



Environmental Product Declaration

Statement of Verification

CARES EPD No.: 0005

Issue 00

This is to verify that the **Environmental Product Declaration**

Provided by:
Union Iron & Steel Company L.L.C.

Is in accordance with the requirements of:
ISO 14025:2010 and EN 15804:2012 + A2:2019/AC2021
and BRE Global PCR for Type III EPD of Construction Products
to EN 15804+A2. PN514 3.1

This declaration is for:
Carbon Steel Reinforcing Bar (Direct Reduced Iron production route)



Company address:

Union Iron & Steel Company L.L.C
P.O. Box 8529
ICAD-1, Mussafah
Abu Dhabi, U.A.E.



شركة الإتحاد للحديد والصلب ذ.م.م
UNION IRON & STEEL co.LLc
MADE IN UAE



LadinCamci

Ladin Camci

15 October 2024

Signed for CARES

Operator

Date of this Issue

15 October 2024

14 November 2027

First Issue Date

Expiry Date

The validity of this Environmental Product Declaration can be verified by contacting CARES on +44 (0)1732 450 000 or visiting CARES website <https://www.carescertification.com/certification-schemes/environmental-product-declarations>.

CARES, Pembroke House, 21 Pembroke Road, Sevenoaks, Kent TN13 1XR



Environmental Product Declaration

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EPD Number: CARES EPD 0005

General Information

| | |
|--|---|
| EPD Programme Operator | CARES Pembroke House, 21 Pembroke Road, Sevenoaks, Kent, TN13 1XR UK www.carescertification.com |
| Applicable Product Category Rules | BRE Global Product Category Rules (PCR) for Type III EPD of Construction Products to EN 15804+A2. PN514 3.1 |
| Commissioner of LCA study | CARES Pembroke House, 21 Pembroke Road, Sevenoaks, Kent, TN13 1XR UK www.carescertification.com |
| LCA consultant/Tool | CARES EPD Tool version 2.8 SPHERA SOLUTIONS UK LIMITED The Innovation Centre Warwick Technology Park, Gallows Hill, Warwick, Warwickshire CV34 6UW UK www.sphera.com |
| Declared/Functional Unit | 1 tonne of carbon steel reinforcing bars manufactured by the Direct Reduced Iron production route |
| Applicability/Coverage | Manufacturer-specific product produced at a single plant of one manufacturer |
| EPD Type | Cradle to Gate with options, Modules C1-C4, and Module D |
| Background database | LCA FE (GaBi) Dataset Documentation (Sphera 2023.1) |

Demonstration of Verification

CEN standard EN 15804 serves as the core PCR ^a

Independent verification of the declaration and data according to EN ISO 14025:2010

Internal External

(Where appropriate ^b) Third party verifier:
Dr Jane Anderson

a: Product category rules

b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4)



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Comparability

Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A2:2019/AC2021. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A2:2019/AC2021 for further guidance

Information modules covered

| Product Stage | | | Construction 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 materials supply | Transport | Manufacturing | Transport to site | Construction – Installation | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstruction demolition | Transport | Waste processing | Disposal | Reuse, Recovery and/or Recycling potential |
| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

Note: Checks indicate the Information Modules declared.

Manufacturing site

Union Iron & Steel Company L.L.C.
P.O. Box 8529
ICAD-1, Mussafah
Abu Dhabi
U.A.E.

Construction Product:

Product Description

Reinforcing Steel Bar (according to product standards listed in Sources of Additional Information) that is obtained from Direct Reduced Iron (DRI), melted in an Electric Arc Furnace (EAF) followed by hot rolling. These are used to provide tensile strength in reinforced concrete building elements.

The declared unit is 1 tonne of carbon steel reinforcing bars manufactured by the Direct Reduced Iron production route.



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Technical Information

| Property | Value, Unit |
|---|---|
| Production route | DRI - EAF |
| Density | 7850 kg/m ³ |
| Modulus of elasticity | 200000 N/mm ² |
| Weldability (C _{eq}) | max 0.50 % |
| Yield strength (as per BS 4449:2005+A3:2016) | min 500 N/mm ² – max 650 N/mm ² |
| Tensile strength (as per BS 4449:2005+A3:2016) | min 540 N/mm ² (Tensile strength/Yield Strength ≥ 1.08) |
| Agt (% total elongation at maximum force as per BS 4449:2005+A3:2016) | min 5 % |
| Surface geometry (Relative rib area, fR as per BS 4449:2005+A3:2016) | min 0.040 for Bar Size >6mm & ≤12mm & min 0.056 for Bar size >12 |
| Re-bend test (as per BS 4449:2005+A3:2016) | Pass |
| Fatigue test (as per BS 4449:2005+A3:2016) | Pass |
| Recycled content (as per ISO 14021:2016/Amd:2021) | 24.5 % |

Main Product Contents

| Material/Chemical Input | % |
|---|----|
| Fe | 97 |
| C, Mn, Si, V, Ni, Cu, Cr, Mo and others | 3 |

Manufacturing Process

Direct reduced iron (DRI) is produced as a first step from imported iron ore pellets. DRI is then melted in an Electric Arc Furnace (EAF) to obtain liquid metal. This is then refined to remove impurities, and alloying additives can be made to give the required properties of the steel.

