

## Statement of Verification

BREG EN EPD No.: 000230

Issue 1

ECO EPD Ref. No. 00000775

This is to verify that the

### Environmental Product Declaration

provided by:

**Jindal Shadeed Iron and Steel LLC**



is in accordance with the requirements of:

**EN 15804:2012+A1:2013**

and

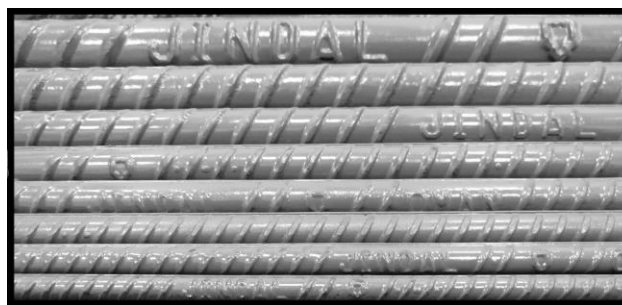
**BRE Global Scheme Document SD207**

This declaration is for:

**Carbon Steel Reinforcing Bar (Direct Reduced Iron (DRI) production route)**

### Company Address

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



Signed for BRE Global Ltd

Laura Critien

Operator

09 November 2018

Date of this Issue

09 November 2018

Date of First Issue

08 November 2021

Expiry Date



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# Environmental Product Declaration

**EPD Number: 000230**

## General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9XX United Kingdom	BRE Environmental Profiles 2013 Product Category Rules for Type III environmental product declaration of construction products to EN 15804:2012+A1:2013
Commissioner of LCA study	LCA consultant/Tool
UK CARES Pembroke House 21 Pembroke Road Sevenoaks Kent, TN13 1XR UK	UK CARES EPD Tool thinkstep UK Ltd Euston Tower - Level 33, 286 Euston Road London, NW1 3DP www.thinkstep.com
Declared/Functional Unit	Applicability/Coverage
1 tonne of carbon steel reinforcing bars manufactured by the direct reduced iron (DRI) route as used within concrete structures for a commercial building.	Manufacturer-specific product
EPD Type	Background database
Cradle to Gate with options	GaBi
Demonstration of Verification	
CEN standard EN 15804 serves as the core PCR <sup>a</sup>	
Independent verification of the declaration and data according to EN ISO 14025:2010 <input type="checkbox"/> Internal <input checked="" type="checkbox"/> External	
(Where appropriate <sup>b</sup> ) Third party verifier: Kim Allbury	
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+A1:2013. 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+A1:2013 for further guidance	

## Information modules covered

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

Note: Ticks indicate the Information Modules declared.

## Manufacturing site

Jindal Shaded Iron and Steel LLC (member of UK CARES)

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 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 <sup>3</sup>
Modulus of elasticity	200000 N/mm <sup>2</sup>
Weldability (Ceq)	max 0.50 %
Yield strength (as per BS 4449:2005)	min 500 N/mm <sup>2</sup>
Tensile strength (as per BS 4449:2005)	min 540 N/mm <sup>2</sup> (Tensile strength/Yield Strength $\geq$ 1.08)
Surface geometry (Relative rib area, $f_R$ as per BS 4449:2005)	min 0.040 for Bar Size >6mm & $\leq$ 12mm min 0.056 for Bar Size >12
Agt (% total elongation at maximum force as per BS 4449:2005)	min 5 %
Re-bend test (as per BS 4449:2005)	Pass
Fatigue test (as per BS 4449:2005)	Pass
Recycled content (as per ISO 14021:2016)	6.6 %

