

Statement of Verification

BREG EN EPD No.: 000618

Issue 01

This is to verify that the

Environmental Product Declaration

provided by:

Al Tital Steel Company Ltd (member of CARES)

is in accordance with the requirements of:

EN 15804:2012+A2:2019

and

BRE Global Scheme Document SD207

This declaration is for:

Carbon Steel Reinforcing Bar (secondary production route - scrap)



Company Address

7044 Al-Sahil District, Unit No. 1
Jeddah 22517 – 4098
Kingdom of Saudi Arabia



Emma Baker
Operator

09 July 2024
Date of this Issue

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Date of First Issue

07 July 2027
Expiry Date



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Environmental Product Declaration

EPD Number: 000618

General Information

| EPD Programme Operator | Applicable Product Category Rules |
|---|---|
| BRE Global Watford, Herts WD25 9XX United Kingdom | BRE 2023 Product Category Rules (PN 514 Rev 3.1) for Type III environmental product declaration of construction products to EN 15804:2012+A2:2019 |
| Commissioner of LCA study | LCA consultant/Tool |
| CARES Pembroke House 21 Pembroke Road Sevenoaks Kent, TN13 1XR UK www.carescertification.com | CARES EPD Tool SPHERA SOLUTIONS UK LIMITED The Innovation Centre Warwick Technology Park Gallows Hill, Warwick Warwickshire CV34 6UW www.sphera.com |
| Declared/Functional Unit | Applicability/Coverage |
| 1 tonne of carbon steel reinforcing bars manufactured by the the secondary (scrap-based) production route as used within concrete structures for a commercial building. | Manufacturer-specific product. |
| EPD Type | Background database |
| Cradle to Gate with Modules C and D and Options | GaBi |
| 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 <input type="checkbox"/> Internal <input checked="" type="checkbox"/> External | |
| (Where appropriate ^b)Third party verifier: Pat Hermon | |
| a: Product category rules b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4) | |
| Comparability | |
| Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A2:2019. 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 for further guidance | |

Information modules covered

| Product | | | Construction | | Use stage | | | | | | | End-of-life | | | | Benefits and loads beyond the system boundary |
|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---|
| | | | | | Related to the building fabric | | | | | Related to the building | | | | | | |
| 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 |
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |

Note: Ticks indicate the Information Modules declared.

Manufacturing site

Al Tilal Steel Company Ltd (member of CARES)

7044 Al-Sahil District, Unit No. 1
 Jeddah 22517 – 4098
 Kingdom of Saudi Arabia

Construction Product:

Product Description

Reinforcing steel bar (according to product standards listed in References) that is obtained from scrap, melted in an Electric Induction Furnace followed by hot rolling.

The declared unit is 1 tonne of carbon steel reinforcing bars as used within concrete structures for a commercial building.

Technical Information

| Property | Value, Unit |
|---|---|
| Production route | Induction Furnace |
| Density | 7850 kg/m ³ |
| Modulus of elasticity | 200 GPa |
| Carbon Equivalent (C.E.) as per ASTM A706/706M | max 0.55 % |
| Yield strength: ASTM A615/A615M grades: Grade 40, Grade 60, Grade 80, Grade 100 | min 280 MPa for Grade 40 MPa min 420 MPa for Grade 60 MPa min 550 MPa for Grade 80 MPa min 690 MPa for Grade 100 MPa |
| ASTM A706/A706M grades: Grade 60, Grade 80, Grade 100 | min 420 MPa – max 540 MPa for Grade 60 min 550 MPa – max 675 MPa for Grade 80 min 690 MPa – max 815 MPa for Grade 100 |
| Ratio of actual tensile strength to actual yield strength ASTM A615/A615M | min 1.10 for all grades |
| ASTM A706/A706M | min 1.25 for Grade 60 and Grade 80 min 1.17 for Grade 100 |
| Tensile strength: ASTM A615/A615M grades: Grade 40, Grade 60, Grade 80, Grade 100 | min 420 MPa for Grade 40 min 550 MPa for Grade 60 min 690 MPa for Grade 80 min 790 MPa for Grade 60 |
| ASTM A706/A706M grades: Grade 60, Grade 80, Grade 100 | min 550 MPa for Grade 60 min 690 MPa for Grade 80 min 805 MPa for Grade 60 |
| Elongation in 200mm (as per ASTM A615/A615M and ASTM A706/A706M requirements) | As per Table A1.2 for each size and grade |
| Bend test requirements (as per ASTM A615/A615M and ASTM A706/A706M requirements) | Pass |
| Recycled content (as per ISO 14021:2016/Amd:2021) (from CARES Sector average EPD) | 97.7 % |

