TATA STEEL

TATA

High Frequency Welded Pipe for Onshore & Offshore Linepipe and OCTG applications

Environmental Product Declaration

CONTENTS

High Frequency Welded Pipe for Onshore & Offshore Linepipe and OCTG applications
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-2022-002
Date of Issue: 3rd March 2022
Valid until: 2nd March 2027

Owner of the Declaration: Tata Steel UK
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 UK
Product & module	High Frequency Welded Pipe for Onshore & Offshore Linepipe and OCTG applications
Manufacturer	Tata Steel UK
Manufacturing sites	Hartlepool and Port Talbot
Product applications	Oil and gas extraction and transportation
Declared unit	1 tonne of steel HFW pipe
Date of issue	3rd March 2022
Valid until	2nd March 2027

This Environmental Product Declaration (EPD) is for HFW (High Frequency Welded) Pipe for Onshore & Offshore Linepipe and OCTG (Oil Country Tubular Goods) applications, manufactured by Tata Steel in the UK. The environmental indicators are for linepipe products from 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

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2 Product information

2.1 Product description

Tata Steel produce a wide range of High Frequency Welded (HFW) pipe for oil and gas extraction and transportation applications, with Figure 1 showing a linepipe being reeled onto a lay vessel, which ultimately unreels the pipe onto the seabed. The pipe is produced in diameters from 219.1mm (8") to 508mm (20") external diameter, and from 8mm to 16.3mm wall thickness. HFW pipe is available in a wide range of grades for both onshore and offshore linepipe applications as well as surface casing and OCTG, including grades B, X52, X60, X65 and X70 for offshore linepipe and casing in J55 and H40 grades.

HFW pipe is produced through a fully integrated supply chain which ensures an optimised product route with targeted investment to produce the highest integrity pipe, mitigation of logistical and schedule risks, and a coordinated and coherent philosophy of continuous improvement across safety, environmental and technical performance.

This integrated process delivers enhanced mechanical properties in the pipe body and weld through a combination of weld line annealing and full body heat treatment. This process ensures both enhanced mechanical performance and, in combination with digital process control, NDT (Non-Destructive Testing) and digital metrology, an HFW pipe product of the highest integrity for safety critical applications. The tight wall thickness tolerances achieved with HFW pipe are recognised in the API 5L standard [8], enabling significant potential material savings when compared with an equivalent seamless linepipe solution.

Tata Steel's supply chain management goes beyond these integrated processes with a fully audited and certified 'responsibly sourced' supply chain in accordance with BES 6001 [9].

Figure 1 HFW pipe for oil and gas extraction and transportation

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
Hartlepool	HFW pipe	Tata Steel	UK

The process of steel pipe manufacture at Tata Steel begins with sinter 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 pipe manufacturing process. The hot rolled coils are transported by rail, from Port Talbot to the Hartlepool HFW pipe manufacturing site. An overview of the process from raw materials to the hot rolled coil being received at Hartlepool is shown in Figure 2.

The pipe making process is shown in detail in Figure 3 and begins with the uncoiling and levelling 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 and a further set of rolls effect the final shaping and sizing of the pipe. 100% NDT is performed in-line on the weld-seam to ensure integrity. Depending on the final application, weld line annealing can be performed in-line or the pipe can be full-body heat-treated. Depending on customer specifications, end facing and bevelling, weld-seam or full-body ultrasonic testing and hydrostatic testing are performed.

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 both Port Talbot and Hartlepool, 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 2 Process overview from raw materials to hot rolled coil

