SAB PROFIEL
A Tata Steel Enterprise

EPD
THIRD PARTY VERIFIED ISO 14025 & EN 15804

SAB structural deep decks & liner trays with Colorcoat® PE15 (135R/930 0.88mm deck reference product)

Environmental Product Declaration for NMD

Owner of the Declaration: SAB-profiel bv, produktieweg 2, NL-3401 MG, IJsselstein
Programme Operator: Tata Steel UK Limited, 18 Grosvenor Place, London, SW1X 7HS

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Environmental Product Declaration for NMD (National Environmental Database of the Netherlands)
(in accordance with ISO 14025 and EN 15804)

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

Declaration Number: EPD-TS-NMD-2023-004
Date of Issue: 30th January 2023
Valid until: 29th January 2028

Owner of the Declaration: SAB-profiel bv, produktieweg 2, NL-3401 MG, IJsselstein
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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 and according to the NMD verification protocol May 2022

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 for SBK: René Kraaijenbrink, LBP Sight, Nieuwegein, Netherlands

1 General information

Owner of EPD	SAB-profiel
Product & module	SAB structural deep decks & liner trays with Colorcoat® PE15 (135/930 0.88mm deck reference product)
Manufacturer	SAB-profiel & Tata Steel Europe
Manufacturing sites	IJsselstein and IJmuiden
Product applications	Construction
Functional unit	1m^2 of steel structural roof deck or liner tray (working width 930mm)
Date of issue	30th January 2023
Valid until	29th January 2028

This Environmental Product Declaration (EPD) is for SAB structural deep decks and liner trays (135R/930 0.88mm deck reference product) manufactured by SAB-profiel in the Netherlands using Colorcoat® pre-finished steel. The environmental indicators are for products manufactured at SAB-profiel in IJsselstein with feedstock from IJmuiden.

The information in the Environmental Product Declaration is based on production data from 2016 and 2018.

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].

This declaration has been produced in accordance with the calculation rules of the Stichting Nationale Milieudatabase (sNMD), as detailed in the Determination Method document [8] of the National Environmental Database (NMD) of the Netherlands. It should be used where the product application is in the Netherlands.

Third party verifier

René Kraaijenbrink, LBP Sight - Kelvinbaan 40, 3439 MT Nieuwegein, Postbus 1475, 3430 BL Nieuwegein, Netherlands

2 Product information

2.1 Product description

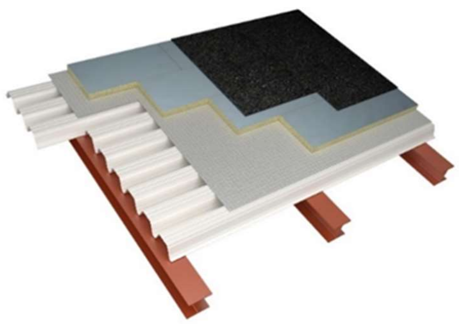
The SAB deep deck family of products consists of 14 steel roof trapezoidal profiles which are designed to support all types of insulated roof systems. The SAB liner tray profile family of products consists of 11 steel profiles which are designed to support all types of wall profiles together with insulation. Both are manufactured from MagiZinc® hot dip zinc coated steel, with a Colorcoat® PE15 pre-finished interior coating, a guaranteed minimum yield stress of 320N/mm^2, and has a fire rating of Class A1 to EN 13501-1 [9].

Figure 1 SAB 135R/930 roof deep deck

SAB 135R/930 (Figure 1) has a profile depth of 137mm and a cover width of 930mm, to meet the designers' needs for efficiency, aesthetics, and structural performance and is an ideal choice of roof deck profile when securing to purlins, typically spanning 4m to 8m. It has a 310mm profile pitch and the crown is 145mm, which provides an approximate 50% surface area and is more than sufficient for most adhesive systems when bonding to the deck. For those looking for additional architectural features, the SAB 135R/930 profile can be supplied perforated for additional acoustic requirements.