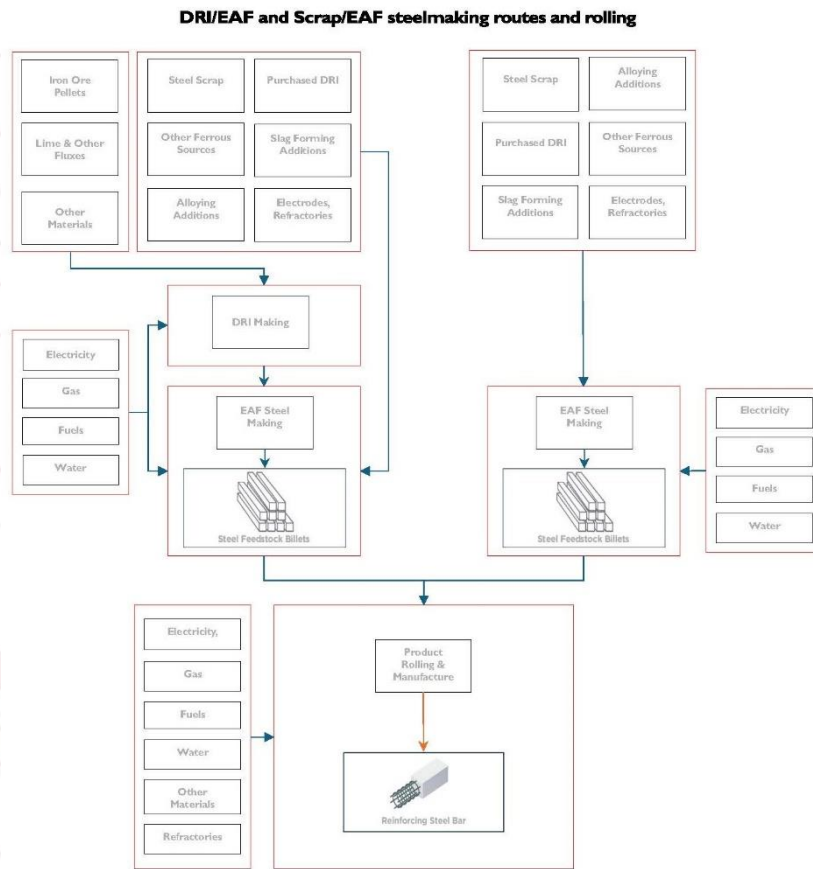
Hot metal (molten steel) from the EAF is then cast into steel billets before being sent to the rolling mill where they are rolled and shaped to the required dimensions for the finished bars of reinforcing steel.

The products are packaged by binding with steel wires or straps, both the steel ties and products do not include any biogenic materials.



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Process flow diagram



Construction Installation

Processing and proper use of reinforcing steel products depends on the application and should be made in accordance with generally accepted practices, standards and manufacturing recommendations.

During transport and storage of reinforcing steel products the usual requirement for securing loads is to be observed.

Use Information

The composition of the reinforcing steel products does not change during use.

Reinforcing steel products do not cause adverse health effects under normal conditions of use.

No risks to the environment and living organisms are known to result from the mechanical destruction of the reinforcing steel product itself.

End of Life

Reinforcing steel products are not reused at end of life but can be recycled to the same (or higher/lower) quality of steel depending upon the metallurgy and processing of the recycling route.

It is a high value resource, so efforts are made to recycle steel scrap rather than disposing of it at EoL. A recycling rate of 92% is typical for reinforcing steel products



Life Cycle Assessment Calculation Rules

This EPD uses the “Cut-off by Classification” method, also known as the recycled content method. It assigns the environmental impacts of primary material production to the initial user. Recyclable materials enter the recycling process without burdens, and secondary materials only bear the impacts of recycling.

This method promotes recycling by making producers responsible for waste management. It supports a circular economy by reducing the environmental impacts of primary material production.

This approach follows ISO 14040 and ISO 14044 standards for Life Cycle Assessments.

The Life Cycle Impact Assessment (LCIA) has been carried out using the characterisation method described in EN 15804+A2. The characterisation factors from Environmental Footprint v3.0 (EF 3.0) was applied.

Declared unit description

The declared unit is 1 tonne of carbon steel reinforcing bars manufactured by the Direct Reduced Iron production route

System boundary

The system boundary of the EPD follows the modular design defined by EN 15804+A2. Type of this EPD is Cradle to Gate with options, Modules C1-C4, and Module D.

Impacts and aspects related to losses/wastage (i.e. production, transport and waste processing and end-of-life stage of lost waste products and materials) are considered in the modules in which the losses/wastage occur.

Once steel scrap has been collected for recycling it is considered to have reached the end of waste state.

Data sources, quality and allocation

Data Sources and Quality:

The selection of data and the data quality requirements have been provided according to the requirements of BS EN 15941:2024.

Data Sources: Manufacturing data of the period 01/01/2023-31/12/2023 has been provided by Union Iron & Steel Company L.L.C. operating on the geographical area noted in Manufacturing Site. A brief description of technology and inputs for the product is given in Manufacturing Process and in simplified Process Flow Diagram

The primary data collection was thorough, considering all relevant flows and these data were verified during the audit conducted by CARES in August 2024, including also the verification of mass balance, to ensure that data for all the inputs and outputs for the process over the period of data collection have been collected, and that the unit process data will comply with the cut-off rules of EN 15804. The EPD covers transport to, and end-of-life in United Arab Emirates.

