Statement of Verification

BREG EN EPD No.: 000619 Issue 02

This is to verify that the

Environmental Product Declaration

provided by:

Red Sea Steel Co. Ltd (member of UK 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 (Direct Reduced Iron production route)

Company Address

Madinah Road, Gulf Plaza Building 4th Floor,
Office 416
P.O. 54118 - Jeddah 23218
Kingdom of Saudi Arabia

حديد البحر الاحمر RED SEA STEEL

Signed for BRE Global Ltd	Emma Baker Operator	23 July 2024 Date of this Issue
08 July 2024 Date of First Issue		07 July 2027 Expiry Date

Environmental Product Declaration

EPD Number: 000619

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 Direct Reduced Iron 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 ☐Internal ☒ 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
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑		☑

Note: Ticks indicate the Information Modules declared.

Manufacturing site

Red Sea Steel Co. Ltd (member of UK CARES)

Madinah Road, Gulf Plaza Building 4th Floor
Office 416 P.O. 54118
Jeddah 23218
Kingdom of Saudi Arabia

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.

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	EAF
Density	7850 kg/m^3
Modulus of elasticity	200000 N/mm^2
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 ASTM A706/A706M grades: Grade 60, Grade 80, Grade 100	min 280 for Grade 40 min 420 for Grade 60 min 550 for Grade 80 min 690 for Grade 100 min 420 – max 540 for Grade 60 min 550 – max 675 for Grade 80 min 690 – max 815 for Grade 100
Ratio of actual tensile strength to actual yield strength ASTM A615/A615M ASTM A706/A706M	min 1.10 for all grades 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 ASTM A706/A706M grades: Grade 60, Grade 80, Grade 100	min 420 for Grade 40 min 550 for Grade 60 min 690 for Grade 80 min 790 for Grade 100 min 550 for Grade 60 min 690 for Grade 80 min 805 for Grade 100
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) (weighted average of supplier's recycled contents)	15.1 %

Main Product Contents

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

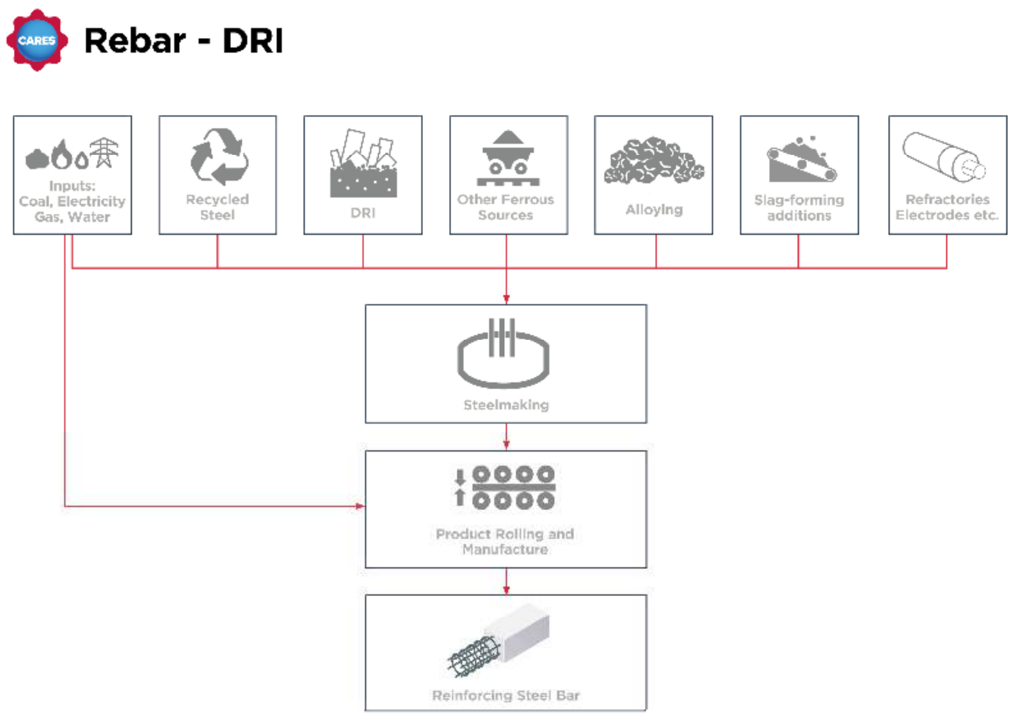
Manufacturing Process

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 added to give the required properties of the steel.

