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Statement of Verification

BREG EN EPD No.: 000198 Issue 07

ECO EPD Ref. No. 00000640

This is to verify that the

Environmental Product Declaration

provided by:

ArcelorMittal Kryvyi Rih

is in accordance with the requirements of:

EN 15804:2012+A2:2019

and

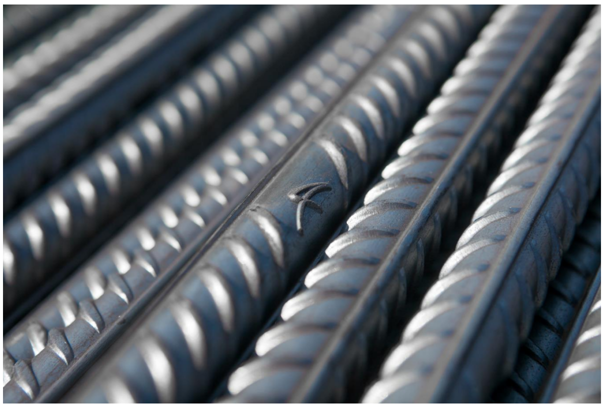
BRE Global Scheme Document SD207

This declaration is for:

Carbon Steel Reinforcing Bar

Company Address

1 Ordzhonikidze Street
Kryvyi Rih
50095
Dnepropetrovsk Region
Ukraine



ArcelorMittal

Signed for BRE Global Ltd	Emma Baker Operator	28 April 2025 Date of this Issue
12 January 2018 Date of First Issue		27 July 2025 Expiry Date

Environmental Product Declaration

EPD Number: 000198

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+A2 PN 514 Rev 3.0
Commissioner of LCA study		**LCA consultant/Tool**
ArcelorMittal Kryvyi Rih 1 Ordzhonikidze Street Kryvyi Rih 50095 Dnepropetrovsk Region Ukraine http://corporate.arcelormittal.com	UK CARES Pembroke House 21 Pembroke Road Sevenoaks Kent TN13 1XR www.ukcares.com	Thinkstep Ltd. (Sphera) 1st Floor 1 East Poultry Avenue London ECA1A 9PT www.sphera.com
Declared/Functional Unit		**Applicability/Coverage**
1 tonne carbon steel reinforcing bar as installed in a building (accounting for fabrication & installation losses).		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 [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(s)

The production data used in this EPD are representative of manufacture of reinforced steel bars by ArcelorMittal Kryvyi Rih (Member of UK CARES).

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

Construction Product:

Product Description

Carbon steel reinforcing bars ("rebar") (according to the product standards listed in the references section of this EPD) that are manufactured via the blast furnace/basic oxygen furnace route (BF/BOF), followed by hot rolling. These are used to provide tensile strength in reinforced concrete building elements.

Technical Information

Property	Value, Unit
Production route (EAF or BF/BOF)	BF/BOF
Density	7850 kg/m^3
Weldability (to BS4449:2005+A3:2016)	≤ 0.50 Ceq.
Yield strength (to BS4449:2005+A3:2016)	≥ 500 N/mm^2
Tensile strength to BS4449:2005+A3:2016)	≥ 540 N/mm^2 (Tensile strength/Yield strength ≥ 1.08)
Surface geometry (relative rib area) (to BS4449:2005+A3:2016)	For bar size 6-12 mm, min 0.040 For bar size >12 mm, min 0.056
Elongation (Agt) (to BS4449:2005+A3:2016)	≥5 %
Re-bend test (to BS4449:2005+A3:2016)	Pass

Property	Value, Unit
Fatigue test requirements (to BS4449:2005+A3:2016)	Pass
Recycled content (externally sourced scrap only) Recycled content (including both internally and externally sourced scrap)	16.4% 23.2%

A list of applicable standards relating to steel reinforcing bar that the product complies with is provided in the references section.

Main Product Contents

The typical composition of carbon steel reinforcing bars is given below

Material/Chemical Input	%
Iron	97
Alloying elements (e.g. C, Mn, Si, V, Cu, Cr, Mo)	3