The selection of the background data for electricity generation is in line with the BRE Global PCR PN514 3.1. Country or region-specific power grid mixes are selected from LCA FE (GaBi) Dataset Documentation (Sphera 2023.1); thus, consumption grid mix of United Arab Emirates has been selected to suit specific manufacturing location, and also for fabrication, installation and demolishing location. The emission factor of carbon footprint of the applied consumption grid mix of United Arab Emirates is 0.620 kg CO₂ eq/kWh.

Data Quality: Background data are consistently sourced from the LCA FE (GaBi) Dataset Documentation (Sphera 2023.1). The primary data collection was thorough, considering all relevant flows and these data have been verified by CARES.

There isn't any data from different LCI/LCA databases are used considering that the overall consistency of the study is not adversely affected.

Schemes applied for data quality assessment was as per EN 15804:2012+A2:2019, Annex E, Table E.1 — Data quality level and criteria of the UN Environment Global Guidance on LCA database development. No fair, poor or very poor data was found during the assessment of relevant data.



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Data quality level and criteria of the UN Environment Global Guidance on LCA database development:

Geographical Representativeness : Good
Technical Representativeness : Very good
Time Representativeness : Good

Allocation:

Mill scale is produced as co-products from the rolling process. Impacts are allocated between the steel, the slag and the mill scale based on economic value. The revenue generated from mill scale is 0.12%, which is less than 1% in relation to the product based on current market prices, this co-product is of definite value and are freely/readily traded in reality. For this reason, economic allocation has been applied to the processes where these co-products arise.

Production losses of steel during the production process are recycled in a closed loop offsetting the requirement for external scrap. Specific information on allocation within the background data is given in the LCA FE (GaBi) Dataset Documentation (Sphera 2023.1).

Cut-off criteria

On the input side all flows entering the system and comprising more than 1% in total mass or contributing more than 1% to primary energy consumption are considered. All inputs used as well as all process-specific waste and process emissions were assessed. For this reason, material streams which were below 1% (by mass) were captured as well. In this manner the cut-off criteria according to the PCR requirements are fulfilled).

The mass of steel wire or strap used for binding the product coil is less than 1 % of the total mass of the product.



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LCA Results

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

| Core environmental impact indicators | | | | | | | | | |
|---|--------------------------------------|------|-----------------------|-----------------------|-----------------------|-----------------------|-------------|-----------------------|---------------|
| Life Cycle Stage | Impact Category | | GWP-total | GWP-fossil | GWP-biogeni c | GWP-luluc | ODP | AP | EP-freshwater |
| | | | kg CO ₂ eq | kg CO ₂ eq | kg CO ₂ eq | kg CO ₂ eq | kg CFC11 eq | mol H ⁺ eq | Kg P eq |
| Product stage | Raw material supply | A1 | 1.56E+03 | 1.56E+03 | 5.13 | 0.815 | 3.40E-09 | 8.07 | 4.93E-03 |
| | Transport | A2 | 4.72 | 4.74 | -0.066 | 0.043 | 4.08E-13 | 0.016 | 1.69E-05 |
| | Manufacturing | A3 | 162 | 162 | 0.075 | 0.003 | 1.95E-10 | 0.254 | 5.78E-06 |
| | Total (of product stage) | A1-3 | 1.73E+03 | 1.73E+03 | 5.14 | 0.861 | 3.60E-09 | 8.34 | 4.95E-03 |
| Construction process stage | Transport | A4 | 20.9 | 21.0 | -0.292 | 0.191 | 1.81E-12 | 0.064 | 7.53E-05 |
| | Construction | A5 | 186 | 185 | 0.440 | 0.135 | 4.05E-10 | 0.877 | 5.14E-04 |
| Use stage | Use | B1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| %92 Recycling / %8 Landfill Scenario | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 2.05 | 2.05 | 8.04E-04 | 4.51E-05 | 6.29E-14 | 0.011 | 2.45E-07 |
| | Transport | C2 | 47.1 | 47.3 | -0.617 | 0.407 | 4.04E-12 | 0.235 | 1.61E-04 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 1.17 | 1.20 | -0.040 | 0.004 | 3.05E-12 | 0.009 | 2.42E-06 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -1.63E+03 | -1.63E+03 | 3.18 | -0.676 | 4.78E-09 | -3.67 | -1.21E-04 |
| 100% Landfill Scenario | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 2.05 | 2.05 | 8.04E-04 | 4.51E-05 | 6.29E-14 | 0.011 | 2.45E-07 |
| | Transport | C2 | 2.17 | 2.18 | -0.030 | 0.020 | 1.88E-13 | 0.009 | 7.83E-06 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 14.6 | 15.0 | -0.499 | 0.047 | 3.82E-11 | 0.107 | 3.02E-05 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 440 | 441 | -0.860 | 0.183 | -1.29E-09 | 0.992 | 3.26E-05 |
| 100% Recycling Scenario | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 2.05 | 2.05 | 8.04E-04 | 4.51E-05 | 6.29E-14 | 0.011 | 2.45E-07 |
| | Transport | C2 | 51.0 | 51.2 | -0.668 | 0.440 | 4.37E-12 | 0.255 | 1.74E-04 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -1.81E+03 | -1.81E+03 | 3.54 | -0.751 | 5.31E-09 | -4.08 | -1.34E-04 |

GWP-total = Global warming potential, total;
 GWP-fossil = Global warming potential, fossil;
 GWP-biogenic = Global warming potential, biogenic;
 GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
 AP = Acidification potential, accumulated exceedance; and
 EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment



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LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Core environmental impact indicators

| Life Cycle Stage | Impact Category | | EP-marine | EP-terrestrial | POCP | ADP-mineral & metals | ADP-fossil | WDP |
|---|--------------------------------------|------|-----------|----------------|-------------|----------------------|-------------------------|----------------------------------|
| | | | kg N eq | mol N eq | kg NMVOC eq | kg Sb eq | MJ, net calorific value | m ³ world eq deprived |
| Product stage | Raw material supply | A1 | 0.007 | 12.6 | 3.56 | 1.11E-04 | 2.16E+04 | -139 |
| | Transport | A2 | 0.007 | 0.077 | 0.014 | 2.99E-07 | 63.5 | 0.054 |
| | Manufacturing | A3 | 0.109 | 1.20 | 0.308 | 2.86E-06 | 2.60E+03 | 1.57 |
| | Total (of product stage) | A1-3 | 0.123 | 13.9 | 3.88 | 1.14E-04 | 2.43E+04 | -1.37E+02 |
| Construction process stage | Transport | A4 | 0.029 | 0.329 | 0.058 | 1.33E-06 | 281 | 0.238 |
| | Construction | A5 | 0.149 | 1.63 | 0.438 | 1.18E-05 | 2.65E+03 | -13.5 |
| Use stage | Use | B1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 | 0 | 0 | 0 |
| %92 Recycling / %8 Landfill Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.004 | 0.044 | 0.011 | 1.25E-08 | 27.6 | 0.016 |
| | Transport | C2 | 0.113 | 1.26 | 0.235 | 2.86E-06 | 633 | 0.511 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0.002 | 0.024 | 0.007 | 5.54E-08 | 16.0 | 0.132 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -0.881 | -9.54 | -2.93 | -1.69E-05 | -1.21E+04 | -23.2 |
| 100% Landfill Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.004 | 0.044 | 0.011 | 1.25E-08 | 27.6 | 0.016 |
| | Transport | C2 | 0.004 | 0.048 | 0.008 | 1.38E-07 | 29.2 | 0.025 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0.028 | 0.303 | 0.083 | 6.92E-07 | 200 | 1.65 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 0.238 | 2.58 | 0.793 | 4.57E-06 | 3.26E+03 | 6.26 |
| 100% Recycling Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.004 | 0.044 | 0.011 | 1.25E-08 | 27.6 | 0.016 |
| | Transport | C2 | 0.122 | 1.36 | 0.255 | 3.10E-06 | 685 | 0.553 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -0.978 | -10.6 | -3.26 | -1.88E-05 | -1.34E+04 | -25.7 |

ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;
 ADP-fossil = Depletion potential of the stratospheric ozone layer;
 WDP = Water (user) deprivation potential, deprivation-weighted water consumption.
 The results of three environmental impact indicators above shall be used with care as the uncertainties on these results are high or as there is limited experienced with these indicators.

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
 EP-terrestrial = Eutrophication potential, accumulated exceedance;
 POCP = Formation potential of tropospheric ozone;
 PM = Particulate matter.



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LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts

| Life Cycle Stage | Impact Category | | PM | IRP | ETP-fw | HTP-c | HTP-nc | SQP |
|---|--------------------------------------|------|-------------------|-------------------------|-----------|-----------|-----------|---------------|
| | | | disease incidence | kBq U ²³⁵ eq | CTUe | CTUh | CTUh | dimensionless |
| Product stage | Raw material supply | A1 | 9.03E-05 | 9.03 | 4.93E-03 | 3.12E-07 | 2.03E-05 | 1.50E+03 |
| | Transport | A2 | 1.05E-07 | 0.012 | 1.69E-05 | 9.00E-10 | 5.61E-08 | 26.3 |
| | Manufacturing | A3 | 2.09E-06 | 0.032 | 5.78E-06 | 3.38E-08 | 3.84E-07 | 3.14 |
| | Total (of product stage) | A1-3 | 9.25E-05 | 9.07 | 4.95E-03 | 3.47E-07 | 2.07E-05 | 1.53E+03 |
| Construction process stage | Transport | A4 | 3.80E-07 | 0.053 | 7.53E-05 | 3.98E-09 | 2.48E-07 | 117 |
| | Construction | A5 | 9.48E-06 | 0.979 | 5.14E-04 | 3.26E-08 | 2.14E-06 | 186 |
| Use stage | Use | B1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 | 0 | 0 | 0 |
| %92 Recycling / %8 Landfill Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 6.69E-08 | 5.08E-04 | 2.45E-07 | 6.18E-10 | 1.84E-08 | 0.043 |
| | Transport | C2 | 1.73E-06 | 0.117 | 1.61E-04 | 8.94E-09 | 5.50E-07 | 249 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 1.05E-07 | 0.021 | 2.42E-06 | 1.34E-09 | 1.48E-07 | 3.89 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -5.36E-05 | 23.7 | -1.21E-04 | -2.51E-06 | -9.72E-06 | 1.13E+03 |
| 100% Lanfill Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 6.69E-08 | 5.08E-04 | 2.45E-07 | 6.18E-10 | 1.84E-08 | 0.043 |
| | Transport | C2 | 4.68E-08 | 0.005 | 7.83E-06 | 4.14E-10 | 2.59E-08 | 12.2 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 1.31E-06 | 0.263 | 3.02E-05 | 1.68E-08 | 1.85E-06 | 48.6 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 1.45E-05 | -6.39 | 3.26E-05 | 6.78E-07 | 2.63E-06 | -307 |
| 100% Recycling Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 6.69E-08 | 5.08E-04 | 2.45E-07 | 6.18E-10 | 1.84E-08 | 0.043 |
| | Transport | C2 | 1.88E-06 | 0.127 | 1.74E-04 | 9.68E-09 | 5.96E-07 | 270 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -5.95E-05 | 26.3 | -1.34E-04 | -2.79E-06 | -1.08E-05 | 1.26E+03 |

IRP = Potential human exposure efficiency relative to U235; 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.