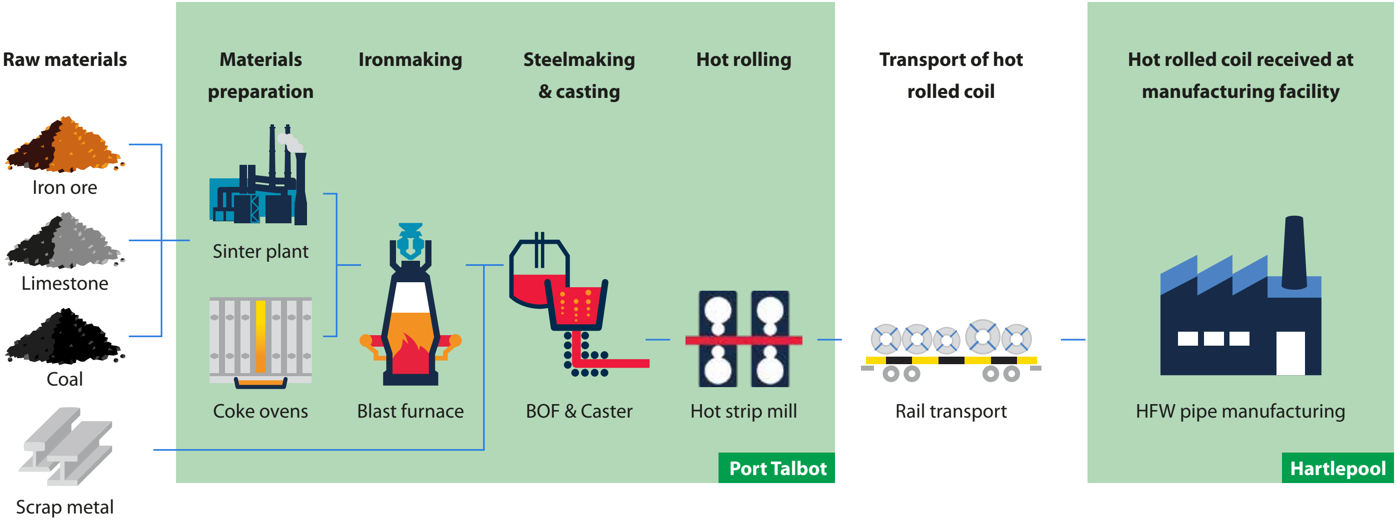
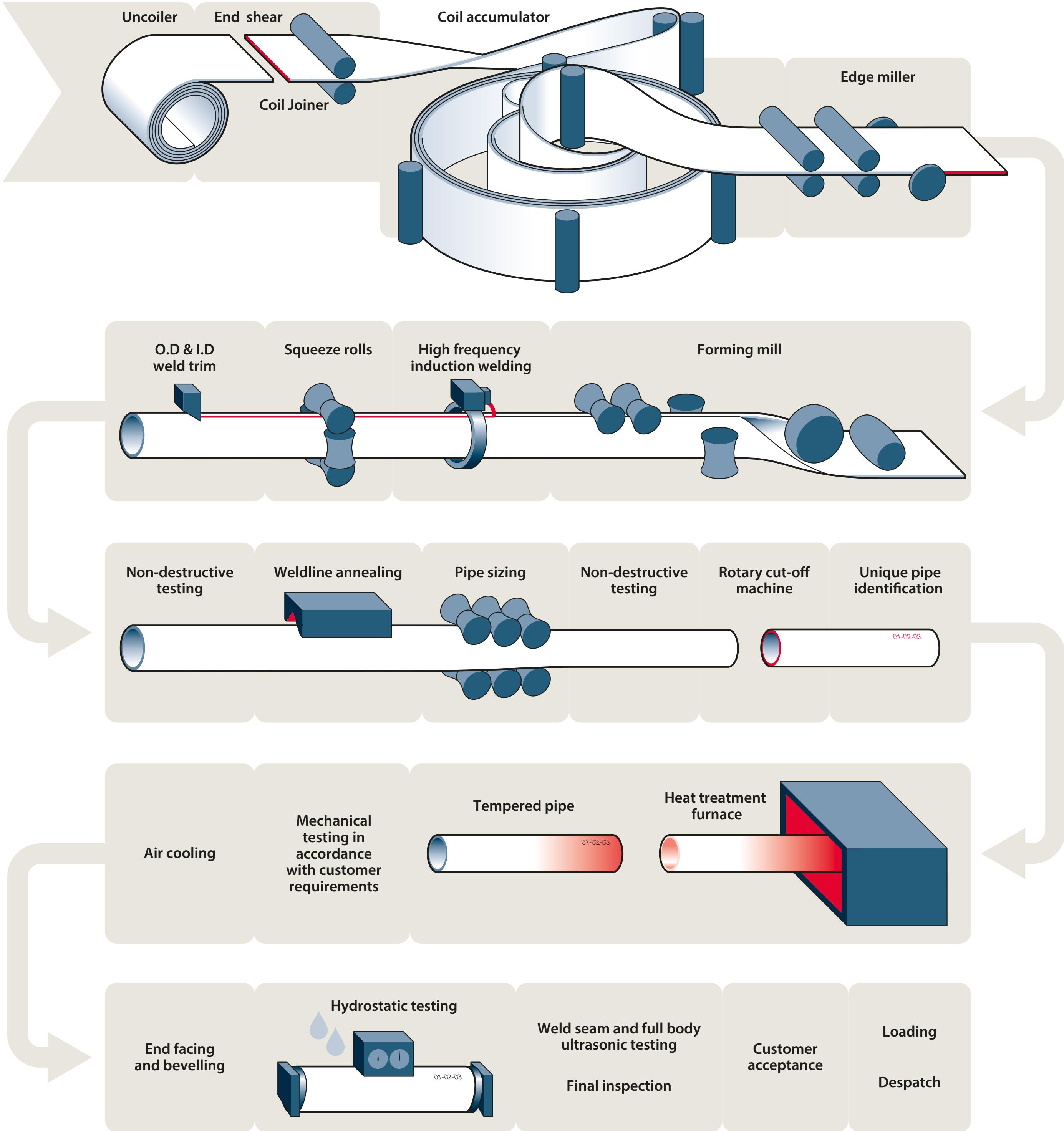