Main Product Contents

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

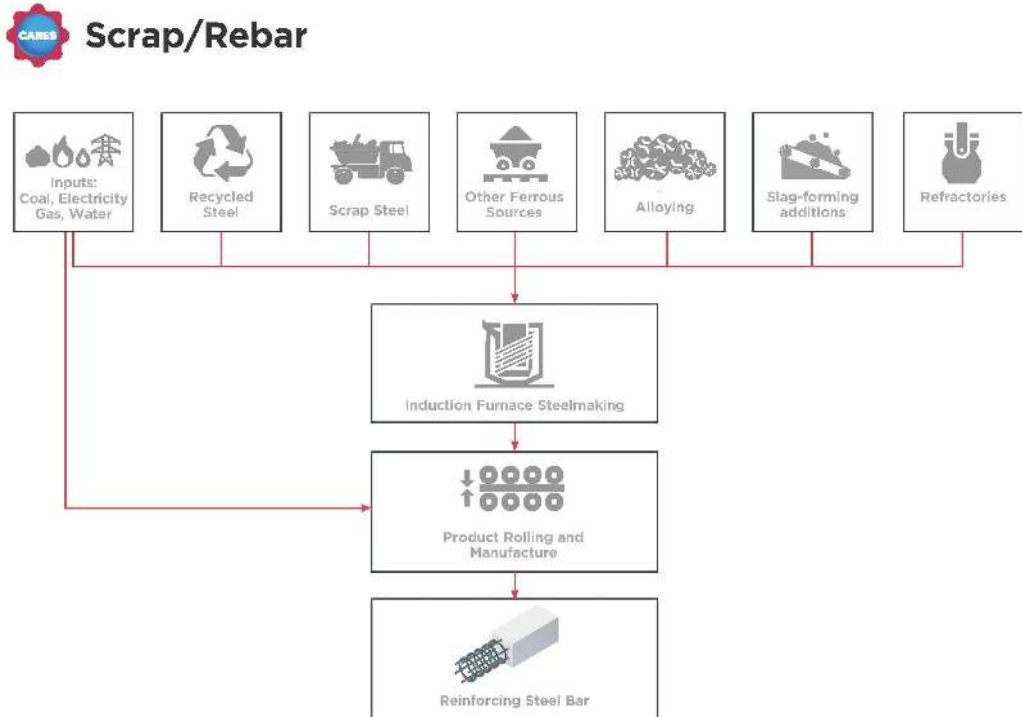
Manufacturing Process

Scrap metal is melted in an induction furnace to obtain liquid steel. This is then refined to remove impurities and alloying additives can be added to give the required properties of the steel.

Hot metal (molten steel) from the induction furnace 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 packed with steel wire or straps to bind the products, either of the steel ties and products do not include any biogenic materials.

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 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 reinforcing steel products

Life Cycle Assessment Calculation Rules

Declared unit description

The declared unit is 1 tonne of carbon steel reinforcing bars manufactured by the secondary (scrap-based) production route as used within concrete structures for a commercial building (i.e. 1 tonne in use, accounting for losses during fabrication and installation, not 1 tonne as produced)

System boundary

The system boundary of the EPD follows the modular design defined by EN 15804+A2. This is a cradle to gate – with all options EPD and thus covers all modules from A1 to C4 and includes module D as well.

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: Manufacturing data of the period 01/01/2023-31/12/2023 has been provided by Al Tital Steel Company Ltd (member of CARES).

The selection of the background data for electricity generation is in line with the BRE Global PCR. Country or region specific power grid mixes are selected from LCA FE (GaBi) Dataset Documentation (Sphera 2023.1); thus, consumption grid mix of Saudi Arabia has been selected to suit specific manufacturing location.

Data Quality: Data quality can be described as good. 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.

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: Induction furnace slag and mill scale are produced as co-products from the steel manufacturing processes. Impacts are allocated between the steel, the slag and the mill scale based on economic value. The revenue generated from both mill scale and induction furnace slag are 0.51% and 0.11% respectively, and their total is less than 1% in relation to the product based on current market prices, these co-products are of definite value and are freely/readily traded in reality. For this reason, economic allocation has been applied to the processes where this co-product 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 BRE guidelines are fulfilled.