## Main Product Contents

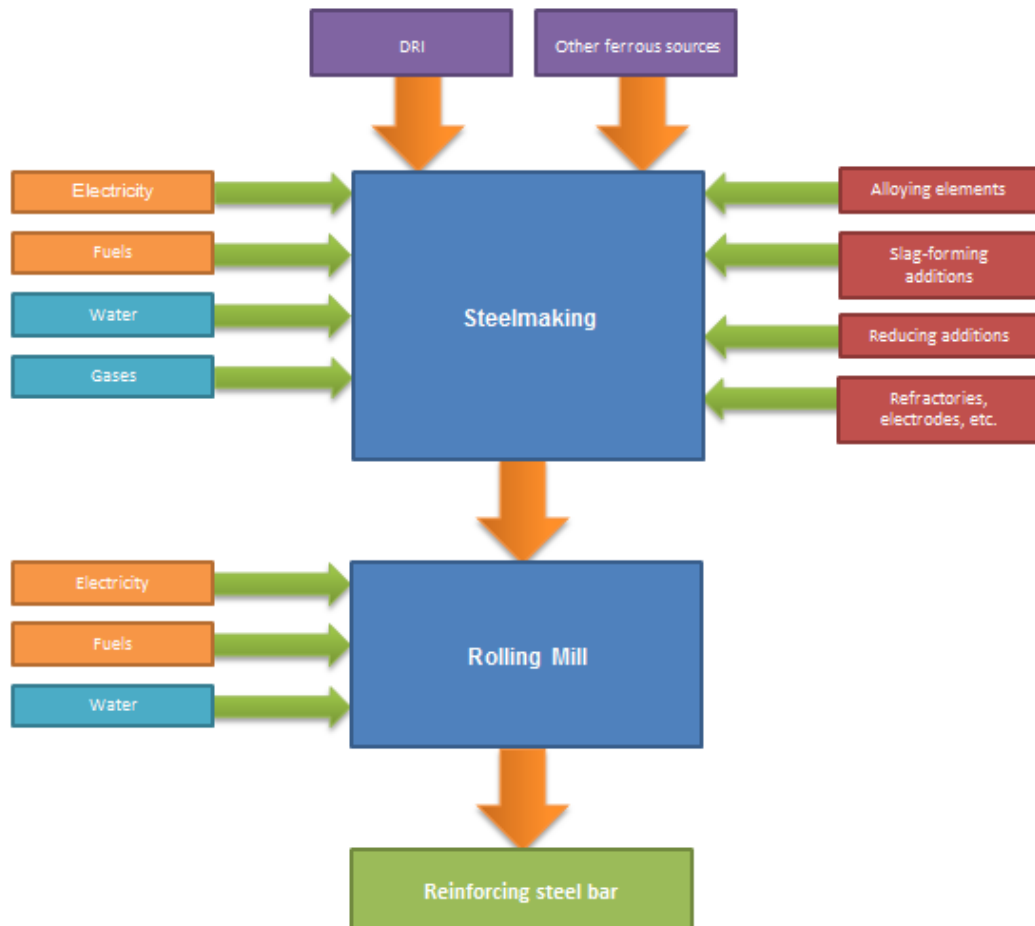
Material/Chemical Input	%
Fe	97
C, Mn, Si, V, Ni, Cu, Cr, Mo and others	3

## 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.

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

## 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 requirements 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 bar 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 bar products.

Disposal results in minimal environmental impacts due to the inert nature of the material.

## Life Cycle Assessment Calculation Rules

### Declared / Functional unit description

The declared unit is 1 tonne of carbon steel reinforcing bars manufactured by the direct reduced iron (DRI) 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. 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.

### Data sources, quality and allocation

Data Sources: Manufacturing data of the period 01/01/2017-31/12/2017 has been provided by Jindal Shaded Iron and Steel LLC (member of UK CARES).

Data Quality: Data quality can be described as good. Background data are consistently sourced from thinkstep databases. The primary data collection was thorough, considering all relevant flows and these data have been verified by UK CARES.

Allocation: EAF slag and mill scale are produced as co-products from the steel manufacturing process. Impacts are allocated between the steel, the slag and the mill scale based on economic value.

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 2017/).

### 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.

## LCA Results

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

Parameters describing environmental impacts			GWP	ODP	AP	EP	POCP	ADPE	ADPF
			kg CO <sub>2</sub> equiv.	kg CFC 11 equiv.	kg SO <sub>2</sub> equiv.	kg (PO <sub>4</sub> ) <sup>3-</sup> equiv.	kg C <sub>2</sub> H <sub>4</sub> equiv.	kg Sb equiv.	MJ, net calorific value.
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	2.28E+03	1.16E-06	6.25	0.731	0.487	2.85E-04	3.06E+04
Construction process stage	Transport	A4	16.1	5.41E-12	0.037	0.0088	-0.0118	1.30E-06	223
	Construction	A5	239	1.16E-07	0.635	0.0768	0.044	2.97E-05	3.26E+03
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
End of life	Deconstruction, demolition	C1	2.05	5.68E-13	0.00306	0.000422	0.000317	6.33E-08	28.5
	Transport	C2	38.9	1.29E-11	0.12	0.029	-0.0344	3.02E-06	537
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	1.29	1.30E-12	0.00764	0.00104	0.00061	4.62E-07	16.7
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.69E+03	-7.70E-09	-6.46	-0.507	-0.932	1.51E-04	-1.58E+04

GWP = Global Warming Potential;  
 ODP = Ozone Depletion Potential;  
 AP = Acidification Potential for Soil and Water;  
 EP = Eutrophication Potential;

POCP = Formation potential of tropospheric Ozone;  
 ADPE = Abiotic Depletion Potential – Elements;  
 ADPF = Abiotic Depletion Potential – Fossil Fuels;