Figure 3 Process overview from hot rolled coil to HFW pipe



2.3 Technical data and specifications

HFW pipe for onshore and offshore linepipe and OCTG applications is manufactured to a range of detailed specifications depending on customer requirements. The general properties are shown in Table 2, while Table 3 presents the typical range of technical specifications for these applications.

Table 2 General properties of HFW pipe

	HFW pipe
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 HFW pipe

	HFW Pipe
Specification	API 5L [8] / ISO 3183 [10] grade BM to X70M DNV-ST-F101 [11] 245-285 API 5CT [12] H40 to J55
Yield Strength (N/mm²)	245 - 635
Tensile Strength (N/mm²)	414 - 760
Elongation	20% - 30%
Impact Strength (min) (Joules)	27 - 50
Carbon equivalent (max)	0.19 – 0.25
Certification	Product certification 3.1 or 3.2 [13] Applicable to Tata Steel's Hartlepool site; ISO 9001 [14], ISO 14001 [15], BES 6001 [9] TÜV Nord [16], LRQA [17]

2.4 Packaging

The HFW pipe is secured for transport using steel banding and clips, timbers and anti-slip mats. The mass of this packaging is 0.02kg/tonne for steel banding and clips, 3kg/tonne for timber, and 0.2kg/tonne for anti-slip mats.

2.5 Reference service life

The service life for HFW pipe in onshore and offshore linepipe and OCTG applications can vary significantly and therefore a reference service life is not declared. HFW pipe is generally used in installations with a defined expected life, which may be extended beyond the initial design-life. Assumptions regarding end-of-life treatment of HFW pipe are detailed later in this document, but wherever it is feasible to do so, the steel pipes are recovered and recycled. For applications where the pipe is buried, it is generally left in-situ.

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

	HFW pipe
Biogenic carbon content (product) (kg C)	0
Biogenic carbon content (packaging) (kg C)	1.5

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

3 LCA methodology

3.1 Declared unit

The unit being declared is 1 tonne of steel HFW pipe.

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 the steel pipe 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.

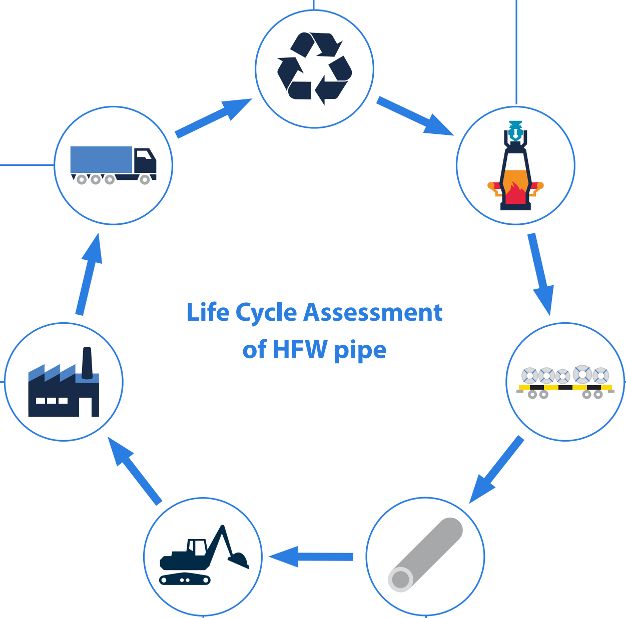
Figure 4 Life Cycle Assessment of HFW pipe

Module D: Benefits & loads beyond the system boundary
Includes impacts from;
- HFW pipe reuse (0%) and recycling of the steel component (see Table 5)