Hot metal (molten steel) from the EAF is then cast into steel billets/blooms/beam-blanks 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 Direct Reduced Iron 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 Red Sea Steel Co. Ltd (member of UK 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 GaBi 2021 databases (Sphera 2021); 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 GaBi 2021 databases (Sphera 2021). 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: EAF slag and mill scale are produced as co-products from the steel manufacturing process. Impacts are allocated between the mill scale based on economic value. The revenue generated from mill scale is 0.08%, and it is less than 1% in relation to the product based on current market prices, this co-product is of definite value and is 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 GaBi datasets documentation (/GaBi 6 2021/)

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	1.88E+03	1.88E+03	6.93	1.02	3.83E-09	9.12	6.05E-03
	Transport	A2	94.1	94.6	-1.32	0.863	8.16E-12	0.291	3.40E-04
	Manufacturing	A3	354	354	0.103	0.007	1.75E-11	9.63	3.64E-05
	Total (of product stage)	A1-3	2.33E+03	2.33E+03	5.71	1.89	3.86E-09	19.0	6.43E-03
Construction process stage	Transport	A4	20.9	21	-0.292	0.191	1.81E-12	0.064	7.53E-05
	Construction	A5	249	248	0.464	0.237	3.98E-10	2.17	6.63E-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	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	-2.15E+03	-2.15E+03	4.21	-0.893	6.32E-09	-4.85	-1.59E-04
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	-83.5	-83.6	0.163	-0.035	2.45E-10	-0.188	-6.18E-06
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	-2.33E+03	-2.33E+03	4.56	-0.968	6.85E-09	-5.26	-1.73E-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

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 deprived	disease incidence
Product stage	Raw material supply	A1	0.132	14.9	4.15	1.29E-04	2.62E+04	-238	1.03E-04
	Transport	A2	0.132	1.49	0.262	6.01E-06	1.27E+03	1.07	1.72E-06
	Manufacturing	A3	0.621	6.80	2.19	1.67E-06	4.68E+03	5.77	7.47E-05
	Total (of product stage)	A1-3	0.885	23.2	6.60	1.37E-04	3.22E+04	-2.31E+02	1.79E-04
Construction process stage	Transport	A4	0.029	0.329	0.058	1.33E-06	281	0.238	3.80E-07
	Construction	A5	0.237	2.59	0.733	1.40E-05	3.48E+03	-22.4	2.00E-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	-1.16	-12.6	-3.88	-2.23E-05	-1.59E+04	-30.6	-7.09E-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	-0.045	-0.489	-0.15	-8.67E-07	-618	-1.19	-2.75E-06
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	-1.26	-13.7	-4.20	-2.42E-05	-1.73E+04	-33.2	-7.68E-05

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	11.0	6.05E-03	3.62E-07	2.17E-05	1.67E+03
	Transport	A2	0.237	3.40E-04	1.80E-08	1.12E-06	529
	Manufacturing	A3	0.075	3.64E-05	1.83E-07	3.43E-06	6.31
	Total (of product stage)	A1-3	11.3	6.43E-03	5.63E-07	2.63E-05	2.21E+03
Construction process stage	Transport	A4	0.053	7.53E-05	3.98E-09	2.48E-07	117
	Construction	A5	1.20	6.63E-04	5.77E-08	2.74E-06	254
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	31.3	-1.59E-04	-3.32E-06	-1.28E-05	1.50E+03
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	1.21	-6.18E-06	-1.29E-07	-4.99E-07	58.2
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	33.9	-1.73E-04	-3.59E-06	-1.39E-05	1.62E+03