SAB decks are usually part of roof system with a foil and insulation layer, and Bitumen or PVC top layer (see Figure 2), and liner trays are usually part of a built-up wall system with a steel profile on the outside and insulation layer in between. Our dedicated and experienced technical team are available to help develop a specification for your project and assist with project specific advice to ensure that all design aspects of the chosen system meet your project requirements.

Figure 2 SAB roof deep deck system



2.2 Manufacturing

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

Table 1 Participating sites

Site name	Product	Manufacturer	Country
IJmuiden	Hot rolled coil	Tata Steel	NL
IJmuiden	Cold rolled coil	Tata Steel	NL
IJmuiden	Pre-finished steel	Tata Steel	NL
IJsselstein	Steel structural deck/liner tray	SAB-profiel	NL

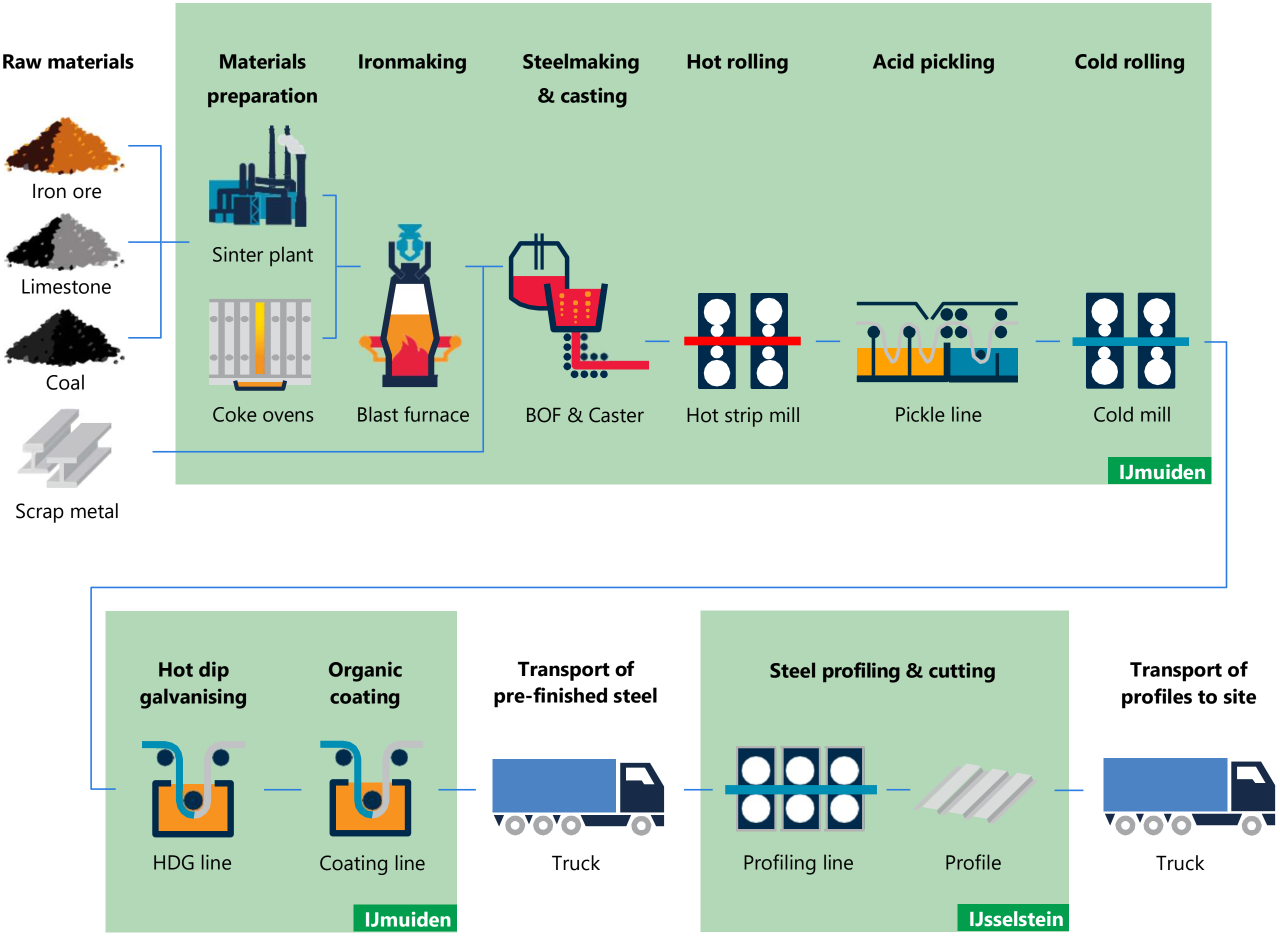
The process of steel coil manufacture at Tata Steel begins with sinter being produced from iron ore and limestone, and together with coke from coal, reduced in a blast furnace to produce iron. Steel scrap is added to the liquid iron and oxygen is blown through the mixture to convert it into liquid steel 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 pickled and cold rolled, before being 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, a zinc based metallic coating is first applied to the steel coil. A pre-treatment is applied and then a primer 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 product. For this pre-finished steel, 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 steel is transported by road from IJmuiden to IJsselstein and is profiled and cut into suitable lengths on a dedicated process line. An overview of the process from raw materials to transport of the steel roof deck or liner tray product to the construction site, is shown in Figure 3.