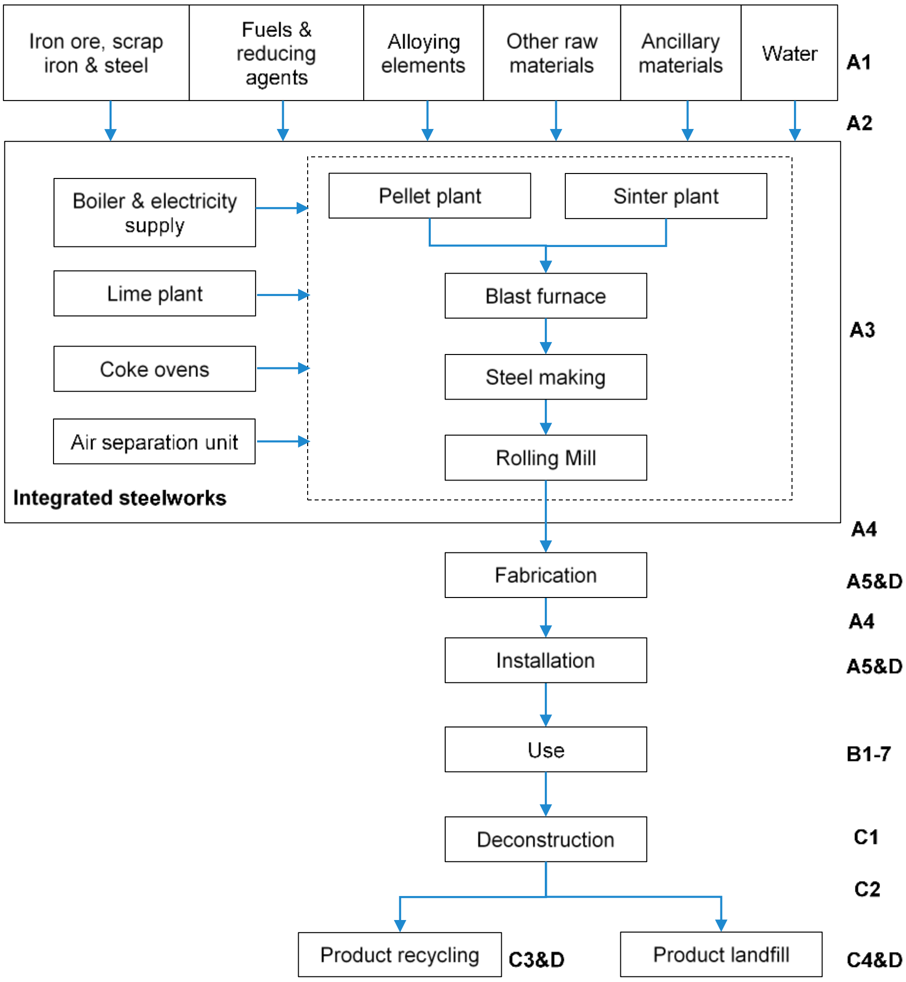
This product is produced from 100% virgin raw material aside from internally recycled scrap. The detail of recycled content is given in the Technical Information Table.

Manufacturing Process

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

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

Process flow diagram



Construction Installation

On leaving the steelworks the steel reinforcing bars are first sent to a fabricator where they are welded together to form the framework structure required for the particular application in the construction project. Based on previous assessments of fabricator operations conducted by UK CARES & Sphera Solutions Inc. this requires 15.34 kWh/t and has a typical wastage rate of 2%.

The assembled framework is then sent to the construction site where it is set in place and concrete is poured around it using shuttering to ensure the desired final dimensions are obtained. A wastage rate of 10% has been assumed for this step.

Use Information

Once installed in a building, steel reinforcing bars are entirely enclosed by concrete. As such they require no cleaning, maintenance, refurbishment or replacement. Reinforcing bars also do not require any energy or water during building operation.

End of Life

At end of life the structure of the building is demolished, and the steel can be recovered by crushing the concrete. It is assumed that 95% of the steel reinforcing bars is recycled and 5% is sent to landfill.

Life Cycle Assessment Calculation Rules

Declared / Functional unit description

The declared unit is 1 tonne of carbon steel reinforcing bars manufactured by the blast furnace/basic oxygen furnace (BF/BOF) production route as used within concrete structures for a commercial building.

System boundary

The system boundary of the EPD is according to the modular approach as defined in EN 15804+A2. The cradle-to-gate with options EPD includes the product stage (A1-A3); transport to the construction site (A4); installation (A5); use (B1-B7); dismantling/deconstruction (C1); transport to waste processing (C2); recovery (C3); disposal at end-of-life (C4), and potential benefits and loads beyond the system boundary (D).

Data sources, quality and allocation

Foreground system
Modules A1-A3: primary data relating to the production of carbon steel reinforcing bars of the period 01/01/2019-31/12/2019 was provided by ArcelorMittal Kryvyi Rih (member of UK CARES) for their production site at Kryvyi Rih, Ukraine. These data were verified by UK CARES during an audit in October 2020.

Modules A4-A5: it is assumed the reinforcing bar is for use in a UK construction project. It is transported 2760 km to a fabricator where it is cut, bent or welded to form the steel framework required for the specific construction project in which it will be used. Data on the fabrication process is based on typical values as determined by previous carbon footprint assessments by UK CARES and Sphera Solutions Inc. on a number of fabricating companies. After fabrication it is assumed that the completed framework is transported 250 km to the construction site. Material losses during fabrication (2%) and installation (10%) are made up with additional steel production (reported in module A5). All waste from fabrication and 98% of waste from installation is assumed to be recycled. The remaining waste from installation is modelled as going to landfill.

Modules B1-7: once installed in a building steel reinforcing bars are entirely enclosed by concrete. As such they do not require cleaning or other maintenance and, if constructed properly, they should last the life of the building so no refurbishment or replacement will be necessary. There are also no air emissions or run off to water associated with the product during use. 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 bases modules B2-B5 are assessed as zero. Similarly, reinforcing bars also do not require any energy or water to operate so modules B6-B7 have also been assessed as zero.

