

Steel Rails and Sections

(including semi-finished long products)

Environmental Product Declaration

Owner of the Declaration: British Steel, Brigg Road, Scunthorpe, North Lincolnshire, DN16 1BP
Programme Operator: Tata Steel UK Limited, 30 Millbank, London, SW1P 4WY



CONTENTS

1 General information	03
2 Product information	04
2.1 Product Description	04
2.2 Manufacturing	04
2.3 Technical data and specifications	06
2.4 Packaging	06
2.5 Reference service life	06
3 Life Cycle Assessment (LCA) methodology	07
3.1 Declared unit	07
3.2 Scope	07
3.3 Cut-off criteria	08
3.4 Background data	08
3.5 Data quality	08
3.6 Allocation	08
3.7 Additional technical information	09
3.8 Comparability	09
4 Results of the LCA	10
5 Interpretation of results	12
6 References and product standards	13

British Steel Rails and Sections (including semi-finished long products)
Environmental Product Declaration
(in accordance with ISO 14025 and EN 15804)

This EPD is representative and valid for the specified (named) products

Declaration Number: EPD-TS-2020-003
Date of Issue: 24th January 2020
Valid until: 23rd January 2026 (see note on page 3)

Owner of the Declaration: British Steel, Brigg Road, Scunthorpe, North Lincolnshire, DN16 1BP
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The CEN standard EN 15804:2012+A1:2013 serves as the core Product Category Rules (PCR)
supported by Tata Steel's EN 15804 verified EPD PCR documents

Independent verification of the declaration and data, according to ISO 14025

Internal ☐ External ☒

Author of the Life Cycle Assessment: Tata Steel UK
Third party verifier: Olivier Muller, PricewaterhouseCoopers, Paris

1 General information

Owner of EPD	British Steel
Product	Steel rails and sections (including semi-finished long products)
Manufacturer	British Steel
Manufacturing sites	Scunthorpe, Teesside and Hayange
Product applications	Steel sections used in construction and infrastructure, steel rails for mainline and urban transport railway networks, and semi-finished long products for subsequent downstream re-rolling and forging
Declared unit	1 tonne of steel sections
Date of issue	24 th January 2020
Valid until	23 rd January 2026 (see note below)

This Environmental Product Declaration (EPD) is for steel rails, sections and semi-finished long products manufactured by British Steel in the UK and France. The environmental indicators are for products manufactured at Scunthorpe, Teesside and Hayange with feedstock supplied from Scunthorpe.

The information in the Environmental Product Declaration is based on production data from 2016.

EN 15804 serves as the core PCR, supported by Tata Steel's EN 15804 verified EPD programme Product Category Rules documents, and this declaration has been independently verified according to ISO 14025 ^[1,2,3,4,5,6,7].

NOTE: a validity extension of 1 year has been granted to allow sufficient time for energy use, resource use and emissions data collection from a stable operation, for renewal of the EPD.

Third party verifier



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2 Product information

2.1 Product Description

Steel sections are supplied in the as-rolled or thermomechanical rolled condition from British Steel rolling mills in Scunthorpe and Teesside. These hot rolled sections can also be supplied in the shot-blasted or shot-blasted and primed conditions. They include universal beams and columns, equal and un-equal angles and parallel flange channels in a range of external dimensions from less than 100mm to over 1000mm, and product weights from less than 20kg/m to over 1000kg/m. Mechanical properties of these products range from those for mild steel grades through to high strength steel grade variants.

Steel rails are supplied in either the as-rolled condition or the heat treated head hardened condition from British Steel rolling mills in Scunthorpe and Hayange. Over 80 different rail profiles are produced, with section weights from 27kg/m to just over 75kg/m, for both rail wheel support and guidance, and third rail electrification requirements.

Steel semi-finished long products (rolled billets) are supplied in the as-rolled condition from the British Steel rolling mill in Scunthorpe for subsequent downstream re-rolling and forging applications. The current size range for these products is 75mm to 160mm square sections, and a range of rectangles including 160mm x 70mm for cathode collector bar applications. Mechanical properties of these products range from those for mild steel grades through to ultra-high strength steel grade variants. Rolling of billet allows for a far wider range of product dimensions than available from direct cast material. Rolled billet provide the highest levels of surface quality and high through process reduction ratios necessary for the most demanding product applications.

2.2 Manufacturing

The manufacturing sites included in the EPD are listed in Table 1 below.

