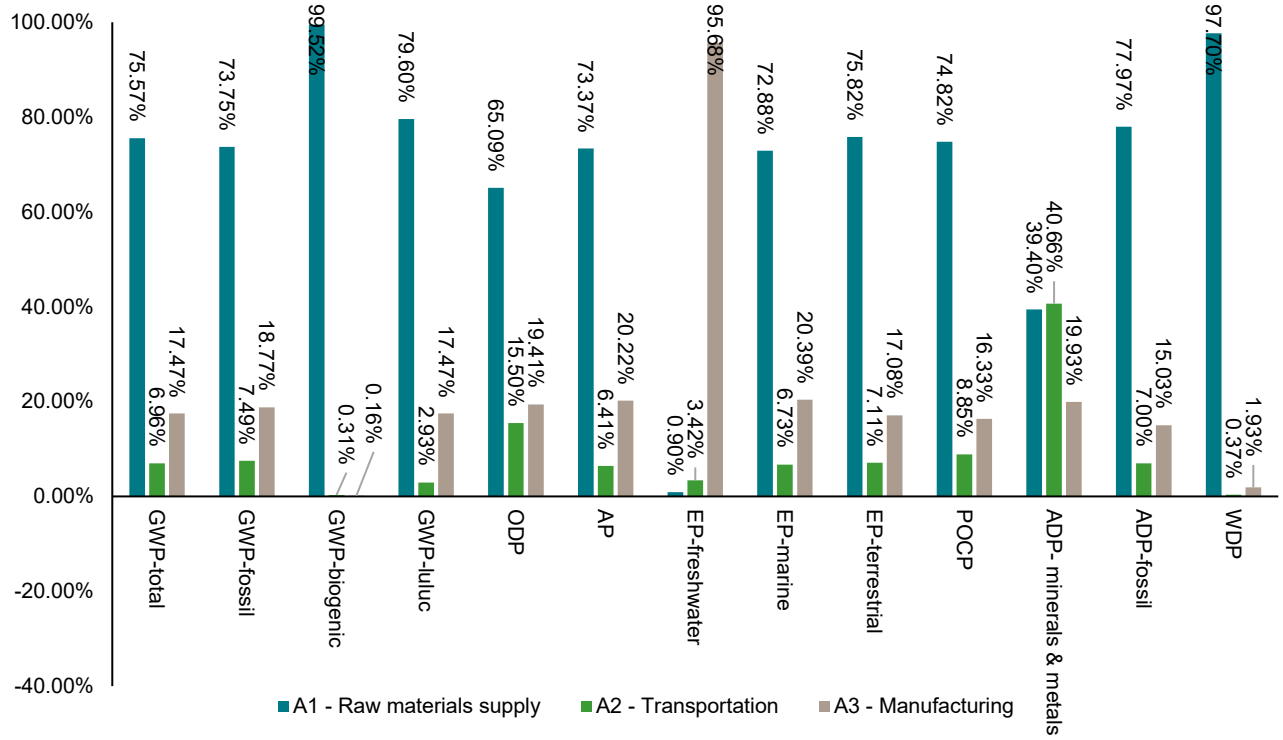


**Figure 2. RESULTS OF THE LCA - ENVIRONMENTAL IMPACT**

### Sensitivity Check

The study considered sensitivities of most uncertain and significant aspects of the data set, including "Input of Steel Bloom", "Transportation distance of Steel Bloom" and "Input of electricity". After adjusting 20% on each item and check the changes of each LCA result, the results of sensitivity check is as shown on the tables below.