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

LCA Results

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

| Parameters describing environmental impacts | | | GWP-total | GWP-fossil | GWP-biogenic | 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 (PO ₄) ³⁻ eq |
| Product stage | Raw material supply | A1 | 102 | 105 | -2.92 | 0.028 | 1.03E-06 | 0.957 | 4.85E-04 |
| | Transport | A2 | 9.10 | 9.13 | -0.082 | 0.056 | 7.32E-13 | 0.122 | 2.27E-05 |
| | Manufacturing | A3 | 910 | 910 | 0.138 | 0.018 | 6.61E-11 | 21.0 | 9.97E-05 |
| | Total (of product stage) | A1-3 | 1.02E+03 | 1.02E+03 | -2.86 | 0.102 | 1.03E-06 | 22.1 | 6.07E-04 |
| Construction process stage | Transport | A4 | 20.9 | 21 | -0.292 | 0.191 | 1.81E-12 | 0.064 | 7.53E-05 |
| | Construction | A5 | 117 | 117 | -0.393 | 0.059 | 1.02E-07 | 2.45 | 8.11E-05 |
| 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 | 0.001 | 4.51E-05 | 6.29E-14 | 0.011 | 2.45E-07 |
| | Transport | C2 | 41.4 | 41.9 | -0.898 | 0.407 | 4.04E-12 | 0.193 | 1.61E-04 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 1.17 | 1.2 | -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 | 480 | 480 | -0.938 | 0.199 | -1.41E-09 | 1.08 | 3.55E-05 |
| 100% Lanfill Scenario | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 2.05 | 2.05 | 0.001 | 4.51E-05 | 6.29E-14 | 0.011 | 2.45E-07 |
| | Transport | C2 | 1.89 | 1.92 | -0.044 | 0.020 | 1.88E-13 | 0.007 | 7.83E-06 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 14.6 | 15 | -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 | 2.55E+03 | 2.55E+03 | -4.98 | 1.060 | -7.48E-09 | 5.74 | 1.89E-04 |
| 100% Recycling Scenario | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 2.05 | 2.05 | 0.001 | 4.51E-05 | 6.29E-14 | 0.011 | 2.45E-07 |
| | Transport | C2 | 44.8 | 45.3 | -0.973 | 0.440 | 4.37E-12 | 0.209 | 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 | 300 | 300 | -0.586 | 0.125 | -8.81E-10 | 0.676 | 2.22E-05 |

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

LCA Results (continued)

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

| Parameters describing environmental impacts | | | EP-marine | EP-terrestrial | POCP | ADP-mineral & metals | ADP-fossil | WDP | PM |
|---|--------------------------------------|------|-----------|----------------|-------------|----------------------|-------------------------|-------------------------|-------------------|
| | | | kg N eq | mol N eq | kg NMVOC eq | kg Sb eq | MJ, net calorific value | m ³ world eq | disease incidence |
| Product stage | Raw material supply | A1 | 0.033 | 1.42 | 0.361 | 5.37E-06 | 1.46E+03 | 12.90 | 1.02E-05 |
| | Transport | A2 | 0.033 | 0.363 | 0.086 | 4.17E-07 | 118 | 0.0749 | 1.91E-06 |
| | Manufacturing | A3 | 1.400 | 15.4 | 4.91 | 3.29E-06 | 1.26E+04 | 20.8 | 1.65E-04 |
| | Total (of product stage) | A1-3 | 1.466 | 17.2 | 5.36 | 9.08E-06 | 1.42E+04 | 33.8 | 1.77E-04 |
| Construction process stage | Transport | A4 | 0.029 | 0.329 | 0.058 | 1.33E-06 | 281 | 0.238 | 3.80E-07 |
| | Construction | A5 | 0.180 | 1.98 | 0.604 | 1.23E-06 | 1.67E+03 | 4.01 | 1.96E-05 |
| 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 | 0.004 | 0.044 | 0.011 | 1.25E-08 | 27.6 | 0.016 | 6.69E-08 |
| | Transport | C2 | 0.091 | 1.01 | 0.195 | 2.86E-06 | 633 | 0.511 | 1.52E-06 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0.002 | 0.024 | 0.007 | 5.54E-08 | 16.0 | 0.132 | 1.05E-07 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 0.260 | 2.81 | 0.864 | 4.98E-06 | 3.55E+03 | 6.83 | 1.58E-05 |
| 100% Lanfill Scenario | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.004 | 0.044 | 0.011 | 1.25E-08 | 27.6 | 0.016 | 6.69E-08 |
| | Transport | C2 | 0.003 | 0.036 | 0.006 | 1.38E-07 | 29.2 | 0.025 | 3.65E-08 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0.028 | 0.303 | 0.083 | 6.92E-07 | 200 | 1.65 | 1.31E-06 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 1.38 | 14.9 | 4.59 | 2.65E-05 | 1.89E+04 | 36.3 | 8.39E-05 |
| 100% Recycling Scenario | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.004 | 0.044 | 0.011 | 1.25E-08 | 27.6 | 0.016 | 6.69E-08 |
| | Transport | C2 | 0.098 | 1.10 | 0.212 | 3.10E-06 | 685 | 0.553 | 1.65E-06 |
| | 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 | 0.162 | 1.76 | 0.540 | 3.11E-06 | 2.22E+03 | 4.27 | 9.88E-06 |