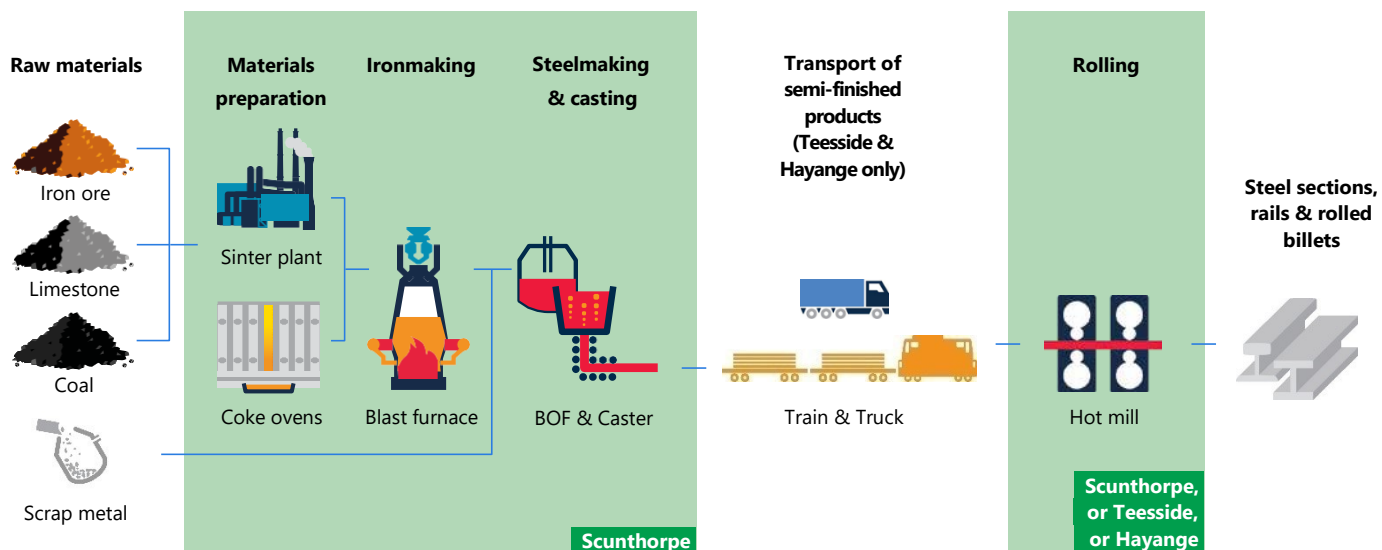
Table 1 Participating sites

Site name	Product	Manufacturer	Country
Scunthorpe	Semi-finished products	British Steel	UK
Scunthorpe	Sections, rails & rolled billets	British Steel	UK
Teesside	Sections	British Steel	UK
Hayange	Rails	British Steel	France

The steel manufacturing process at British Steel begins at Scunthorpe integrated steelworks where sinter is produced from iron ore and limestone, and together with coke from coal, are reduced in a blast furnace to produce liquid iron. Steel scrap is added to the liquid iron and oxygen is blown through the mixture to convert it into liquid steel in the basic oxygen furnace. Gases evolved from these processes are recycled and used to power reheating furnaces and also to generate electricity. Alloys are added to the liquid steel before it is continuously cast into rectangular sections. Discrete blooms, billets and slabs are cut from the continuously cast solid steel strands, and these semi-finished products are subsequently reheated and hot rolled in to a section or rail to make the final product. Blooms are also rolled to produce billet sized sections to meet customer specifications. Some of the semi-finished products are transported from Scunthorpe to Teesside and Hayange by road and rail, and are reheated and hot rolled in a section or rail mill. The process is shown in Figure 1.

Process data for the manufacture of steel long products at Scunthorpe, Teesside and Hayange was gathered as part of the latest worldsteel data collection. This was done for the 2016 calendar year for all three sites.

Figure 1 Process overview from raw materials to steel sections



2.3 Technical data and specifications

The technical specifications of the product are shown in Table 2.

2.4 Packaging

Sections and rail products are supplied singly or in tie wired product bundles to meet customer order requirements, and packaging is an absolute minimum. Steel is delivered to customer premises or directly to site, in lengths ranging from less than 6m to individual rails 216m long. Individual bars or bundles are separated by re-usable timbers or bespoke multi-use spacers, and loads are securely fixed to the railway wagon or truck by re-usable strapping. If required, loads can be sheeted although this is generally not necessary for steel rails and sections.

2.5 Reference service life

A reference service life for steel rails and sections is not declared because the construction or infrastructure application of these products is not part of this LCA study. To determine the full service life of steel rails and sections, all factors would need to be included, such as details of the final product application, and its location and environment.