HTP-nc = Potential comparative toxic unit for humans; and ETP-fw = Potential comparative toxic unit for ecosystems; HTP-c = Potential comparative toxic unit for humans; SQP = Potential soil quality index. The results of four environmental impact indicators above shall be used with care as the uncertainties on these results are high or as there is limited experienced with these indicators.



Environmental Product Declaration

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use

| Life Cycle Stage | Impact Category | | PERE | PERM | PERT | PENRE | PENRM | PENRT |
|---|--------------------------------------|------|----------|------|----------|-----------|-------|-----------|
| | | | MJ | MJ | MJ | MJ | MJ | MJ |
| Product stage | Raw material supply | A1 | 3.77E+03 | 0 | 3.77E+03 | 2.18E+04 | 0 | 2.18E+04 |
| | Transport | A2 | 4.46 | 0 | 4.46 | 63.6 | 0 | 63.6 |
| | Manufacturing | A3 | 61.6 | 0 | 61.6 | 2.60E+03 | 0 | 2.60E+03 |
| | Total (of product stage) | A1-3 | 3.84E+03 | 0 | 3.84E+03 | 2.45E+04 | 0 | 2.45E+04 |
| Construction process stage | Transport | A4 | 19.9 | 0 | 19.9 | 281 | 0 | 281 |
| | Construction | A5 | 404 | 0 | 404 | 2.68E+03 | 0 | 2.68E+03 |
| Use stage | Use | B1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 | 0 | 0 | 0 |
| %92 Recycling / %8 Landfill Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.049 | 0 | 0.049 | 27.6 | 0 | 27.6 |
| | Transport | C2 | 42.4 | 0 | 42.4 | 634 | 0 | 634 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 2.61 | 0 | 2.61 | 16.0 | 0 | 16.0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 2.00E+03 | 0 | 2.00E+03 | -1.22E+04 | 0 | -1.22E+04 |
| 100% Landfill Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.049 | 0 | 0.049 | 27.6 | 0 | 27.6 |
| | Transport | C2 | 2.07 | 0 | 2.07 | 29.3 | 0 | 29.3 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 32.6 | 0 | 32.6 | 200 | 0 | 200 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -542 | 0 | -542 | 3.29E+03 | 0 | 3.29E+03 |
| 100% Recycling Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.049 | 0 | 0.049 | 27.6 | 0 | 27.6 |
| | Transport | C2 | 45.9 | 0 | 45.9 | 687 | 0 | 687 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 2.23E+03 | 0 | 2.23E+03 | -1.35E+04 | 0 | -1.35E+04 |

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
 PERM = Use of renewable primary energy resources used as raw materials;
 PERT = Total use of renewable primary energy resources;

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
 PENRM = Use of non-renewable primary energy resources used as raw materials;
 PENRT = Total use of non-renewable primary energy resource



Environmental Product Declaration

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

| Parameters describing resource use | | | | | | |
|---|--------------------------------------|------|------|------------------------|------------------------|----------------|
| Life Cycle Stage | Impact Category | | SM | RSF | NRSF | FW |
| | | | kg | MJ net calorific value | MJ net calorific value | m ³ |
| Product stage | Raw material supply | A1 | 0 | 0 | 0 | -139 |
| | Transport | A2 | 0 | 0 | 0 | 0.054 |
| | Manufacturing | A3 | -199 | 0 | 0 | 1.57 |
| | Total (of product stage) | A1-3 | -199 | 0 | 0 | -1.37E+02 |
| Construction process stage | Transport | A4 | 0 | 0 | 0 | 0.238 |
| | Construction | A5 | 0 | 0 | 0 | -13.5 |
| Use stage | Use | B1 | 0 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 | 0 |
| %92 Recycling / %8 Landfill Scenario | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0 | 0 | 0 | 0.016 |
| | Transport | C2 | 0 | 0 | 0 | 0.511 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 0.132 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -721 | 0 | 0 | -23.2 |
| 100% Landfill Scenario | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0 | 0 | 0 | 0.016 |
| | Transport | C2 | 0 | 0 | 0 | 0.025 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 1.65 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 199 | 0 | 0 | 6.26 |
| 100% Recycling Scenario | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0 | 0 | 0 | 0.016 |
| | Transport | C2 | 0 | 0 | 0 | 0.553 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -801 | 0 | 0 | -25.7 |

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;

NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water



Environmental Product Declaration

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing waste categories

| Life Cycle Stage | Impact Category | | HWD | NHWD | RWD |
|---|--------------------------------------|------|-----------|----------|----------|
| | | | kg | kg | kg |
| Product stage | Raw material supply | A1 | 1.09E-06 | 16.0 | 0.109 |
| | Transport | A2 | 2.35E-10 | 0.009 | 8.22E-05 |
| | Manufacturing | A3 | 2.10E-07 | 0.630 | 2.29E-04 |
| | Total (of product stage) | A1-3 | 1.30E-06 | 16.6 | 0.109 |
| Construction process stage | Transport | A4 | 1.04E-09 | 0.041 | 3.64E-04 |
| | Construction | A5 | 1.45E-07 | 11.4 | 0.012 |
| Use stage | Use | B1 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 |
| %92 Recycling / %8 Landfill Scenario | | | | | |
| End of life | Deconstruction, demolition | C1 | 1.57E-11 | 0.004 | 7.03E-06 |
| | Transport | C2 | 2.30E-09 | 0.090 | 8.15E-04 |
| | Waste processing | C3 | 0 | 0 | 0 |
| | Disposal | C4 | 3.49E-10 | 80.1 | 1.82E-04 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -3.07E-08 | -24.2 | 0.214 |
| 100% Landfill Scenario | | | | | |
| End of life | Deconstruction, demolition | C1 | 1.57E-11 | 0.004 | 7.03E-06 |
| | Transport | C2 | 1.08E-10 | 0.004 | 3.78E-05 |
| | Waste processing | C3 | 0 | 0 | 0 |
| | Disposal | C4 | 4.36E-09 | 1.00E+03 | 0.002 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 8.31E-09 | 6.54 | -0.058 |
| 100% Recycling Scenario | | | | | |
| End of life | Deconstruction, demolition | C1 | 1.57E-11 | 0.004 | 7.03E-06 |
| | Transport | C2 | 2.49E-09 | 0.097 | 8.82E-04 |
| | Waste processing | C3 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -3.41E-08 | -26.9 | 0.238 |

HWD = Hazardous waste disposed;
 NHWD = Non-hazardous waste disposed;
 RWD = Radioactive waste disposed



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LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing output flows – at end of life

| Life Cycle Stage | Impact Category | | CRU | MFR | MER | EE | Biogenic carbon (product) | Biogenic carbon (packaging) |
|---|--------------------------------------|------|-----|-----------|-----|-----------------------|---------------------------|-----------------------------|
| | | | kg | kg | kg | MJ per energy carrier | kg C | kg C |
| Product stage | Raw material supply | A1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Transport | A2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Manufacturing | A3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total (of product stage) | A1-3 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction process stage | Transport | A4 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Construction | A5 | 0 | -18.8 | 0 | 0 | 0 | 0 |
| Use stage | Use | B1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 | 0 | 0 | 0 |
| %92 Recycling / %8 Landfill Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0 | -920 | 0 | 0 | 0 | 0 |
| | Transport | C2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 0 | 0 | 0 | 0 | 0 | 0 |
| 100% Landfill Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Transport | C2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 0 | 0 | 0 | 0 | 0 | 0 |
| 100% Recycling Scenario | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0 | -1.00E+03 | 0 | 0 | 0 | 0 |
| | Transport | C2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 0 | 0 | 0 | 0 | 0 | 0 |

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy



Scenarios and additional technical information

| Scenarios and additional technical information | | | |
|--|--|--------------------------|---------|
| Scenario | Parameter | Units | Results |
| Module A4 Transport to the Building Site | On leaving the steelworks the reinforcing steel products are transported to a fabricator where they are converted into constructional steel forms suitable for the installation site, then transported on to the construction site, including provision of all materials and products. Road transport distance for rolled steel to fabricators and road transport distance for steel construction forms to site are assumed to be 100 km and 250 km, respectively. Only the one-way distance is considered as it is assumed that the logistics companies will optimise their distribution and not return empty in modules beyond A3. | | |
| | Truck trailer - Fuel | litre/km | 1.56 |
| | Distance | km | 350 |
| | Capacity utilisation (including empty returns) | % | 85 |
| | Bulk density of transported products | kg/m ³ | 7850 |
| Module A5 Installation in the Building | The fabrication process is a relatively simple unit process and accounts for the transformation of the rolled steel product into construction steel forms. The operations in this unit process are primarily cutting and welding. As such, other inputs to the process include electricity, thermal energy, and cutting gases. Other outputs of this process are steel scrap and wastewater (where applicable). Consumption grid mix of United Arab Emirates has been selected to suit specific fabrication and installation location. Fabrication into structural steel products and installation in the building; including provision of all materials, products, and energy, as well as waste processing up to the end-of-waste state or disposal of final residues during the construction stage. Installation of the fabricated product into the building is assumed to result in 10% wastage (determined based on typical installation losses reported by the WRAP Net Waste Tool [WRAP 2017]). It is assumed that fabrication requires 15.34 kWh/tonne finished product, and that there is a 2% wastage associated with this process. | | |
| | Ancillary materials for installation - Waste material from fabrication, losses per tonne of construction steel forms | % | 2 |
| | Energy Use - Energy per tonne required to fabricate construction steel forms | kWh | 15.34 |
| | Waste materials from installation wastage | % | 10 |
| | Module B2 Maintenance | No maintenance required. | |
| Module B3 Repair | No repair process required s. | | |
| Module B4 Replacement | No replacement considerations required. | | |
| Module B5 Refurbishment | No refurbishment process required. | | |
| Reference Service Life | Reinforcing steel products are used in the main building structure so the reference service life will equal the lifetime of the building. BS EN 1990 specifies "building structures and other common structures" as having a lifetime of 50 years. On this basis, the RSL for this EPD is assumed to be 50 years. | | |
| Module B6 Use of Energy | No energy required during use stage related to the operation of the building. | | |
| Module B7 Use of Water | No water required during use stage related to the operation of the building. | | |
| Modules C1 to C4 End of life | The end-of-life stage starts when the construction product is replaced, dismantled or deconstructed from the building or construction works and does not provide any further function. The recovered steel is transported for recycling while a small portion is assumed to be unrecoverable and remains in the rubble which is sent to landfill. 92% of the reinforcing steel is assumed to be recycled and 8% is sent to landfill [STEELCONSTRUCTION.INFO 2012]. The EPD covers transport to, and end-of-life in United Arab Emirates. Once steel scrap is generated through the deconstruction activities on the demolition site it is considered to have reached the "end of waste" state. No further processing is required so there are no impacts associated with this module. Hence no impacts are reported in module C3. | | |
| | Waste for recycling - Recovered steel from crushed concrete | % | 92 |
| | Waste for energy recovery - Energy recovery is not considered for this study as most end-of-life steel scrap is recycled, while the remainder is landfilled | - | - |
| | Waste for final disposal - Unrecoverable steel lost in crushed concrete and sent to landfill | % | 2 |
| | Portion of energy assigned to rebar from energy required to demolish building, per tonne | MJ | 24 |
| | Transport to waste processing by Truck - Fuel consumption | litre/km | 1.56 |
| | Transport to waste processing by Truck - Distance | km | 463 |
| | Transport to waste processing by Truck - Capacity utilisation | % | 85 |
| | Transport to waste processing by Truck - Density of Product | kg/m ³ | 7850 |