Module C: End-of-life stage
Includes impacts from:
- Deconstruction/demolition of the HFW pipe
- Transport from site to end-of-life
- Processing of HFW pipe for reuse or recycling
- Disposal to landfill of steel (0%) and other system components

Module B: Use stage
Includes impacts from;
- Use or application of the HFW pipe
- Maintenance, repair, replacement, refurbishment of the HFW pipe

Modules A4 & A5: Construction process stage
Includes impacts from;
- Delivery of HFW pipe and other components to site
- Installation of HFW pipe at construction site



Module A1: Product stage (primary processing)
Includes impacts from;
- Raw material extraction and processing (iron ore, coal)
- Preparation of recycled scrap
- Steelmaking, casting, and production of hot rolled coil at Port Talbot
- Responsible sourcing of materials to BES 6001 standard

Module A2: Product stage (transport)
Includes impacts from;
- Transport of hot rolled coil to HFW pipe manufacturing at Hartlepool

Module A3: Product stage (HFW pipe manufacture)
Includes impacts from;
- Processing for HFW pipe manufacture
- Packaging of HFW pipe for delivery to site

3.4 Background data

For life cycle modelling of steel HFW pipe, the GaBi Software System for Life Cycle Engineering is used [18]. The GaBi database contains consistent and documented datasets which can be viewed in the online GaBi documentation [19].

Specific data derived from Tata Steel's own production processes at Port Talbot and Hartlepool 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 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 [20]. 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 [21]. 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 as follows. Since OCTG pipe is usually buried, the conservative estimate is 0 / 0 / 100 (% reused / % recycled / % left in situ). For offshore linepipe, the estimate is 0 / 0 / 100 based upon a paper from the 36th International Conference on Ocean, Offshore and Arctic Engineering [22], and for onshore linepipe it is 0 / 75 / 25 which is a Tata Steel estimate based upon anecdotal evidence.

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 [23]. 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 across the three HFW pipe products made at Hartlepool, those for onshore, offshore and OCTG applications.

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 an allowance for installation), 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 Hartlepool and Port Talbot are used
A2 – Transport to the HFW pipe manufacturing site	The hot rolled coils are transported 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 journey powered by diesel is 36% and by electricity, 64%
C1 – Deconstruction and demolition	Energy consumption estimated based upon published data for the dismantling of steel constructions in Germany [24]
C2 – Transport for recycling, reuse, and disposal	A distance of 250km is assumed from the installation site to recycling on a 25t load capacity truck. 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 pipe for recycling and is based upon the same data as C1
C4 - Disposal	There is no impact from disposal as the non-recycled pipes are left in situ. This is 100% for the OCTG and offshore linepipe product, and 25% for the onshore product
D – Reuse, recycling, and energy recovery	No reuse of HFW pipe is assumed. It is also assumed that no OCTG or offshore linepipe is recycled, but anecdotal evidence [25] suggests that approximately 75% of onshore linepipe is recovered and recycled

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 HFW pipe

Parameter	Unit	A1 – A3	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	2.51E+03	1.15E+00	1.36E+01	2.03E-01	0.00E+00	-9.65E+02
GWP-fossil	kg CO_2 eq	2.51E+03	1.44E+00	1.36E+01	2.01E-01	0.00E+00	-9.65E+02
GWP-biogenic	kg CO_2 eq	-3.67E+00	-3.69E-01	4.90E-02	1.77E-03	0.00E+00	-6.26E-01
GWP-luluc	kg CO_2 eq	5.31E-01	6.75E-02	2.00E-03	2.23E-04	0.00E+00	1.40E-01
ODP	kg CFC11 eq	2.11E-12	5.29E-15	2.90E-15	3.67E-15	0.00E+00	-1.61E-12
AP	mol H^+ eq	8.11E+00	6.29E-03	4.44E-02	4.82E-04	0.00E+00	-1.73E+00
EP-freshwater	kg PO_4 eq	6.41E-04	2.49E-05	4.43E-06	4.94E-07	0.00E+00	-1.97E-04
EP-marine	kg N eq	1.73E+00	1.43E-03	2.10E-02	1.04E-04	0.00E+00	-2.59E-01
EP-terrestrial	mol N eq	1.86E+01	1.78E-02	2.31E-01	1.11E-03	0.00E+00	-2.52E+00
POCP	kg NMVOC eq	6.41E+00	4.95E-03	4.12E-02	3.49E-04	0.00E+00	-1.32E+00
ADP-minerals&metals	kg Sb eq	1.86E-04	7.86E-07	7.11E-07	5.58E-08	0.00E+00	-2.10E-03
ADP-fossil	MJ net calorific value	2.57E+04	1.16E+02	1.82E+02	7.22E+00	0.00E+00	-8.40E+03
WDP	m^3 world eq deprived	7.75E+02	1.03E-01	1.92E-02	2.74E-02	0.00E+00	-1.90E+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 (cancer)
HTP-nc = Potential Comparative Toxic Unit for humans (non-cancer)
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 HFW pipe