Steel sections are supplied in a vast range of dimension and product property combinations, to allow maximum design efficiencies to be achieved. Construction and infrastructure projects range from re-usable temporary installations, to permanent structures designed to be serviceable for many decades.

Rail steel grades have been developed to resist the key degradation mechanisms of wear, fatigue and corrosion, and to facilitate simple on-site repairs to provide the maximum possible safe in-service life. Typically, the life of installed rail ranges from many years to decades, with rails often cascaded to lower category track through their serviceable life.

Table 2 Technical specification of the steel products

British Steel sections, rails & rolled billets		
Scope/Product	Attributes	Applicable standards (typical)
Manufacturing facilities	Quality systems and factory production control	ISO 9001 ^[8] , NHSS 3B ^[9] , CPR ^[10]
Sections	Dimensions	EN 10365 ^[11] , ASTM A6 ^[12]
	Mechanical properties	EN 10025 ^[13] , EN 10225 ^[14] , ASTM A572 ^[15] , ASTM A992 ^[16]
Rails	Dimensions	ISO 5003 ^[17] , ISO 22055 ^[18] , EN 13674 ^[19] ,
	Mechanical properties	EN 14811 ^[20] , BS 11 ^[21] , BS 500 ^[22] , BS 7865 ^[23] Customer/network specific rail standards
Rolled billet	Dimensions	Customer specific – dimensions, chemistry
	Mechanical properties	and mechanical properties designed to achieve final product requirements

3 LCA methodology

3.1 Declared unit

The unit being declared is 1 tonne of steel sections, rails and rolled billet.

3.2 Scope

This EPD can be regarded as Cradle-to-Gate (with options) and the modules considered in the LCA are;

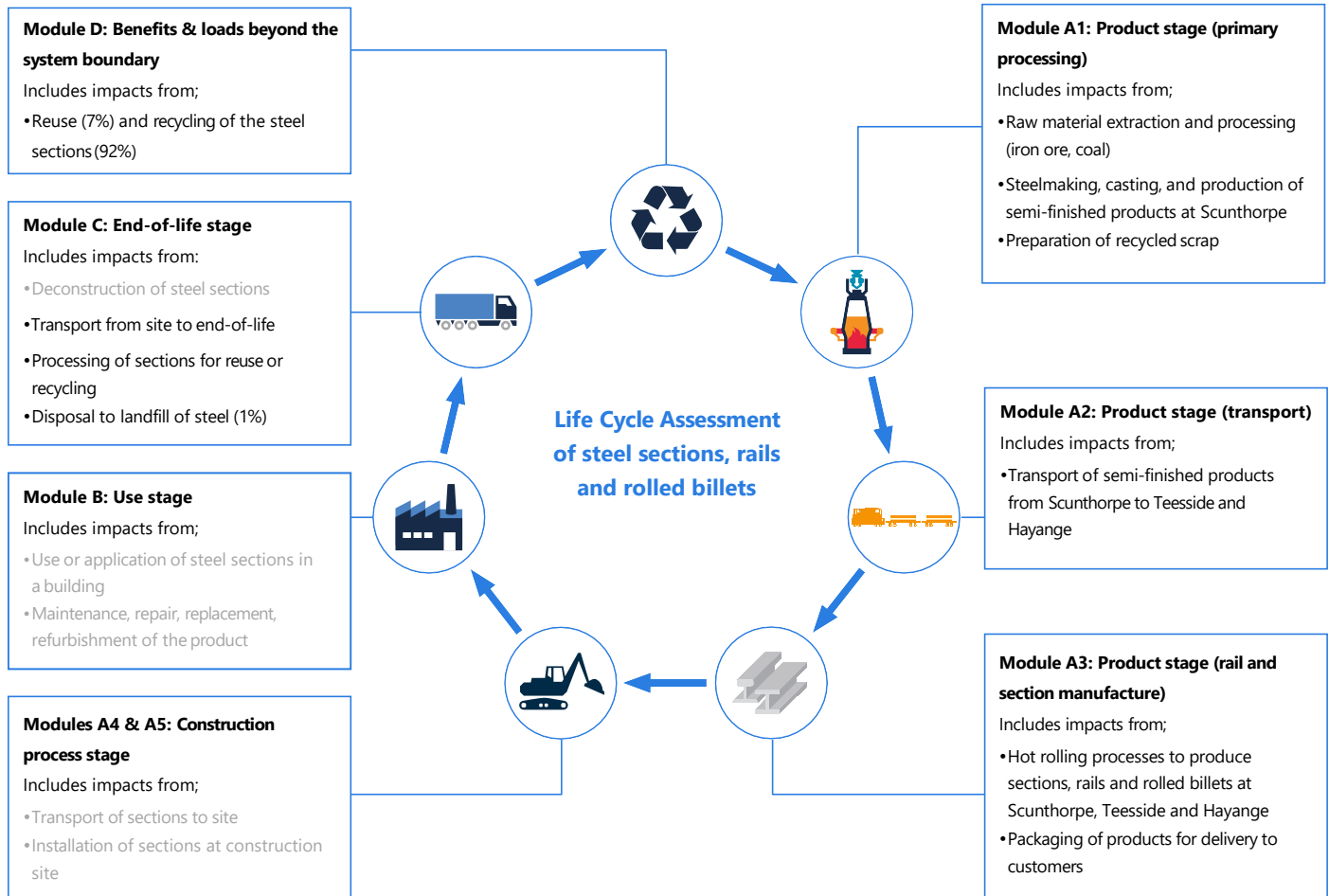
A1-3: Production stage (Raw material supply, transport to production site, manufacturing)

