TATA STEEL

TATA

Building and Industrial Services Pressure Pipework

Environmental Product Declaration

CONTENTS

Building and Industrial Services Pressure Pipework
Environmental Product Declaration
(in accordance with ISO 14025 and EN 15804)

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

Declaration Number: EPD-TS-2022-026
Date of Issue: 4th November 2022
Valid until: 3rd November 2027

Owner of the Declaration: Tata Steel Europe
Programme Operator: Tata Steel UK Limited, 18 Grosvenor Place, London, SW1X 7HS

The CEN standard EN 15804:2012+A2:2019 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: Chris Foster, Eugeos Ltd.

1 General information

Owner of EPD	Tata Steel Europe
Product	Building and Industrial Services Pressure Pipework
Manufacturer	Tata Steel UK
Manufacturing sites	Corby, Hartlepool and Port Talbot
Product applications	Conveyance of pressurised fluid in building and industrial systems such as heating systems, ventilation, and steam conveyance
Declared unit	1 tonne of steel product
Date of issue	7th November 2022
Valid until	6th November 2027

This Environmental Product Declaration (EPD) is for all building and industrial systems pipework "conveyance" products, manufactured by Tata Steel in the UK as the Inline®, Inflow®, and Install® product families. The environmental indicators are average values for hot finished conveyance products from Corby and Hartlepool, with feedstock supplied from Port Talbot.

The information in this Environmental Product Declaration is based on production data from 2017.

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].

Third party verifier

Chris Foster, Eugeos Ltd, Suite 11, The Old Fuel Depot, Twemlow Lane, Twemlow, CW4 8GJ, UK

2 Product information

2.1 Product Description

Tata Steel Building and Industrial Services (B&IS) carbon steel pressure pipework is manufactured in the UK at Corby (≥OD21.3mm ≤OD193.7mm) and Hartlepool (≥OD219.1mm ≤OD508.0mm) and in a range of wall thicknesses from 2 mm to 16 mm. Using proven process routes, premium hot-finished tube products are provided with true application benefits. Made using fully killed, fine grain steel, produced at steelmaking facilities in Port Talbot, these 'conveyance' tubes combine high yield strength for high pressure integrity, with lower carbon content for improved weldability and other installation benefits. The integrity of these products is proven by both destructive and non-destructive testing to ensure that a wide range of conveyance and pressure uses is possible.

B&IS pressure pipework is supplied in accordance with relevant pipework standards (BS, EN, ISO, API etc) that demonstrate suitability for low and elevated temperature use. A multi-standard product approach enables these products to satisfy the widest range of application requirements. Such applications include Heating, Ventilation and Air Conditioning (HVAC) systems, building services, balance of plant, process pipe, sprinkler systems, boiler tubes, and on-shore linepipe applications.

The B&IS pressure pipework product range includes a variety of coating and end finishing options. However, as most of the sold product includes neither of these options, the environmental impacts presented in this document represent the base steel B&IS pressure pipework product with no additional coating or end finishing.

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
Port Talbot	Hot rolled coil	Tata Steel	UK
Corby	B&IS pressure pipework	Tata Steel	UK
Hartlepool	B&IS pressure pipework	Tata Steel	UK

The process of conveyance tube manufacture at Tata Steel begins with sinter and/or pellet being produced from iron ore and limestone, and together with coke from coal, reduced in a blast furnace to produce 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. The liquid steel is continuously cast into discrete slabs, which are subsequently reheated and rolled in a hot strip mill to produce steel coil, the primary feedstock of the conveyance tube manufacturing process. The hot rolled coils are transported from Port Talbot by a combination of rail and truck to the tube manufacturing sites of Corby and Hartlepool. An overview of the process from raw materials to hot rolled coil is shown in Figure 1.

The tube making process begins with the uncoiling, levelling and slitting of the hot rolled coil, which is then passed through a series of shaped rolls that gradually form the flat strip into a circular section. The two strip edges, now adjacent to one another, are welded using a high frequency induction process. Both external and internal weld beads are trimmed in-line before the tube undergoes mid-frequency induction heating.

100% non-destructive testing is performed in-line on the weld-seam to ensure integrity, then the tubes are cut to length prior to despatch. An overview of the process from hot rolled coil to B&IS pressure pipework is shown in Figure 2.

Process data for the manufacture of hot rolled coil at Port Talbot was gathered as part of the latest data collection on behalf of worldsteel. For Port Talbot and the tube making sites, the data collection was not only organised by site, but also by each process within each site. In this way it was possible to attribute resource use and emissions to each process, and using processed tonnage data, also attribute resources and emissions to specific products.