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	4.21E+03	0	4.21E+03	2.66E+04	0	2.66E+04
	Transport	A2	89.7	0	89.7	1.27E+03	0	1.27E+03
	Manufacturing	A3	9.60	0	9.60	4.69E+03	0	4.69E+03
	Total (of product stage)	A1-3	4.31E+03	0	4.31E+03	3.26E+04	0	3.26E+04
Construction process stage	Transport	A4	19.9	0	19.9	281	0	281
	Construction	A5	441	0	441	3.52E+03	0	3.52E+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	16.0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	2.65E+03	0	2.65E+03	-1.61E+04	0	-1.61E+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	103	0	103	-625	0	-625
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	2.87E+03	0	2.87E+03	-1.75E+04	0	-1.75E+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, 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	-238
	Transport	A2	0	0	0	1.07
	Manufacturing	A3	37.8	0	0	5.77
	Total (of product stage)	A1-3	37.8	0	0	-2.31E+02
Construction process stage	Transport	A4	0	0	0	0.238
	Construction	A5	0	0	0	-22.4
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	-958	0	0	-30.6
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	-37.8	0	0	-1.19
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	-1.04E+03	0	0	-33.2

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	1.34E-06	20.4	0.132
	Transport	A2	4.70E-09	1.83E-01	1.64E-03
	Manufacturing	A3	3.40E-08	0.659	0.001
	Total (of product stage)	A1-3	1.38E-06	21.2	0.135
Construction process stage	Transport	A4	1.04E-09	0.041	3.64E-04
	Construction	A5	1.45E-07	11.9	0.014
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	-4.06E-08	-32.0	0.283
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	-1.58E-09	-1.24	0.011
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	-4.40E-08	-34.6	0.306

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	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 (incl. empty returns)	%	85
	Bulk density of transported products	kg/m^3	7850
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). 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
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	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.		
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,	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]. 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	%	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	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. 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. The resulting scrap credit/burden is calculated based on the global "value of scrap" approach (/worldsteel 2011).		
	Recycled Content	kg	151

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
Module D	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 Red Sea Steel Co. Ltd (member of UK CARES) 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 88.10% 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)

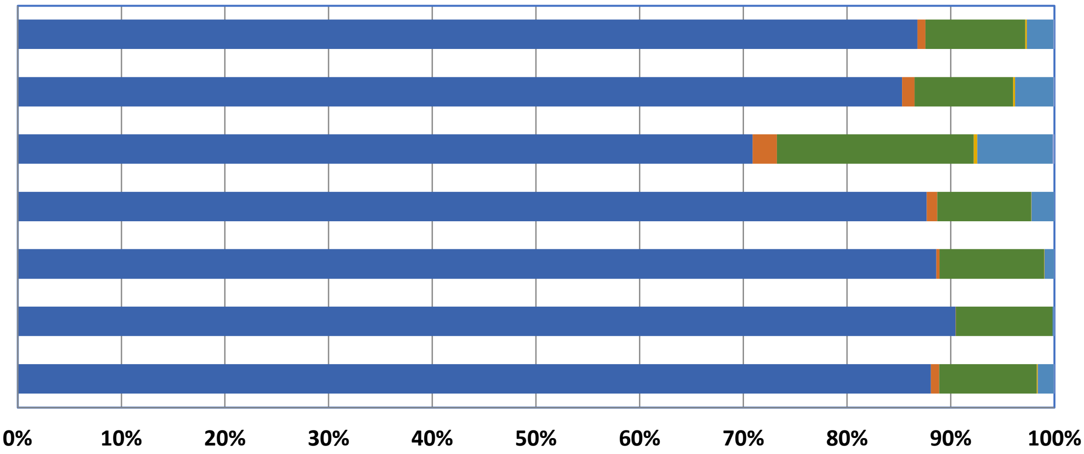
Acidification potential is generally driven by the production of sulphur dioxide and nitrogen oxides through the combustion of fossil fuels, particularly coal and crude oil products. The majority of the lifecycle AP impact occurs in the production phase (A1-A3), similar to GWP. The major contributors 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 (NOx), 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.



	GWP - Total	ODP	AP	EP (freshwater)	EP (marine)	EP (terrestrial)	POCP
A1-3	88.10%	90.45%	88.61%	87.69%	70.90%	85.30%	86.80%
A4	0.79%	0.04%	0.30%	1.03%	2.35%	1.21%	0.76%
A5	9.42%	9.34%	10.10%	9.05%	18.99%	9.53%	9.64%
C1	0.08%	0.00%	0.05%	0.00%	0.32%	0.16%	0.15%
C2	1.57%	0.09%	0.90%	2.20%	7.27%	3.71%	2.56%
C3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
C4	0.04%	0.07%	0.04%	0.03%	0.18%	0.09%	0.09%

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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