Environmental Product Declaration

Statement of Verification

CARES EPD No.: 0017 | Issue 02

This is to verify that the

Environmental Product Declaration

Provided by:
Jindal Steel Sohar LLC

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

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

Company address:

Plot-12, Sohar Industrial Port
PO Box 312, P.C. 321
Sohar
OMAN

Ladin Camci	Ladin Camci	27 March 2025
Signed for CARES	Operator	Date of this Issue
27 March 2025		26 March 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 0017

General Information

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

Demonstration of Verification
CEN standard EN 15804 serves as the core PCR [a]
Independent verification of the declaration and data according to EN ISO 14025:2010 ☐Internal ☒ External
(Where appropriate [b]) Third party verifier: Dr Jane Anderson
a: Product category rules b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4)

Comparability

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

Information modules covered

Product Stage			Construction Stage		Use Stage							End-of-life Stage				Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw materials supply	Transport	Manufacturing	Transport to site	Construction – Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, Recovery and/or Recycling potential
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note: Checks indicate the Information Modules declared.

Manufacturing site

Jindal Steel Sohar LLC
Plot-12, Sohar Industrial Port
PO Box 312, P.C. 321
Sohar
OMAN

Construction Product:

Product Description

Reinforcing steel bar (according to product standards listed in References) that is obtained from scrap and from DRI (Direct Reduced Iron), melted in an Electric Arc Furnace followed by hot rolling. These are used to provide tensile strength in reinforced concrete building elements.

The declared unit is 1 tonne of carbon steel reinforcing bars manufactured by the Direct Reduced Iron and the secondary (scrap-based) production route.

Technical Information

Property	Value, Unit
Production route	Scrap and DRI - EAF
Density	7850 kg/m^3
Modulus of elasticity	200000 N/mm^2
Weldability (C_{eq})	max 0.50 %
Yield strength (as per BS 4449:2005+A3:2016)	min 500 N/mm^2 – max 650 N/mm^2
Tensile strength (as per BS 4449:2005+A3:2016)	min 540 N/mm^2 (Tensile strength/Yield Strength ≥ 1.08)
Agt (% total elongation at maximum force as per BS 4449:2005+A3:2016)	min 5 %
Surface geometry (Relative rib area, f_R 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)	16.6 %