Modules C1-C4: at end of life the building is deconstructed, requiring 24 MJ diesel/tonne. The recovered steel is sent for recycling while a small portion is assumed to be unrecoverable and remains in the rubble which is sent to landfill. 98% of the steel reinforcing bar is assumed to be recycled and 2% is sent to landfill (Sansom, 2014). 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.

Module D: benefits and loads are assigned to the net scrap steel that is generated over the product life cycle i.e., 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.

Background system
The LCA was modelled using GaBi LCA software. The background system comprising impacts associated with raw material production, energy generation, distribution, waste treatment, etc. were based on the most up to date datasets available sourced from the GaBi 2020 databases (Sphera 2020).

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Data Quality
The life cycle inventory data used in this study complies with the quality requirements set out in ISO 14044 (ISO, 2006).
First-hand industry data in combination with consistent background LCA information from the GaBi 2020 database were used. Data quality assessment results are summarised as follows:

- Time-related coverage: All primary data were collected from ArcelorMittal Kryvyi Rih for the calendar year 2019 and these data were audited and verified by UK CARES during an audit in October 2020. Data for all energy inputs, transport processes, packaging, raw materials and waste treatment process are sourced from the GaBi Databases 2020 (Sphera, 2020). The reference years specified for the data range from 2016-2019 and therefore all datasets are within the 10-year limit allowable for generic data under EN 15804+A2. As the study intended to compare the product systems for the reference year 2020, temporal representativeness is considered to be high.
- Geographical coverage: All primary production data are specific to ArcelorMittal Kryvyi Rih's manufacturing plant in Kryvyi Rih, Dnipropetrovsk Region, Ukraine. All relevant background datasets are taken from GaBi Databases 2020 (Sphera, 2020). Where available, geographically correct data were used. In cases where data for the correct geography were not available, proxies from different regions were used and documented. Geographical representativeness is considered to be high.
- Technological coverage: All primary and secondary data were modelled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used. Technological representativeness is considered to be high.

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

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

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

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

There are the following exceptions to this approach:

- Blast furnace slag – this is not recycled internally but is generally sold for use in concrete, road building, etc. Impacts from the steel production process are allocated to the steel and BF slag co-products based on their economic value. Cares and AMKR estimate that the value of reinforcing steel products are around $418/tonne in 2020.

  Specifying a price for BF slag is very difficult as it is not traded openly. Prices agreed between steel producers and users of the slag are not made public and can vary considerably depending on quality, quantity, demand, contract period, etc. The U.S. Geological Survey, Mineral Commodity Summaries, January 2017 states that "Actual prices per ton ranged widely in 2016, from a few cents for some steel slags at a few locations to about $110 for some GGBFS [ground granulated blast furnace slag tonne" (U.S. Geological Survey, 2017),]. Given this wide range of values, a representative price for GGBFS of $47.5/tonne was instead obtained from Alibaba.com and used in this study (Alibaba.com, 2020).

- Coke oven products – impacts were allocated to coke, coke breeze, tar, ammonium sulphate, sulphuric acid, benzene and polymers of benzene separation based on mass as price information was not available due to the consideration of its commercial sensitivity. For this reason, mass-based allocation has been applied for co-products from this process. We acknowledge that this does not fully conform to the requirements of the PCR but feel that this approach is preferable to allocating all the impacts to the coke and coke breeze when some of the co-products are likely to have relatively high values (coke and coke breeze combined account for about 92% (w/w) of the output of this process).
- Energy rich gases – any excess gas generated that is not used within the steelworks is combusted to generate electricity and is sold externally. In the model this is looped back to offset some of the grid electricity inputs to the steelworks.
- Process gases – oxygen, nitrogen, argon and other gases produced from the on-site air separation unit are all consumed on site (no exports beyond A1-A3 boundary). For the particular production route modelled, impacts are allocated to the consumed gases based on volume.
- Rolling mill products – it was not possible to disaggregate data between products from rolling mill/blooming mill operations. Therefore, impacts are allocated to final products from the integrated mill (including reinforcing steel bars, wire rod and profiles) based on mass.

Allocation of background data (energy and materials) taken from the GaBi 2020 Databases is documented online (Sphera Solutions Inc., 2020).

Cut-off criteria

For the processes within the system boundary, all available energy and material flow data have been included in the model. In cases where no matching life cycle inventories were available to represent a flow, proxy data have been applied based on conservative assumptions regarding environmental impacts. Environmental impacts relating to personnel, infrastructure, and production equipment not directly consumed in the process are excluded from the system boundary.

