

**TATA STEEL**



**ComFlor® 80 1.0mm with Colorcoat FD® 170  
steel structural floor deck**  
Environmental Product Declaration



# CONTENTS

<b>1</b>	<b>General information</b>	03
<b>2</b>	<b>Product information</b>	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
<b>3</b>	<b>Life Cycle Assessment (LCA) methodology</b>	07
3.1	Declared unit	07
3.2	Scope	07
3.3	Cut-off criteria	07
3.4	Background data	08
3.5	Data quality	08
3.6	Allocation	08
3.7	Additional technical information	09
3.8	Comparability	09
<b>4</b>	<b>Results of the LCA</b>	10
<b>5</b>	<b>Interpretation of results</b>	12
<b>6</b>	<b>References and product standards</b>	13

ComFlor® 80 1.0mm with Colorcoat FD® 170 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-2018-009

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® 80 1.0mm with Colorcoat FD® 170 structural steel floor deck
Manufacturer	Tata Steel Europe
Manufacturing sites	Port Talbot, Llanwern, and Shotton
Product applications	Construction
Declared unit	1m <sup>2</sup> of steel structural floor deck
Date of issue	1st December 2018
Valid until	30th November 2023



This Environmental Product Declaration (EPD) is for ComFlor® 80 steel structural floor deck manufactured by Tata Steel in the UK, using Colorcoat FD® 170 pre-finished steel. The environmental indicators are for products manufactured at Shotton, with feedstock supplied from Port Talbot and Llanwern.

The information in the 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 <sup>[1,2,3,4,5,6,7]</sup>.

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Third party verifier

Olivier Muller, PwC Stratégie - Développement Durable, PricewaterhouseCoopers Advisory,  
63, rue de Villiers, 92208 Neuilly-sur-Seine, France

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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 ComFlor® family of products comprises seven steel floor profiles, each designed specifically for a particular application area. ComFlor® 80 with Colorcoat FD® 170 is an 80mm deep, round shouldered trapezoidal profile, designed for greater spans. This profile allows the designer to reduce the number of secondary beams in a building to give a cleaner lower cost structure. The steel floor deck is manufactured in Galvalite® hot dip zinc coated steel, which has a tough satin embossed plastisol coating, 170 microns thick, on the underside. The pre-finished steel has an aesthetic guarantee of up to 25 years and a design life of 50 years, and provides significant additional protection to exposed soffits in both internal and external environments. The profile has a guaranteed minimum proof strength of 350N/mm<sup>2</sup> and provides a 600mm cover width. The ComFlor® 80 profile is illustrated in Figure 1.

Figure 1 ComFlor® 80 steel deck profile



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<sup>2</sup> 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. The Colorcoat FD® 170 variant makes it an ideal choice for multi-storey car parks or any applications where the soffit is exposed.

