TATA STEEL

ComFlor® 60 1.0mm steel structural floor deck

Environmental Product Declaration

CONTENTS

ComFlor® 60 1.0mm steel structural floor deck
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-2018-007
Date of Issue: 1st December 2018
Valid until: 30th November 2023

Owner of the Declaration: Tata Steel Europe
Programme Operator: Tata Steel UK Limited, 30 Millbank, London, SW1P 4WY

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	Tata Steel Europe
Product & module	ComFlor® 60 1.0mm steel structural floor deck
Manufacturer	Tata Steel Europe & Tata Steel International (Middle East)
Manufacturing sites	Port Talbot, Llanwern, Shotton and Dubai
Product applications	Construction
Declared unit	1m² of steel structural floor deck
Date of issue	1st December 2018
Valid until	30th November 2023

This Environmental Product Declaration (EPD) is for ComFlor® 60 steel structural floor deck manufactured by Tata Steel in the UK and Dubai. The environmental indicators are for products manufactured at Shotton and Dubai, with feedstock supplied from Port Talbot and Llanwern.

The information in Environmental Product Declaration is based on production data from 2013, 2016 and 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

Composite floor slabs or decks consist of profiled steel decking with an in-situ reinforced concrete topping. The steel decking acts as a permanent formwork for the concrete and provides tensile resistance as a result of the shear bond between the deck and concrete. Once the concrete has gained strength, the two materials act together compositely. The composite slab is connected to the steel beams, with the composite interaction being achieved by the attachment of shear connectors to the top flange of the beam. These connectors generally take the form of headed studs and are welded to the beam, and provide sufficient longitudinal shear connection between the beam and the concrete so that they act together structurally.

The ComFlor® family of products comprises seven steel floor profiles, each designed specifically for a particular application area. ComFlor® 60 is a round shouldered, combined trapezoidal and re-entrant, 60mm profile composite product, which is exceptionally resistant to compressive buckling. The steel floor deck is manufactured in Galvatite® hot dip zinc coated steel, with a guaranteed minimum proof strength of 350N/mm^2. Shear studs are placed centrally in the troughs and the profile provides a 600mm cover width. It is designed to minimise the volume of concrete required, and thus reduce the weight of the floor. A section through the composite slab in shown in Figure 1.

Figure 1 ComFlor® 60 steel deck as part of composite slab

Composite slabs are commonly used in the commercial, industrial, leisure, health and residential building sectors because of the speed of construction and general structural economy that can be achieved. The ComFlor® steel deck product is specifically designed for rapid installation of flooring and to facilitate lower mass buildings with long clear span composite concrete floors. Large areas of ComFlor® can be easily craned into position and in excess of 400m^2 laid by one team per day. With minimal mesh or fibre reinforcement and pumped concrete, the finished floor can quickly follow, and the completed ComFlor® slabs offer a high level of fire resistance, which in most cases, dictates the minimum slab depth.