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

LCA Results (continued)

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

| Parameters describing environmental impacts | | | IRP | ETP-fw | HTP-c | HTP-nc | SQP |
|---|--------------------------------------|------|----------------------------|----------|----------|----------|---------------|
| | | | kBq U ²³⁵ eq | CTUe | CTUh | CTUh | dimensionless |
| Product stage | Raw material supply | A1 | 2.19 | 4.85E-04 | 2.03E-08 | 1.95E-06 | 384 |
| | Transport | A2 | 0.022 | 2.27E-05 | 1.63E-09 | 9.42E-08 | 34.5 |
| | Manufacturing | A3 | 0.195 | 9.97E-05 | 4.35E-07 | 7.32E-06 | 18.2 |
| | Total (of product stage) | A1-3 | 2.41 | 6.07E-04 | 4.57E-07 | 9.36E-06 | 4.37E+02 |
| Construction process stage | Transport | A4 | 0.053 | 7.53E-05 | 3.98E-09 | 2.48E-07 | 117 |
| | Construction | A5 | 0.310 | 8.11E-05 | 4.67E-08 | 1.05E-06 | 77.1 |
| Use stage | Use | B1 | 0 | 0 | 0 | 0 | 0 |
| | Maintenance | B2 | 0 | 0 | 0 | 0 | 0 |
| | Repair | B3 | 0 | 0 | 0 | 0 | 0 |
| | Replacement | B4 | 0 | 0 | 0 | 0 | 0 |
| | Refurbishment | B5 | 0 | 0 | 0 | 0 | 0 |
| | Operational energy use | B6 | 0 | 0 | 0 | 0 | 0 |
| | Operational water use | B7 | 0 | 0 | 0 | 0 | 0 |
| %92 Recycling / %8 Landfill Scenario | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.001 | 2.45E-07 | 6.18E-10 | 1.84E-08 | 0.043 |
| | Transport | C2 | 0.117 | 1.61E-04 | 8.94E-09 | 5.22E-07 | 249 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 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 | -6.97 | 3.55E-05 | 7.39E-07 | 2.86E-06 | -334 |
| 100% Lanfill Scenario | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.001 | 2.45E-07 | 6.18E-10 | 1.84E-08 | 0.043 |
| | Transport | C2 | 0.005 | 7.83E-06 | 4.14E-10 | 2.45E-08 | 12.2 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 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 | -37.0 | 1.89E-04 | 3.93E-06 | 1.52E-05 | -1.78E+03 |
| 100% Recycling Scenario | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.001 | 2.45E-07 | 6.18E-10 | 1.84E-08 | 0.043 |
| | Transport | C2 | 0.127 | 1.74E-04 | 9.68E-09 | 5.65E-07 | 270 |
| | Waste processing | C3 | 0 | 0 | 0 | 0 | 0 |
| | Disposal | C4 | 0 | 0 | 0 | 0 | 0 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -4.36 | 2.22E-05 | 4.62E-07 | 1.79E-06 | -209 |

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;

HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results (continued)

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

| Parameters describing resource use, primary energy | | | PERE | PERM | PERT | PENRE | PENRM | PENRT |
|---|--------------------------------------|------|-----------|------|-----------|----------|-------|----------|
| | | | MJ | MJ | MJ | MJ | MJ | MJ |
| Product stage | Raw material supply | A1 | 101 | 0 | 101 | 1.46E+03 | 0 | 1.46E+03 |
| | Transport | A2 | 5.98 | 0 | 5.98 | 119 | 0 | 119 |
| | Manufacturing | A3 | 30.2 | 0 | 30.2 | 1.26E+04 | 0 | 1.26E+04 |
| | Total (of product stage) | A1-3 | 1.37E+02 | 0 | 1.37E+02 | 1.42E+04 | 0 | 1.42E+04 |
| Construction process stage | Transport | A4 | 19.9 | 0 | 19.9 | 281 | 0 | 281 |
| | Construction | A5 | 24.2 | 0 | 24.2 | 1.67E+03 | 0 | 1.67E+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 | -591 | 0 | -591 | 3.59E+03 | 0 | 3.59E+03 |
| 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 | -3.14E+03 | 0 | -3.14E+03 | 1.91E+04 | 0 | 1.91E+04 |
| 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 | -369 | 0 | -369 | 2.25E+03 | 0 | 2.25E+03 |