C2-4: End-of-life (Transport to EoL, processing for recycling & reuse and disposal)

D: Reuse, recycling and recovery

The life cycle stages are explained in more detail in Figure 2.

Figure 2 Life Cycle Assessment of steel sections, rails and rolled billets



3.3 Cut-off criteria

All information from the data collection process has been considered, covering all used and registered materials, and all fuel and energy consumption. On-site emissions were measured and those emissions have been considered. Data for all relevant sites were thoroughly checked and also cross-checked with one another to identify potential data gaps. No processes, materials or emissions that are known to make a significant contribution to the environmental impact of the sections, rails and rolled billets have been omitted. On this basis, there is no evidence to suggest that input or outputs contributing more than 1% to the overall mass or energy of the system, or that are environmentally significant, have been omitted. It is estimated that the sum of any excluded flows contribute less than 5% to the impact assessment categories. The manufacturing of required machinery and other infrastructure is not considered in the LCA.

3.4 Background data

For life cycle modelling of the steel products, the GaBi Software System for Life Cycle Engineering is used ^[24]. The GaBi database contains consistent and documented datasets which can be viewed in the online GaBi documentation ^[25].

Where possible, specific data derived from British Steel's own production processes were the first choice to use where available.

To ensure comparability of results in the LCA, the basic data of the GaBi database were used for energy, transportation and auxiliary materials.

3.5 Data quality

The data from the British Steel production processes are from 2016, and the technologies on which these processes were based during that period, are those used at the date of publication of this EPD. All relevant background datasets are taken from the GaBi software database, and the last revision of these data sets took place less than 10 years ago. Therefore, the study is considered to be based on high quality data.

3.6 Allocation

To align with the requirements of EN 15804, a methodology is applied to assign impacts to the production of slag and hot metal from the blast furnace (co-products from steel manufacture), that was developed by the World Steel Association and EUROFER ^[26]. This methodology is based on physical and chemical partitioning of the manufacturing process, and therefore avoids the need to use allocation methods, which are based on relationships such as mass or economic value. It takes account of the manner in which changes in inputs and outputs affect the production of co-products and also takes account of material flows that carry specific inherent properties. This method is deemed to provide the most representative method to account for the production of blast furnace slag as a co-product.

Economic allocation was considered, as slag is designated as a low value co-product under EN 15804. However, as neither hot metal nor slag are tradable products upon leaving the blast furnace, economic allocation would most likely be based on estimates. Similarly

BOF slag must undergo processing before being used as a clinker or cement substitute. The World Steel Association and EUROFER also highlight that companies purchasing and processing slag work on long term contracts which do not follow regular market dynamics of supply and demand.

Process gases arise from the production of the semi-finished products at Scunthorpe and are accounted for using the system expansion method. This method is also referenced in the same EUROFER document and the impacts of co-product allocation, during manufacture, are accounted for in the product stage (Module A1).

End-of-life assumptions for recovered steel and steel recycling are accounted for as per the current methodology from the World Steel Association 2017 Life Cycle Assessment methodology report ^[27]. A net scrap approach is used to avoid double accounting, and the net impacts are reported as benefits and loads beyond the system boundary (Module D).