Figure 1 Process overview from raw materials to hot rolled coil

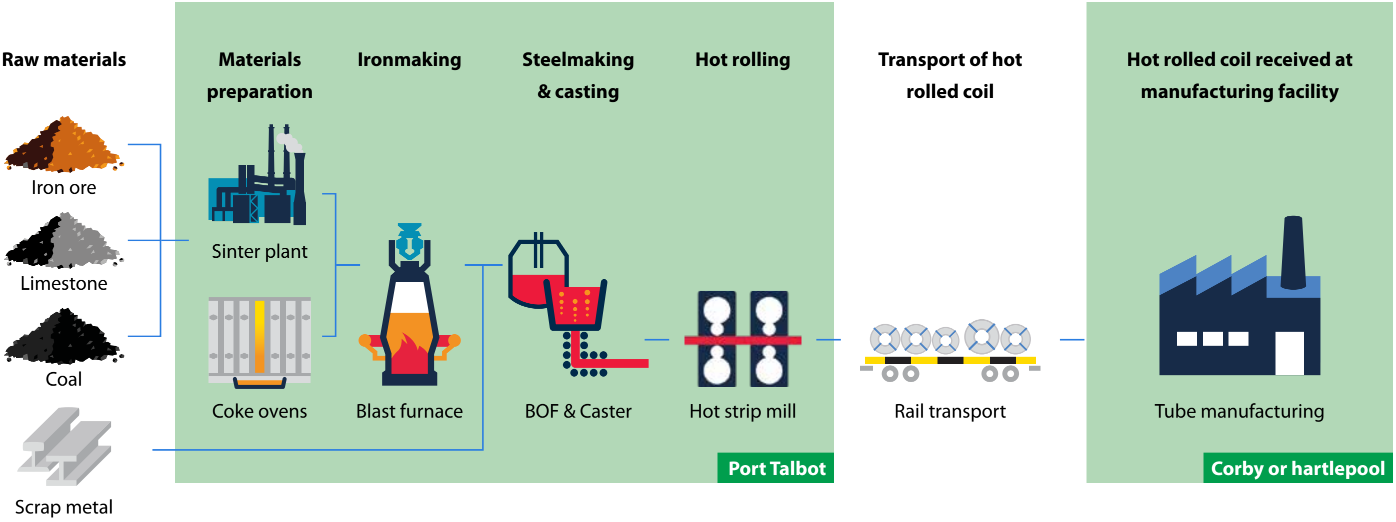
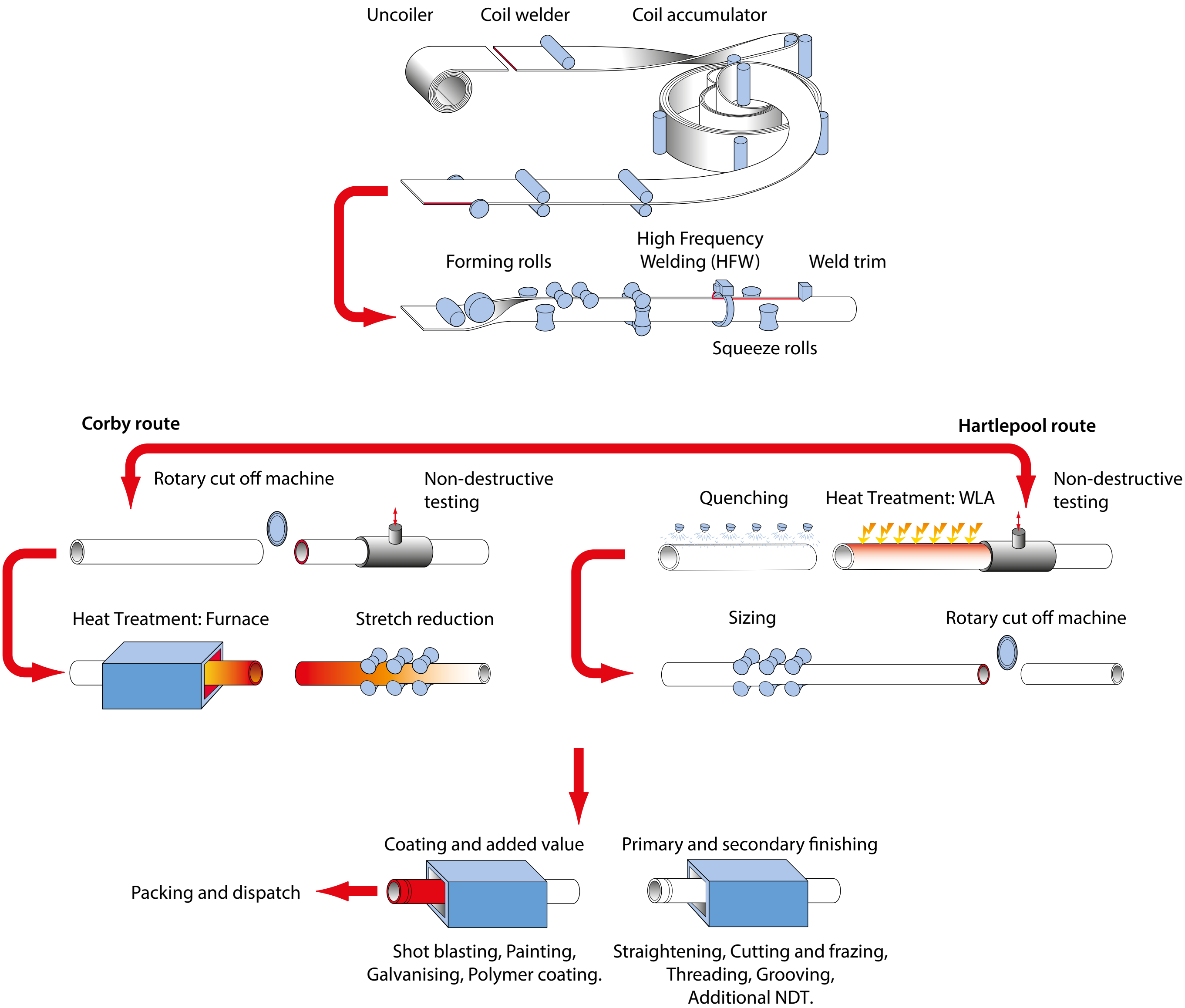