### 2.2 Manufacturing

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

Table 1 Participating sites

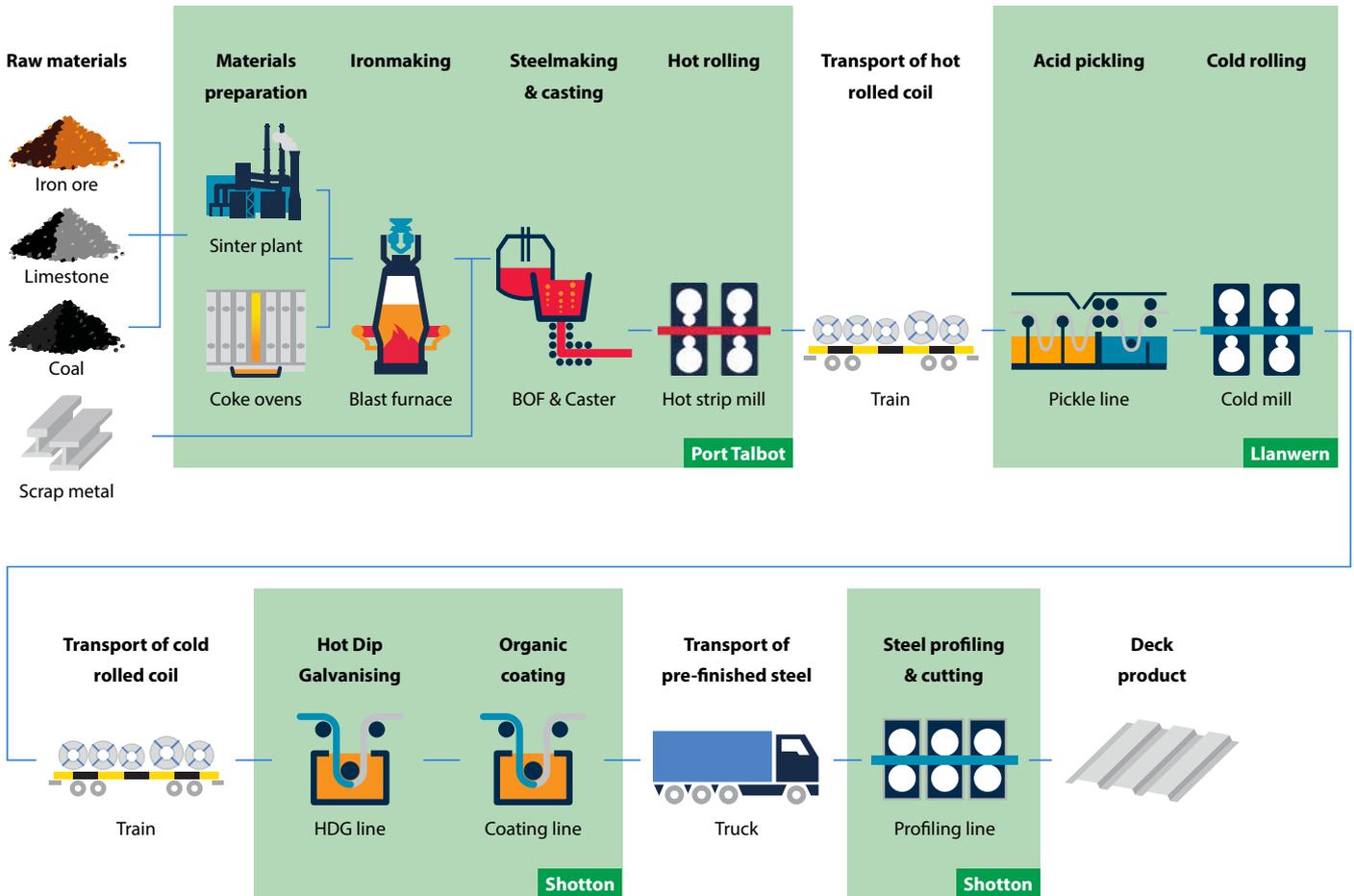
Site name	Product	Manufacturer	Country
Port Talbot	Hot rolled coil	Tata Steel	UK
Llanwern	Cold rolled coil	Tata Steel	UK
Shotton	Hot dip galvanised coil	Tata Steel	UK
Shotton	Pre-finished coil	Tata Steel	UK
Shotton	Floor deck	Tata Steel	UK

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 it is galvanised and coated.

Pre-finished steel comprises a number of paint layers and treatments which are applied to the steel in an automated and carefully controlled process with each layer of the product having a particular function. It is the combined effect of all these layers that give the product its overall performance and ensures a material that is robust. During the organic coating process for Colorcoat FD® 170, a Galvalite® metallic coating is first applied to the steel coil. A primer is then applied before adding the final top coat layer in the form of liquid paint. These are cured at elevated temperatures before being recoiled prior to use in the manufacture of the profiled deck. For this pre-finished steel product, the primer and topcoat are applied on the underside surface only, while the top side of the strip has no organic coating.

The pre-finished coils are then transported by road to the ComFlor® structural deck manufacturing facility on the Shotton site. The pre-finished 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 and organic coating 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.

### 2.3 Technical data and specifications

The general properties of the product are shown in Table 2, and the technical specifications of the product are presented in Table 3.