Process data for the manufacture of hot and cold rolled coil, and pre-finished steel at IJmuiden was gathered as part of the latest worldsteel data collection. 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 roof deck or liner tray, process data was also collected from the profiling lines at IJsselstein.

Figure 3 Process overview from raw materials to deck or liner tray product



2.3 Technical data and specifications

The general properties of the reference product are shown in Table 2, and the property ranges of the product family are in Table 3. The technical specifications of the product are presented in Table 4.

Table 2 General characteristics/specification (reference profile)

	135R/930 roof deck with Colorcoat® PE15
Thickness of decking (mm)	0.88
Cover (working) width (mm)	930
Standard maximum single span (mm)	5570
Standard maximum double span (mm)	6168
Profile weight (kg/m²)	11.14
Mass of coating (kg/m²)	0.02
CE marking	DoP spec to EN 1090-1 [10]
Certification	Certifications applicable to SAB IJsselstein are; ISO 9001 [11], ISO 14001 [12], BES 6001 [13]

Table 3 General characteristics/specification (product family)

	SAB deck & liner trays with Colorcoat® PE15
Thickness of decking (mm)	0.75 to 1.50
Cover (working) width (mm)	400 to 1120
Profile weight (kg/m²)	7.11 to 23.55
Mass of coating (kg/m²)	0.02
Mass of fixings (kg/m²)	0.01
CE marking	DoP spec to EN 1090-1 [10]
Certification	Certifications applicable to SAB IJsselstein are; ISO 9001 [11], ISO 14001 [12], BES 6001 [13]

Table 4 Technical specification of Colorcoat®

	Colorcoat® pre-finished steel
Metallic coating	Colorcoat® pre-finished steel is supplied with a zinc based metallic coating that conforms to EN 10346:2015 [14]
Paint coating (organic)	Colorcoat® PE15 polyester coating on the underside (exposed face) All pre-finished steel products are fully REACH [15] compliant and chromate free
Certification	Certifications applicable to Tata Steel's IJmuiden site are; ISO 9001 [11], ISO 14001 [12] , BES 6001 [13] BBA (Colorcoat®) [16]

2.4 Packaging

The profiles are packaged using wood base supports and plastic strapping in order to protect them during delivery to site and prior to installation. The mass of this packaging is 0.023kg of timber and 0.0025 kg of plastic banding per m² of deck or liner tray product.

