SAB WB 100.1000 insulated wall panel system

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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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-2021-020
Date of Issue: 20th April 2021
Valid until: 22nd March 2025

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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 WB 100.1000 insulated wall panel system
U-Value	$0.21W/m^2K$
Manufacturer	SAB-profiel & Tata Steel Europe
Manufacturing sites	Nieuwegein, Port Talbot, Llanwern, Shotton, and IJmuiden
Product applications	Construction
Declared unit	$1m^2$ of steel cladding system
Date of issue	20^{th} April 2021
Valid until	22^{nd} March 2025

This Environmental Product Declaration (EPD) is for SAB WB 100.1000 insulated wall panels manufactured by SAB profiel in the Netherlands, using Colorcoat HPS200 Ultra®, Colorcoat Prisma®, or Colorcoat® pre-finished steel and PIR foam insulation. The environmental indicators are for products manufactured at SAB in Nieuwegein 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

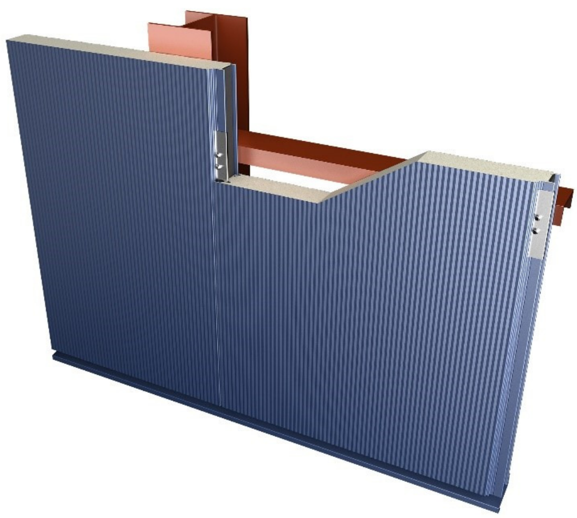
Olivier Muller, PwC Stratégie - Développement Durable, PricewaterhouseCoopers Advisory,
63, rue de Villiers, 92208 Neuilly-sur-Seine, France

2 Product information

2.1 Product Description

The SAB WB 100.1000 wall system is an insulated panel system comprising a pre-finished steel liner profile, a polyisocyanurate (PIR) insulation core, and a Colorcoat® pre-finished steel external weathering profile. The panel, shown in Figure 1, falls into category B-s2,d0 according to the EN 13501-1 standard [8] and also has Factory Mutual (FM) Approvals [9].

Figure 1 SAB WB 100.1000 wall panel system



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
Nieuwegein	Insulated panel system	SAB-profiel	NL