LCA Results (Scenario: 95% Recycling, 5% Landfill)

(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	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	2.54E+03	2.54E+03	-3.12	0.335	1.72E-12	2.92	8.23E-04
Construction process stage	Transport	A4	66.8	66.3	0.143	0.374	6.16E-13	0.187	2.00E-04
	Construction	A5	319	319	-0.330	0.071	3.65E-13	0.372	1.25E-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
End of life	Deconstruction, demolition	C1	2.15	2.15	0.003	4.93E-05	2.48E-16	0.003	4.10E-07
	Transport	C2	0.190	0.188	-2.40E-04	0.002	2.41E-17	1.87E-04	5.59E-07
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	0.736	0.756	-0.022	2.22E-03	2.94E-15	0.005	1.27E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.68E+03	-1.68E+03	2.96	0.265	8.06E-12	-4.70	-1.87E-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 (Scenario: 95% Recycling, 5% Landfill, 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	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	6.15	1.65	1.28E-04	2.60E+04	5.06E+03	2.78E-05	6.15
Construction process stage	Transport	A4	0.775	0.197	1.09E-05	1.02E+03	4.47	1.74E-06	0.775
	Construction	A5	0.794	0.212	1.77E-05	3.32E+03	619	3.52E-06	0.794
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	0.013	0.003	7.01E-08	28.3	0.005	1.89E-08	0.013
	Transport	C2	7.14E-04	1.63E-04	1.43E-08	2.51	0.002	1.11E-09	7.14E-04
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	0.015	0.004	7.13E-08	10.00	0.081	6.69E-08	0.015
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-10.5	-3.25	3.97E-05	-1.21E+04	35.7	-6.16E-05	-10.5

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 (Scenario: 95% Recycling, 5% Landfill, 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	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	52.2	3.49E+03	1.23E-07	1.12E-05	1.64E+03
Construction process stage	Transport	A4	6.71	574	1.37E-08	6.54E-07	360
	Construction	A5	9.15	499	1.70E-08	1.45E-06	248
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
End of life	Deconstruction, demolition	C1	0.004	20.5	5.02E-10	1.64E-08	0.077
	Transport	C2	4.35E-04	1.81	3.66E-11	1.90E-09	0.862
	Waste processing	C3	0	0	0	0	0
	Disposal	C4	0.011	5.77	8.43E-10	9.31E-08	2.03
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	19.8	-1.87E+03	-2.73E-06	-8.98E-06	1.20E+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 (Scenario: 95% Recycling, 5% Landfill, 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	494	0	494	2.60E+04	0	2.60E+04
Construction process stage	Transport	A4	249	0	249	1.02E+03	0	1.02E+03
	Construction	A5	115	0	115	3.32E+03	0	3.32E+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	0.098	0	0.098	28.3	0	28.3
	Transport	C2	0.140	0	0.140	2.51	0	2.51
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	1.35	0	1.35	10.0	0	10.0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	1.63E+03	0	1.63E+03	-1.22E+04	0	-1.22E+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 (Scenario: 95% Recycling, 5% Landfill, 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^3
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	167	0	0	119
Construction process stage	Transport	A4	0	0	0	0.161
	Construction	A5	20.4	0	0	14.5
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	1.98E-04
	Transport	C2	0	0	0	1.60E-04
	Waste processing	C3	0	0	0	0
	Disposal	C4	0	0	0	0.002
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0	0	0	-1.13

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 (Scenario: 95% Recycling, 5% Landfill, 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	1.92E-06	236	0.656
Construction process stage	Transport	A4	1.65E-07	0.467	0.072
	Construction	A5	2.67E-07	30.8	0.097
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	2.42E-10	0.006	3.10E-05
	Transport	C2	1.27E-10	3.73E-04	3.04E-06
	Waste processing	C3	0	0	0
	Disposal	C4	1.07E-09	50.0	1.05E-04
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	1.57E-06	-24.8	0.207

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

LCA Results (Scenario: 95% Recycling, 5% Landfill, 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	0.452	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	950	0	0
	Disposal	C4	0	0	0	0
Potential benefits and loads beyond the system	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

LCA Results (Scenario: 100% Recycling)

(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	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	2.54E+03	2.54E+03	-3.12	0.335	1.72E-12	2.92	8.23E-04
Construction process stage	Transport	A4	66.8	66.3	0.14	0.374	6.16E-13	0.187	2.00E-04
	Construction	A5	319	319	-0.33	0.071	3.65E-13	0.372	1.25E-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
End of life	Deconstruction, demolition	C1	2.15	2.15	0.003	4.93E-05	2.48E-16	0.003	4.10E-07
	Transport	C2	0	0	0	0	0	0	0
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	0	0	0	0	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.78E+03	-1.78E+03	3.12	0.277	8.52E-12	-4.96	-1.98E-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 (Scenario: 100% Recycling, 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	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	0.560	6.15	1.65	1.28E-04	2.60E+04	5.06E+03	2.78E-05
Construction process stage	Transport	A4	0.070	0.775	0.197	1.09E-05	1.02E+03	4.47	1.74E-06
	Construction	A5	0.072	0.794	0.212	1.77E-05	3.32E+03	619	3.52E-06
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	0.001	0.013	0.003	7.01E-08	28.3	0.005	1.89E-08
	Transport	C2	0	0	0	0	0	0	0
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	0	0	0	0	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.03	-11.1	-3.44	4.19E-05	-1.27E+04	37.8	-6.51E-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 (Scenario: 100% Recycling, 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	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	52.2	3.49E+03	1.23E-07	1.12E-05	1.64E+03
Construction process stage	Transport	A4	6.71	574	1.37E-08	6.54E-07	360
	Construction	A5	9.15	499	1.70E-08	1.45E-06	248
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
End of life	Deconstruction, demolition	C1	0.004	20.5	5.02E-10	1.64E-08	0.077
	Transport	C2	0	0	0	0	0
	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	20.9	-1.98E+03	-2.88E-06	-9.50E-06	1.26E+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 (Scenario: 100% Recycling, 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	494	0	494	2.60E+04	0	2.60E+04
Construction process stage	Transport	A4	249	0	249	1.02E+03	0	1.02E+03
	Construction	A5	115	0	115	3.32E+03	0	3.32E+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	0.098	0	0.098	28.3	0	28.3
	Transport	C2	0	0	0	0	0	0
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	0	0	0	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	1.72E+03	0	1.72E+03	-1.29E+04	0	-1.29E+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 (Scenario: 100% Recycling, 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^3
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	167	0	0	119
Construction process stage	Transport	A4	0	0	0	0.161
	Construction	A5	20.4	0	0	14.5
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	1.98E-04
	Transport	C2	0	0	0	0
	Waste processing	C3	0	0	0	0
	Disposal	C4	0	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0	0	0	-1.19

