# SAB 35/1035 wall profile

## Environmental Product Declaration

**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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SAB 35/1035 wall profile
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-2021-021
Date of Issue: 20th April 2021
Valid until: 22nd March 2025

Owner of the Declaration: SAB-profiel bv, produktieweg 2, NL-3401 MG, IJsselstein
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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 | SAB-profiel |
| Product & Module | SAB 35/1035 wall profile |
| Manufacturer | SAB-profiel & Tata Steel Europe |
| Manufacturing sites | IJsselstein, Port Talbot, Llanwern, Shotton and IJmuiden |
| Product applications | Construction and infrastructure |
| Declared unit | $1m^2$ of steel profile |
| Date of issue | 20th April 2021 |
| Valid until | 22nd March 2025 |

This Environmental Product Declaration (EPD) is for SAB 35/1035 wall profiles manufactured by SAB-profiel in the Netherlands, using Colorcoat HPS200 Ultra®, Colorcoat Prisma®, or Colorcoat® pre-finished steel. The environmental indicators are for products manufactured at SAB in IJsselstein with feedstock supplied primarily from IJmuiden in the Netherlands or Shotton in the UK.

The information in the Environmental Product Declaration is based on production data from 2016, 2017 and 2018.

EN 15804 serves as the core PCR, supported by Tata Steel's EN 15804 verified EPD programme Product Category Rules documents, and the LCA model (Cladding V2) supporting this declaration has been independently verified according to ISO 14025 [1,2,3,4,5,6,7].

Third party verifier

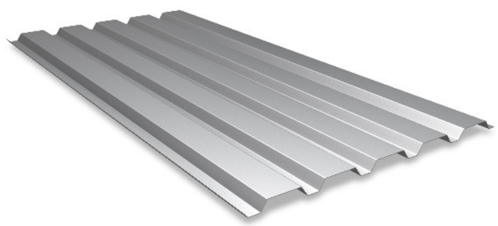
Olivier Muller, PwC Stratégie - Développement Durable, PricewaterhouseCoopers Advisory, 63, rue de Villiers, 92208 Neuilly-sur-Seine, France

# 2 Product information

## 2.1 Product Description

The SAB 35/1035 profile is a trapezoidal external weathering profile, manufactured from Colorcoat® pre-finished steel, and is illustrated in Figure 1. It often forms part of a built-up insulated wall cladding system where it is combined with a galvanised or pre-finished steel liner and mineral wool insulation, but can also be used for roofing applications.

**Figure 1 SAB 35/1035 wall and roof profile**



## 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 | Pre-finished steel | Tata Steel | UK |
| IJmuiden | Hot rolled coil | Tata Steel | NL |
| IJmuiden | Cold rolled coil | Tata Steel | NL |
| IJmuiden | Pre-finished steel | Tata Steel | NL |
| IJsselstein | Steel cladding profiles | SAB-profiel | NL |