Figure 2 Process overview from hot rolled coil to B&IS pressure pipework



2.3 Technical data and specifications

The general properties of B&IS pressure pipework are shown in Table 2, and the technical specifications of B&IS pressure pipework are presented in Table 3. The relevant European standards for B&IS pressure pipework are EN 10255[8] and EN 10217-2&3 [9,10].

Table 2 General properties of B&IS pressure pipework

	B&IS pressure pipework
Density (kg/m³)	7850
Modulus of elasticity (N/mm²)	210000
Coefficient of thermal expansion (10^{-6} /K)	12
Thermal conductivity (W/mK)	48
Melting point (°C)	1520
Electrical conductivity at 20°C (/Ωm)	3.9

Table 3 Technical specification of B&IS pressure pipework

	B&IS pressure pipework
Specification	EN 10255 S195G, S235GT EN 10217-2 P235GH, P265GH EN 10217-3 P355N/NH, API5LB
Yield strength (N/mm²)	195 - 355
Tensile strength (N/mm²)	320 - 650
Elongation	20-25%
Impact strength (Joules)	N/A
Carbon equivalent (max)	0.43
Certification	Product certification 2.2, 3.1, 3.2 [11] Certifications applicable to Tata Steel's Corby and Hartlepool sites: ISO 9001 [12], ISO 14001 [13], BES 6001 [14]

2.4 Packaging

Structural hollow sections are not normally painted or galvanised at Corby or Hartlepool as this is usually carried out after fabrication, and prior to this, the sections would be pickled or blast cleaned. Therefore the normal despatch from the tube mills merely consists of sheeting the load or enclosing in covered trailers. The tubes are secured for transport using steel banding and clips, timbers and anti-slip mats. The mass of this packaging is 0.6kg/tonne for steel banding and clips, 3.1kg/tonne for timber, and 0.2kg/tonne for anti-slip mats.

2.5 Reference service life

A reference service life for structural hollow sections is not declared because they can be used in a variety of different forms of construction, and the final construction application is not defined. To determine the full service life of structural hollow sections, all factors would need to be included such as location and environment, corrosion protection, and fire protection. Corrosion and fire protection are usually applied during installation on site. Under 'normal' conditions, structural hollow sections would not need to be replaced over the life of the building or structure.