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 (Scenario: 100% Recycling, 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	1.92E-06	236	0.656
Construction process stage	Transport	A4	1.65E-07	0.467	0.072
	Construction	A5	2.67E-07	30.8	0.097
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	2.42E-10	0.006	3.10E-05
	Transport	C2	0	0	0
	Waste processing	C3	0	0	0
	Disposal	C4	0	0	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	1.65E-06	-26.3	0.219

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

LCA Results (Scenario: 100% Recycling, 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	0.452	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	1.00E+03	0	0
	Disposal	C4	0	0	0	0
Potential benefits and loads beyond the system	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

LCA Results (Scenario: 100% Landfill)

(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	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	2.54E+03	2.54E+03	-3.12	0.335	1.72E-12	2.92	8.23E-04
Construction process stage	Transport	A4	66.8	66.3	0.143	0.374	6.16E-13	0.187	2.00E-04
	Construction	A5	319	319	-0.330	0.071	3.65E-13	0.372	1.25E-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
End of life	Deconstruction, demolition	C1	2.15	2.15	0.003	4.93E-05	2.48E-16	0.003	4.10E-07
	Transport	C2	3.79	3.77	-0.005	0.031	4.82E-16	0.004	1.12E-05
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	14.7	15.1	-0.439	0.044	5.87E-14	0.108	2.54E-05
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	136	136	-0.235	0.037	-6.17E-13	0.371	3.53E-05

GWP-total = Global warming potential, total;
GWP-fossil = Global warming potential, fossil;
GWP-biogenic = Global warming potential, biogenic;
GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
AP = Acidification potential, accumulated exceedance; and
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results (Scenario: 100% Landfill, 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	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	0.560	6.15	1.65	1.28E-04	2.60E+04	5.06E+03	2.78E-05
Construction process stage	Transport	A4	0.070	0.775	0.197	1.09E-05	1.02E+03	4.47	1.74E-06
	Construction	A5	0.072	0.794	0.212	1.77E-05	3.32E+03	619	3.52E-06
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	0.001	0.013	0.003	7.01E-08	28.3	0.005	1.89E-08
	Transport	C2	0.001	0.014	0.003	2.87E-07	50.2	0.033	0
	Waste processing	C3	0	0	0	0	0	0	0
	Disposal	C4	0.028	0.307	0.085	1.43E-06	201	1.62	0
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.08	0.843	0.259	-2.50E-06	1.02E+03	-2.68	-6.51E-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 (Scenario: 100% Landfill, 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 U235 eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	AGG	AGG	AGG	AGG	AGG
	Transport	A2	AGG	AGG	AGG	AGG	AGG
	Manufacturing	A3	AGG	AGG	AGG	AGG	AGG
	Total (of product stage)	A1-3	52.2	3.49E+03	1.23E-07	1.12E-05	1.64E+03
Construction process stage	Transport	A4	6.71	574	1.37E-08	6.54E-07	360
	Construction	A5	9.15	499	1.70E-08	1.45E-06	248
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
End of life	Deconstruction, demolition	C1	0.004	20.5	5.02E-10	1.64E-08	0.077
	Transport	C2	0	0	0	0	0
	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	20.9	-1.98E+03	-2.88E-06	-9.50E-06	1.26E+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 (Scenario: 100% Landfill, 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	494	0	494	2.60E+04	0	2.60E+04
Construction process stage	Transport	A4	249	0	249	1.02E+03	0	1.02E+03
	Construction	A5	115	0	115	3.32E+03	0	3.32E+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	0.098	0	0.098	28.3	0	28.3
	Transport	C2	2.80	0	2.80	50.2	0	50.2
	Waste processing	C3	0	0	0	0	0	0
	Disposal	C4	27.0	0	2.70E+01	201	0	201
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-120	0	-120	1.03E+03	0	1.03E+03