Main Product Contents

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

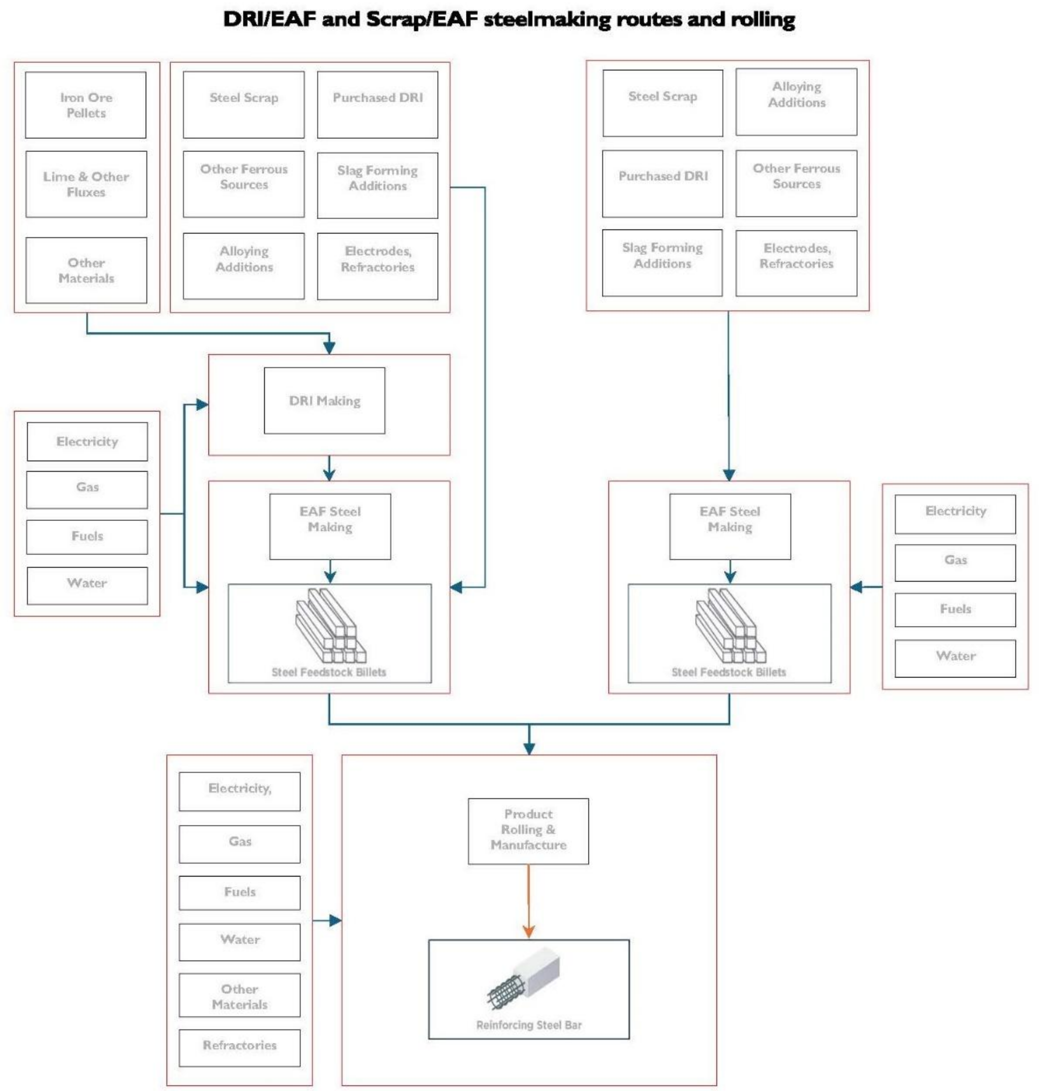
Manufacturing Process

Reinforcing steel bar (according to product standards listed in Summary, Comments and Additional Information) manufactured by hot rolling of steel billets manufactured via the Direct Reduced Iron (DRI) production route (DRI and specified quantities of scrap melted in Electric Arc Furnace) and the secondary production route (scrap melted in Electric Arc Furnace).

Molten steel obtained from either of the process routes 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 by binding with steel wire or strap. Both 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 products the usual requirement for securing loads is to be observed.

Use Information

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

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

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

End of Life

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

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

Life Cycle Assessment Calculation Rules

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

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

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

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

Declared unit description

1 tonne of carbon steel reinforcing bars manufactured by the Direct Reduced Iron and the secondary (scrap-based) production route.

System boundary

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

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

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

Data sources, quality and allocation

Data Sources and Quality:

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

Data Sources: Manufacturing data of the period 01/01/2024 - 31/12/2024 has been provided by Jindal Steel Sohar LLC 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 by CARES, including also the verification of mass balance, to ensure that data for all the inputs and outputs for the process over the period of data collection have been collected, and that the unit process data will comply with the cut-off rules of EN 15804. The EPD covers transport to, and end-of-life in Oman.

The selection of the background data for electricity generation is in line with the BRE Global PCR PN514 3.1. Country or region-specific power grid mixes are selected from LCA FE (GaBi) Dataset Documentation (Sphera 2023.1); thus, consumption grid mix of Oman has been selected to suit specific manufacturing location, and also for fabrication, installation and demolishing location. The emission factor of carbon footprint of the applied consumption grid mix of Oman in 0.607 kg CO_2 eq/kWh.

Data Quality: Background data is 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 during the audit conducted by CARES in March 2025.

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

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

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 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 EAF slag are 0.02% and 0.37% 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 arises.