3.7 Additional technical information

The main scenario assumptions used in the LCA are detailed in Table 3. The end-of-life percentages are based upon a Tata Steel/ EUROFER recycling and reuse survey of UK demolition contractors carried out in 2014 ^[28].

The environmental impacts presented in the 'LCA Results' section (4) are expressed with the impact category parameters of Life Cycle Impact Assessment (LCIA) using characterisation factors. The LCIA method used is CML 2001-April 2013 ^[29].

3.8 Comparability

Care must be taken when comparing EPDs from different sources. EPDs may not be comparable if they do not have the same functional unit or scope (for example, whether they include installation allowances in the building), or if they do not follow the same standard such as EN 15804. The use of different generic datasets for upstream or downstream processes that form part of the product system may also mean that EPDs are not comparable.

Comparisons should ideally be integrated into a whole building assessment, in order to capture any differences in other aspects of the building design that may result from specifying different products. For example, a more durable product would require less maintenance and reduce the number of replacements and associated impacts over the life of the building.

Table 3 Main scenario assumptions

Module	Scenario assumptions
A1 to A3 – Product stage	Manufacturing data from British Steel's sites at Scunthorpe, Teesside and Hayange are used
A2 – Transport of semi-finished products to Teesside and Hayange	The semi-finished products are transported to Teesside and Hayange by road and rail from Scunthorpe. A utilisation factor of 45% was assumed to allow for empty returns and the distances travelled are 336km to Teesside (by rail) and 866km (by road and rail) to Hayange
C2 – Transport for recycling, reuse, and disposal	A transport distance of 100km to landfill or to a recycling site is assumed, while a distance of 250km is assumed for reuse. Transport is by road on a 27 tonne load capacity lorry with 40% utilisation to account for empty returns
C3 – Waste processing for reuse, recovery and/or recycling	There is no additional processing of material for recycling or reuse
C4 - Disposal	At end-of-life, 1% of the steel is disposed to landfill, in accordance with the findings of an NFDC survey
D – Reuse, recycling, and energy recovery	At end-of-life, 92% of the steel is recycled and 7% is reused, in accordance with the findings of an NFDC survey

4 Results of the LCA

Description of the system boundary

Product stage			Construction stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse Recovery Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X

X = Included in LCA; MND = module not declared

Environmental impact:

1 tonne of steel sections, rails and rolled billet

Parameter	Unit	A1 – A3	C2	C3	C4	D
GWP	kg CO ₂ eq	2.45E+03	8.98E+00	0.00E+00	1.49E-01	-1.60E+03
ODP	kg CFC11 eq	3.59E-12	1.48E-15	0.00E+00	8.64E-16	4.09E-12
AP	kg SO ₂ eq	6.05E+00	7.94E-03	0.00E+00	8.92E-04	-3.18E+00
EP	Kg PO ₄ ³⁻ eq	4.68E-01	1.83E-03	0.00E+00	1.01E-04	-2.24E-01
POCP	kg Ethene eq	1.54E+00	-1.35E-04	0.00E+00	6.96E-05	-7.74E-01
ADPE	kg Sb eq	7.84E-04	6.90E-07	0.00E+00	5.47E-08	-2.41E-02
ADPF	MJ	2.45E+04	1.21E+02	0.00E+00	2.08E+00	-1.51E+04

- GWP =

Global warming potential
- ODP =

Depletion potential of stratospheric ozone layer
- AP =

Acidification potential of land & water
- EP =

Eutrophication potential
- POCP =

Formation potential of tropospheric ozone photochemical oxidants
- ADPE =

Abiotic depletion potential for non-fossil resources
- ADPF =

Abiotic depletion potential for fossil resources

Resource use:

1 tonne of steel sections, rails and rolled billet

Parameter	Unit	A1 – A3	C2	C3	C4	D
PERE	MJ	6.26E+02	7.06E+00	0.00E+00	2.73E-01	9.52E+02
PERM	MJ	8.11E+00	0.00E+00	0.00E+00	0.00E+00	-5.68E-01
PERT	MJ	6.34E+02	7.06E+00	0.00E+00	2.73E-01	9.51E+02
PENRE	MJ	2.66E+04	1.31E+02	0.00E+00	2.32E+00	-1.51E+04
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.66E+04	1.31E+02	0.00E+00	2.32E+00	-1.51E+04
SM	kg	6.72E+01	0.00E+00	0.00E+00	0.00E+00	-4.70E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	1.43E+00	1.36E-01	0.00E+00	1.29E-02	-5.45E+00

PERE = Use of renewable primary energy excluding renewable primary energy resources 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 resources