## LCA Results (continued)

Parameters describing resource use, primary energy			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	1.09E+03	0.00E+00	1.09E+03	3.10E+04	0	3.10E+04
Construction process stage	Transport	A4	11.2	0	11.2	223	0	223
	Construction	A5	115	0	115	3.29E+03	0	3.29E+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
End of life	Deconstruction, demolition	C1	0.0811	0	0.0811	28.6	0	28.6
	Transport	C2	25.7	0	25.7	539	0	539
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	2.01	0	2.01	17.3	0	17.3
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	9.55E+02	0	9.55E+02	-1.52E+04	0	-1.52E+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)

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 <sup>3</sup>
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	3.98E+01	1.22E-02	0.0878	4.94E+00
Construction process stage	Transport	A4	0	0	0	0.0208
	Construction	A5	3.98	0.00122	0.00878	0.509
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
End of life	Deconstruction, demolition	C1	0	0	0	0.000215
	Transport	C2	0	0	0	0.0476
	Waste processing	C3	0	0	0	0
	Disposal	C4	0	0	0	0.00329
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0	0.00E+00	0	-9.72E-01

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)

Other environmental information describing waste categories			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG
	Total (of product stage)	A1-3	0.0744	5.87E+01	0.127
Construction process stage	Transport	A4	1.17E-05	0.0171	0.000305
	Construction	A5	0.00744	15.7	0.0134
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
End of life	Deconstruction, demolition	C1	3.38E-09	0.00344	3.40E-05
	Transport	C2	2.68E-05	0.0392	0.000729
	Waste processing	C3	0	0	0
	Disposal	C4	2.73E-07	80.1	0.000236
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.14E-05	-2.35E+01	0.262

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

## LCA Results (continued)

Other environmental information describing output flows – at end of life			CRU	MFR	MER	EE
			kg	kg	kg	MJ per energy carrier
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	0	0	0	0
Construction process stage	Transport	A4	0	0	0	0
	Construction	A5	0	120	0	0
Use stage	Use	B1	0	0	0	0
	Maintenance	B2	0	0	0	0
	Repair	B3	0	0	0	0
	Replacement	B4	0	0	0	0
	Refurbishment	B5	0	0	0	0
	Operational energy use	B6	0	0	0	0
	Operational water use	B7	0	0	0	0
End of life	Deconstruction, demolition	C1	0	0	0	0
	Transport	C2	0	0	0	0
	Waste processing	C3	0	920	0	0
	Disposal	C4	0	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	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	Transport to the fabricators and 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.		
	Truck trailer - Fuel	L/km	1.56
	Distance	km	350
	Capacity utilisation (including empty returns)	%	85
	Bulk density of transported products	kg/m <sup>3</sup>	7850
A5 – Installation in the building	Fabrication into reinforcing 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.		
	Reference service life	Years	50
B6 – Use of energy; B7 – Use of water	No water or energy required during use stage related to the operation of the building		
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. This stage comprises: de-construction, demolition; transport to waste processing; waste processing for reuse, recovery and/or recycling; disposal		
	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	-	-

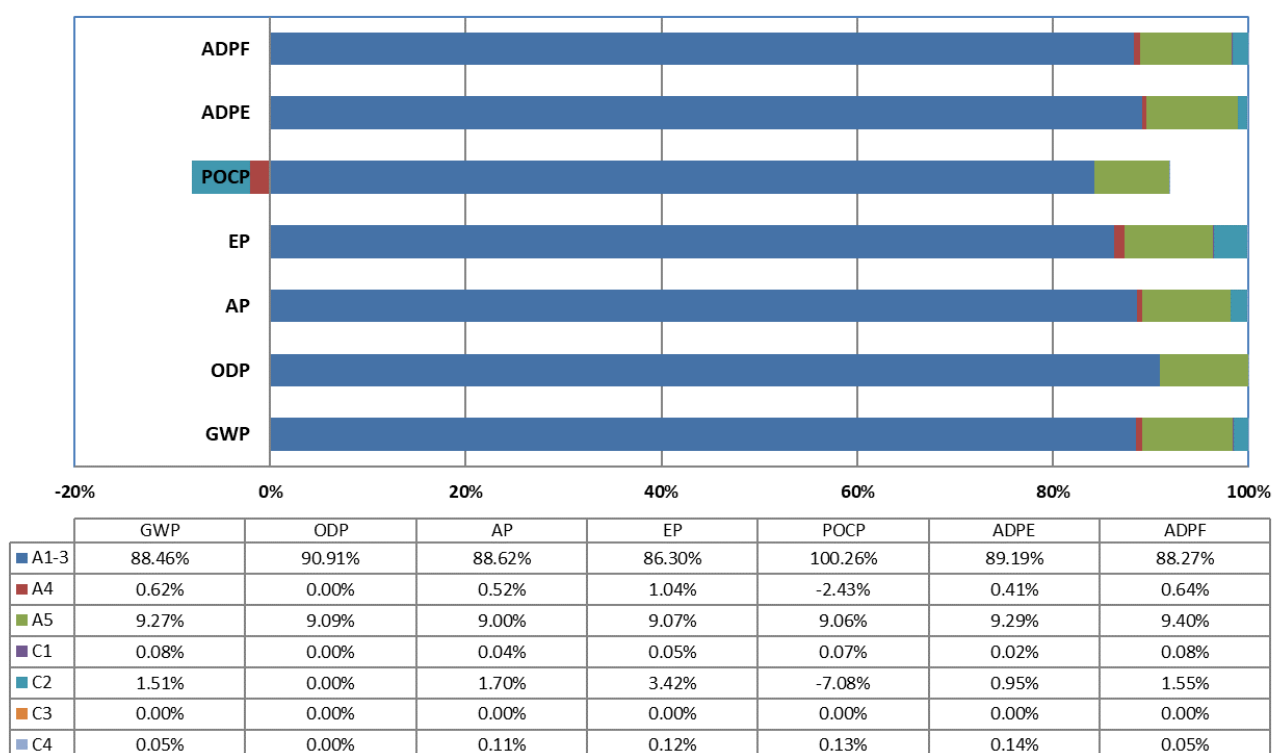
### Scenarios and additional technical information