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

Cut-off criteria

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

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

LCA Results

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

Core environmental impact indicators									
Life Cycle Stage	Impact Category		GWP-total	GWP-fossil	GWP-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 P eq
Product stage	Raw material supply	A1	1.21E+03	1.21E+03	1.07	0.706	1.09E-09	3.96	1.15E-03
	Transport	A2	23.7	23.7	-0.007	0.021	1.64E-12	0.75	1.29E-05
	Manufacturing	A3	731	731	0.0565	0.024	1.39E-11	1.76	3.52E-05
	Total (of product stage)	A1-3	1.96E+03	1.96E+03	1.12	0.751	1.11E-09	6.47	1.20E-03
Construction process stage	Transport	A4	20.9	21.0	-0.292	0.191	1.81E-12	0.064	7.53E-05
	Construction	A5	208	208	0.037	0	1.22E-10	0.701	1.39E-04
Use stage	Use	B1	0	0	0	0	0	0	0
	Maintenance	B2	0	0	0	0	0	0	0
	Repair	B3	0	0	0	0	0	0	0
	Replacement	B4	0	0	0	0	0	0	0
	Refurbishment	B5	0	0	0	0	0	0	0
	Operational energy use	B6	0	0	0	0	0	0	0
	Operational water use	B7	0	0	0	0	0	0	0
%92 Recycling / %8 Landfill Scenario									
End of life	Deconstruction, demolition	C1	2.05	2.05	8.04E-04	4.51E-05	6.29E-14	0.011	2.45E-07
	Transport	C2	47.1	47.3	-0.617	0.407	4.04E-12	0.235	1.61E-04
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	1.17	1.20	-0.040	0.004	3.05E-12	0.009	2.42E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.55E+03	-1.55E+03	3.03	-0.644	4.55E-09	-3.49	-1.15E-04
100% Landfill Scenario									
End of life	Deconstruction, demolition	C1	2.05	2.05	8.04E-04	4.51E-05	6.29E-14	0.011	2.45E-07
	Transport	C2	2.17	2.18	-0.030	0.020	1.88E-13	0.009	7.83E-06
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	14.6	15	-0.499	0.047	3.82E-11	0.107	3.02E-05
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	518	518	-1.01	0.215	-1.52E-09	1.17	3.83E-05
100% Recycling Scenario									
End of life	Deconstruction, demolition	C1	2.05	2.05	8.04E-04	4.51E-05	6.29E-14	0.011	2.45E-07
	Transport	C2	51.0	51.2	-0.668	0.440	4.37E-12	0.255	1.74E-04
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	0	0	0	0	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.73E+03	-1.73E+03	3.38	-0.718	5.08E-09	-3.90	-1.28E-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)

Core environmental impact indicators

Life Cycle Stage	Impact Category		EP-marine kg N eq	EP-terrestrial mol N eq	POCP kg NMVOC eq	ADP-mineral & metals kg Sb eq	ADP-fossil MJ, net calorific value	WDP m^3 world eq deprived
Product stage	Raw material supply	A1	0.178	11.4	3.06	1.32E-04	1.78E+04	111
	Transport	A2	0.178	1.95	0.50	3.36E-07	290	0.061
	Manufacturing	A3	0.476	5.21	1.36	3.96E-06	8.62E+03	-16.0
	Total (of product stage)	A1-3	0.832	18.6	4.92	1.36E-04	2.67E+04	95.1
Construction process stage	Transport	A4	0.029	0.329	0.058	1.33E-06	281	0.238
	Construction	A5	0.191	2.09	0.539	1.38E-05	2.88E+03	9.46
Use stage	Use	B1	0	0	0	0	0	0
	Maintenance	B2	0	0	0	0	0	0
	Repair	B3	0	0	0	0	0	0
	Replacement	B4	0	0	0	0	0	0
	Refurbishment	B5	0	0	0	0	0	0
	Operational energy use	B6	0	0	0	0	0	0
	Operational water use	B7	0	0	0	0	0	0
%92 Recycling / %8 Landfill Scenario								
End of life	Deconstruction, demolition	C1	0.004	0.044	0.011	1.25E-08	27.6	0.016
	Transport	C2	0.113	1.26	0.235	2.86E-06	633	0.511
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	0.002	0.024	0.007	5.54E-08	16.0	0.132
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-0.839	-9.08	-2.79	-1.61E-05	-1.15E+04	-22.1
100% Landfill Scenario								
End of life	Deconstruction, demolition	C1	0.004	0.044	0.011	1.25E-08	27.6	0.016
	Transport	C2	0.004	0.048	0.008	1.38E-07	29.2	0.025
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	0.028	0.303	0.083	6.92E-07	200	1.65
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.280	3.03	0.933	5.38E-06	3.83E+03	7.37
100% Recycling Scenario								
End of life	Deconstruction, demolition	C1	0.004	0.044	0.011	1.25E-08	27.6	0.016
	Transport	C2	0.122	1.36	0.255	3.10E-06	685	0.553
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	0	0	0	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-0.936	-10.1	-3.12	-1.80E-05	-1.28E+04	-24.6