2.2 Manufacturing

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

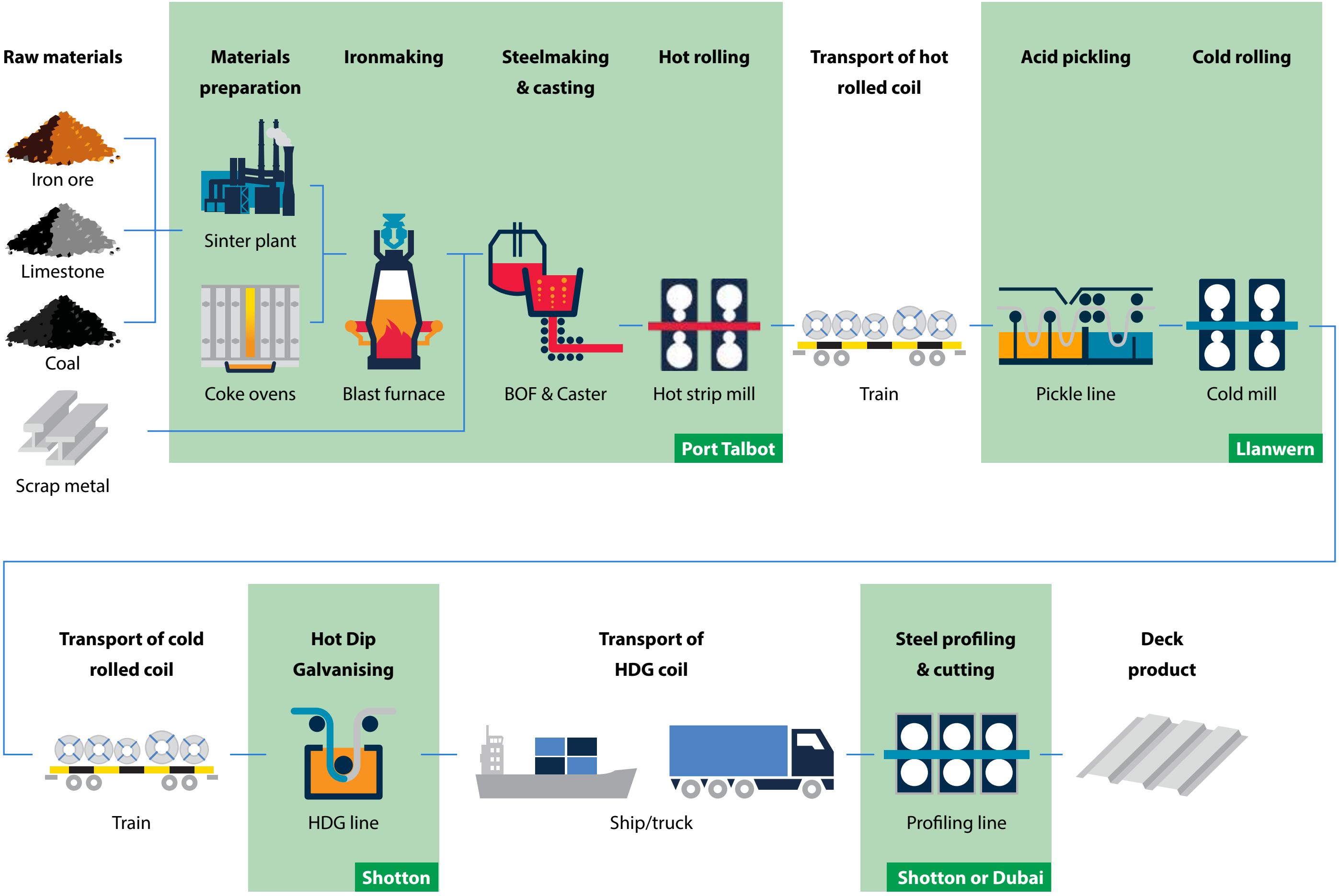
Table 1 Participating sites

Site name	Product	Manufacturer	Country
Port Talbot	Hot rolled coil	Tata Steel	UK
Llanwern	Cold rolled coil	Tata Steel	UK
Shotton	Hot dip galvanised coil	Tata Steel	UK
Shotton & Dubai	Floor deck	Tata Steel	UK & UAE

The process of steel coil 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 hot rolled coils are transported by rail, from Port Talbot to Llanwern where they are pickled and cold rolled. Following, cold rolling the coil is transported by train to Shotton where the strip is galvanised.

The hot dip galvanised coils are transported from Shotton, either by road transport to the ComFlor® structural deck manufacturing facility elsewhere on the Shotton site, or by road and ship to the manufacturing facility at Jebel Ali in Dubai. The zinc coated steel is then profiled and cut into suitable lengths on a dedicated process line. An overview of the process from raw materials to production of the steel floor deck product, is shown in Figure 2.

Figure 2 Process overview from raw materials to deck product



Process data for the manufacture of hot and cold rolled coil at Port Talbot and Llanwern was gathered as part of the latest worldsteel data collection. For Port Talbot and Llanwern, and hot dip galvanising at Shotton, the data collection was not only organised by site, but also by each process line within the site. In this way it was possible to attribute resource use and emissions to each process line, and using processed tonnage data for that line, also attribute resources and emissions to specific products. For the manufacture of the floor deck, process data was also collected from the profiling lines at Shotton and Dubai.

2.3 Technical data and specifications

The general properties of the product are shown in Table 2.

Table 2 General characteristics and specification of the floor deck

	ComFlor® 60 floor deck
Thickness of decking (mm)	1.0
Cover width (mm)	600
Ultimate moment capacity sagging (kNm/m)	11.27
Ultimate moment capacity hogging (kNm/m)	9.36
Profile weight (kg/m²)	11.64
CE marking	DoP spec to EN 1090-1 [8]
Certification	Certifications applicable to Tata Steel's Shotton site are; ISO 9001 [9], ISO 14001 [10], OHSAS 18001 [11] BES 6001 certification [12], EN 10346 [13] Certifications applicable to Tata Steel's Dubai site are; ISO 9001 [9] Operation Fitness Certificate [14]

2.4 Packaging

The deck profiles are packaged using wood base supports and plastic or steel strapping in order to protect them during delivery to site and prior to installation.

2.5 Reference service life

A reference service life for structural deck is not declared because the steel profiles are part of a composite flooring system that also comprises concrete and steel reinforcing bar, and the final construction application of the composite floor deck is not defined. To determine the full service life of steel structural deck, all factors would need to be included such as the type of concrete used, and the location and environment.

The indicative design working life of a structure is classed in accordance with EN 1990 [15] clause 2.3. The design life ranges from category 1 at 10 years, to category 5 at 100 years. Common building structures are classed as category 4 at 50 years. In accordance with EN 1994-1-1 [16], clause 4.2, the exposed surface of the steel decking shall be adequately protected to resist the particular atmospheric conditions. A zinc coating mass of 275g/m² (including both sides) is sufficient for the internal floors in a non-aggressive environment. Under 'normal' conditions, steel deck would not need to be replaced over the life of the building and structure.

3 LCA methodology

3.1 Declared unit

The unit being declared is 1m² of steel structural deck.

3.2 Scope

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

A1-A3: Production stage (Raw material supply, transport to production site, manufacturing)
C2, C3 & C4: End-of-life (transport, processing for recycling and disposal)
D: Reuse, recycling and recovery

All of the life cycle stages are explained in more detail in Figure 3, but where the text is in light grey, the impacts from this part of the life cycle are not considered for this particular product.

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 deck 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.

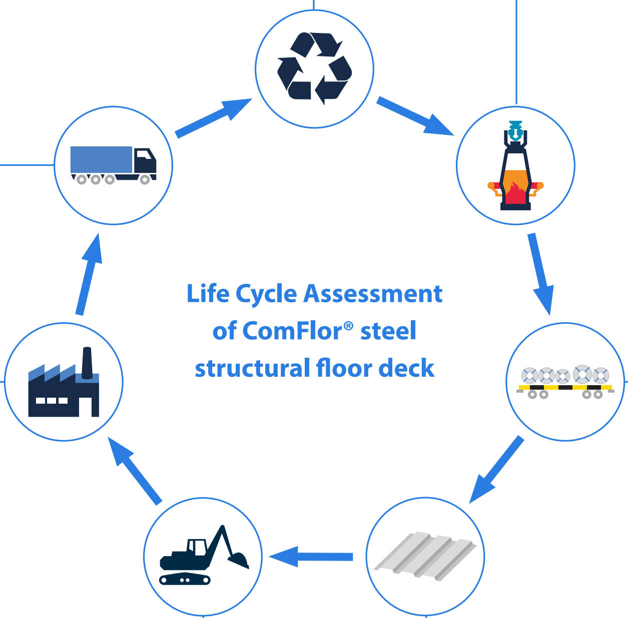
Figure 3 Life Cycle Assessment of steel deck

Module D: Benefits & loads beyond the system boundary
Includes impacts from;
- Deck reuse (0%) and recycling of the steel component (85%)

Module C: End-of-life stage
Includes impacts from:
- Deconstruction of composite deck system
- Transport from site to end-of-life
- Processing of deck system for reuse or recycling
- Disposal to landfill of steel (15%) and other system components

Module B: Use stage
Includes impacts from;
- Use or application of the composite deck in a building
- Maintenance, repair, replacement, refurbishment of the system

Modules A4 & A5: Construction process stage
Includes impacts from;
- Delivery of steel decks and other components to site
- Installation of composite deck system at construction site



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

Module A2: Product stage (transport)
Includes impacts from;
- Transport of hot dip galvanised steel coils from Shotton to deck manufacturing site

Module A3: Product stage (deck manufacture)
Includes impacts from;
- Profiling and cutting of hot dip galvanised steel
- Packaging of decks for delivery to site

3.4 Background data

For life cycle modelling of steel deck, the GaBi Software System for Life Cycle Engineering is used [17]. The GaBi database contains consistent and documented datasets which can be viewed in the online GaBi documentation [18].

Where possible, specific data derived from Tata 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 Tata Steel's own production processes are from 2013, 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 all but two of these data sets took place less than 10 years ago. However, the contribution to impacts of these two datasets is small and relatively insignificant, and 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 [19]. 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 [20]. 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 below in Table 3. The end of life percentages are based upon the results of a survey carried out by the Steel Construction Institute in 2000 [21].

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 [22].

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 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 Tata Steel's sites at Port Talbot, Llanwern, Shotton and Dubai are used
A2 – Transport to the deck manufacturing site	The ComFlor® manufacturing facilities are located on the Shotton site, and in Dubai. For transport to Shotton, the steel coils are taken 5km by road on a 25 tonne payload truck. A utilisation factor of 45% was assumed to account for empty returns. For steel coils destined for Dubai, they are first transported 413km by road to the port of Felixstowe, from where they travel by ship 11489km to the port of Jebel Ali in Dubai. The final part of the journey is 5km by road from the port to the plant in Jebel Ali. Both of these road journeys are made with a 25 tonne payload truck and a utilisation factor of 0.45 as before
C2 – Transport for recycling, reuse, and disposal	A transport distance of 100km to landfill or to a recycling site is assumed. Transport is on a 25 tonne load capacity lorry with 15% utilisation to account for empty returns
C3 – Waste processing for reuse, recovery and/or recycling	Steel deck that is recycled is processed in a shredder
C4 – Disposal	At end-of-life, 15% of the steel is disposed in a landfill, based upon the findings of an SCI survey
D – Reuse, recycling, and energy recovery	At end-of-life, 85% of the steel is recycled based upon the findings of a SCI 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:

1m² of 1.0mm ComFlor® 60

Parameter	Unit	A1 – A3	C2	C3	C4	D
GWP	kg CO_2 eq	3.20E+01	2.45E-01	1.16E-01	2.78E-02	-1.34E+01
ODP	kg CFC11 eq	-1.42E-11	3.84E-15	5.00E-12	6.30E-15	7.47E-08
AP	kg SO_2 eq	7.46E-02	6.53E-04	3.43E-04	1.65E-04	-2.63E-02
EP	kg PO_4^{3-} eq	7.81E-03	1.55E-04	3.27E-05	2.27E-05	-1.96E-03
POCP	kg Ethene eq	1.20E-02	-2.51E-04	2.37E-05	1.30E-05	-6.19E-03
ADPE	kg Sb eq	2.24E-03	4.47E-09	4.74E-08	1.07E-08	-3.82E-05
ADPF	MJ	3.35E+02	3.29E+00	1.65E+00	3.59E-01	-1.28E+02

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:

1m² of 1.0mm ComFlor® 60

Parameter	Unit	A1 – A3	C2	C3	C4	D
PERE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ	3.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	3.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRE	MJ	1.13E+01	7.93E-02	6.51E-02	1.00E-02	-5.16E+00
PENRM	MJ	4.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.18E+01	7.93E-02	6.51E-02	1.00E-02	-5.16E+00
SM	kg	1.57E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	2.64E-04	1.40E-30	0.00E+00	5.65E-24	-6.31E-05
NRSF	MJ	2.53E-03	2.12E-29	0.00E+00	6.64E-23	-4.99E-04
FW	m^3	5.36E-02	3.06E-04	1.50E-03	2.26E-03	-7.78E-02

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:

1m² of 1.0mm ComFlor® 60

Parameter	Unit	A1 – A3	C2	C3	C4	D
HWD	kg	2.97E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	2.14E+00	0.00E+00	0.00E+00	1.75E+00	0.00E+00
RWD	kg	4.35E-03	0.00E+00	3.10E-04	1.00E-05	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	1.53E-02	0.00E+00	8.33E+00	0.00E+00	0.00E+00
MER	kg	5.86E-03	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
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 4 shows the relative contribution per life cycle stage for each of the seven environmental impact categories for 1m^2 of Tata Steel's ComFlor® 60 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 all but one of the impact categories are A1-A3 (burdens) and D (benefits beyond the system boundary). The manufacture of the cold rolled coil during stage A1-A3 is responsible for approximately 90% of each impact in most of the categories, specifically, the conversion of iron ore into liquid steel which is the most energy intensive part of the overall deck manufacturing process.

The primary site emissions come from the use of coal and coke in the blast and basic oxygen furnaces as well as combustion of the process gases. These processes give rise to emissions of CO_2, which contributes 94% of the Global Warming Potential (GWP), and sulphur oxides, which are responsible for almost two thirds of the impact in the Acidification Potential (AP) category. In addition, oxides of nitrogen are emitted which contribute one third of the A1-A3 Acidification Potential, and almost 90% of the Eutrophication Potential (EP), and the combined emissions of carbon monoxide (68%) together with sulphur and nitrogen oxides, contribute to the Photochemical Ozone indication (POCP).

The depletion potential of the stratospheric ozone layer (ODP) is the one category where the product stage impact is actually negative, and this occurs because the steel strapping and galvanised steel packaging used to protect the coil from Shotton to Dubai are modelled using worldsteel average datasets from the GaBi database. These datasets have a negative ODP impact as a result of the slag calculation methodology used, and this is sufficiently large to make the total A1-A3 ODP impact a relatively small negative value.

Figure 4 clearly indicates the relatively small contribution to each impact from the other life cycle stages, which are transport of the decks to their end-of-life fate, processing of the steel scrap for recycling, and disposal to landfill.

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 deck 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 [20]. This contributes a significant reduction to most of the environmental impact category results, with the specific emissions that represent the burden in A1-A3, essentially the same as those responsible for the impact reductions in Module D.

The exception, with regard to the end-of-life credit given to steel scrap after the use stage in Module D, is the ODP indicator. This particular impact score is a positive value and does not contribute a reduction

Figure 4 LCA results for the deck profile

to the total results as do the other listed impact categories. For ODP, the recycling of steel deck at end-of-life results in a relatively large burden when compared with that from the product stage, A1-A3. In other words, for ODP, the recycling impact is larger than the impact of primary manufacture. The very different energy sources (coal versus grid electricity mix) and technologies (BF/BOS versus EAF) are the main reasons why the recycling impact for ODP is larger than that of primary manufacture. The Module D burden comes from the allocation methodology used in the worldsteel model for calculating the 'value of scrap'.

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. This is explained by the Module D benefit for net use of fresh water being based upon a worldsteel calculation for many steel plants worldwide. Port Talbot, the biggest water user in this study, is a relatively modest user of fresh water as reported in A1-A3. The worldwide average calculation for Module D includes many sites with considerably greater fresh water use in A1-A3 than Port Talbot.

The impact values presented in the results tables are weighted averages based upon manufacture of equivalent deck products at two separate sites, Shotton and Dubai. For the manufacturing stages A1-A3, the indicators for product manufactured at Dubai were slightly higher than those for the same product made at Shotton. The main reason for this are the increased transport emissions resulting from shipping hot dip galvanised coils from Shotton to Dubai.

6 References and product standards

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10. ISO 14001:2015, Environmental management systems

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