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

LCA Results (continued)

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

| Parameters describing resource use, secondary materials and fuels, use of water | | | | | | |
|---|--------------------------------------|------|-----------|---------------------------|---------------------------|----------------|
| | | | SM | RSF | NRSF | FW |
| | | | kg | MJ net calorific value | MJ net calorific value | m ³ |
| Product stage | Raw material supply | A1 | 0 | 0 | 0 | 12.9 |
| | Transport | A2 | 0 | 0 | 0 | 0.0749 |
| | Manufacturing | A3 | -1.16E+03 | 0 | 0 | 20.8 |
| | Total (of product stage) | A1-3 | -1.16E+03 | 0 | 0 | 33.8 |
| Construction process stage | Transport | A4 | 0 | 0 | 0 | 0.238 |
| | Construction | A5 | 0 | 0 | 0 | 4.0 |
| 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 | 235 | 0 | 0 | 6.83 |
| 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 | 1.16E+03 | 0 | 0 | 36.3 |
| 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 | 155 | 0 | 0 | 4.27 |

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

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

LCA Results (continued)

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

| Other environmental information describing waste categories | | | | | |
|---|--------------------------------------|------|-----------|----------|----------|
| | | | HWD | NHWD | RWD |
| | | | kg | kg | kg |
| Product stage | Raw material supply | A1 | -1.30E-09 | 1.32 | 0.024 |
| | Transport | A2 | 4.21E-10 | 0.015 | 1.49E-04 |
| | Manufacturing | A3 | 1.83E-07 | 106 | 0.002 |
| | Total (of product stage) | A1-3 | 1.82E-07 | 1.07E+02 | 0.026 |
| Construction process stage | Transport | A4 | 1.04E-09 | 0.041 | 3.64E-04 |
| | Construction | A5 | 2.46E-08 | 20.4 | 0.003 |
| 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 | 9.06E-09 | 7.13 | -0.063 |
| 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 | 4.81E-08 | 37.9 | -0.335 |
| 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 | 5.66E-09 | 4.46 | -0.039 |

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

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 | | | | | | | | |
|--|--------------------------------------|------|-----|-----------|-----|-----------------------|---------------------------|-----------------------------|
| | | | 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 |
| A4 – Transport to the building site | <p>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.</p> | | |
| | Truck trailer - Fuel | litre/km | 1.56 |
| | Distance | km | 350 |
| | Capacity utilisation (incl. empty returns) | % | 85 |
| | Bulk density of transported products | kg/m ³ | 7850 |
| A5 – Installation in the building | <p>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).</p> <p>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.</p> | | |
| | 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 |
| B2 – Maintenance | No maintenance required | | |
| B3 – Repair | No repair process required | | |
| B4 – Replacement | No replacement considerations required | | |
| B5 – Refurbishment | No refurbishment process required | | |
| Reference service life | <p>Reinforcing steel products are used in the main building structure so the reference service life will equal the lifetime of the building. The Concrete Society follows the definitions provided in BS EN 1990, which specifies “building structures and other common structures” as having a lifetime of 50 years (The Concrete Society, n.d.; BSI, 2005). On this basis, the RSL for this EPD is assumed to be 50 years.</p> | | |
| B6 – Use of energy; B7 – Use of water | No water or energy required during use stage related to the operation of the building | | |

Scenarios and additional technical information

| Scenario | Parameter | Units | Results |
|--------------------------|--|-------------------|---------|
| C1 to C4 End of life, | <p>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].</p> <p>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.</p> | | |
| | 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 | % | 8 |
| | 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 |
| | 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 induction furnace 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>This study is concerned with the secondary production route and more scrap is required as input to the system than is recovered at end of life. The net effect of this is that module D mainly models the burdens associated with the scrap input (secondary material) to the steelmaking process.</p> <p>The resulting scrap credit/burden is calculated based on the global “value of scrap” approach (/worldsteel 2011).</p> | | |
| | Recycled Content (from CARES Sector Average EPD) | kg | 977 |
| 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

Scrap based reinforcing steel product of Al Tital Steel Company Ltd (member of CARES) is made via the Induction Furnace production 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 84.84% 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.