2.5 Reference service life

Structural deep deck or liner trays are generally part of a composite roof or wall system that also comprises an insulating material such as mineral wool, slate or tiles, or felt, and the final construction application of the composite product is not defined. To determine an accurate service life of steel structural deck and liner trays, all factors would need to be included such as the type of roof/wall material used, and the location and environment. However, the NMD refer to a knowledge database [27] which states that 'for flat roofs with a galvanised steel deck, the reference service life is shown to be 100 years.'

Under 'normal' conditions, steel deck and liner trays would not need to be replaced over the life of the building and structure.

2.6 Biogenic Carbon content

There are no materials containing biogenic carbon in the deck or liner tray product. Timber is used to package the steel decks and liner trays, and comprises a measurable mass of the total packaging as shown in Table 5.

Table 5 Biogenic carbon content at the factory gate

	SAB 135R/930 roof deck with Colorcoat® PE15
Biogenic carbon content (product) (kg)	0
Biogenic carbon content (packaging) (kg)	0.0115

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

3 LCA methodology

3.1 Declared unit

The functional unit being declared is 1m^2 of steel structural deck or liner tray with a working width of 930mm for the reference profile. In the sNMD functional descriptions, the category is 27.2 Roofs; construction – structural roofs.

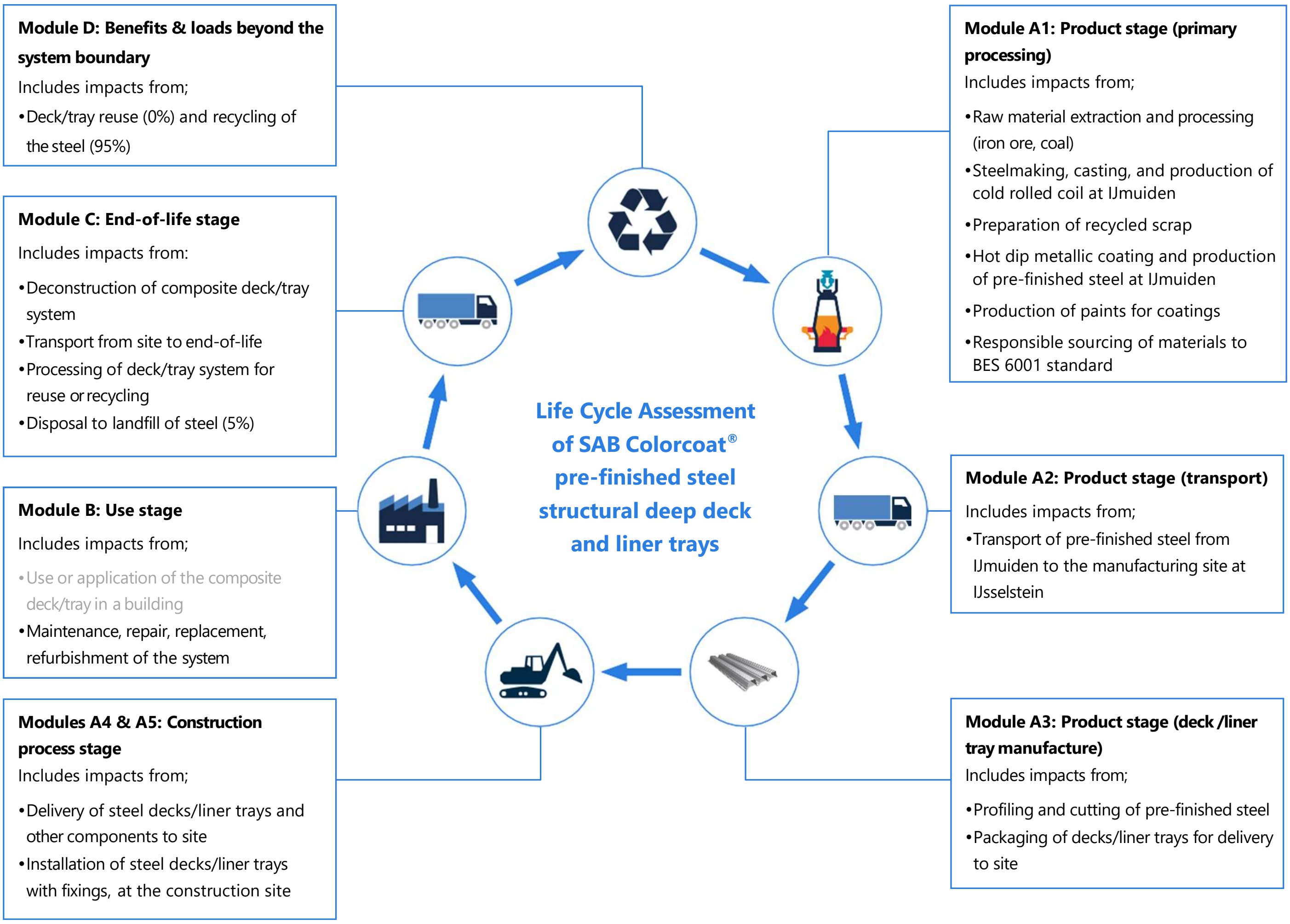
3.2 Scope

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

A1-3: Production stage (Raw material supply, transport to production site, manufacturing)
A4 & A5: Production stage (Transport to the construction site and installation)
B1-5: Use stage (related to the building fabric including maintenance, repair, replacement)
C1-4: End-of-life (Deconstruction, transport, processing for recycling & reuse and disposal)
D: Reuse, recycling and recovery

All of 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 for this particular product.

Figure 4 Life Cycle Assessment of steel deck or liner tray



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 or liner tray 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.

3.4 Background data

For life cycle modelling of the cladding system, 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 and SAB's own production processes were the first choice to use where available. Data was also obtained directly from the relevant suppliers, such as the paint which is used in the coating process.