Structural hollow steel sections can be recovered and re-used or recycled repeatedly without loss of quality as a building material and they comply with the requirements of construction product class A1 (non-combustible). Celsius® is supplied with full certification, declaration of performance (DoP) & factory production control (FPC) ensuring full traceability during and after the original service life.

2.6 Biogenic Carbon content

There are no biogenic carbon containing materials in the product. The biogenic carbon content of the packaging materials is shown in Table 4.

Table 4 Biogenic carbon content at the factory gate

	B&IS pressure pipework
Biogenic carbon content (product) (kg C)	0
Biogenic carbon content (packaging) (kg C)	1.53

Note: 1kg biogenic carbon is equivalent to 44/12 kg of CO_2

3 Life Cycle Assessment (LCA) methodology

3.1 Declared unit

The unit being declared is 1 tonne of steel B&IS pressure pipework

3.2 Scope

This EPD can be regarded as Cradle-to-Gate with modules C and D and the specific modules considered in the LCA are;

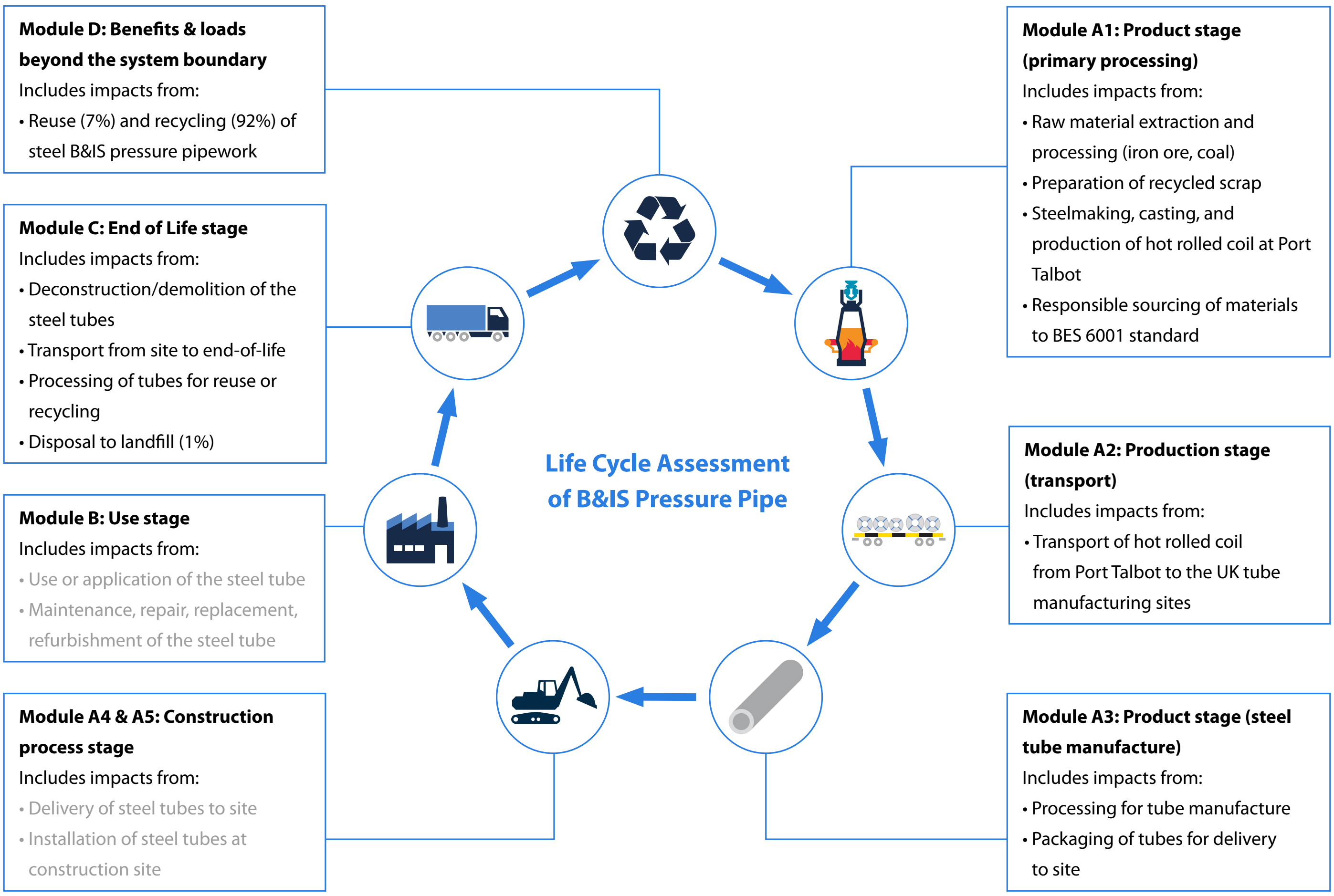
A1-A3: Production stage (raw material supply, transport to production site, manufacturing)
C1-C4: End-of-life (demolition/deconstruction, transport, processing for recycling and disposal)
D: Reuse, recycling and recovery

The life cycle stages are explained in more detail in Figure 4, but where the text is in light grey, the impacts from this part of the life cycle are not considered.