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 U235 eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	5.06E-05	13.8	1.15E-03	2.04E-07	8.55E-06	1.23E+03
	Transport	A2	1.29E-05	0.049	1.29E-05	3.78E-09	1.80E-07	13.4
	Manufacturing	A3	1.31E-05	0.397	3.52E-05	1.05E-06	1.11E-04	37.7
	Total (of product stage)	A1-3	7.66E-05	14.2	1.20E-03	1.26E-06	1.20E-04	1.28E+03
Construction process stage	Transport	A4	3.80E-07	0.053	7.53E-05	3.98E-09	2.48E-07	117
	Construction	A5	7.99E-06	1.49	1.39E-04	1.23E-07	1.20E-05	161
Use stage	Use	B1	0	0	0	0	0	0
	Maintenance	B2	0	0	0	0	0	0
	Repair	B3	0	0	0	0	0	0
	Replacement	B4	0	0	0	0	0	0
	Refurbishment	B5	0	0	0	0	0	0
	Operational energy use	B6	0	0	0	0	0	0
	Operational water use	B7	0	0	0	0	0	0
%92 Recycling / %8 Landfill Scenario								
End of life	Deconstruction, demolition	C1	6.69E-08	5.08E-04	2.45E-07	6.18E-10	1.84E-08	0.043
	Transport	C2	1.73E-06	0.117	1.61E-04	8.94E-09	5.50E-07	249
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	1.05E-07	0.021	2.42E-06	1.34E-09	1.48E-07	3.89
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.11E-05	22.5	-1.15E-04	-2.39E-06	-9.25E-06	1.08E+03
100% Lanfill Scenario								
End of life	Deconstruction, demolition	C1	6.69E-08	5.08E-04	2.45E-07	6.18E-10	1.84E-08	0.043
	Transport	C2	4.68E-08	0.005	7.83E-06	4.14E-10	2.59E-08	12.2
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	1.31E-06	0.263	3.02E-05	1.68E-08	1.85E-06	48.6
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	1.71E-05	-7.53	3.83E-05	7.98E-07	3.09E-06	-361
100% Recycling Scenario								
End of life	Deconstruction, demolition	C1	6.69E-08	5.08E-04	2.45E-07	6.18E-10	1.84E-08	0.043
	Transport	C2	1.88E-06	0.127	1.74E-04	9.68E-09	5.96E-07	270
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	0	0	0	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.70E-05	25.1	-1.28E-04	-2.67E-06	-1.03E-05	1.21E+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	1.19E+03	0	1.19E+03	1.78E+04	0	1.78E+04
	Transport	A2	3.26	0	3.26	291	0	291
	Manufacturing	A3	34.3	0	34.3	8.62E+03	0	8.62E+03
	Total (of product stage)	A1-3	1.23E+03	0	1.23E+03	2.67E+04	0	2.67E+04
Construction process stage	Transport	A4	19.9	0	19.9	281	0	281
	Construction	A5	132	0	132	2.88E+03	0	2.88E+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
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	1.91E+03	0	1.91E+03	-1.16E+04	0	-1.16E+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	-638	0	-638	3.88E+03	0	3.88E+03
100% Recycling Scenario								
End of life	Deconstruction, demolition	C1	0.049	0	0.049	27.6	0	27.6
	Transport	C2	45.9	0	45.9	687	0	687
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	0	0	0	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	2.13E+03	0	2.13E+03	-1.30E+04	0	-1.30E+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	0	0	0	111
	Transport	A2	0	0	0	0.061
	Manufacturing	A3	235	0	0	-16.0
	Total (of product stage)	A1-3	235	0	0	95.1
Construction process stage	Transport	A4	0	0	0	0.238
	Construction	A5	0	0	0	9.46
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	685	0	0	-22.1
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	-235	0	0	7.37
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	765	0	0	-24.6

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	9.21E-07	6.50	0.104
	Transport	A2	1.01E-09	0.028	3.43E-04
	Manufacturing	A3	4.89E-07	25.3	0.004
	Total (of product stage)	A1-3	1.41E-06	31.8	0.108
Construction process stage	Transport	A4	1.04E-09	0.041	3.64E-04
	Construction	A5	1.50E-07	12.9	0.011
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	-2.93E-08	-23.0	0.204
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	9.78E-09	7.69	-0.068
100% Recycling Scenario					
End of life	Deconstruction, demolition	C1	1.57E-11	0.004	7.03E-06
	Transport	C2	2.49E-09	0.097	8.82E-04
	Waste processing	C3	0	0	0
	Disposal	C4	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-3.27E-08	-25.7	0.227