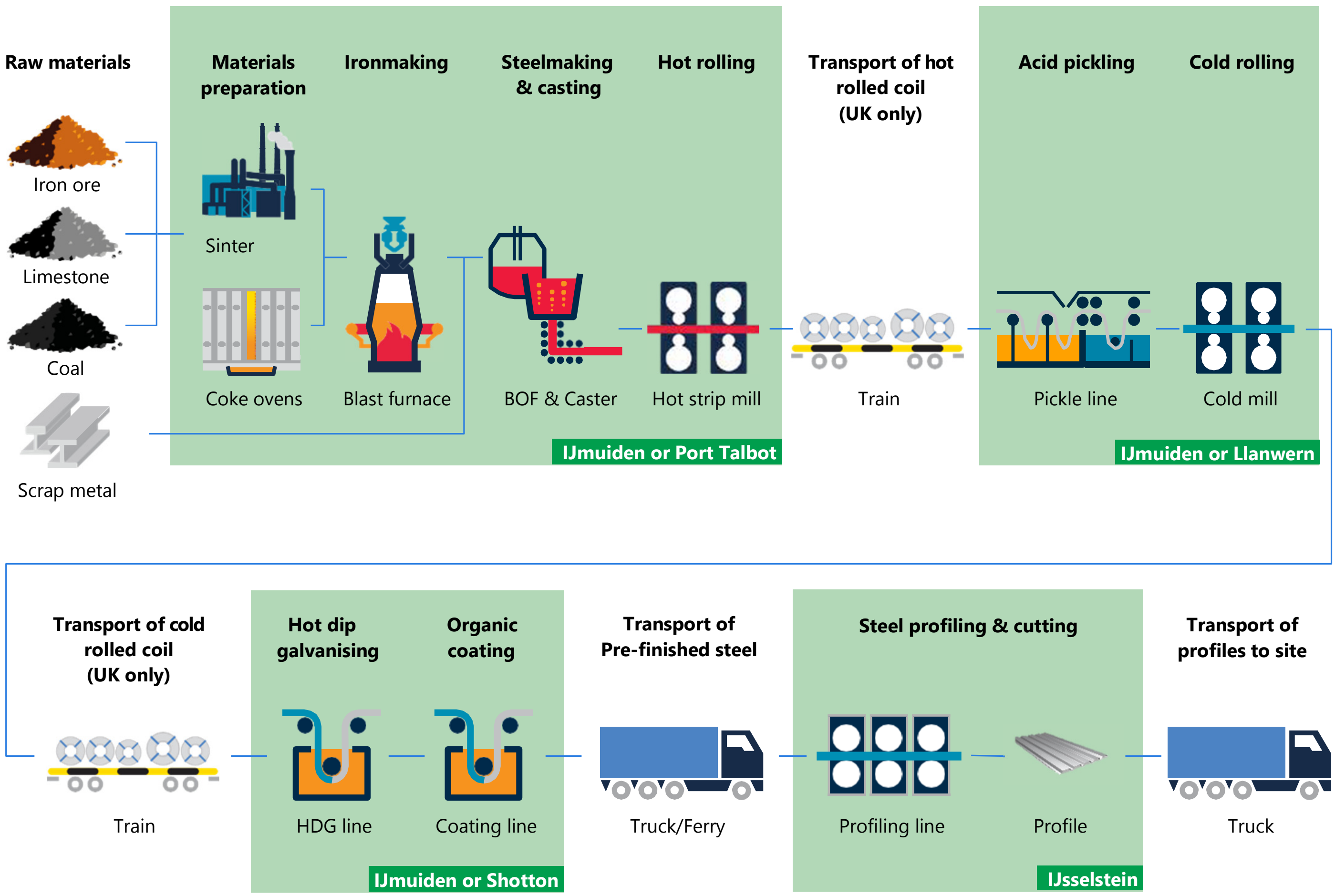
The process of steel coil manufacture at Tata Steel begins with sinter being produced from iron ore and limestone, and together with coke from coal, reduced in a blast furnace to produce iron. Steel scrap is then added to the liquid iron and oxygen is blown through the mixture to convert it into liquid 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 then pickled and cold rolled, before being galvanised and coated. In the Netherlands, these processes are all carried out on the integrated IJmuiden site. In the UK, the hot rolled coils are transported by rail, from Port Talbot to Llanwern for pickling and cold rolling, and the cold rolled coils are transported by rail to Shotton where the strip 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 and offers the specifier a choice of colour and effect. 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(s) in the form of liquid paint. For the vast majority of pre-finished steel products, the above topcoats are applied on the top surface only, while the reverse or back side of the strip is produced with a high performing backing coat. These are cured at elevated temperatures before being recoiled prior to use in the manufacture of the profiles.

The pre-finished steel is profiled and cut into suitable lengths on a continuous production line and an overview of the process from raw materials to transport of the profiles to the construction site, is shown in Figure 2.

**Figure 2 Process overview from raw materials to profile product**



Process data for the manufacture of hot and cold rolled coil at IJmuiden, Port Talbot and Llanwern was gathered as part of the latest worldsteel data collection. For IJmuiden, Port Talbot and Llanwern, and Colorcoat® manufacture 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 cladding profile, process data was also collected from the manufacturing line on the SAB site at IJsselstein.

## 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.

## 2.4 Packaging

The profiles are packaged using wood, and plastic banding and film, in order to protect them during delivery to site and prior to installation.