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 B&IS pressure pipework have been omitted. On this basis, there is no evidence to suggest that inputs 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.

Figure 3 Life Cycle Assessment of hot finished structural hollow sections



3.4 Background data

For life cycle modelling of steel B&IS pressure pipework, the GaBi Software System for Life Cycle Engineering is used [15]. The GaBi database contains consistent and documented datasets which can be viewed in the online GaBi documentation [16].

Specific data derived from Tata Steel's own production processes at Port Talbot and the tube manufacturing sites, 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 Tata Steel's own production processes are from 2016 and 2017, 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 datasets took place less than 10 years ago. An assessment of the quality of data used in this study has been made using the scheme provided in the UN Environment Global Guidance on LCA database development, referenced in EN 15804. The study is considered to be based on good 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 [17].

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 continuously cast steel slabs at Port Talbot, 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 [18]. 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 5. The end-of-life percentages are taken from a Tata Steel/ EUROFER recycling and re-use survey of UK demolition contractors carried out in 2012 [19].

For all indicators the characterisation factors from the EC-JRC are applied, identified by the name EN_15804, and based upon the EF Reference Package 3.0 [20]. In GaBi, the corresponding impact assessment is used, denoted by 'EN 15804+A2'.

The values presented in the LCA results tables of section 4 are tonnage weighted average values for B&IS pipe products produced across the UK sites

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 data sets 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/infrastructure assessment, in order to capture any differences in other aspects of the building or infrastructure 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 or infrastructure, or, a higher strength product may require less material for the same function.

Table 5 Main scenario assumptions

Module	Scenario assumptions
A1 to A3 – Product stage	Manufacturing data from Tata Steel's sites at Port Talbot, Corby and Hartlepool (UK) are used
A2 – Transport to the tube manufacturing site	The hot rolled coils are transported from Port Talbot to Corby a distance of 476km and from Port Talbot to Hartlepool a distance of 721km, on a 726t load capacity diesel/electric train. A load capacity utilisation of 0.45 is assumed to allow for empty returns and the proportion of the journeys powered by diesel and by electricity, are approximately 50% for each.
C1 – Deconstruction and demolition	Energy consumption estimated based upon published data for the dismantling of steel constructions in Germany [21]
C2 – Transport for recycling, reuse, and disposal	In the UK, a distance of 250km is assumed from the installation site to both recycling and reuse, on a 25t load capacity truck, and a distance of 100km is assumed from the installation site to landfill. A load capacity utilisation of 0.45 is assumed to allow for empty returns.
C3 – Waste processing for reuse, recovery and/or recycling	This considers the energy associated with cutting the tubes for recycling and is based upon the same data as C1
C4 - Disposal	At end of life, 1% of product is disposed to landfill
D – Reuse, recycling, and energy recovery	At end of life, 92% of product is recycled and 7% is re-used

Please note that in the GaBi software, an empty return journey is accounted for by halving the load capacity utilisation of the outbound journey.

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	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X

X = Included in LCA; ND = module not declared

Environmental impact:

1 tonne of B&IS pipe product

Parameter	Unit	A1 – A3	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	2.68E+03	4.29E+01	2.04E+01	6.94E-01	1.45E-01	-1.57E+03
GWP-fossil	kg CO_2 eq	2.68E+03	4.28E+01	2.06E+01	6.91E-01	1.49E-01	-1.57E+03
GWP-biogenic	kg CO_2 eq	4.19E+00	6.27E-02	-1.93E-01	2.59E-03	-4.42E-03	4.76E-01
GWP-luluc	kg CO_2 eq	5.35E-01	6.90E-04	2.87E-04	5.20E-05	2.75E-04	-4.80E-02
ODP	kg CFC11 eq	1.72E-09	1.11E-11	2.69E-12	3.19E-12	3.51E-13	-1.20E-10
AP	mol H^+ eq	8.41E+00	4.47E-02	6.77E-02	1.07E-03	1.06E-03	-3.44E+00
EP-freshwater	kg PO_4 eq	7.41E-04	9.99E-06	4.15E-06	8.60E-07	2.53E-07	-2.96E-04
EP-marine	kg N eq	1.82E+00	1.47E-02	3.21E-02	3.04E-04	2.71E-04	-6.19E-01
EP-terrestrial	mol N eq	1.95E+01	1.63E-01	3.53E-01	3.29E-03	2.97E-03	-5.55E+00
POCP	kg NMVOC eq	6.70E+00	4.79E-02	6.30E-02	9.47E-04	8.22E-04	-2.49E+00
ADP-minerals&metals	kg Sb eq	1.99E-04	1.54E-06	1.28E-06	7.85E-08	1.53E-08	-3.69E-03
ADP-fossil	MJ net calorific value	2.84E+04	5.63E+02	2.71E+02	1.04E+01	1.95E+00	-1.46E+04
WDP	m^3 world eq deprived	7.86E+02	2.22E-01	2.69E-02	5.40E-02	1.64E-02	-3.00E+02
PM	Disease incidence	ND	ND	ND	ND	ND	ND
IRP	kBq U235 eq	ND	ND	ND	ND	ND	ND
ETP-fw	CTUe	ND	ND	ND	ND	ND	ND
HTP-c	CTUh	ND	ND	ND	ND	ND	ND
HTP-nc	CTUh	ND	ND	ND	ND	ND	ND
SQP		ND	ND	ND	ND	ND	ND

GWP-total = Global Warming Potential total
GWP-fossil = Global Warming Potential fossil fuels
GWP-biogenic = Global Warming Potential biogenic
GWP-luluc = Global Warming Potential land use and land use change
ODP = Depletion potential of stratospheric ozone layer
AP = Acidification potential, Accumulated Exceedance
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment
EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment
EP-terrestrial = Eutrophication potential, Accumulated Exceedance
POCP = Formation potential of tropospheric ozone
ADP-minerals&metals = Abiotic depletion potential for non-fossil resources
ADP-fossil = Abiotic depletion potential for fossil resources
WDP = Water (user) deprivation potential, deprivation-weighted water consumption
PM = Potential incidence of disease due to PM emissions
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
SQP = Potential soil quality index
The following indicators should be used with care as the uncertainties on these results are high or as there is limited experience with the indicator : ADP-minerals&metals, ADP-fossil, and WDP.

Resource use:

1 tonne of B&IS pipe product

Parameter	Unit	A1 – A3	C1	C2	C3	C4	D
PERE	MJ	1.83E+03	7.64E+00	1.09E+01	2.20E+00	2.93E-01	7.51E+02
PERM	MJ	3.99E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.79E+00
PERT	MJ	1.87E+03	7.64E+00	1.09E+01	2.20E+00	2.93E-01	7.48E+02
PENRE	MJ	2.84E+04	5.63E+02	2.73E+02	1.04E+01	1.96E+00	-1.46E+04
PENRM	MJ	4.06E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.84E-01
PENRT	MJ	2.84E+04	5.63E+02	2.73E+02	1.04E+01	1.96E+00	-1.46E+04
SM	kg	6.76E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.15E-01
RSF	MJ	0.00E+00	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	0.00E+00
FW	m^3	1.96E+01	8.81E-03	1.63E-03	2.20E-03	4.97E-04	-6.85E+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 = Input 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 B&IS pipe product

Parameter	Unit	A1 – A3	C1	C2	C3	C4	D
HWD	kg	1.11E-05	1.90E-09	7.11E-10	3.89E-10	1.00E-10	-4.77E-07
NHWD	kg	1.90E+02	1.29E-01	2.17E-02	4.34E-03	2.00E+01	1.99E+02
RWD	kg	2.38E-01	1.94E-03	4.29E-04	6.33E-04	2.17E-05	-1.46E-02
CRU	kg	0.00E+00	0.00E+00	0.00E+00	7.00E+01	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	9.20E+02	0.00E+00	0.00E+00
MER	kg	2.21E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.55E-01
EEE	MJ	0.00E+00	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	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 4 shows the relative contribution per life cycle stage for selected environmental impact categories for 1 tonne of Tata Steel's B&IS pressure pipework. 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 the impact categories are A1-A3 (burdens) and D (benefits beyond the system boundary). The manufacture of hot rolled coil during stage A1-A3 is responsible for over 90% of each impact in almost all of the categories, specifically, the conversion of iron ore into liquid steel which is the most energy intensive part of the overall tube manufacturing process.