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
PERM = Use of renewable primary energy resources used as raw materials;
PERT = Total use of renewable primary energy resources;

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
PENRM = Use of non-renewable primary energy resources used as raw materials;
PENRT = Total use of non-renewable primary energy resource

LCA Results (Scenario: 100% Landfill, 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^3
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	167	0	0	119
Construction process stage	Transport	A4	0	0	0	0.161
	Construction	A5	20.4	0	0	14.5
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	1.98E-04
	Transport	C2	0	0	0	0.003
	Waste processing	C3	0	0	0	0
	Disposal	C4	0	0	0	0.050
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0	0	0	0.092

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 (Scenario: 100% Landfill, 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	1.92E-06	236	0.656
Construction process stage	Transport	A4	1.65E-07	0.467	0.072
	Construction	A5	2.67E-07	30.8	0.097
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	2.42E-10	0.006	3.10E-05
	Transport	C2	2.53E-09	0.007	6.08E-05
	Waste processing	C3	0	0	0
	Disposal	C4	2.13E-08	1.00E+03	0.002
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.15E-07	1.92	-0.016

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

LCA Results (Scenario: 100% Landfill, 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	0.452	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	0	0	0
	Disposal	C4	0	0	0	0
Potential benefits and loads beyond the system	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

<table>
<tr><th colspan="4">Scenarios and additional technical information</th></tr>
<tr><td>Scenario</td><td>Parameter</td><td>Units</td><td>Results</td></tr>
<tr><td rowspan="5">A4 – Transport to the building site</td><td colspan="3">Transport of steel reinforcing bars from AMKR site in Ukraine to fabricator in UK and on to UK construction site.</td></tr>
<tr><td>Truck-trailer, Euro 6, 34 - 40 t gross weight / 27t payload capacity
Rail transport cargo - average, average train, gross tonne weight 1000t / 726t payload capacity
Bulk commodity carrier, average, ocean going</td><td>Litre (diesel) /100 km
Litre (diesel) /100 tonne.km
kWh electricity/ 100 tonne.km
Litre HFO/ 100 tonne.km</td><td>42.7
0.122
2.77
0.103</td></tr>
<tr><td>Distance:
Steelworks to fabricator
Fabricator to construction site</td><td>km by road
km by rail
km by sea
km by road</td><td>200
2515
45
250</td></tr>
<tr><td>Capacity utilisation (incl. empty returns)</td><td>%</td><td>45</td></tr>
<tr><td>Bulk density of transported products</td><td>kg/m^3</td><td>Ca. 6000</td></tr>
<tr><td rowspan="3">A5 – Installation in the building</td><td colspan="3">On leaving the steelworks the reinforcing steel bars are sent to a fabricator where they are converted into constructional steel forms suitable for the installation site. The assembled framework is then sent to the construction site where it is set in place and concrete is poured around it using shuttering to ensure the desired final dimensions are obtained</td></tr>
<tr><td>Fabrication into constructional steel forms. All losses are assumed to be recycled.</td><td>Elec, kWh/t
Loss, %</td><td>15.34
2</td></tr>
<tr><td>Installation losses estimated based on WRAP's Net Waste Tool (WRAP, 2017). 95% of the waste is recycled and 5% landfilled (see C1 to C4, below).</td><td>%</td><td>10</td></tr>
<tr><td>B1 - Use</td><td colspan="3" rowspan="5">Once installed in a building, steel reinforcing bars are entirely enclosed by concrete. As such they require no cleaning, maintenance, refurbishment or replacement.</td></tr>
<tr><td>B2 – Maintenance</td></tr>
<tr><td>B3 – Repair</td></tr>
<tr><td>B4 – Replacement</td></tr>
<tr><td>B5 – Refurbishment</td></tr>
<tr><td rowspan="2">Reference service life</td><td colspan="3">Reinforcing steel bars are used within the structure of the building so the RSL is the lifetime of the building in which the reinforcing steel bars are installed. 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)</td></tr>
<tr><td>Reference service life (RSL)</td><td>Years</td><td>50</td></tr>
<tr><td>B6 – Use of energy;
B7 – Use of water</td><td colspan="3">Reinforcing bars do not require any energy or water during building operation.</td></tr>
</table>

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Scenarios and additional technical information			
Scenario	Parameter	Units	Results
C1 to C4 End of life,	The end of life stages accounts for the demolition of the building and the recovery of the construction steel from the reinforced concrete. Once steel scrap is generated through deconstruction activities on the demolition site it is considered to have reached the "end of waste" state. The recovered steel is sent for recycling while a small portion is assumed to be unrecoverable and remains in the rubble which is sent to landfill. No further processing for cleaning of superfluous concrete material on rebar prior to recycling is required so there are no impacts associated with module C3.		
	Mechanical equipment is used to deconstruct the building at end of life. (Athena Sustainable Materials Institute, 1997)	MJ (diesel)/t	24
	Waste for recycling - Recovered steel from crushed concrete (Waste treatment data based on industry survey (Sansom, 2014))	%	95
	Waste for final disposal - Unrecoverable steel lost in crushed concrete and sent to landfill	%	5
	Transport of demolition waste to landfill (Truck parameter same as for A4 above)	km by road	50
	Transport of scrap to recycling (UK Cares, 2020) (Truck parameter same as for A4 above)	km by road	463
		km by ship	158
Module D	A large amount of net scrap is generated over the life cycle as the BF/BOF production route is primarily from virgin sources and there is a very high end of life recycling rate for this product. Benefits and loads associated with this scrap are calculated by including the burdens of recycling process and accounting for the avoided primary production.		