Specific data [24] were used to model the primary steel manufacture at Tata Steel, using Ecoinvent 3.6 [25, 26] to comply with the requirements of the NMD. All other relevant processes and life cycle stages were modelled using Ecoinvent background data (including energy and transport), available as part of the GaBi database.

3.5 Data quality

The data from Tata Steel's own production processes are from 2016, and the SAB production data was from 2018. 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 one of these data sets took place less than 10 years ago. However, the contribution to impacts of this dataset is small and relatively insignificant, and therefore, 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 [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 IJmuiden 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 in Table 4. The end-of-life percentages are based upon values in the sNMD Determination Method document [8].

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 based upon that of the CML [21] and denoted in GaBi by SBK-NMD Jan 2021.

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 4 Main scenario assumptions

Module	Scenario assumptions
A1 to A3 – Product stage	Manufacturing data from Tata Steel's site at IJmuiden is used, as well as data from SAB-profiel at IJsselstein
A2 – Transport to the deck manufacturing site	The deck and liner tray manufacturing facilities are located at IJsselstein and the pre-finished steel coils are transported there from IJmuiden a distance of 69km by road. A 30 tonne payload truck was used for all road journeys
A4 – Transport to construction site	A transport distance of 150km by road on a 30 tonne capacity lorry was considered representative of a typical installation
A5 – Installation at construction site	Energy consumption estimated based upon published data for the erection of steel constructions in Germany [22]
B1 to B5 – Use stage	This stage includes any maintenance or repair, replacement or refurbishment of the steel deck or tray over the life cycle. This is not required for the duration of the reference service life of the product
C1 – Deconstruction & demolition	Energy consumption estimated based upon published data for the dismantling of steel constructions in Germany [22]
C2 – Transport for recycling, reuse, and disposal	A transport distance of 100km to landfill or to a recycling site is assumed, while a distance of 250km is assumed for reuse. Transport is on a 30 tonne load capacity lorry
C3 – Waste processing for reuse, recovery and/or recycling	Steel deck or liner tray that is recycled is processed in a shredder
C4 - Disposal	At end-of-life, 5% of the steel deck or tray is disposed in a landfill, in accordance with the data in the Determination Method document
D – Reuse, recycling, and energy recovery	At end-of-life, 95% of the steel is recycled in accordance with data in the Determination Method document