**Table 14. Sensitivity Analysis for Stage A1**

| Impact Category | Item of Sensitivity Check | The current LCA result | The LCA result after adjusting 20% on input of Steel Bloom | Sensitivity(%) |
|---|---|---|---|---|
| GWP-total(Global warming potential total) | Input of Steel Bloom | 5.22E+02 | 6.00E+02 | 14.88% |
| GWP-fossil(Global warming potential fossil fuels) | Input of Steel Bloom | 4.85E+02 | 5.56E+02 | 14.51% |
| GWP-biogenic(Global warming potential biogenic) | Input of Steel Bloom | 3.58E+01 | 4.28E+01 | 19.63% |
| GWP-luluc(GWP from land use and land use change) | Input of Steel Bloom | 4.71E-01 | 5.45E-01 | 15.70% |
| ODP(Depletion potential of the stratospheric ozone layer) | Input of Steel Bloom | 3.07E-07 | 3.29E-07 | 7.11% |
| AP(Acidification potential, accumulated exceedance) | Input of Steel Bloom | 1.79E+00 | 2.05E+00 | 14.42% |
| EP-freshwater(Eutrophication, fraction of nutrients reaching freshwater end compartment) | Input of Steel Bloom | 7.31E-02 | 7.32E-02 | 0.15% |
| EP-marine(Eutrophication, fraction of nutrients reaching marine end compartment) | Input of Steel Bloom | 3.61E-01 | 4.13E-01 | 14.35% |

| | | | | |
|---|---|---|---|---|
| EP-terrestrial(Eutrophication, accumulated exceedance) | Input of Steel Bloom | 3.73E+00 | 4.29E+00 | 14.94% |
| POCP(Formation potential of tropospheric ozone photochemical oxidants) | Input of Steel Bloom | 1.13E+00 | 1.30E+00 | 14.72% |
| ADP- minerals & metals(Abiotic depletion potential for non-fossil resources) | Input of Steel Bloom | 2.86E-04 | 3.07E-04 | 7.53% |
| ADP-fossil(Abiotic depletion potential for fossil resources) | Input of Steel Bloom | 8.10E+03 | 9.34E+03 | 15.32% |
| WDP(Water (user) deprivation potential, deprivationweighted water consumption) | Input of Steel Bloom | 5.30E+02 | 6.33E+02 | 19.34% |

**Table 15. Sensitivity Analysis for Stage A2**

| Impact Category | Item of Sensitivity Check | The current LCA result | The LCA result after adjusting 20% on tansportaion distance of Steel Bloom | Sensitivity(%) |
|---|---|---|---|---|
| GWP-total(Global warming potential total) | Transportation distance of Steel Bloom | 5.22E+02 | 5.29E+02 | 1.38% |
| GWP-fossil(Global warming potential fossil fuels) | Transportation distance of Steel Bloom | 4.85E+02 | 4.92E+02 | 1.49% |
| GWP-biogenic(Global warming potential biogenic) | Transportation distance of Steel Bloom | 3.58E+01 | 3.58E+01 | 0.06% |
| GWP-luluc(GWP from land use and land use change) | Transportation distance of Steel Bloom | 4.71E-01 | 4.74E-01 | 0.58% |
| ODP(Depletion potential of the stratospheric ozone layer) | Transportation distance of Steel Bloom | 3.07E-07 | 3.17E-07 | 3.09% |
| AP(Acidification potential, accumulated exceedance) | Transportation distance of Steel Bloom | 1.79E+00 | 1.81E+00 | 1.21% |
| EP-freshwater(Eutrophication, fraction of nutrients reaching freshwater end compartment) | Transportation distance of Steel Bloom | 7.31E-02 | 7.36E-02 | 0.68% |
| EP-marine(Eutrophication, fraction of nutrients reaching marine end compartment) | Transportation distance of Steel Bloom | 3.61E-01 | 3.66E-01 | 1.26% |
| EP-terrestrial(Eutrophication, accumulated exceedance) | Transportation distance of Steel Bloom | 3.73E+00 | 3.78E+00 | 1.33% |
| POCP(Formation potential of tropospheric ozone photochemical oxidants) | Transportation distance of Steel Bloom | 1.13E+00 | 1.15E+00 | 1.69% |
| ADP- minerals & metals(Abiotic depletion potential for non-fossil resources) | Transportation distance of Steel Bloom | 2.86E-04 | 3.09E-04 | 8.11% |
| ADP-fossil(Abiotic depletion potential for fossil resources) | Transportation distance of Steel Bloom | 8.10E+03 | 8.21E+03 | 1.39% |

| | | | | |
|---|---|---|---|---|
| WDP(Water (user) deprivation potential, deprivationweighted water consumption) | Transportation distance of Steel Bloom | 5.30E+02 | 5.31E+02 | 0.07% |