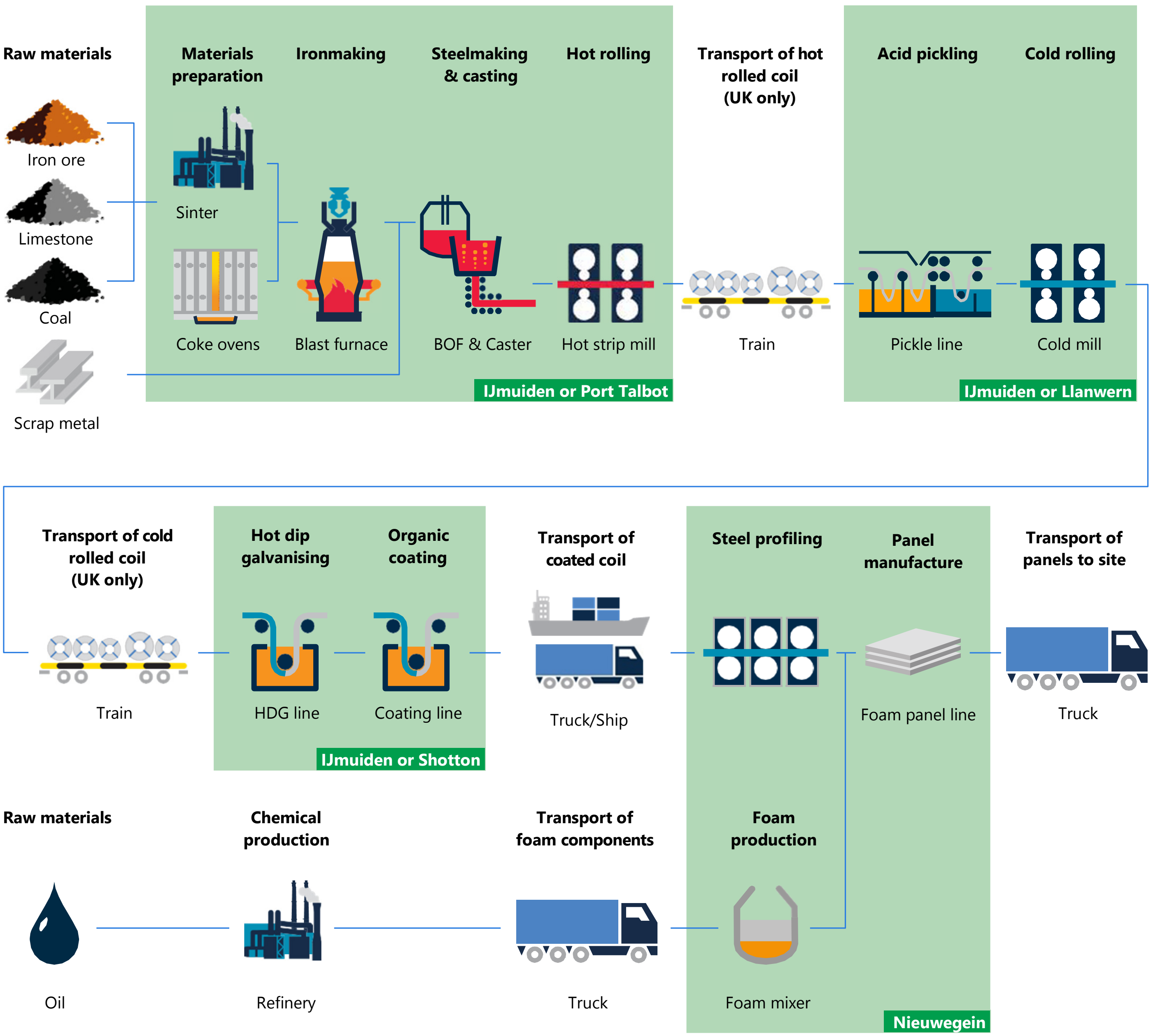
The process of steel coil manufacture at Tata Steel begins with sinter being produced from iron ore and limestone, and together with coke from coal, reduced in a blast furnace to produce iron. Steel scrap is then added to the liquid iron and oxygen is blown through the mixture to convert it into liquid 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 then 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 topcoat 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 insulated panel system.

The pre-finished steel is profiled on a dedicated process line and the foam is deposited between the backing or liner profile and the top or outer profile. This profile/foam assembly is then cut into suitable lengths to create the insulated panel. The foam insulation is formed by mixing an isocyanate chemical with a polyol chemical, and the foaming is achieved using a suitable blowing agent. The insulation thickness is controlled to achieve the desired panel thickness and the foam itself is also the means by which the two pre-finished steel sheets are held together. An overview of the process from raw materials to transport of the panel product to the construction site, is shown in Figure 2.

Figure 2 Process overview from raw materials to panel 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 panel system, process data was also collected from the manufacturing line on the SAB site at Nieuwegein.

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 panels are packaged using expanded polystyrene, plastic film and timber in order to protect them during delivery to site and prior to installation.

2.5 Reference service life

Steel faced PIR foam insulated panels 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 [19] 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 cladding beyond this period. Further details of the Confidex® Guarantee are available at www.colorcoat-online.com

Table 2 General characteristics and specification of the panel

	SAB WB 100.1000 insulated panel system
Thickness of outer sheet (mm)	0.50 (Class 1) [10]
Thickness of liner sheet (mm)	0.40 (Class 3) [10]
Core thickness of insulation (mm)	100
Cover width (mm)	1000
U-value (W/m²K)	0.21
Panel weight (kg/m²)	12.11
CE marking	Insulated panel to EN 14509 [11]
Certification	Certifications applicable to SAB Nieuwegein are; ISO 9001 [12], ISO 14001 [13], BES 6001[14] FM Approvals 4880 and 4881 [9]