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	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
	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
	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
	Disposal	C4	0	0	0	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0	0	0	0	0	0

CRU = Components for reuse;
MFR = Materials for recycling
MER = Materials for energy recovery;
EE = Exported Energy

Scenarios and additional technical information

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
Module A4 Transport to the Building Site	On leaving the steelworks the reinforcing steel products are transported to a fabricator where they are converted into constructional steel forms suitable for the installation site, then transported on to the construction site, including provision of all materials and products. Road transport distance for rolled steel to fabricators and road transport distance for steel construction forms to site are assumed to be 100 km and 250 km, respectively. Only the one-way distance is considered as it is assumed that the logistics companies will optimise their distribution and not return empty in modules beyond A3.		
	Truck trailer - Fuel	litre/km	1.56
	Distance	km	350
	Capacity utilisation (including empty returns)	%	85
	Bulk density of transported products	kg/m³	7850
Module A5 Installation in the Building	The fabrication process is a relatively simple unit process and accounts for the transformation of the rolled steel product into construction steel forms. The operations in this unit process are primarily cutting and welding. As such, other inputs to the process include electricity, thermal energy, and cutting gases. Other outputs of this process are steel scrap and wastewater (where applicable). Consumption grid mix of Oman has been selected to suit specific fabrication and installation location. Fabrication into structural steel products and installation in the building; including provision of all materials, products, and energy, as well as waste processing up to the end-of-waste state or disposal of final residues during the construction stage. Installation of the fabricated product into the building is assumed to result in 10% wastage (determined based on typical installation losses reported by the WRAP Net Waste Tool [WRAP 2017]). It is assumed that fabrication requires 15.34 kWh/tonne finished product, and that there is a 2% wastage associated with this process.		
	Ancillary materials for installation - Waste material from fabrication, losses per tonne of construction steel forms	%	2
	Energy Use - Energy per tonne required to fabricate construction steel forms	kWh	15.34
	Waste materials from installation wastage	%	10
Module B2 Maintenance	No maintenance required.		
Module B3 Repair	No repair process required s.		
Module B4 Replacement	No replacement considerations required.		
Module B5 Refurbishment	No refurbishment process required.		
Reference Service Life	Reinforcing steel products are used in the main building structure so the reference service life will equal the lifetime of the building. BS EN 1990 specifies “building structures and other common structures” as having a lifetime of 50 years. On this basis, the RSL for this EPD is assumed to be 50 years.		
Module B6 Use of Energy	No energy required during use stage related to the operation of the building.		
Module B7 Use of Water	No water required during use stage related to the operation of the building.		
Modules C1 to C4 End of life	The end-of-life stage starts when the construction product is replaced, dismantled or deconstructed from the building or construction works and does not provide any further function. The recovered steel is transported for recycling while a small portion is assumed to be unrecoverable and remains in the rubble which is sent to landfill. 92% of the reinforcing steel is assumed to be recycled and 8% is sent to landfill [STEELCONSTRUCTION.INFO 2012]. The EPD covers transport to, and end-of-life in Saudi Arabia. Once steel scrap is generated through the deconstruction activities on the demolition site it is considered to have reached the “end of waste” state. No further processing is required so there are no impacts associated with this module. Hence no impacts are reported in module C3.		
	Waste for recycling - Recovered steel from crushed concrete	%	92
	Waste for energy recovery - Energy recovery is not considered for this study as most end-of-life steel scrap is recycled, while the remainder is landfilled	-	-
	Waste for final disposal - Unrecoverable steel lost in crushed concrete and sent to landfill	%	2
	Portion of energy assigned to rebar from energy required to demolish building, per tonne	MJ	24
	Transport to waste processing by Truck - Fuel consumption	litre/km	1.56
	Transport to waste processing by Truck – Distance	km	463
	Transport to waste processing by Truck – Capacity utilisation	%	85
	Transport to waste processing by Truck – Density of Product	kg/m³	7850