Summary, comments and additional information

Interpretation

Figure 1 shows the contribution to the total life cycle impact from the different modules reported in this EPD. It can be seen that the production stage (A1-A3) is the most important, accounting for more than 80% of the burden in all impact categories except for ODP. Installation (A5) also shows significant impacts in all categories, this is mainly due to the additional reinforcing bar required to account for losses during fabrication and installation. Impacts from transport to the fabricators and installation site (A4) are also noticeable – with a particularly large contribution to ODP. Impacts from other life cycle stages are negligible in comparison.

Figure 2 shows the contribution of different manufacturing processes and raw materials to the total impact from modules A1-A3. Significant burdens are seen for several main process steps. The blast furnace and coke ovens have the biggest overall contributions but sintering, steelmaking and rolling also have noticeable impacts.

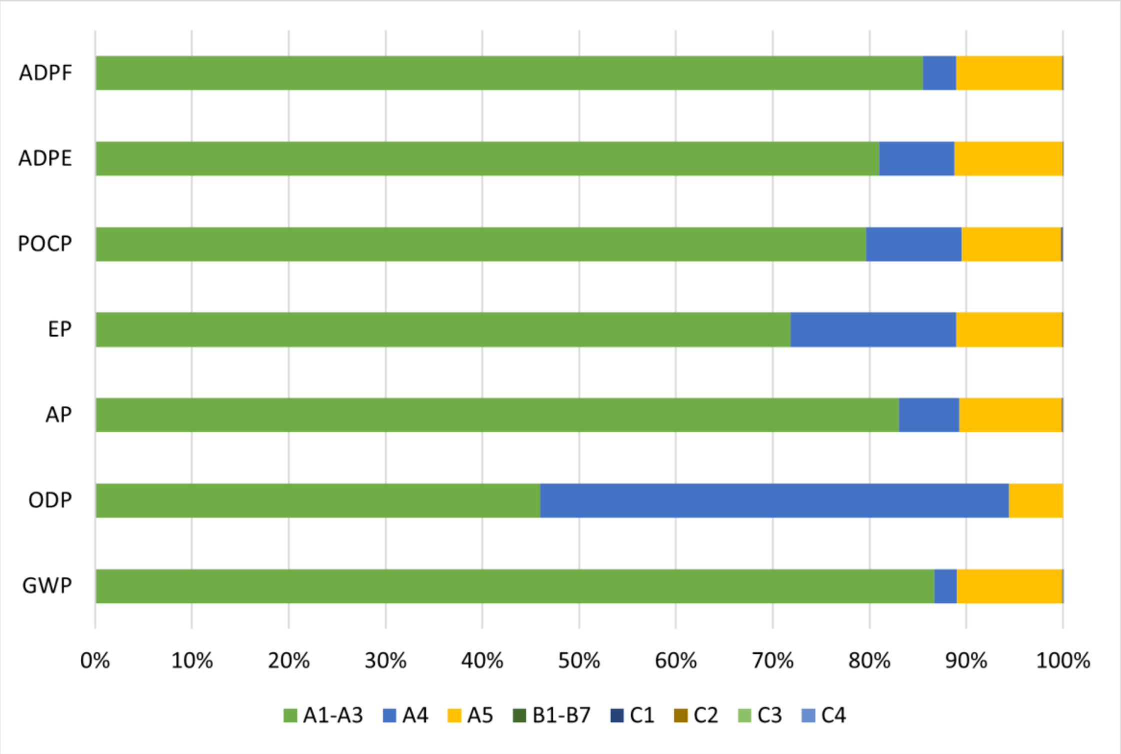

Figure 1 - Contribution from different life cycle modules to the total impact for the impact categories assessed in this EPD study