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 [15] Colorcoat® pre-finished steel is supplied with a zinc based metallic coating that conforms to EN 10346:2015 [15]
Paint coating (organic)	Colorcoat HPS200 Ultra®, three-layer Colorcoat Prisma® or Colorcoat® external face Colorcoat® PE15 or generic PE15 product internal face All pre-finished steel products are fully REACH [16] compliant and chromate free
Certification	Certifications applicable to Tata Steel's Shotton site are; ISO 9001 [12], ISO 14001 [13], ISO 45001 [17] BES 6001 certification [14], BBA certification (Colorcoat®) [18] RC5, Ruv4, CPI5 certificates in accordance with EN 10169 [19] Certifications applicable to Tata Steel Colors IJmuiden site are; ISO 9001 [12], ISO 14001 [13], BES 6001 certification [14]

3 LCA methodology

3.1 Declared unit

The unit being declared is 1m^2 of insulated panel system 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;

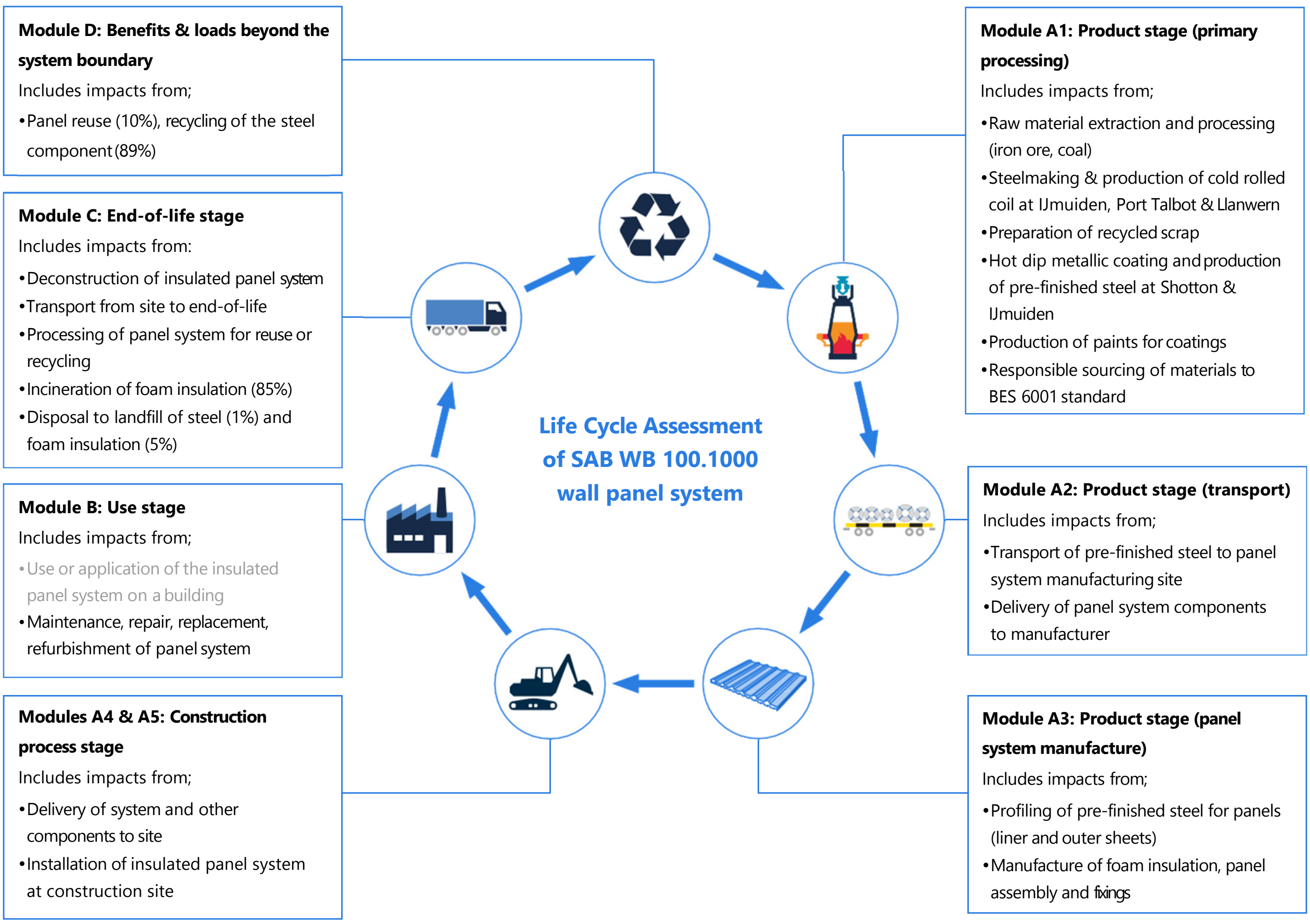
A1-3: Production stage (Raw material supply, transport to production site, manufacturing)
A4 & A5: Production stage (Transport to the construction site and installation)
B1-5: Use stage (related to the building fabric including maintenance, repair, replacement)
C1-4: End-of-life (Deconstruction, transport, 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 panels per declared unit