**Table 2 General characteristics and specification of the floor deck**

ComFlor® 80 with Colorcoat FD® 170 floor deck	
Thickness of decking (mm)	1.0
Cover width (mm)	600
Ultimate moment capacity sagging (kNm/m)	13.34
Ultimate moment capacity hogging (kNm/m)	10.65
Profile weight (kg/m <sup>2</sup> )	12.61
Mass of coating (kg/m <sup>2</sup> )	0.25
CE marking	DoP spec to EN 1090-1 <sup>[8]</sup>
Certification	Certifications applicable to Tata Steel's Shotton site are; ISO 9001 <sup>[9]</sup> , ISO 14001 <sup>[10]</sup> , OHSAS 18001 <sup>[11]</sup> BES 6001 certification <sup>[12]</sup> , EN 10346 <sup>[13]</sup>

**Table 3 Technical specification of Colorcoat FD® 170**

Colorcoat FD® 170 pre-finished steel	
Metallic coating	Colorcoat FD® 170 is supplied with Galvatite® metallic coating which comprises 99% Zinc and conforms to EN 10346:2015 <sup>[13]</sup>
Paint coating (organic)	Colorcoat FD® 170 plastisol coating on the underside (exposed face) All pre-finished steel products are fully REACH <sup>[14]</sup> compliant and chromate free
Certification	Certifications applicable to Tata Steel's Shotton site are; ISO 9001 <sup>[9]</sup> , ISO 14001 <sup>[10]</sup> , OHSAS 18001 <sup>[11]</sup> BES 6001 certification <sup>[12]</sup> BBA certification (Colorcoat) <sup>[15]</sup> RC5, Ruv4, CPI5 certificates in accordance with EN 10169 <sup>[16]</sup>

### 2.4 Packaging

The deck profiles are packaged using wood base supports and plastic 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<sup>[17]</sup> 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<sup>[18]</sup>, 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/m<sup>2</sup> (including both sides) is sufficient for the internal floors in a non-aggressive environment. In addition, the 170 micron plastisol coating to the exposed underside of the deck makes the product suitable for both internal and external environments, with specific project guarantees available for both inland and coastal applications. Under 'normal' conditions, this 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 1m<sup>2</sup> 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)

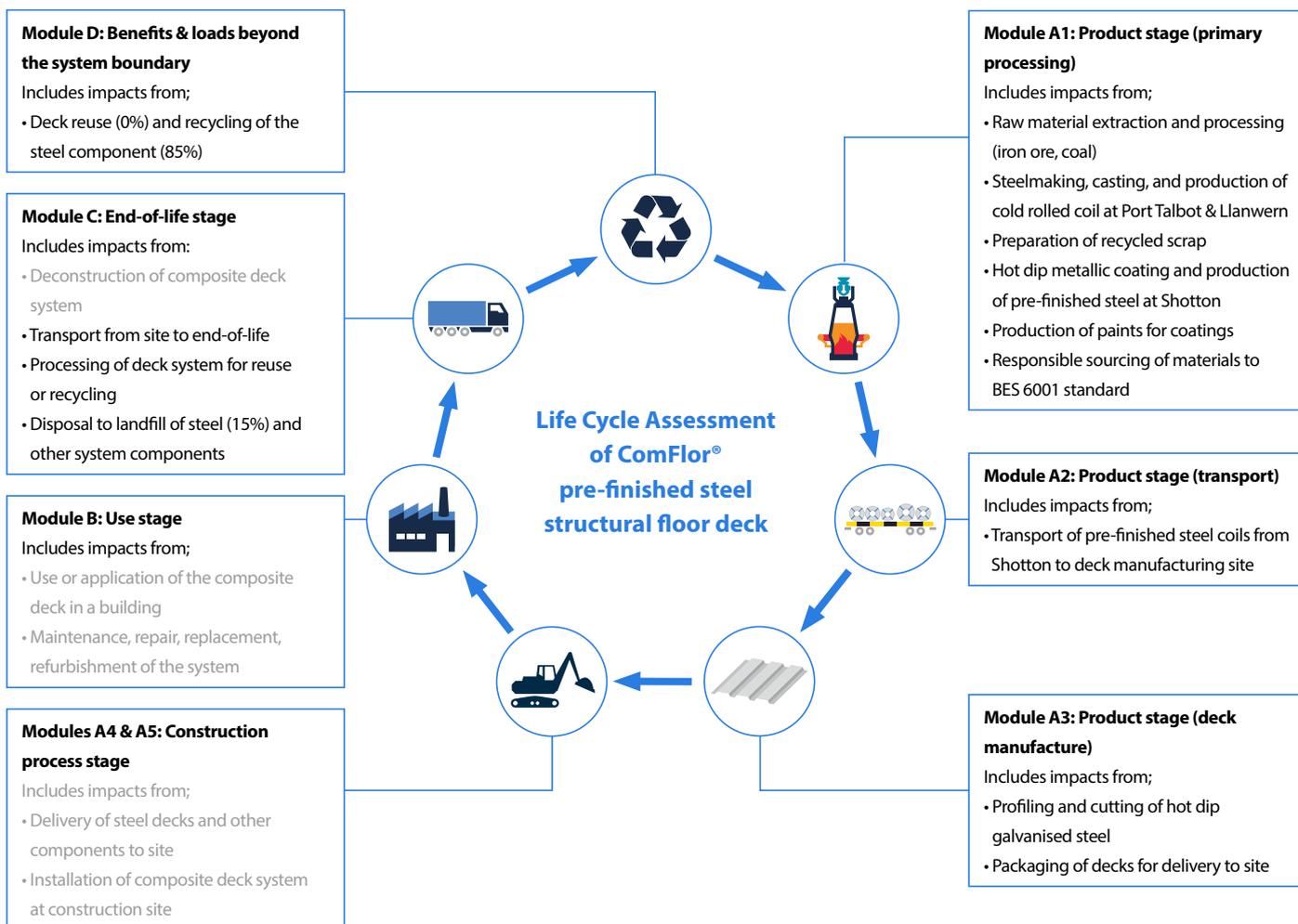
D: Reuse, recycling and recovery

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



### 3.4 Background data

For life cycle modelling of steel deck, the GaBi Software System for Life Cycle Engineering is used <sup>[19]</sup>. The GaBi database contains consistent and documented datasets which can be viewed in the online GaBi documentation <sup>[20]</sup>.

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 <sup>[21]</sup>. 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<sup>[22]</sup>. 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 4. The end-of-life percentages are based upon the results of a survey carried out by the Steel Construction Institute in 2000<sup>[23]</sup>.

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<sup>[24]</sup>.

### 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
<b>A1 to A3 – Product stage</b>	Manufacturing data from Tata Steel's sites at Port Talbot, Llanwern, and Shotton are used
<b>A2 – Transport to the deck manufacturing site</b>	The ComFlor® manufacturing facilities are located on the Shotton site. For transport to Shotton, the pre-finished 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
<b>C2 – Transport for recycling, reuse, and disposal</b>	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
<b>C3 – Waste processing for reuse, recovery and/or recycling</b>	Steel deck that is recycled is processed in a shredder
<b>C4 – Disposal</b>	At end-of-life, 15% of the steel is disposed in a landfill, based upon the findings of an SCI survey
<b>D – Reuse, recycling, and energy recovery</b>	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:

1m<sup>2</sup> of 1.0mm ComFlor® 80 with Colorcoat FD® 170

Parameter	Unit	A1 – A3	C2	C3	C4	D
<b>GWP</b>	kg CO <sub>2</sub> eq	3.85E+01	2.72E-01	1.30E-01	3.11E-02	-1.54E+01
<b>ODP</b>	kg CFC11 eq	3.91E-07	4.72E-15	5.60E-12	7.04E-15	8.58E-08
<b>AP</b>	kg SO <sub>2</sub> eq	8.44E-02	7.18E-04	3.84E-04	1.84E-04	-3.02E-02
<b>EP</b>	kg PO <sub>4</sub> <sup>3-</sup> eq	8.71E-03	1.72E-04	3.66E-05	2.54E-05	-2.26E-03
<b>POCP</b>	kg Ethene eq	1.42E-02	-2.81E-04	2.65E-05	1.45E-05	-7.10E-03
<b>ADPE</b>	kg Sb eq	2.51E-03	4.15E-09	5.30E-08	1.19E-08	-4.39E-05
<b>ADPF</b>	MJ	6.92E+02	3.66E+00	1.85E+00	4.02E-01	-1.47E+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:

#### 1m<sup>2</sup> of 1.0mm ComFlor® 80 with Colorcoat FD® 170

Parameter	Unit	A1 – A3	C2	C3	C4	D
PERE	MJ	1.50E-02	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	3.36E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRE	MJ	1.51E+01	8.83E-02	7.29E-02	1.12E-02	-5.93E+00
PENRM	MJ	5.80E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.09E+01	8.83E-02	7.29E-02	1.12E-02	-5.93E+00
SM	kg	1.51E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	2.95E-04	1.82E-30	0.00E+00	6.32E-24	-7.24E-05
NRSF	MJ	2.83E-03	2.76E-29	0.00E+00	7.43E-23	-5.73E-04
FW	m <sup>3</sup>	6.43E-02	3.37E-04	1.68E-03	2.53E-03	-8.93E-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:

#### 1m<sup>2</sup> of 1.0mm ComFlor® 80 with Colorcoat FD® 170

Parameter	Unit	A1 – A3	C2	C3	C4	D
HWD	kg	1.63E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	2.40E+00	0.00E+00	0.00E+00	1.95E+00	0.00E+00
RWD	kg	5.54E-03	0.00E+00	3.40E-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	1.71E-02	0.00E+00	9.56E+00	0.00E+00	0.00E+00
MER	kg	7.02E-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 1 m<sup>2</sup> of Tata Steel's ComFlor® 80 with Colorcoat FD® 170 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<sub>2</sub>, 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).

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<sup>[22]</sup>. 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 depletion potential of the stratospheric ozone layer (ODP) indicator. This particular impact score is a positive value and does not contribute a reduction 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.

Figure 4 LCA results for the deck profile



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 environmental impact of the additional organic coating is a small increase across all the main categories, but most notably to the ODP indicator, from the paint manufacturing process and to a lesser extent, the paint curing process during its application to the steel deck.

## 6 References and product standards

1. Tata Steel's EN 15804 verified EPD programme, General programme instructions, Version 1.0, January 2017
2. Tata Steel's EN 15804 verified EPD programme, Product Category Rules Part 1, Version 1.0, January 2017
3. Tata Steel's EN 15804 verified EPD programme, Product Category Rules Part 2 – Steel Structural Deck, Version 1.0, October 2018
4. ISO 14044:2006, Environmental management - Life Cycle Assessment - Requirements and guidelines
5. ISO 14025:2010, Environmental labels and declarations - Type III environmental declarations - Principles and procedures
6. ISO 14040:2006, Environmental management - Life Cycle Assessment - Principles and framework
7. EN 15804:2012+A1:2013, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
8. EN 1090-1:2009+A1:2011, Requirements for conformity assessment for structural components
9. ISO 9001:2015, Quality management systems
10. ISO 14001:2015, Environmental management systems
11. BS OHSAS 18001:2007, Occupational health and safety management
12. BES 6001, Responsible sourcing of construction products
13. EN 10346:2015, Continuously hot-dip coated steel flat products for cold forming
14. REACH, EU regulation for Registration, evaluation, authorisation and restriction of chemicals
15. BBA Certification, British Board of Agrément product certification
16. EN 10169:2010+A1:2012, Continuously organic coated (coil coated) steel flat products
17. EN 1990:2002, Eurocode. Basis of structural design
18. EN 1994-1-1:2004, Eurocode 4. Design of composite steel and concrete structures. General rules and rules for buildings
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22. World Steel Association: Life Cycle Assessment methodology report, 2017
23. Steel Construction Institute (SCI), Survey of recycling and reuse rates for UK demolition contractors, European Commission funded research project on LCA for steel construction, Sansom M and Meijer J, 2000
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[www.tatasteelconstruction.com](http://www.tatasteelconstruction.com)

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**Tata Steel**

Shotton Works  
Deeside  
Flintshire  
CH5 2NH  
United Kingdom  
T: +44 (0) 1244 892199  
E: [technical.structuralproducts@tatasteelurope.com](mailto:technical.structuralproducts@tatasteelurope.com)

**Tata Steel**

610th St  
Jebel Ali Free zone  
Dubai  
UAE  
T: +971 50 658 5323  
E: [lubna.karim@tatasteelurope.com](mailto:lubna.karim@tatasteelurope.com)

Tata Steel UK Limited is registered in England under number 2280000 with registered office at 30 Millbank, London, SW1P 4WY.

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