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	X	X	X	X	X	X	X	MND	MND	X	X	X	X	X

X = Included in LCA; MND = module not declared

Environmental impact:

1m² of SAB 135R/930 roof deck with Colorcoat® PE15

Parameter	Unit	A1 – A3	A4	A5	B	C1	C2	C3	C4	D
GWP	kg CO_2 eq	3.26E+01	1.52E-01	2.82E-01	0.00E+00	5.68E-01	9.60E-02	1.22E-01	5.53E-03	-1.84E+01
ODP	kg CFC11 eq	7.86E-07	2.86E-08	5.18E-08	0.00E+00	1.66E-07	1.81E-08	5.12E-12	1.39E-09	-2.45E-07
AP	kg SO_2 eq	1.11E-01	4.98E-04	1.44E-03	0.00E+00	4.29E-03	3.15E-04	3.26E-04	3.63E-05	-3.72E-02
EP	kg PO_4^{3-} eq	1.38E-02	9.26E-05	3.02E-04	0.00E+00	9.23E-04	5.86E-05	3.33E-05	6.87E-06	-4.48E-03
POCP	kg Ethene eq	1.78E-02	1.09E-04	2.42E-04	0.00E+00	7.59E-04	6.89E-05	2.69E-05	6.27E-06	-9.24E-03
ADPE	kg Sb eq	4.35E-02	2.61E-06	1.79E-07	0.00E+00	4.23E-07	1.65E-06	4.41E-08	6.00E-08	5.02E-06
ADPF	kg Sb eq	2.96E-01	1.13E-03	2.60E-03	0.00E+00	6.35E-03	7.17E-04	8.08E-04	6.35E-05	-1.00E-01
HTP	Kg DCB eq	6.05E+00	7.06E-02	6.26E-02	0.00E+00	1.85E-01	4.47E-02	5.42E-03	3.02E-03	-2.57E+00
FAETP	Kg DCB eq	2.23E-01	2.64E-03	2.56E-03	0.00E+00	8.38E-03	1.67E-03	4.21E-04	9.02E-05	-2.14E-02
MAETP	Kg DCB eq	4.78E+02	1.04E+01	9.25E+00	0.00E+00	2.94E+01	6.57E+00	1.51E+00	2.98E-01	-6.47E+01
TETP	Kg DCB eq	4.64E-02	6.61E-04	5.46E-04	0.00E+00	1.46E-03	4.19E-04	1.32E-04	5.71E-05	2.22E-01

GWP = Global warming potential

ODP = Depletion potential of stratospheric ozone layer

AP = Acidification potential of land &water

EP = Eutrophication potential

ADPE = Abiotic depletion potential for non-fossil resources

ADPF = Abiotic depletion potential for fossil resources

POCP = Formation potential of tropospheric ozone photochemical oxidants

HTP = Human toxicity potential

FAETP = Freshwater aquatic ecotoxicity potential

MAETP = Marine aquatic ecotoxicity potential

TETP = Terrestrial ecotoxicity potential

Resource use:

1m² of SAB 135R/930 roof deck with Colorcoat® PE15

Parameter	Unit	A1 – A3	A4	A5	B	C1	C2	C3	C4	D
PERE	MJ	1.80E+01	3.00E-02	1.10E-01	0.00E+00	1.12E-01	1.90E-02	7.08E-01	2.18E-03	0.00E+00
PERM	MJ	3.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.83E+01	3.00E-02	1.10E-01	0.00E+00	1.12E-01	1.90E-02	7.08E-01	2.18E-03	0.00E+00
PENRE	MJ	5.61E+02	2.39E+00	5.52E+00	0.00E+00	1.33E+01	1.51E+00	2.48E+00	1.35E-01	0.00E+00
PENRM	MJ	1.49E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	5.62E+02	2.39E+00	5.52E+00	0.00E+00	1.33E+01	1.51E+00	2.48E+00	1.35E-01	0.00E+00
SM	kg	9.17E-01	0.00E+00	-5.61E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	1.55E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	2.35E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	9.70E-02	2.71E-04	9.25E-04	0.00E+00	4.91E-04	1.71E-04	1.02E-03	1.39E-04	0.00E+00