## 2.5 Reference service life

Steel profiles have a design life dependant on a number of factors including the building use, location, weather conditions and the specification of the pre-finished steel product.

Products specified with Colorcoat HPS200 Ultra® are designed to withstand even the most demanding and aggressive environments and are used in a wide range of industrial and commercial buildings, providing super durability and corrosion resistance.

Three layer Colorcoat Prisma® not only uniquely pushes the boundaries for UV performance but also outperforms the highest European corrosion resistance standards [18] and makes it ideal for commercial, retail, warehouse, public sector and superior aesthetic buildings which are built to last.

Tata Steel offer a Confidex® Guarantee directly to the industrial/ commercial building owner for the weather side of both of these pre-finished steel products. Confidex® offers the longest and most comprehensive guarantee for pre-finished steel available in Europe. Colorcoat HPS200 Ultra® and Colorcoat Prisma® are guaranteed for up to 40 years. The exact length of the guarantee is project specific and depends upon the building location, use and colour. Appropriate inspection and maintenance can significantly extend the functional life of the profile beyond this period. Further details of the Confidex® Guarantee are available at www.colorcoat-online.com

### Table 2 General characteristics and specification of the profile

| | SAB 35/1035 wall profile |
|---|---|
| **Thickness of profile (mm)** | 0.75 (Class 1) [8] |
| **Cover width (mm)** | 1035 |
| **Profile weight (kg/m²)** | 7.11 |
| **CE marking** | Profile to EN 14782 [9] and EN 1090-1 [10] |
| **Certification** | Certifications applicable to SAB IJsselstein are; ISO 9001 [11], ISO 14001 [12] BES 6001 [13] |

### Table 3 Technical specification of Colorcoat®

| | Colorcoat® pre-finished steel |
|---|---|
| **Metallic coating** | Colorcoat HPS200 Ultra® and Colorcoat Prisma® are supplied with Galvalloy® metallic coating which is manufactured using a mix of 95% Zinc and 5% Aluminium that conforms to EN 10346:2015 [14]<br>Colorcoat® pre-finished steel is supplied with a zinc based metallic coating that conforms to EN 10346:2015 [14] |
| **Paint coating (organic)** | Colorcoat HPS200 Ultra®, three layer Colorcoat Prisma® , or Colorcoat® external face<br>All pre-finished steel products are fully REACH [15] compliant and chromate free |
| **Certification** | Certifications applicable to Tata Steel's Shotton site are;<br>ISO 9001 [11], ISO 14001 [12], ISO 45001 [16]<br>BES 6001 [13] , BBA (Colorcoat®) [17]<br>RC5, Ruv4, CPI5 certificates in accordance with EN 10169 [18]<br>Certifications applicable to Tata Steel Colors IJmuiden site are;<br>ISO 9001 [11], ISO 14001 [12], BES 6001 [13] |

# 3 LCA methodology

### 3.1 Declared unit

The unit being declared is 1m$^2$ of pre-finished steel profile and the composition is detailed in Table 4.