Scenario	Parameter	Units	Results
	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	L/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 <sup>3</sup>	7850
	Transport to waste processing by Container ship - Fuel consumption	L/km	0.00401
	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 <sup>3</sup>	7850
Module D	<p>It is assumed that 92% of the steel used in the structure is recovered for recycling, while the remainder is landfilled.</p> <p>“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.</p> <p>The resulting scrap credit/burden is calculated based on the global “value of scrap” approach (/worldsteel 2011).</p>		

## Summary, comments and additional information

### Interpretation

Direct Reduced Iron (DRI)-based carbon steel rebar of Jindal Shadeed Iron and Steel LLC (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. For GWP for instance, A1-A3 impacts account for 88.46% overall life cycle impacts for this category.



### References

BSI. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products. BS EN 15804:2012+A1:2013. London, BSI, 2013.

BSI. Environmental labels and declarations – Type III Environmental declarations – Principles and procedures. BS EN ISO 14025:2010 (exactly identical to ISO 14025:2006). London, BSI, 2010.

BSI. Environmental management – Life cycle assessment – Principles and framework. BS EN ISO 14040:2006. London, BSI, 2006.

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Demolition Energy Analysis of Office Building Structural Systems, Athena Sustainable Materials Institute, 1997.

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International Energy Agency, Energy Statistics 2013. <http://www.iea.org>

Kreißig, J. und J. Kuemmel (1999): Baustoff-Oekobilanzen. Wirkungsabschätzung und Auswertung in der Steine-Erden-Industrie. Hrsg. Bundesverband Baustoffe Steine + Erden e.V.

London Metal Exchange, Steel Billet Prices, March 2014. <https://www.lme.com/en-gb/metals/ferrous/>

U.S. Geological Survey, Mineral Commodity Summaries, Iron and Steel Slag, January 2006

Sustainability of construction works – Environmental product declarations – Methodology for selection and use of generic data; German version CEN/TR 15941

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

CARES SCS Sustainable Constructional Steel Scheme. Appendix 1 – Operational assessment schedule for the sustainable production of steel billets, steel bars/coils and wire rod for further processing into carbon steel bar, coil or rod for the reinforcement of concrete.

CARES SRC Steel for the Reinforcement of Concrete Scheme. Appendix 1 – Quality and operations assessment schedule for carbon steel bars for the reinforcement of concrete including inspection and testing requirements - <http://www.ukcares.com/approved-companies> - Certificate number of conformance to BS4449 at the time of LCA study – 150802

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

BS 4449:1997+A1 Carbon Steel Bars for the reinforcement of concrete – Specification.

ASTM A615/A615M – 16 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

ASTM A706/A706M – 16 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.

EN 10080:2005 Steel for the reinforcement of concrete. Weldable reinforcing steel. General

ISO 6935-2:2015 - Steel for the reinforcement of concrete - Part 2: Ribbed bars.

DIN 488-1:2009 - Reinforcing steels – Grades, properties, marking.

DIN 488-2:2009 - Reinforcing steels - Reinforcing steel bars.

IS 1786-2008- High Strength Deformed Steel Bars & Wires for Concrete Reinforcement Specification.

CAN/CSA G30.18-09:2009 Carbon steel bars for concrete reinforcement.

ES: 262-2/2009 Steel for the reinforcement of concrete - Part 2: Ribbed bars.

KWS GSO ISO 6935-2/2012- Steel for the reinforcement of concrete - Part 2: Ribbed bars.

CS2:2012- Steel Reinforcing Bars for the Reinforcement of concrete.

SASO ASTM A615/A 615M+A1:2015 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

SASO 2/1992- Steel Bars for the Reinforcement of concrete.

D