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Scenarios and additional technical information

| Scenario | Parameter | Units | Results |
|----------|---|-------------------|---------|
| | Transport to waste processing by Container ship - Fuel consumption | litre/km | 0.0041 |
| | Transport to waste processing by Container ship - Distance | km | 158 |
| | Transport to waste processing by Container ship – Capacity utilisation | % | 50 |
| | Transport to waste processing by Container ship – Density of Product | kg/m ³ | 7850 |
| Module D | <p>It is assumed that 92% of the steel used in the structure is recovered for recycling, while the remainder is landfilled. "Benefits and loads beyond the system boundary" (module D) accounts for the environmental benefits and loads resulting from net steel scrap that is used as raw material in the EAF and that is collected for recycling at end of life. The balance between total scrap arisings recycled from fabrication, installation and end of life and scrap consumed by the manufacturing process (internally sourced scrap is not included in this calculation). These benefits and loads are calculated by including the burdens of recycling and the benefit of avoided primary production.</p> <p>A large amount of net scrap is generated over the life cycle as the Direct Reduced Iron (DRI) production route is primarily from virgin sources and there is a very high end of life recycling rate for reinforcing steel products. As a result, module D reports the credits associated with the scrap output.</p> <p>The resulting scrap credit/burden is calculated based on the global "value of scrap" approach (/worldsteel 2011).</p> | | |
| | Recycled Content | kg | 245 |
| | Re-used Content | kg | 0 |
| | Recovered for recycling | kg | 920 |
| | Recovered for re-use | kg | 0 |
| | Recovered for energy | kg | 0 |



Summary, comments and additional information

Interpretation

Direct Reduced Iron based reinforcing steel product of Union Iron & Steel Company L.L.C. is made via the EAF route. The bulk of the environmental impacts and primary energy demand is attributed to the manufacturing phase, covered by information modules A1-A3 of EN 15804+A2.

The interpretation of the results has been carried out considering the methodology- and data-related assumptions and limitations declared in the EPD. This interpretation section focuses on the environmental impact categories as well as the primary energy demand indicators only.

Global Warming Potential (GWP)

The majority of the life cycle GWP impact occurs in the production phase (A1-A3). A1-A3 impacts account for 87.03% overall life cycle impacts for this category. The most significant contributions to production phase impacts are the upstream production of raw materials used in the steelmaking process, generation/supply of electricity and the production/use of fuels on site. Fabrication, installation and the end-of-life processes covered in C1-C4 make a minimal contribution to GWP. For overall climate change impacts, carbon dioxide emissions account for the majority of impacts with methane being the second most significant contributor.

Ozone Depletion Potential (ODP)

The majority of impacts are associated with the production phase (A1-3). Significant contributions to production phase impact come from the emission of ozone depleting substances during the upstream production of raw materials/pre-products as well as those arising from electricity production. Module D shows a very small credit even though scrap burdens are being assessed in this phase. This is explained because ODP emissions are linked to grid electricity production used.

Acidification Potential (AP)

Acidification potential is generally driven by the production of sulphur dioxide and nitrogen oxides through the combustion of fossil fuels, particularly coal and crude oil products. The majority of the lifecycle AP impact occurs in the production phase (A1-A3), similar to GWP. The major contributors to production phase AP impacts comes from energy resources used in the production of the raw materials and pre-products for the steelmaking process and from transportation. Fabrication, installation and the end-of-life processes classed under C1-C4 make minimal contributions.

Eutrophication Potential (EP)

Eutrophication is driven by nitrogen and phosphorus containing emissions and as with GWP and AP is often strongly linked with the use of fossil fuels. The major eutrophication impacts occur in the production phase (A1-A3). Significant contributions to production phase impact comes from the production of raw materials and transport. Fabrication, installation and the end-of-life processes classed under C1-C4 again make minimal contributions.