### 3.2 Scope

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

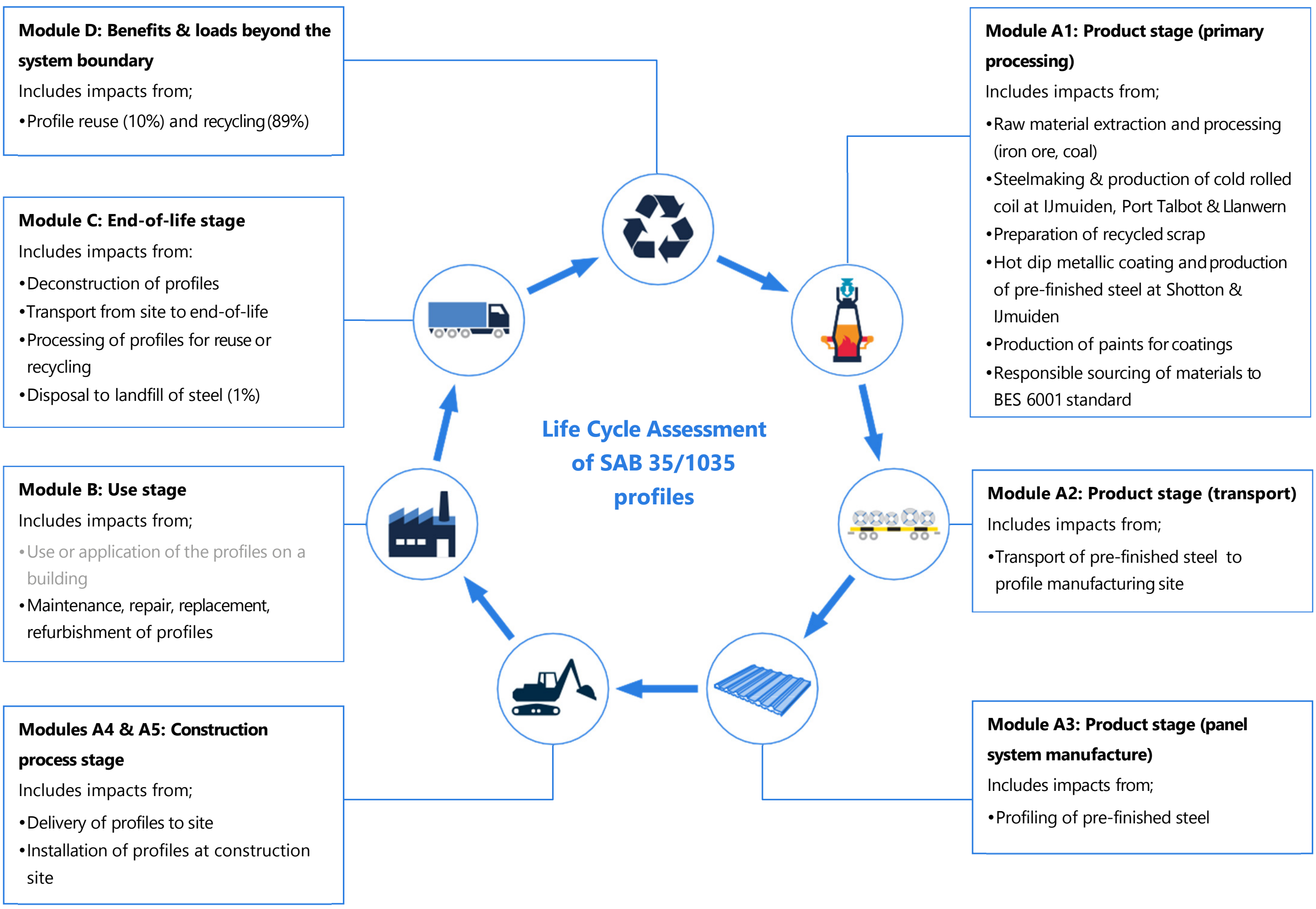
A1-3: Production stage (Raw material supply, transport to production site, manufacturing)
A4 & A5: Production stage (Transport to the construction site and installation)
B1-5: Use stage (related to the building fabric including maintenance, repair, replacement)
C1-4: End-of-life (Deconstruction, transport,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

The life cycle stages are explained in more detail in Figure 3.

**Table 4 Material composition of profile per declared unit**

| | Material declaration |
|---|---|
| **Declared unit (m$^2$)** | 1 |
| **Pre-finished steel (kg)** | 7.11 |

**Figure 3 Life Cycle Assessment of profile**



### 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 pre-finished steel profiles 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.

### 3.4 Background data

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

Where possible, specific data derived from the production processes of Tata Steel and SAB-profiel 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.

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 the production processes of Tata Steel are from 2016 and 2017, and data from SAB-profiel are 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 three of these datasets took place less than 10 years ago. However, the net contribution to impacts of these three 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 [21]. 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 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 [22]. 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).

In order to avoid allocation between different coatings produced from the same line, specific data for the manufacture of each paint type was obtained, and the amount of paint applied was considered, based upon the thickness of the coating.

### 3.7 Additional technical information

The main scenario assumptions used in the LCA are detailed in Table 5. The end-of-life percentages are based upon a Tata Steel/ EUROFER recycling and reuse survey of UK demolition contractors carried out in 2014 [23].

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 [24].