Scenarios and additional technical information			
Scenario	**Parameter**	**Units**	**Results**
	Transport to waste processing by Container ship - Fuel consumption	litre/km	0.0041
	Transport to waste processing by Container ship - Distance	km	158
	Transport to waste processing by Container ship – Capacity utilisation	%	50
	Transport to waste processing by Container ship – Density of Product	kg/m³	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. This study is concerned with billets manufacturers from both the DRI production route and the secondary production route (steel scrap). In secondary production route using steel scrap only, more scrap is required as input to the system than is recovered at end of life. In DRI production route, a large amount of net scrap is generated over the life cycle as the iron ore used to obtain DRI is a virgin source and there is a high end of life recycling rate for reinforcing steel products. As billets from both secondary production route (steel scrap) and DRI production route were used in the production of rebars, the net effect of the weighted average of the used quantities is that module D module mainly models 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	16.6
	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

DRI and Scrap based reinforcing steel product of Jindal Steel Sohar LLC is made via the Electric Arc 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 87.56% 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)

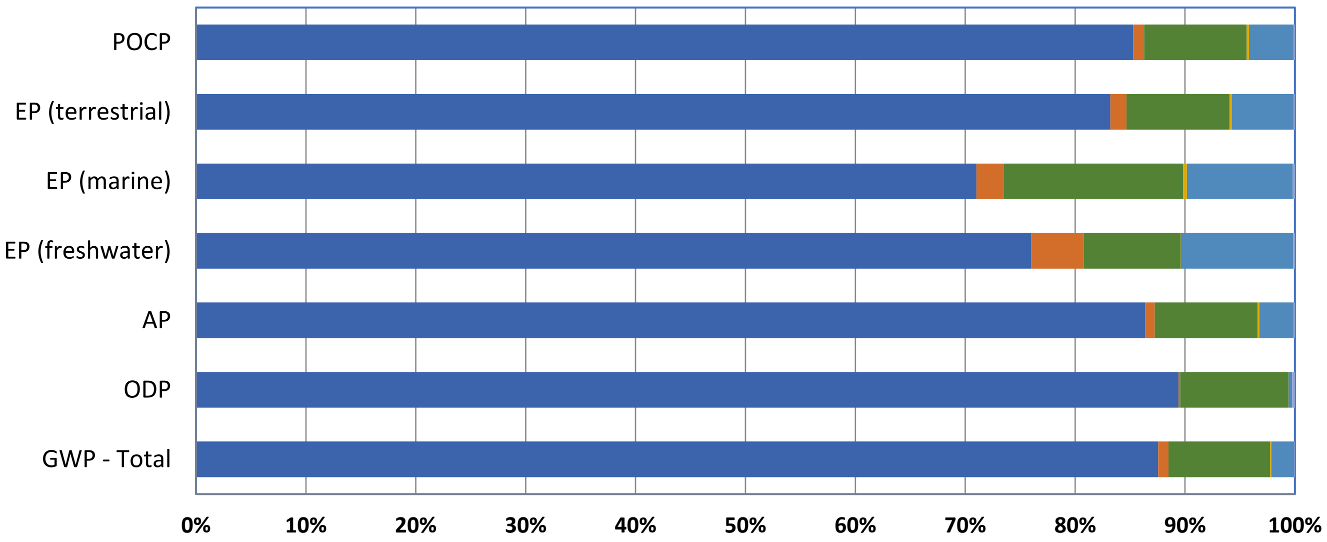
Acidification potential is generally driven by the production of sulphur dioxide and nitrogen oxides through the combustion of fossil fuels, particularly coal and crude oil products. The majority of the lifecycle AP impact occurs in the production phase (A1-A3), similar to GWP. The major contributors 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	87.56%	89.41%	86.38%	76.02%	71.02%	83.20%	85.28%
A4	0.93%	0.15%	0.86%	4.78%	2.50%	1.47%	1.00%
A5	9.27%	9.87%	9.36%	8.82%	16.30%	9.37%	9.34%
C1	0.09%	0.01%	0.15%	0.02%	0.35%	0.20%	0.19%
C2	2.10%	0.33%	3.14%	10.22%	9.65%	5.65%	4.07%
C3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
C4	0.05%	0.25%	0.11%	0.15%	0.19%	0.11%	0.12%

Figure 1 - shows the relative contribution of each life cycle stage to different environmental indicators for the carbon steel reinforcing bars manufactured by the primary (DRI) and the secondary (scrap-based) hybrid production routes

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