Photochemical Ozone Creation Potential (POCP)

POCP tends to be driven by emissions of carbon monoxide, nitrogen oxides (NO_x), sulphur dioxide and NMVOCs. The production phase is the dominant phase of the lifecycle with regards to POCP impacts. Again, these are all emissions commonly associated with the combustion of fuels. Significant contributors to POCP are the upstream production of raw materials/pre-products and transport, directly linked to fossil fuel combustion. It should be noted that the impacts for steel recycling in module D is almost of the same magnitude as the production phase impacts



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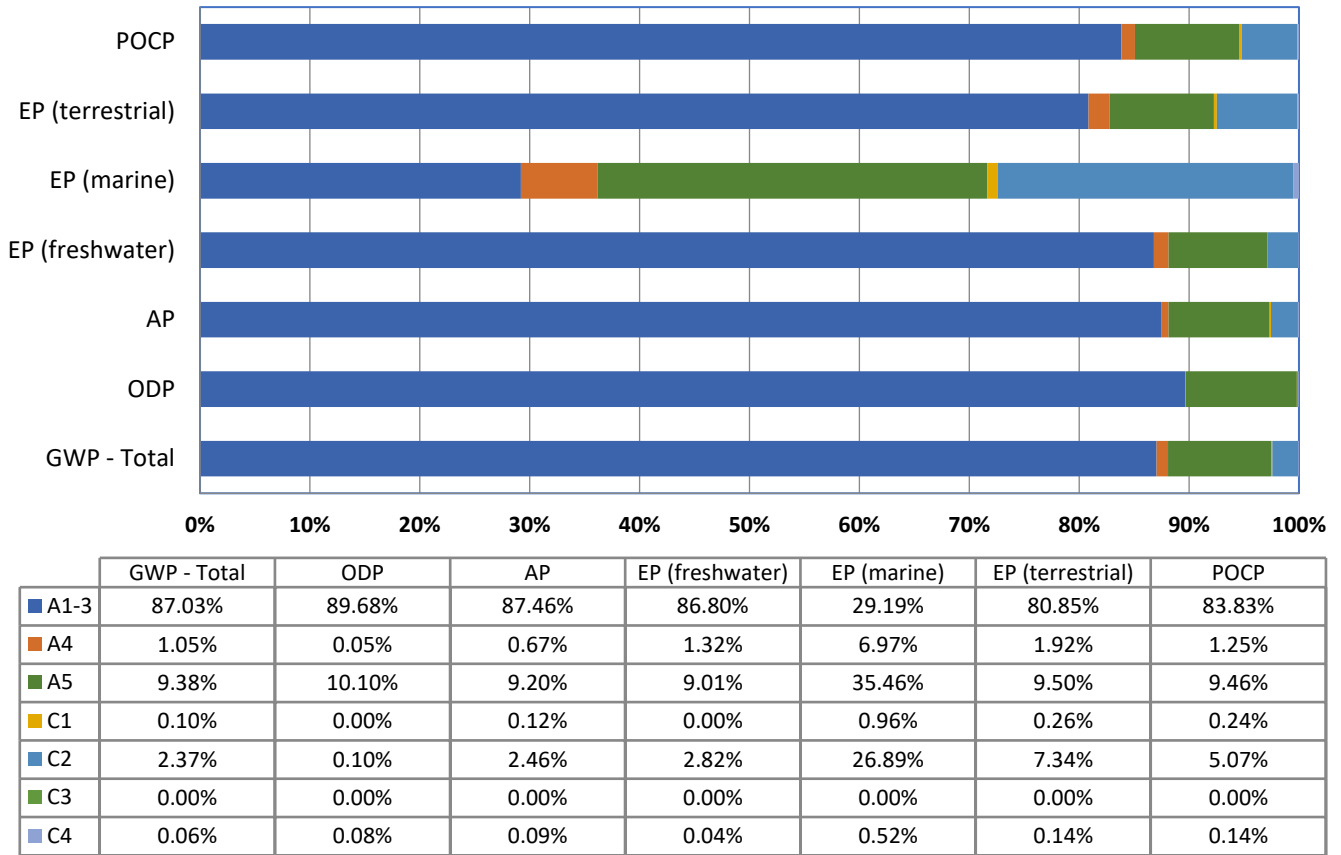


Figure 1 - shows the relative contribution of each life cycle stage to different environmental indicators for the carbon steel reinforcing bars manufactured by the Direct Reduced Iron production route

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CARES SRC Steel for the Reinforcement of Concrete Scheme. Appendix 1 – Quality and operations assessment schedule for carbon steel bars for the reinforcement of concrete including inspection and testing requirements - <https://www.carescertification.com/certified-companies/search> - Certificate number of conformance to BS4449 at the time of LCA study – 150601

CARES SSRC Singapore Steel for the Reinforcement of Concrete Scheme - Appendix 1 Quality and operations assessment schedule for Singapore Standard (SS 560:2016) weldable reinforcing steel bars, coils and decoiled products for the reinforcement of concrete including inspection and testing requirements - <https://www.carescertification.com/certified-companies/search> - Certificate number of conformance to SS 560:2016 at the time of LCA study – 221102

CARES SRC Steel for the Reinforcement of Concrete Scheme. Appendix CP&AS 24 - Quality and operations assessment schedule for Hong Kong Standard (CS2:2012) Steel Reinforcing Bars for the Reinforcement of Concrete - <https://www.carescertification.com/certified-companies/search> - Certificate number of conformance to CS2:2012 at the time of LCA study – 221103

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