SM = Use of secondary material

RSF = Use of renewable secondary fuels

NRSF = Use of non-renewable secondary fuels

FW = Use of net fresh water

Output flows and waste categories:

1 tonne of steel sections, rails and rolled billet

Parameter	Unit	A1 – A3	C2	C3	C4	D
HWD	kg	6.96E-05	0.00E+00	0.00E+00	0.00E+00	-4.87E-06
NHWD	kg	1.31E+02	0.00E+00	0.00E+00	1.00E+01	-9.20E+00
RWD	kg	1.09E-02	1.65E-04	0.00E+00	2.89E-05	-3.10E-04
CRU	kg	0.00E+00	0.00E+00	7.00E+01	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	9.20E+02	0.00E+00	0.00E+00
MER	kg	3.12E-01	0.00E+00	0.00E+00	0.00E+00	-2.18E-02
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

HWD = Hazardous waste disposed

NHWD = Non-hazardous waste disposed

RWD = Radioactive waste disposed

CRU = Components for reuse

MFR = Materials for recycling

MER = Materials for energy recovery

EEE = Exported electrical energy

EET = Exported thermal energy

5 Interpretation of results

Figure 3 shows the relative contribution per life cycle stage for each of the seven environmental impact categories for 1 tonne of steel sections, rails and rolled billet. Each column represents 100% of the total impact score, which is why all the columns have been set with the same length. A burden is shown as positive (above the 0% axis) and a benefit is shown as negative (below the 0% axis). The main contributors across all impact categories are A1-A3 (burdens) and D (benefits beyond the system boundary).

The manufacturing stage A1-A3 is responsible for almost 100% of the burden in most of the categories, specifically, the conversion of iron ore into liquid steel which is the most energy intensive part of the manufacturing process.

The primary site emissions come from the use of coal and coke in the blast furnace, and from the injection of oxygen into the basic oxygen furnace, as well as combustion of the process gases. These processes give rise to emissions of CO₂, which contribute 95% of the Global Warming Potential (GWP), and sulphur oxides, which are responsible for around 70% of the impact in the Acidification Potential (AP) category. In addition, oxides of nitrogen are emitted which contribute just over 25% of the A1-A3 Acidification Potential, over 90% of the Eutrophication Potential (EP). The combined emissions of sulphur and nitrogen oxides also contribute to the Photochemical Ozone indication (POCP) category, but the largest contributor to this indicator is actually carbon monoxide at more than 75%.

Figure 3 clearly indicates the relatively small contribution to each impact from the other life cycle stages, C2 through to C4. Of these stages, the most significant contributions are from C2, to the Eutrophication Potential, mainly the result of nitrogen oxides emissions from the combustion of diesel fuel used in road transport.

Module D values are largely derived using worldsteel's value of scrap methodology which is based upon many steel plants worldwide, including both BF/BOF and EAF steel production routes. At end-of-life, the recovered steel is modelled with a credit given as if it were re-melted in an Electric Arc Furnace and substituted by the same amount of steel produced in a Blast Furnace^[27]. This contributes a significant reduction to most of the environmental impact category results, but the Module D impact for the ODP indicator is a positive value and does not contribute a reduction to the total. In other words, for ODP, the recycling impact is larger than the impact of primary manufacture, and this burden comes from the way that the scrap credit is modelled.

Figure 3 LCA results for the steel sections, rails and rolled billet



For the ADPE indicator, the benefit in Module D is much greater than the impact from manufacturing in A1-A3 and this results from the worldsteel 'value of scrap' calculation being based on many steel plants worldwide. In the case of ADPE, the Module D benefit is greater than the steel manufacturing burden because the Scunthorpe liquid steel production process is more efficient than the average (the Module D benefit being a reflection of the world-wide steel plant average).

Referring to the LCA results, the impact in Module D for the Use of Renewable Primary Energy indicator (PERT) is different to other impact categories, being a burden or load rather than a benefit. Renewable energy consumption is strongly related to the use of electricity, during manufacture, and as the recycling (EAF) process uses significantly more electricity than primary manufacture (BF/BOS), there is a positive value for renewable energy consumption in Module D but a negative value for non-renewable energy consumption.

For use of net fresh water, Module D is a benefit, but the magnitude of this benefit is greater than the impact from Modules A1-A3. Once again, this is a result of the way Module D is calculated. Scunthorpe is a relatively modest user of fresh water, and the worldwide average calculation for Module D includes many sites with considerably greater fresh water use in A1-A3 than Scunthorpe.

6 References and product standards

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