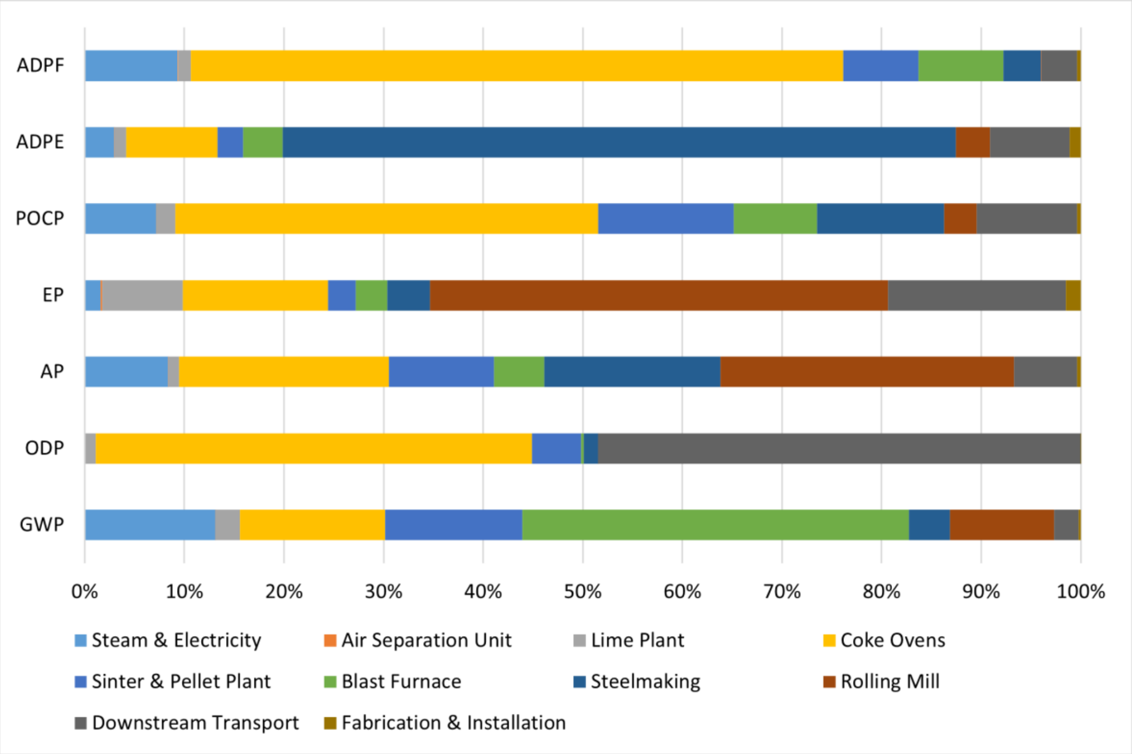

Figure 2 - Contribution from different processes to the total impact from the manufacturing stage (A1-A3) for the impact categories assessed in this EPD study

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Standards for Steel Reinforcement Bars Specification

The assessed steel reinforcing bar conforms to the requirements of the following standards:

CARES SCS Sustainable Constructional Steel Scheme. Appendix 1 – Operational assessment schedule for the sustainable production of carbon steel bars for the reinforcement of concrete - http://www.ukcares.com/approved-companies - Certificate number at the time of LCA study – 1520

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 – 061101

CARES SRC Steel for the Reinforcement of Concrete Scheme. Appendix CP&AS 21 Quality and operations assessment schedule for Singapore Standard (SS 560:2016) weldable reinforcing steel bars, coils and decoiled products for the reinforcement of concrete including inspection and testing requirements- http://www.ukcares.com/approved-companies - Certificate number of conformance to SS 560:2016 at the time of LCA study – 200302

CARES SRC Steel for the Reinforcement of Concrete Scheme. Appendix CP&AS 24 - Quality and operations assessment schedule for Hong Kong Standard (CS2:2012) Steel Reinforcing Bars for the Reinforcement of Concrete - http://www.ukcares.com/approved-companies - Certificate number of conformance to CS2:2012 at the time of LCA study – 210203

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

DSTU 3760:2006 Rolled Products for Reinforcement of Ferroconcrete Structures. General Specification.

GOST 5781-82 Hot-rolled steel for reinforcement of ferroconcrete structures. Specifications.

STO ASCHM 7-93 Rolled deformed reinforcing steel bars. Specifications.

GOST R 52544:2006 Weldable deformed reinforcing rolled products of A500C and B500C classes for reinforcement of concrete constructions. Specifications.

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

SS 560:2010 - Steel for the reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product. BDS 9252:2007 - Steel for the reinforcement of concrete - Weldable reinforcing steel B500.

CS2:2012 - Steel Reinforcing Bars for the Reinforcement of Concrete

ASTM A615/A615M – 20 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.

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IS 1786:2008/Amd.1,2 High strength deformed steel bars and wires for concrete reinforcement.
IQS 2091/1999 Carbon steel bars for the reinforcement.

NF A35-080-1 Décembre 2013 Aciers pour béton armé - Aciers soudables - Partie 1 : barres et couronnes.

NEN 6008:2008 nl Steel for the reinforcement of concrete.

NBN A 24-301&304:1986 - Steel for reinforcement.

BDS 9252:2007 Steel for the reinforcement of concrete - Weldable reinforcing steel B500.

BDS 4758:2007 Steel for the reinforcement of concrete - Weldable reinforcing steels B235 and B420.

ES:262-2:2015/ISO6935-2:2007 Steel for the reinforcement of concrete Part 2 Ribbed bars (rebars).

NA 8634:1997 Acier a beton pour armatures passives-Barres nervurees.

NTC 2289:2015 Barras corrugadas y lisas de acero de baja aleacion, para feruerzo de concreto.

SASO-ASTM-A615:2015 Standard specification for deformed and plain Carbon-Steel Bars for Concrete Reinforcement.