### 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 datasets 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 5 Main scenario assumptions**

| Module | Scenario assumptions |
|---|---|
| **A1 to A3 – Product stage** | Manufacturing data from Tata Steel's sites at IJmuiden, Port Talbot, Llanwern and Shotton are used, as well as data from SAB-profiel at IJsselstein |
| **A2 – Transport to the profile manufacturing site** | The Colorcoat® manufacturing facilities are located at IJmuiden and Shotton. The pre-finished steel coils are transported from IJmuiden to IJsselstein, 69km by road. From Shotton, they are transported a total of 280km by road, and 406km by using the cross channel ferry from Hull to Rotterdam. A 28 tonne payload truck was used for all road journeys and a utilisation factor of 45% was assumed to account for empty returns |
| **A4 – Transport to construction site** | A transport distance of 250km by road on a 28 tonne capacity truck was considered representative of a typical installation. A utilisation factor of 30% was assumed to account for empty returns |
| **A5 – Installation at construction site** | Based on data collected from 10 typical UK installations by a Tata Steel supply chain partner for the installation of cladding systems on site |
| **B1 to B5 – Use stage** | This stage includes any maintenance or repair, replacement or refurbishment of the profiles over the life cycle. This is not required for the duration of the reference service life of the profiles |
| **C1 – Deconstruction & demolition** | Deconstruction is primarily removal of the profiles from the building and is also based upon supply chain partner data |
| **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 25 tonne load capacity lorry with 20% utilisation to account for empty returns |
| **C3 – Waste processing for reuse, recovery and/or recycling** | The profiles that are recycled are processed in a shredder. There is no additional processing of material for reuse |
| **C4 - Disposal** | At end-of-life, 1% of the steel profiles are disposed in a landfill, in accordance with the findings of an NFDC survey |
| **D – Reuse, recycling, and energy recovery** | At end-of-life, 89% of the steel profiles are recycled and 10% are reused, in accordance with the findings of an NFDC 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 | 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 35/1035 profiles

| Parameter | Unit | A1 – A3 | A4 | A5 | B1 - B5 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|
| GWP | kg $CO_2$ eq | 1.97E+01 | 1.87E-01 | 5.83E-01 | 0.00E+00 | 2.30E-01 | 1.39E-01 | 7.51E-02 | 1.07E-03 | -1.20E+01 |
| ODP | kg CFC11 eq | 2.01E-07 | 2.93E-17 | 9.90E-17 | 0.00E+00 | 3.62E-17 | 2.18E-17 | 3.25E-12 | 6.24E-18 | -2.01E-08 |
| AP | kg $SO_2$ eq | 4.05E-02 | 4.81E-04 | 4.38E-03 | 0.00E+00 | 2.18E-03 | 3.73E-04 | 2.23E-04 | 6.44E-06 | -2.33E-02 |
| EP | Kg $PO_4^{3-}$ eq | 4.59E-03 | 1.13E-04 | 9.43E-04 | 0.00E+00 | 4.67E-04 | 8.82E-05 | 2.12E-05 | 7.29E-07 | -1.80E-03 |
| POCP | kg Ethene eq | 6.34E-03 | -1.67E-04 | 5.94E-04 | 0.00E+00 | 2.97E-04 | -1.31E-04 | 1.54E-05 | 4.94E-07 | -5.27E-03 |
| ADPE | kg Sb eq | 7.82E-04 | 1.15E-08 | 3.00E-08 | 0.00E+00 | 1.42E-08 | 8.58E-09 | 3.08E-08 | 3.95E-10 | -2.46E-04 |
| ADPF | MJ | 2.01E+02 | 2.53E+00 | 6.31E+00 | 0.00E+00 | 3.12E+00 | 1.88E+00 | 1.07E+00 | 1.50E-02 | -1.13E+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$^2$ of SAB 35/1035 profiles