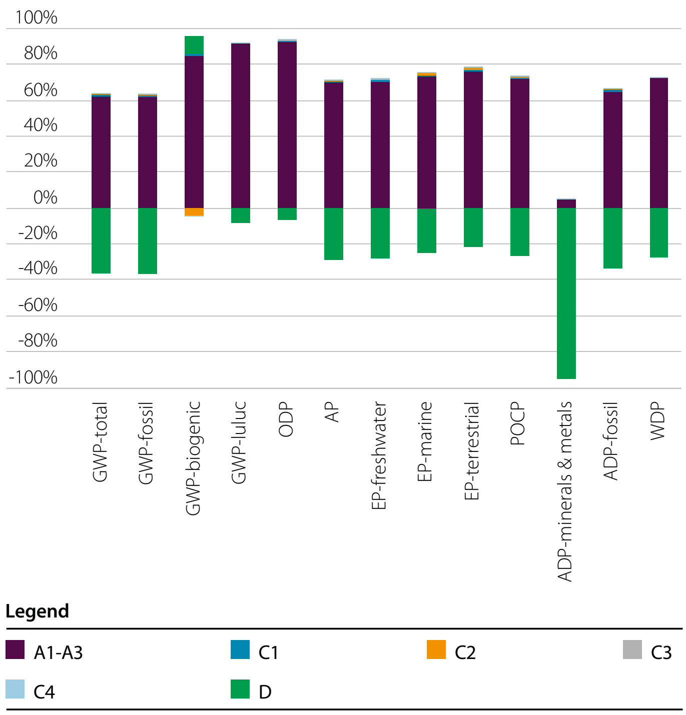
The primary site emissions come from the use of coal and coke in the blast furnace, and from the injection of oxygen into the basic oxygen furnace, as well as combustion of the process gases. These processes give rise to emissions of CO_2, which contributes 89% of the Global Warming Potential (GWP), and sulphur oxides, which are responsible for 60% of the impact in the Acidification Potential (AP) category. In addition, oxides of nitrogen are emitted which contribute 39% of the A1-A3 Acidification Potential, and over 95% of the Eutrophication Potentials (EP-marine and EP-terrestrial), and the combined emissions of nitrogen oxides (67%) together with sulphur oxides, carbon monoxide and methane, contribute to the Photochemical Ozone indication (POCP).

Figure 4 clearly indicates the relatively small contribution to each impact from the other life cycle stages, which are the end-of-life stages C1 to C4.

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 pipe 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 [17]. The specific emissions that represent the burden in A1-A3, are essentially the same as those responsible for this Module D credit. It is important that the life cycle of the steel product is considered here, because in most cases, the Module D credit provides significant benefits in terms of reducing the overall environmental impacts across successive uses.

It is worth noting that for the ADP-minerals & metals indicator, the benefit in Module D is much greater than the manufacturing impact in A1-A3. This is a feature of the worldsteel 'value of scrap' calculation being based upon many steel plants worldwide. The tube making process does not consume zinc, so this burden is small when compared with the 'value of scrap' which features significant recovery of zinc from recycling in electric arc furnaces. Additionally, the GWP-bio indicator shows a small burden from module D, which comes from biogenic carbon emissions arising from the processes involved in recycling scrap.

Figure 4 LCA results for B&IS



Referring to the LCA results, the impact in Module D for the Use of Renewable Primary Energy indicator (PERT) is also different to the 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.

There is some variation of environmental impacts between the two tube manufacturing sites. This is highlighted in Table 6, which shows that the variations are mostly within 10% of the declared values and originate from differences in energy consumption at the sites and the transport of the feedstock hot rolled coil.