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials

PERM = Use of renewable primary energy resources used as raw materials

PERT = Total use of renewable primary energy resources

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials

PENRM = Use of non-renewable primary energy resources used as raw materials

PENRT = Total use of non-renewable primary energy resources

SM = Use of secondary material

RSF = Use of renewable secondary fuels

NRSF = Use of non-renewable secondary fuels

FW = Use of net fresh water

Output flows and waste categories:

1m² of SAB 135R/930 roof deck with Colorcoat® PE15

Parameter	Unit	A1 – A3	A4	A5	B	C1	C2	C3	C4	D
HWD	kg	4.73E-05	0.00E+00	1.49E-10	0.00E+00	1.10E-11	0.00E+00	2.27E-08	0.00E+00	0.00E+00
NHWD	kg	3.70E+00	0.00E+00	3.37E-03	0.00E+00	1.59E-04	0.00E+00	1.36E-03	5.33E-01	0.00E+00
RWD	kg	8.78E-04	0.00E+00	6.41E-09	0.00E+00	3.81E-06	0.00E+00	3.14E-04	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	2.35E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.77E+00	0.00E+00	0.00E+00
MER	kg	6.37E-02	0.00E+00	2.30E-02	0.00E+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	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	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

Environmental impact: according to EN15804+A2 [23]

1m^2 of SAB 135R/930 roof deck with Colorcoat® PE15

Parameter	Unit	A1 – A3	A4	A5	B	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	3.33E+01	1.53E-01	3.20E-01	0.00E+00	5.76E-01	9.69E-02	1.22E-01	5.66E-03	-1.88E+01
GWP-fossil	kg CO_2 eq	3.32E+01	1.53E-01	2.86E-01	0.00E+00	5.75E-01	9.68E-02	1.23E-01	5.61E-03	-1.90E+01
GWP-biogenic	kg CO_2 eq	4.52E-04	1.11E-04	3.37E-02	0.00E+00	9.01E-04	7.03E-05	-1.14E-03	4.54E-05	2.22E-01
GWP-luluc	kg CO_2 eq	1.46E-02	4.65E-05	3.43E-05	0.00E+00	7.68E-05	2.94E-05	5.81E-04	2.71E-06	7.04E-03
ODP	kg CFC11 eq	8.12E-07	3.59E-08	6.45E-08	0.00E+00	2.10E-07	2.28E-08	2.79E-12	1.74E-09	-7.39E-08
AP	mol H^+ eq	1.39E-01	6.42E-04	1.94E-03	0.00E+00	5.86E-03	4.07E-04	3.94E-04	4.79E-05	-5.14E-02
EP-freshwater	kg P eq	1.41E-03	1.17E-06	4.63E-06	0.00E+00	2.29E-06	7.38E-07	4.25E-07	9.40E-08	-4.02E-04
EP-marine	kg N eq	2.42E-02	1.93E-04	7.37E-04	0.00E+00	2.35E-03	1.23E-04	7.32E-05	1.62E-05	-9.96E-03
EP-terrestrial	mol N eq	2.76E-01	2.14E-03	8.11E-03	0.00E+00	2.58E-02	1.35E-03	7.83E-04	1.79E-04	-9.18E-02
POCP	kg NMVOC eq	9.00E-02	6.87E-04	2.27E-03	0.00E+00	7.23E-03	4.35E-04	2.10E-04	5.16E-05	-3.75E-02
ADP-minerals&metals	kg Sb eq	4.35E-02	2.61E-06	1.80E-07	0.00E+00	4.30E-07	1.65E-06	4.41E-08	6.00E-08	5.09E-06
ADP-fossil	MJ net calorific value	5.52E+02	2.39E+00	5.52E+00	0.00E+00	1.33E+01	1.51E+00	2.48E+00	1.35E-01	-1.17E+02
WDP	m^3 world eq deprived	-5.86E+00	1.16E-02	3.93E-02	0.00E+00	2.02E-02	7.36E-03	2.39E-02	5.95E-03	-2.28E+00
PM	Disease incidence	ND	ND	ND	ND	ND	ND	ND	ND	ND
IRP	kBq U235 eq	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	CTUe	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-nc	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP		ND	ND	ND	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
ADPE = Abiotic depletion potential for non-fossil resources
ADPF = 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.