| Parameter | Unit | A1 – A3 | A4 | A5 | B1 - B5 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|
| PERE | MJ | 1.29E+01 | 7.51E-02 | 1.93E-01 | 0.00E+00 | 9.28E-02 | 5.59E-02 | 4.50E-01 | 1.97E-03 | 5.80E+00 |
| PERM | MJ | 3.02E-01 | 0.00E+00 | 8.53E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -3.02E-02 |
| PERT | MJ | 1.32E+01 | 7.51E-02 | 1.05E+00 | 0.00E+00 | 9.28E-02 | 5.59E-02 | 4.50E-01 | 1.97E-03 | 5.77E+00 |
| PENRE | MJ | 2.21E+02 | 2.72E+00 | 6.79E+00 | 0.00E+00 | 3.36E+00 | 2.02E+00 | 1.66E+00 | 1.68E-02 | -1.14E+02 |
| PENRM | MJ | 4.71E+00 | 0.00E+00 | 1.43E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -4.71E-01 |
| PENRT | MJ | 2.25E+02 | 2.72E+00 | 8.22E+00 | 0.00E+00 | 3.36E+00 | 2.02E+00 | 1.66E+00 | 1.68E-02 | -1.15E+02 |
| SM | kg | 3.97E-01 | 0.00E+00 | -7.05E-02 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -6.28E+00 | 0.00E+00 | -3.97E-02 |
| RSF | MJ | 2.61E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -2.61E-09 |
| NRSF | MJ | 3.98E-07 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -3.98E-08 |
| FW | m$^3$ | 4.06E-02 | 9.70E-04 | 2.46E-03 | 0.00E+00 | 1.20E-03 | 7.22E-04 | 9.73E-04 | 7.94E-05 | -4.15E-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$^2$ of SAB 35/1035 profiles

| Parameter | Unit | A1 – A3 | A4 | A5 | B1 – B5 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|
| HWD | kg | 5.12E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -5.12E-02 |
| NHWD | kg | 6.63E-01 | 0.00E+00 | 2.98E-02 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 7.22E-02 | -6.63E-02 |
| RWD | kg | 1.31E-03 | 2.22E-06 | 7.59E-06 | 0.00E+00 | 2.74E-06 | 1.66E-06 | 1.99E-04 | 2.09E-07 | -1.22E-04 |
| CRU | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 7.22E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MFR | kg | 3.55E-03 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 6.28E+00 | 0.00E+00 | -3.55E-04 |
| MER | kg | 1.32E-02 | 0.00E+00 | 6.56E-02 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -1.32E-03 |
| 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

# 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 SAB 35/1035 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).

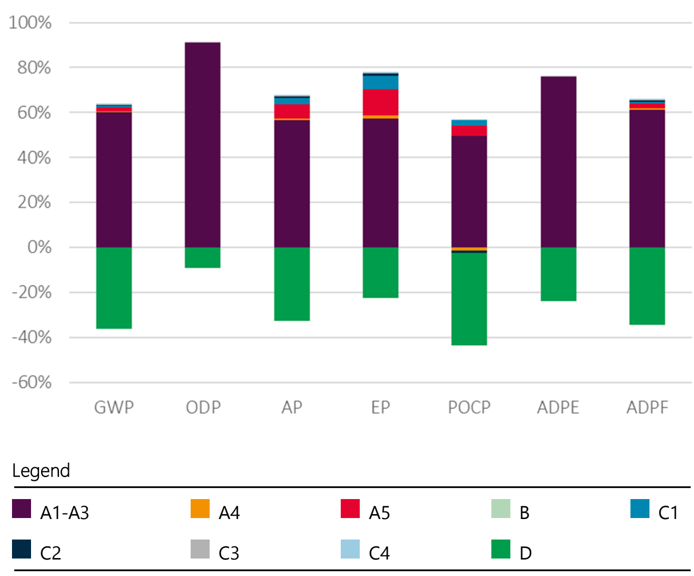
The manufacture of the hot dip galvanised coil during stage A1-A3 is responsible for around 90% of each impact in most of the categories, specifically, the conversion of iron ore into liquid steel which is the most energy intensive part of the profile manufacturing process.

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 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 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 4 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 A5 (installation of the product on the building), in 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. The emission of sulphur dioxide also contributes to the Acidification Potential indicator.

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 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 [22]. This contributes a significant reduction to all 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.

**Figure 4 LCA results for the profiles**




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

For use of net fresh water, Module D is a benefit, but the magnitude of this benefit is slightly 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 and IJmuiden, the biggest water users in this study, are relatively modest users 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 both Port Talbot and IJmuiden.

# 6 References and product standards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