**Table 16. Sensitivity Analysis for Stage A3**

| IMPACT CATEGORY | ITEM OF SENSITIVITY CHECK | THE CURRENT LCA RESULT | THE LCA RESULT AFTER ADJUSTING 20% ON INPUT OF ELECTRICITY | SENSITIVITY(%) |
|---|---|---|---|---|
| GWP-total(Global warming potential total) | Input of electricity | 5.22E+02 | 5.39E+02 | 3.27% |
| GWP-fossil(Global warming potential fossil fuels) | Input of electricity | 4.85E+02 | 5.02E+02 | 3.53% |
| GWP-biogenic(Global warming potential biogenic) | Input of electricity | 3.58E+01 | 3.57E+01 | -0.12% |
| GWP-luluc(GWP from land use and land use change) | Input of electricity | 4.71E-01 | 4.87E-01 | 3.41% |
| ODP(Depletion potential of the stratospheric ozone layer) | Input of electricity | 3.07E-07 | 3.14E-07 | 2.24% |
| AP(Acidification potential, accumulated exceedance) | Input of electricity | 1.79E+00 | 1.86E+00 | 3.85% |
| EP-freshwater(Eutrophication, fraction of nutrients reaching freshwater end compartment) | Input of electricity | 7.31E-02 | 8.69E-02 | 18.86% |
| EP-marine(Eutrophication, fraction of nutrients reaching marine end compartment) | Input of electricity | 3.61E-01 | 3.75E-01 | 3.82% |
| EP-terrestrial(Eutrophication, accumulated exceedance) | Input of electricity | 3.73E+00 | 3.85E+00 | 3.20% |
| POCP(Formation potential of tropospheric ozone photochemical oxidants) | Input of electricity | 1.13E+00 | 1.17E+00 | 3.05% |
| ADP- minerals & metals(Abiotic depletion potential for non-fossil resources) | Input of electricity | 2.86E-04 | 2.95E-04 | 3.22% |
| ADP-fossil(Abiotic depletion potential for fossil resources) | Input of electricity | 8.10E+03 | 8.32E+03 | 2.84% |
| WDP(Water (user) deprivation potential, deprivationweighted water consumption) | Input of electricity | 5.30E+02 | 5.32E+02 | 0.41% |

**Table 17. information on disclaimer for environmental indicators**

| ILCD CLASSIFICATION | INDICATOR | DISCLAIMER |
|---|---|---|
| ILCD Type 1 | Global warming potential (GWP) | none |
| | Depletion potential of the stratospheric ozone layer (ODP) | none |
| | Potential incidence of disease due to PM emissions (PM) | none |
| ILCD Type 2 | Acidification potential, Accumulated Exceedance (AP) | none |
| | Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater) | none |
| | Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine) | none |
| | Eutrophication potential, Accumulated Exceedance (EP-terrestrial) | none |
| | Formation potential of tropospheric ozone (POCP) | none |
| | Potential Human exposure efficiency relative to U235 (IRP) | 1 |
| ILCD Type 3 | Abiotic depletion potential for non-fossil resources (ADP-minerals&metals) | 2 |

| | | |
|---|---|---|
| | Abiotic depletion potential for fossil resources (ADP- fossil) | 2 |
| | Water (user) deprivation potential, deprivation-weighted water consumption (WDP) | 2 |
| | Potential Comparative Toxic Unit for ecosystems (ETP- fw) | 2 |
| | Potential Comparative Toxic Unit for humans (HTP-c) | 2 |
| | Potential Comparative Toxic Unit for humans (HTP-nc) | 2 |
| | Potential Soil quality index (SQP) | 2 |

Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

**Critical review**

The purpose of the project report is not a comparative assertion, but an independent disclosure, so the critical review is not performed.

## 5. Additional Environmental Information

### 5.1. Environment and Health During Manufacturing

The quality management system is ISO 9001. The environmental management system is ISO 14001. The occupational safety management system is ISO 45001. The energy management system is ISO 50001.