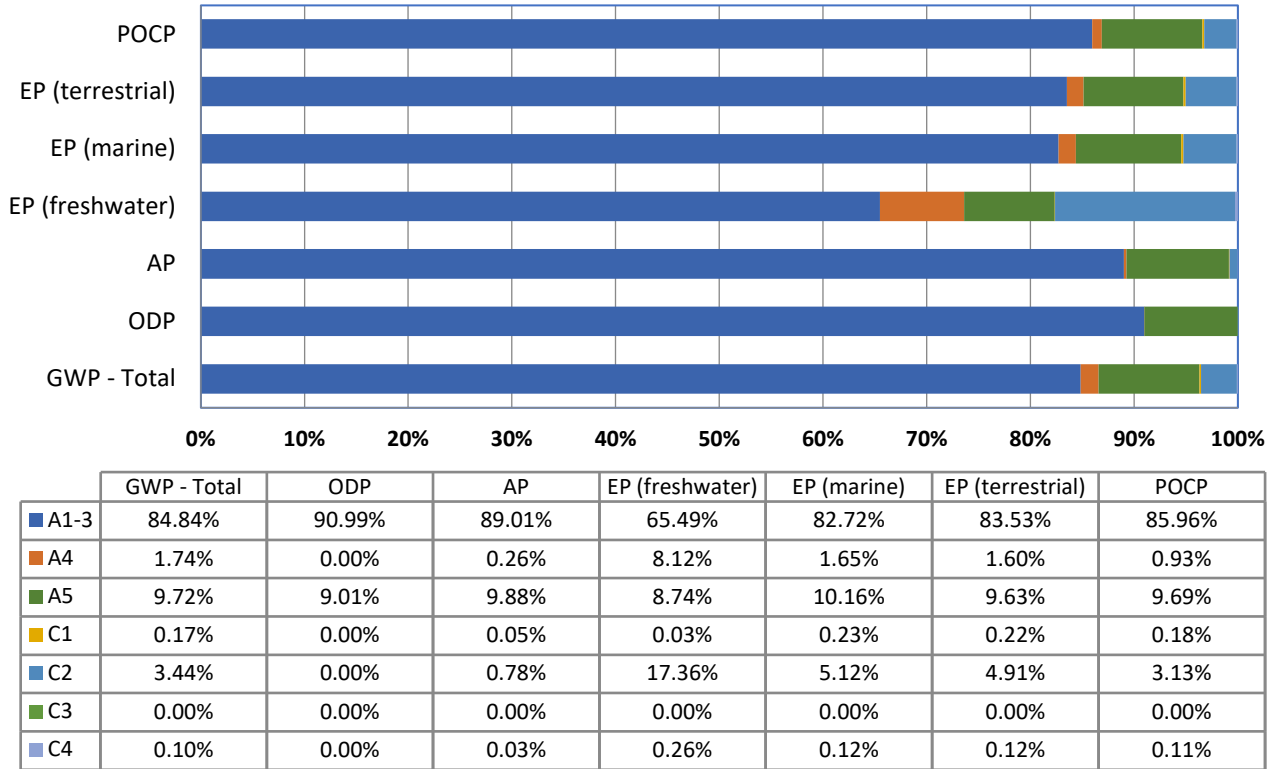


Figure 1 - shows the relative contribution of each life cycle stage to different environmental indicators for the carbon steel reinforcing bars manufactured by the scrap – Induction Furnace production route

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REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

CARES SRC Steel for the Reinforcement of Concrete Scheme. Appendix CP&AS 20 – CARES Quality and operations assessment schedule for ASTM carbon and low alloy steel bars and coils for the reinforcement of concrete including inspection and testing requirements -
<https://www.carescertification.com/certifiedcompanies/search> - Certificate number of conformance to ASTM A615/A615M:2022 at the time of LCA study – 160501

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/certifiedcompanies/search> - Certificate number of conformance to BS4449 at the time of LCA study – 230604

ASTM A615/A615M – 22 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

ASTM A706/A706M – 22 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.

SASO-ASTM-A615/A615M A: 2021 Standard Specification for Deformed and Plain Carbon-Steel Bars for concrete reinforcement.

SASO-ASTM-A706M:2022 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

BS 4449:2005+A3:2016 Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification.