Environmental Product Declaration

Statement of Verification

CARES EPD No.: 0022 | Issue 02

This is to verify that the

Environmental Product Declaration

Provided by:

ArcelorMittal Kryvyi Rih PJSC

Is in accordance with the requirements of:

EN 15804:2012 + A2:2019 and ISO 14025:2010

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 (Primary production route – Iron Ore)

Company address:

1 Ordzhonikidze Street
Kryvyi Rih
50095
Dnepropetrovsk Region
Ukraine

LadinCamci

	Ladin Camci	03 May 2025
Signed for CARES	Operator	Date of this Issue
03 May 2025		02 May 2028
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

EPD Number: CARES EPD 0022

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	SPHERA SOLUTIONS UK LIMITED The Innovation Centre Warwick Technology Park, Gallows Hill, Warwick, Warwickshire CV34 6UW UK www.sphera.com
Declared/Functional Unit	Declared Unit 1 tonne of carbon steel reinforcing bar manufactured by the Blast Furnace/Basic Oxygen Furnace (BF/BOF) 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) Databases 2024 (Sphera, 2024)

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)

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 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, ND indicates Not Declared.

Manufacturing site

ArcelorMittal Kryvyi Rih PJSC
1 Ordzhonikidze Street
Kryvyi Rih
50095
Dnepropetrovsk Region
Ukraine

Construction Product:

Product Description

Carbon Steel Reinforcing Bar (in the form of straight bar bundles or in coils according to the product standards listed in the Summary, Comments and Additional Information section), manufactured by the blast furnace/basic oxygen furnace (BF/BOF) route followed by hot rolling, is used to provide tensile strength in reinforced concrete structural members.

The declared unit is 1 tonne of carbon steel reinforcing bar manufactured from the blast furnace/basic oxygen furnace (BF/BOF) production route.

Technical Information

Property	Value, Unit
Production route	BF-BOF
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 500 N/mm^2 (Tensile strength/Yield Strength ≥ 1.08)
Agt (% total elongation at maximum force as per BS 4482:2005)	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)	8.1%[2)], 8.1%[3)]

1) Technical Information details are as per relevant product standards listed in References section
2) External scrap only
3) Including both internal and external scrap

Main Product Contents

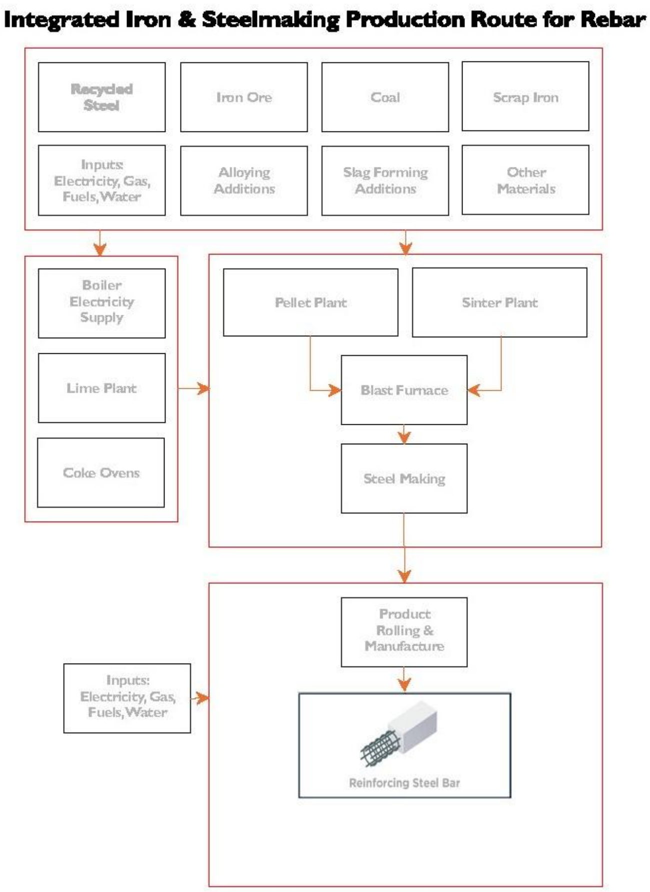
Material/Chemical Input	%
Fe	97
C, Mn, Si, V, Ni, Cu, Cr, Mo and others	3

Manufacturing Process

Integrated steelworks are complicated operations comprising multiple production processes as described below.

- Boilers/CHP: generates the steam used on site and some of the electricity (the remainder is sourced from the national grid of Ukraine). This process also supplies the blast air used in the blast furnace.
- Air separation unit: Generates the gases and compressed air used in the production process (e.g. nitrogen, oxygen, hydrogen, argon, etc.).
- Lime plant: Converts limestone and dolomite into lime/dololime for use in the basic oxygen furnace and sinter plant.
- Coke ovens: Converts coking coal into coke that is used as a reducing agent in the blast furnace and as a fuel in the sinter plant. Various co-products are generated from this process including coke oven gas (used as a fuel elsewhere on site), benzene, ammonium sulphate, sulphuric acid and tar.
- Sinter plant: Agglomerates iron ore fines with other materials (e.g. lime and limestone) to form nodules of iron rich material that are suitable for charging into the blast furnace.
- Blast furnace: Ferrous rich materials (sinter, iron ore, pellets and steel scrap), slag-forming materials (such as limestone), reducing agents (such as coke) and fuels (such as blast furnace gas and natural gas) with process gases and blast air generates molten iron ("hot metal") and slag and blast furnace gas (which is used as fuel in various site operations). The hot metal also undergoes desulphurisation to remove this unwanted element from the product.
- Steelmaking: covers the basic oxygen furnace (BOF) and secondary steelmaking steps in which the carbon content of the hot metal is reduced, and alloying materials are added to give the desired physical properties to the finished steel, which are formed into billets. BOF gas is also generated and is used as a fuel in various site operations. Slags are also generated from these processes, some of which are recycled in the sinter plant.
- Rolling mills: Converts the steel billets into the final products from the steel mill such as reinforcing bars, wire rod and steel profiles. Offcuts, mill scale, etc. are recycled within the steelworks.

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 95% is typical for reinforcing steel products

Life Cycle Assessment Calculation Rules

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 v3.1 (EF 3.1) was applied.

Declared unit description

The declared unit is 1 tonne of carbon steel reinforcing bar manufactured by the blast furnace/basic oxygen furnace (BF/BOF) production route

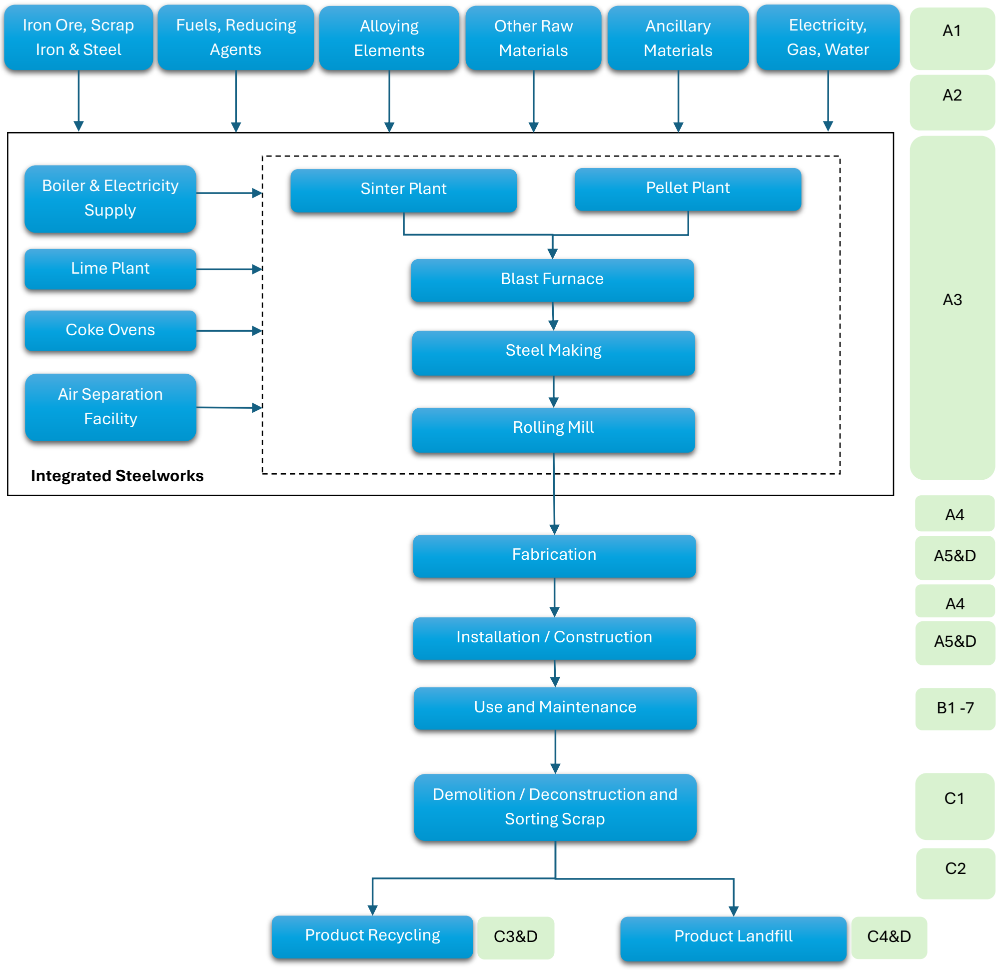
System boundary

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 such as 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.

Overview of Product System for Carbon Steel Reinforcing Bar



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.

Manufacturing data of the period 01/01/2023 – 31/12/2023 has been provided by ArcelorMittal Kryvyi Rih PJSC 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 September 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 end-of-life in United Kingdom.

Background data are consistently sourced from the MLC (GaBi) 2024.2 LCI database (Sphera, 2024).

The selection of the background data for electricity generation is in line with the BRE Global PCR PN514 3.1 for Type III EPD of Construction Products to EN 15804+A2. Country or region-specific power grid mixes are selected from https://lcadatabase.sphera.com/. Thus, consumption grid mix of Ukraine has been selected to suit specific manufacturing location. The emission factor of carbon footprint of the applied consumption grid mix of Ukraine in 0.520 kg CO_2 eq/kWh.

There wasn't any data from different LCI/LCA databases used considering that the overall consistency of the study has not been 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.

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

Allocation

Steel production (modules A1-A3) is a complex process and generates many co-products including:

- Slags and sludges from the blast furnace, basic oxygen furnace and secondary steelmaking processes
- Energy rich gases from the coke ovens, blast furnace, basic oxygen furnace, secondary steelmaking processes
- Dusts and sludges from the blast furnace, basic oxygen furnace and secondary steelmaking, sintering, pelletising and lime production processes
- Coke breeze from the coke ovens
- Scrap iron and steel from the blast furnace, basic oxygen furnace, secondary steelmaking and rolling mill processes
- Mill scale from the basic oxygen furnace, secondary steelmaking and rolling mill processes

Most of these co-products are recycled within the steel mill itself and these internal loops have been included in the LCA model. The balance of inputs and outputs is not always closed and where excess material is generated no credits are modelled in module D for material leaving the system following EN 15804+A2 (section 6.3.4.2). Similarly, where recycling occurs outside the steelworks, transport to the recycler is included, but no credits are awarded for secondary material leaving the system boundary. Instead, all benefits and loads are cut off after the transport step. This cut-off approach is more conservative than EN 15804 section 6.3.5.2, which states that "Flows leaving the system at the end-of-waste boundary of the product stage (A1-A3) shall be allocated as co-products (see 6.4.3.2)."

The value of the steel product far exceeds the value of the cut-off secondary material streams, meaning that co-product allocation would typically allocate a very large share (approaching 100%) to the main product and a very low share (approaching 0%) to the co-products. As such, the difference in results between the cut-off and co-product allocation approaches will be small.

There are the following exceptions to this approach:

- Blast furnace slag (BF slag) – this is not recycled internally but is generally sold for use in concrete, road building, etc. Impacts from the steel production process are allocated to the steel and BF slag co-products based on their economic value. CARES estimates that the value of reinforcing steel products is around $670/tonne in 2023.
- Specifying a price for BF slag is very difficult as it is not traded openly. Prices agreed between steel producers and users of the slag are not made public and can vary considerably depending on quality, quantity, demand, contract period, etc. CARES estimates as per its market intelligence that the value of GGBFS products is around $60/tonne in 2023.
- Coke oven products – as well as coke and coke breeze the coking process generates tar, ammonium sulphate, sulphuric acid, benzene and polymers of benzene separation. Due to commercial sensitivity, there is no price information available on these co-products. For this reason, mass-based allocation has been applied for co-products from this process. We acknowledge that this does not fully conform to the requirements of the PCR but feel that this approach is preferable to allocating all the impacts to the coke and coke breeze when some of the co-products are likely to have relatively high values (coke and coke breeze combined account for >99% of the output of this process).
- Energy rich gases – any excess gas generated that is not used within the steelworks is combusted to generate electricity and is sold externally. In the model this is looped back to satisfy some of the electricity demand of the steelworks.
- Process gases – Oxygen, Nitrogen, Argon and other gases produced from the on-site air separation unit are all consumed on site (no exports beyond A1-A3 boundary). For the particular production route modelled, impacts are allocated to the consumed gases based on volume.
- Rolling mill products – it was not possible to disaggregate data between products from rolling mill operations. Therefore, impacts are allocated to final products from the integrated mill (including reinforcing steel bar, wire rod) based on mass.
- Pre-consumer steel scrap is produced as co-product from the steel manufacturing processes. This co-product is internally recycled.
- Post-consumer scrap is an input to steelmaking processes and is assumed to be free of burdens as once steel scrap has been collected for recycling it is considered to have reached the end of waste state. Hence, only transport impacts associated with importing the scrap are considered.

Allocation of background data (energy and materials) taken from the MLC (GaBi) 2024.2 LCI database (Sphera, 2024).

All impacts associated with solid and liquid waste disposal are allocated to steel products. This includes transport and landfill or wastewater treatment processes (modules A & C).

Cut-off criteria

For the processes within the system boundary, all available energy and material flow data have been included in the model. In cases where no matching life cycle inventories are available to represent a flow, proxy data have been applied based on conservative assumptions regarding environmental impacts. Burdens relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary. As no material or energy flows were knowingly omitted, the requirements of the PCR have been met (BRE Global PCR PN514 3.1).

The mass of steel wire or strap used for binding the product coil 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)

Core environmental impact indicators									
Life Cycle Stage	Impact Category		GWP-total kg CO_2 eq	GWP-fossil kg CO_2 eq	GWP-biogenic kg CO_2 eq	GWP-luluc kg CO_2 eq	ODP kg CFC11 eq	AP mol H^+ eq	EP-freshwater kg P eq
Product stage	Raw material supply	A1	6.70E+02	6.69E+02	4.71E-01	4.08E-01	4.76E-10	1.37E+00	1.32E-03
	Transport	A2	8.23E+00	8.12E+00	4.31E-02	6.87E-02	6.67E-11	3.35E-02	3.28E-05
	Manufacturing	A3	1.53E+03	1.53E+03	8.05E-03	1.10E-01	2.73E-11	1.16E+00	3.55E-05
	Total (of product stage)	A1-3	2.20E+03	2.20E+03	5.22E-01	5.87E-01	5.70E-10	2.56E+00	1.39E-03
Construction process stage	Transport	A4	7.09E+01	6.98E+01	2.93E-01	8.06E-01	3.61E-10	2.23E-01	2.87E-04
	Construction	A5	2.77E+02	2.77E+02	1.15E-01	1.26E-01	1.80E-10	3.26E-01	2.03E-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
%95 Recycling / %5 Landfill Scenario									
End of life	Deconstruction, demolition	C1	2.21E+00	2.21E+00	2.17E-03	8.06E-05	1.89E-13	5.07E-03	4.22E-07
	Transport	C2	2.36E-01	2.31E-01	5.51E-04	3.88E-03	3.40E-14	3.34E-04	9.86E-07
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	7.53E-01	7.48E-01	1.84E-06	4.49E-03	2.02E-12	5.31E-03	1.70E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.87E+03	-1.87E+03	3.22E+00	-1.69E-01	6.07E-09	-4.31E+00	1.22E-05
100% Landfill Scenario									
End of life	Deconstruction, demolition	C1	2.21E+00	2.21E+00	2.17E-03	8.06E-05	1.89E-13	5.07E-03	4.22E-07
	Transport	C2	4.71E+00	4.62E+00	1.10E-02	7.76E-02	6.80E-13	6.68E-03	1.97E-05
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	1.51E+01	1.50E+01	3.69E-05	8.98E-02	4.04E-11	1.06E-01	3.40E-05
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-3.50E+01	-3.51E+01	7.75E-02	6.66E-02	1.28E-10	-8.24E-02	1.81E-05
100% Recycling Scenario									
End of life	Deconstruction, demolition	C1	2.21E+00	2.21E+00	2.17E-03	8.06E-05	1.89E-13	5.07E-03	4.22E-07
	Transport	C2	0	0	0	0	0	0	0
	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	-1.97E+03	-1.97E+03	3.38E+00	-1.82E-01	6.38E-09	-4.54E+00	1.19E-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)

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	3.41E-01	3.70E+00	9.75E-01	1.62E-04	2.61E+04	3.42E+01
	Transport	A2	1.22E-02	1.35E-01	3.45E-02	1.04E-06	1.39E+02	8.15E-01
	Manufacturing	A3	1.26E-01	1.39E+00	4.12E-01	9.04E-07	1.70E+02	6.75E+03
	Total (of product stage)	A1-3	4.79E-01	5.22E+00	1.42E+00	1.64E-04	2.64E+04	6.78E+03
Construction process stage	Transport	A4	8.03E-02	8.95E-01	2.25E-01	7.86E-06	1.09E+03	4.77E+00
	Construction	A5	6.24E-02	6.81E-01	1.84E-01	2.12E-05	3.37E+03	8.29E+02
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
%95 Recycling / %5 Landfill Scenario								
End of life	Deconstruction, demolition	C1	2.04E-03	2.24E-02	6.02E-03	5.33E-08	2.87E+01	6.01E-03
	Transport	C2	1.19E-04	1.42E-03	3.24E-04	2.01E-08	3.04E+00	3.58E-03
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	1.37E-03	1.51E-02	4.19E-03	4.85E-08	9.87E+00	8.56E-02
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.04E+00	-1.12E+01	-3.47E+00	-1.73E-05	-1.40E+04	-1.53E+01
100% Landfill Scenario								
End of life	Deconstruction, demolition	C1	2.04E-03	2.24E-02	6.02E-03	5.33E-08	2.87E+01	6.01E-03
	Transport	C2	2.38E-03	2.84E-02	6.48E-03	4.02E-07	6.08E+01	7.15E-02
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	2.74E-02	3.01E-01	8.37E-02	9.70E-07	1.97E+02	1.71E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.92E-02	-2.05E-01	-6.56E-02	6.85E-10	-2.39E+02	-2.57E-01
100% Recycling Scenario								
End of life	Deconstruction, demolition	C1	2.04E-03	2.24E-02	6.02E-03	5.33E-08	2.87E+01	6.01E-03
	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	-1.09E+00	-1.18E+01	-3.65E+00	-1.83E-05	-1.47E+04	-1.61E+01

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 the 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.

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	1.90E-05	-2.97E-01	2.12E+03	8.48E-08	4.15E-06	1.44E+03
	Transport	A2	3.32E-07	1.26E+00	6.07E+01	2.13E-09	5.71E-08	6.10E+01
	Manufacturing	A3	6.74E-06	1.74E-01	1.84E+02	2.38E-09	1.02E-07	5.55E+01
	Total (of product stage)	A1-3	2.60E-05	1.14E+00	2.37E+03	8.93E-08	4.31E-06	1.56E+03
Construction process stage	Transport	A4	2.25E-06	6.86E+00	5.81E+02	1.66E-08	5.38E-07	4.96E+02
	Construction	A5	3.30E-06	2.80E+00	3.50E+02	1.32E-08	5.80E-07	2.53E+02
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
%95 Recycling / %5 Landfill Scenario								
End of life	Deconstruction, demolition	C1	2.94E-08	4.42E-03	2.13E+01	5.50E-10	1.23E-08	1.02E-01
	Transport	C2	3.28E-09	8.04E-04	2.26E+00	4.56E-11	2.05E-09	1.50E+00
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	6.67E-08	1.20E-02	6.57E+00	1.34E-10	5.19E-09	2.72E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-6.35E-05	2.60E+01	-1.76E+03	-2.99E-06	3.03E-06	1.63E+03
100% Landfill Scenario								
End of life	Deconstruction, demolition	C1	2.94E-08	4.42E-03	2.13E+01	5.50E-10	1.23E-08	1.02E-01
	Transport	C2	6.57E-08	1.61E-02	4.52E+01	9.12E-10	4.09E-08	2.99E+01
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	1.33E-06	2.39E-01	1.31E+02	2.69E-09	1.04E-07	5.44E+01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.24E-06	5.60E-01	4.38E+00	-6.20E-08	1.01E-07	6.13E+01
100% Recycling Scenario								
End of life	Deconstruction, demolition	C1	2.94E-08	4.42E-03	2.13E+01	5.50E-10	1.23E-08	1.02E-01
	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	-6.68E-05	2.73E+01	-1.85E+03	-3.15E-06	3.18E-06	1.72E+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 the 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.

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	5.63E+02	0	5.63E+02	2.61E+04	0	2.61E+04
	Transport	A2	5.40E+01	0	5.40E+01	1.39E+02	0	1.39E+02
	Manufacturing	A3	2.63E+01	0	2.63E+01	1.70E+02	0	1.70E+02
	Total (of product stage)	A1-3	6.43E+02	0	6.43E+02	2.64E+04	0	2.64E+04
Construction process stage	Transport	A4	3.19E+02	0	3.19E+02	1.09E+03	0	1.09E+03
	Construction	A5	1.55E+02	0	1.55E+02	3.37E+03	0	3.37E+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
%95 Recycling / %5 Landfill Scenario								
End of life	Deconstruction, demolition	C1	1.43E-01	0	1.43E-01	2.87E+01	0	2.87E+01
	Transport	C2	2.62E-01	0	2.62E-01	3.04E+00	0	3.04E+00
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	1.72E+00	0	1.72E+00	9.87E+00	0	9.87E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	2.60E+03	0	2.60E+03	-1.40E+04	0	-1.40E+04
100% Landfill Scenario								
End of life	Deconstruction, demolition	C1	1.43E-01	0	1.43E-01	2.87E+01	0	2.87E+01
	Transport	C2	5.24E+00	0	5.24E+00	6.08E+01	0	6.08E+01
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	3.44E+01	0	3.44E+01	1.97E+02	0	1.97E+02
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	5.94E+01	0	5.94E+01	-2.39E+02	0	-2.39E+02
100% Recycling Scenario								
End of life	Deconstruction, demolition	C1	1.43E-01	0	1.43E-01	2.87E+01	0	2.87E+01
	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	2.74E+03	0	2.74E+03	-1.47E+04	0	-1.47E+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

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	m³
Product stage	Raw material supply	A1	8.88E+01	0	0.00E+00	1.75E+00
	Transport	A2	0	0	0	2.99E-02
	Manufacturing	A3	0	0	0	1.57E+02
	Total (of product stage)	A1-3	8.88E+01	0	0.00E+00	1.59E+02
Construction process stage	Transport	A4	0	0	0	1.93E-01
	Construction	A5	1.08E+01	0	0.00E+00	1.94E+01
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
%95 Recycling / %5 Landfill Scenario						
End of life	Deconstruction, demolition	C1	0	0	0	2.15E-04
	Transport	C2	0	0	0	2.92E-04
	Waste processing	C3	0	0	0	0
	Disposal	C4	0	0	0	2.62E-03
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0	0	0	-1.23E+00
100% Landfill Scenario						
End of life	Deconstruction, demolition	C1	0	0	0	2.15E-04
	Transport	C2	0	0	0	5.84E-03
	Waste processing	C3	0	0	0	0
	Disposal	C4	0	0	0	5.23E-02
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0	0	0	-2.06E-02
100% Recycling Scenario						
End of life	Deconstruction, demolition	C1	0	0	0	2.15E-04
	Transport	C2	0	0	0	0
	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	0	0	0	-1.30E+00

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					
Life Cycle Stage	Impact Category		HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	3.24E-07	1.96E+01	-8.48E-03
	Transport	A2	-4.26E-09	7.79E-02	1.35E-02
	Manufacturing	A3	3.42E-08	6.58E+02	1.47E-03
	Total (of product stage)	A1-3	3.54E-07	6.78E+02	6.50E-03
Construction process stage	Transport	A4	-9.65E-09	4.74E-01	7.30E-02
	Construction	A5	1.91E-07	8.48E+01	1.70E-02
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
%95 Recycling / %5 Landfill Scenario					
End of life	Deconstruction, demolition	C1	8.84E-10	6.02E-03	3.23E-05
	Transport	C2	1.16E-10	4.97E-04	5.54E-06
	Waste processing	C3	0	0	0
	Disposal	C4	2.46E-09	5.00E+01	1.03E-04
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	6.53E-06	-2.88E+01	2.32E-01
100% Landfill Scenario					
End of life	Deconstruction, demolition	C1	8.84E-10	6.02E-03	3.23E-05
	Transport	C2	2.33E-09	9.94E-03	1.11E-04
	Waste processing	C3	0	0	0
	Disposal	C4	4.91E-08	1.00E+03	2.07E-03
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	1.39E-07	-5.95E-01	4.97E-03
100% Recycling Scenario					
End of life	Deconstruction, demolition	C1	8.84E-10	6.02E-03	3.23E-05
	Transport	C2	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0	0	0
	Disposal	C4	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	6.87E-06	-3.03E+01	2.44E-01

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								
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	3.85E+00	0	0	0	0
	Total (of product stage)	A1-3	0	3.85E+00	0	0	0	0
Construction process stage	Transport	A4	0	0	0	0	0	0
	Construction	A5	0	1.20E+02	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
%95 Recycling / %5 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	9.50E+02	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	0	0	0	0	0
	Transport	C2	0	0	0	0	0	0
	Waste processing	C3	0	1.00E+03	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 200 km and 250 km, respectively. Only the one-way distance is considered as it is assumed that the logistics companies will optimise their distribution. As per the Sphera modelling assumption:		
	One-way transport to fabricator by truck trailer (34-40 t gross-weight) - Fuel	litre/km	1.56
	Distance	km	200
	Capacity utilisation (filled to the capacity)	%	90
	Bulk density of transported products	kg/m³	7850
	Empty return distance	km	50
	Rail transport cargo – average train (gross tonne weight 1000 t (86% electric & 14% diesel)	km	2515
	Ship transport – Bulk commodity carrier, average	km	45
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 Kingdom 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.		
	One-way transport to fabricator by truck trailer (34-40 t gross-weight) - Fuel	litre/km	1.56
	Distance	km	250
	Capacity utilisation (filled to the capacity)	%	90
	Bulk density of transported products	kg/m³	7850
	Empty return distance	km	50
	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.		
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. 95% of the reinforcing steel is assumed to be recycled and 5% is sent to landfill [STEELCONSTRUCTION.INFO 2012]. 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.		

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
	Waste for recycling - Recovered steel from crushed concrete	%	95
	Waste for energy recovery	%	-
	Waste for final disposal - Unrecoverable steel lost in crushed concrete and sent to landfill	%	5
	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 (filled to the capacity)	%	90
	Empty return distance	km	50
	Transport to waste processing by Truck – Density of Product	kg/m³	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	%	90
	Transport to waste processing by Container ship – Density of Product	kg/m³	7850
Module D	It is assumed that 95% of the steel used in the structure is recovered for recycling, while the remainder is landfilled. Module D accounts for the environmental benefits and loads resulting from net steel scrap that is used for recycling at end of life. The balance between total scrap arisings recycled from 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. A large amount of net scrap is generated over the life cycle as the BF/BOF production route is primarily from virgin sources and there is a very high end of life recycling rate for this product. Benefits and loads associated with this scrap are calculated by including the burdens of recycling process and accounting for the avoided primary production. As a result, module D reports the credits associated with the scrap output. The resulting scrap credit/burden is calculated based on the global "value of scrap" approach (/worldsteel 2011).		
	Recycled Content	kg	81
	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

The production stage (A1-A3) is the most important module for climate change, eutrophication freshwater, resource use (mineral and metals) and resource use (energy carriers) as well as water scarcity.