**Environmental Monitoring and Disaster Prevention Drills**

The Company set up work environment monitoring plans and flowchart in accordance with the "Measures for Implementing Exposure Monitoring in the Workplace", and a quality work environment monitoring agency is appointed for the implementation of regular work environment monitoring on the Head Office and the all Worksnote, and the items include noise, comprehensive temperature heat index, carbon dioxide, chemical substances (sulfuric acid, butanone), illuminance monitoring, and dust. Improvement will be immediately made if there is any abnormality found in the monitoring results to protect the health of the personnel.

To improve the on-site emergency response capabilities in all the works to avoid or reduce injuries of personnel, property loss and environmental impact, various emergency response drills are conducted according to the on-site operation risks. In 2024, a total of 5 sessions of emergency response and disaster prevention drills were held (3 emergency response drills, 2 firefighting drills), and the content included emergency response drills for natural gas pipelines, wastewater treatment equipment failures, rolling air pollution, confined space operations and earthquake escape emergency response drills, self-defense fire prevention education and training, disaster prevention and escape drills, etc.

### 5.2. Environment and Health During Installation

This inventory calculation covers stages A1 to A3, and the scope of the inventory does not include Environment and Health During Installation.

## 5.3. Extraordinary Effects

**Fire**

Special Fire Fighting Procedures - Do not use water on molten metal. Do not use Carbon Dioxide ($CO_2$). Firefighters should not enter confined spaces without wearing NIOSH/MSHA approved positive pressure breathing apparatus (SCBA) with full face mask and full protective equipment.

Unusual Fire or Explosion Hazards - Steel products do not present fire or explosion hazards under normal conditions. Any non-oxidized fine metal particles/ dust generated by grinding, sawing, abrasive blasting, or individual customer processes may produce materials that the customer should test for combustibility and other hazards in accordance with applicable regulations. High concentrations of combustible metallic fines in the air may present an explosion hazard.

**Water**

Not relevant.

**Mechanical Destruction**

Not relevant.

## 5.4. Delayed Emissions

No delayed emissions are expected from these products.

## 5.5. Environmental Activities and Certifications

**ISO 9001**

We have established the ISO 9001 management system and set up standards for hot rolling operation and reheating furnace operation. We reduce the consumption of materials and energy to further reduce the environmental impact.

**Other Energy-saving and Carbon Reduction Measures**

To cooperate with the development of the national GHG reduction strategy while taking into account the sustainable energy development goals of resource efficiency, energy conservation and environmental protection, Tung Ho Steel has promoted ISO 50001 energy management system, ISO 14064-1 GHG inventory, and ISO 14067 product carbon footprint certification. At the same time, we also invest capital expenditures and related manpower and material resources through the resource requirement of various energy saving programs, aiming at grasping production costs and making effective and appropriate use of energy.

**ISO 14001**

The Company complies with the ISO 14001 environmental management system and continues improvement of its production operation, products and services to reduce the impact on the natural environment. Tung Ho Steel continues to monitor and is devoted to air pollution prevention and control. By adopting the best available control technology （BACT）, the emission of particulate pollutants is effectively reduced.

## 5.6. Further Information

Additional information can be obtained from https://www.tunghosteel.com/Home/Index.

## 6. Supporting Documentation

LCA calculation sheet - Tung Ho Steel Enterprise Corp(Kaohsiung Works) -Hot rolled structural steel sections

LCA report- Tung Ho Steel Enterprise Corp (Kaohsiung Works)- Hot rolled structural steel sections

## 7. References

**EN 15804**

EN 15804:201204+A2 2019, Sustainability of construction works – Environmental product declarations - Core rules for the product category of construction products.

**ISO 14025**

DIN EN ISO 14025:201110, Environmental labels and declarations — Type III environmental declarations — Principles and procedures.

**SimaPro**

SimaPro 10.2.0.0, the LCI databases include Ecoinvent 3.8, Ecoinvent system processes, EF database 3.1, USLCI, USLCI+, AGRIBALYSE 3, EU & DK Input Output Database, and LCIA methodologies include EN 15804 + A2 Method version 1.03, EDIP2003 version 1.07, AWARE version 1.07, and Cumulated Exergy Demand method version 1.09.

**Product Category Rules**

Construction Products, PCR 2019:14 version 2.0.1

## 8. Study Commissioner

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## 9. LCA Practitioner

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