Parameter	Unit	A1 – A3	C1	C2	C3	C4	D
PERE	MJ	9.64E+02	7.57E+00	4.59E+00	1.26E+00	0.00E+00	7.73E+02
PERM	MJ	3.90E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.00E+03	7.57E+00	4.59E+00	1.26E+00	0.00E+00	7.73E+02
PENRE	MJ	2.57E+04	1.17E+02	1.83E+02	7.23E+00	0.00E+00	-8.41E+03
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.57E+04	1.17E+02	1.83E+02	7.23E+00	0.00E+00	-8.41E+03
SM	kg	8.19E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	1.90E+01	8.52E-03	1.42E-03	1.30E-03	0.00E+00	-4.25E+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 HFW pipe

Parameter	Unit	A1 – A3	C1	C2	C3	C4	D
HWD	kg	1.08E-05	6.55E-09	2.30E-09	7.48E-10	0.00E+00	2.35E-06
NHWD	kg	1.95E+02	1.96E-02	1.40E-02	2.39E-03	3.48E+02	1.01E+02
RWD	kg	9.08E-02	6.06E-04	2.92E-04	4.06E-04	0.00E+00	3.04E-04
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	0.00E+00	6.52E+02	0.00E+00	0.00E+00
MER	kg	4.55E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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

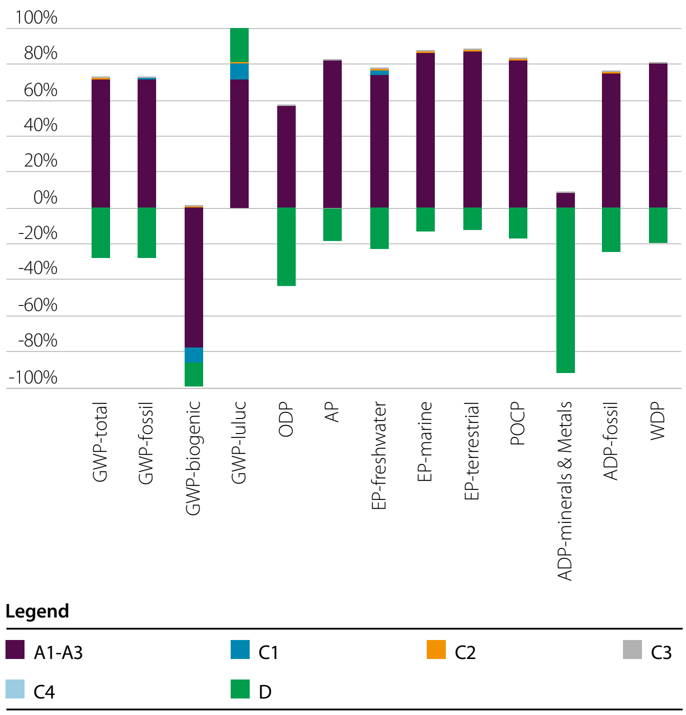
Figure 4 shows the relative contribution per life cycle stage for selected environmental impact categories for 1 tonne of Tata Steel's HFW pipe product. Each column represents 100% of the total impact score, which is why all the columns have been set with the same length. A burden is shown as positive (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 all of the categories, specifically, the conversion of iron ore into liquid steel which is the most energy intensive part of the overall HFW pipe 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 90% of the Global Warming Potential (GWP), and sulphur oxides, which are responsible for 55% of the impact in the Acidification Potential (AP) category. In addition, oxides of nitrogen are emitted which contribute 43% of the A1-A3 Acidification Potential, and over 90% of the Eutrophication Potentials (EP-marine and EP-terrestrial), and the combined emissions of nitrogen oxides (73%) 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. The exceptions are the contribution of C1 to the GWP-biogenic and GWP-luluc indicators. The contribution to GWP-biogenic comes from the biotic carbon component in the diesel mix used in the deconstruction process, and this impacts land use because of the requirement of land for the production of biodiesel.

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 [21]. 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 whole life environmental impacts.

Figure 4 LCA results for HFW pipe



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 pipe 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 steel recycling in electric arc furnaces.

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.

6 References and product standards

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

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