Table 6 Variation in A1-A3 impact by tube manufacturing site

	A1-A3 declared value	Maximum difference from declared value (by site) (%)
GWP total [kg CO_2 eq]	2680	6
ODP [kg CFC11 eq]	1.72E-9	66
AP [mol H^+ eq]	8.41	3
EP-freshwater [kg P eq]	7.41E-04	11
EP-marine [kg N eq]	1.82	4
EP-terrestrial [mol N eq]	19.5	4
POCP [kg NMVOC eq]	6.70	4
ADP-m&m [kg Sb eq]	1.99E-04	8
ADP fossil [MJ]	28400	9

6 References and product standards

1. Tata Steel's EN 15804 verified EPD programme, General programme instructions, V2 January 2022

2. Tata Steel's EN 15804 verified EPD programme, Product Category Rules Part 1, V2 January 2022

3. Tata Steel's EN 15804 verified EPD programme, Product Category Rules Part 2 – Structural Steels, V2 January 2022

4. ISO 14044:2006, Environmental management - Life Cycle Assessment - Requirements and guidelines

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6. ISO 14040:2006, Environmental management - Life Cycle Assessment - Principles and framework

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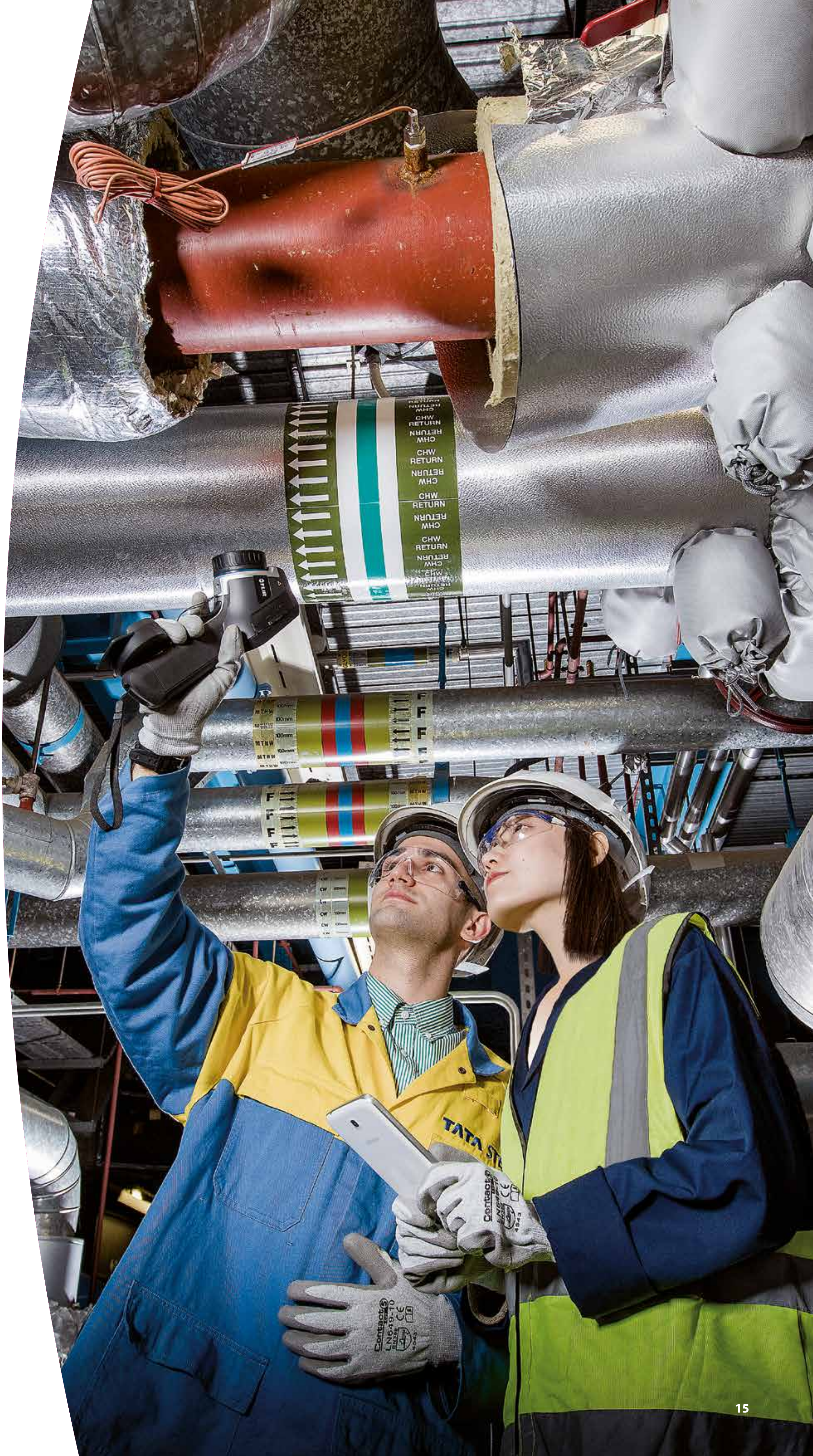
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