Installation (A5) also shows significant impacts in all categories; this is mainly due to the additional steel material required to account for losses during fabrication and installation. Impacts from transport to the fabricators and installation site (A4) are also noticeable.

Module D presents a significant credit in all impact categories, except for ODP. Impacts from other life cycle stages are negligible in comparison.

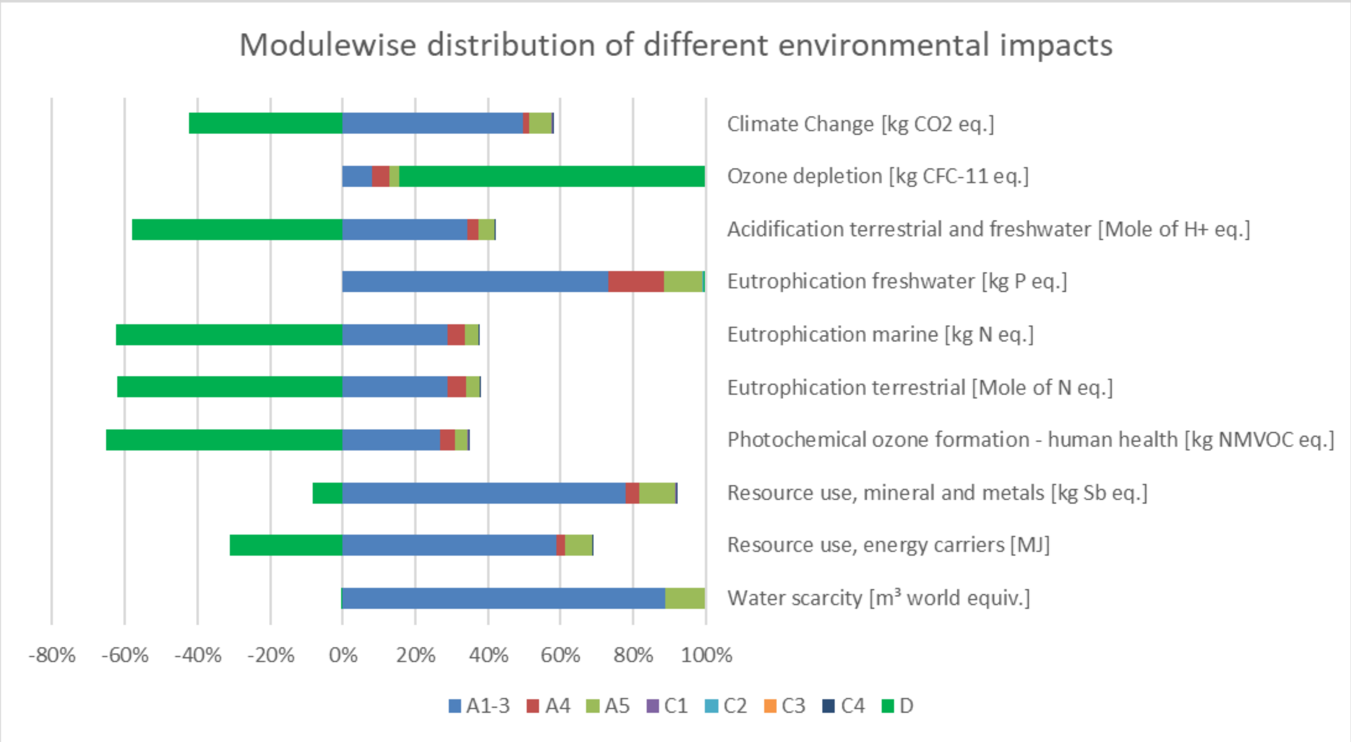


Figure 1 - shows the relative contribution of each life cycle stage to different environmental indicators for the carbon steel reinforcing bars manufactured by the BF/BOF production route

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