5 Interpretation of results

Figure 5 shows the relative contribution per life cycle stage for each of the eleven environmental impact categories for 1m^2 of SAB 135R/930 (reference) roof deck profiles. Each column represents 100% of the total impact score, which is why all the columns have been set with the same length. A burden is shown as positive (above the 0% axis) and a benefit is shown as negative (below the 0% axis). The main contributors across all impact categories are A1-A3 (burdens) and D (benefits beyond the system boundary).

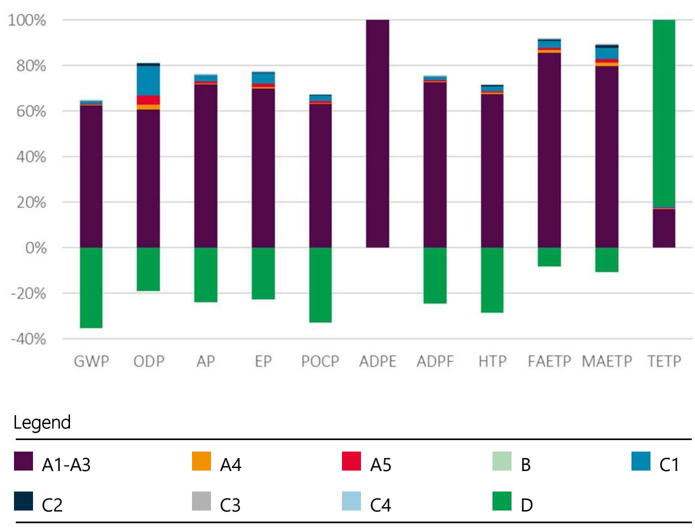
The manufacture of the hot dip galvanised coil during stage A1-A3 is responsible for around 90% of each impact in most of the categories, specifically, the conversion of iron ore into liquid steel which is the most energy intensive part of the deck or liner tray manufacturing process.

The primary site emissions come from 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 over 95% of the Global Warming Potential (GWP), and sulphur oxides, which are responsible for half of the impact in the Acidification Potential (AP) category. In addition, oxides of nitrogen are emitted which contribute half of the A1-A3 Acidification Potential, and three quarters of the Eutrophication Potential (EP), and the combined emissions of sulphur and nitrogen oxides, together with emissions of carbon monoxide, methane, and VOCs all contribute to the Photochemical Ozone indication (POCP).

Figure 5 clearly indicates the relatively modest contribution to each impact from the other life cycle stages, A4 and A5, and C1 through to C4. Of these stages, the most significant contribution is from stage C1 (removal of the product from the building). For the Acidification (AP) and Eutrophication (EP) Potential indicators, this is mainly the result of nitrogen oxides emissions from the combustion of diesel fuel used to power site machinery such as fork lift trucks, scissor lifts and cherry pickers and for the POCP and ODP indicators, it is mainly VOC emissions from the same combustion source.

Consideration of the additional indicators that have been declared to comply with NMD requirements, shows that the largest contribution are from the A1-A3 impacts. The main source of impacts in these toxicity categories are from emissions of heavy metals and inorganics to air and fresh water, during the mining of coal and iron ore and the subsequent smelting process, and during production of the zinc used in the galvanising process.

Figure 5 LCA results for the deck profile



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.

6 References and product standards

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