	Material declaration
Declared unit (m^2)	1
Insulation (kg)	3.90
Steel (kg)	8.14
Fixings & brackets (kg)	0.07

Figure 3 Life Cycle Assessment of foam insulated panel system



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 insulated panel system 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 panel system, the GaBi Software System for Life Cycle Engineering is used [20]. The GaBi database contains consistent and documented datasets which can be viewed in the online GaBi documentation [21].

Where possible, specific data derived from the production processes of Tata Steel and SAB-profiel were the first choice to use where available. Data were 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 data sets 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 [22]. 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 way 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 [23]. 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 [24].

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 [25].

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 Nieuwegein
A2 – Transport to the panel manufacturing site	The Colorcoat® manufacturing facilities are located at IJmuiden and Shotton. The pre-finished steel coils are transported from IJmuiden to Nieuwegein, 69km by road. From Shotton, they are transported a total of 280km by road, and 406km by sea 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 8% 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. The fixing screws are made from stainless steel
B1 to B5 – Use stage	This stage includes any maintenance or repair, replacement or refurbishment of the panels over the life cycle. This is not required for the duration of the reference service life of the panels
C1 – Deconstruction & demolition	Deconstruction is primarily removal of the panels 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, an incinerator, 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 insulated panels are processed in a shredder and the steel component is recycled. 85% of the waste foam insulation is incinerated for energy recovery. There is no additional processing of material for reuse
C4 - Disposal	At end-of-life, 1% of the steel is disposed in a landfill in accordance with the findings of an NFDC survey, and 5% of the insulation is disposed in a landfill
D – Reuse, recycling, and energy recovery	At end-of-life, 89% of the steel is recycled and 10% of the panels (steel and insulation) 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 WB 100.1000 panels

Parameter	Unit	A1 – A3	A4	A5	B1 - B5	C1	C2	C3	C4	D
GWP	kg CO_2 eq	3.38E+01	1.07E+00	7.08E-01	0.00E+00	2.30E-01	2.36E-01	8.20E+00	4.41E-03	-1.53E+01
ODP	kg CFC11 eq	2.01E-05	1.67E-16	2.79E-15	0.00E+00	3.62E-17	3.71E-17	5.52E-12	2.56E-17	-2.01E-06
AP	kg SO_2 eq	7.10E-02	3.01E-03	5.73E-03	0.00E+00	2.18E-03	6.34E-04	5.90E-03	2.64E-05	-3.02E-02
EP	Kg PO_4^{3-} eq	9.76E-03	7.16E-04	1.02E-03	0.00E+00	4.67E-04	1.50E-04	1.39E-03	3.00E-06	-2.63E-03
POCP	kg Ethene eq	1.66E-02	-1.09E-03	6.63E-04	0.00E+00	2.97E-04	-2.23E-04	3.42E-04	2.03E-06	-7.06E-03
ADPE	kg Sb eq	8.74E-04	6.57E-08	1.39E-05	0.00E+00	1.42E-08	1.46E-08	4.75E-07	1.62E-09	-2.86E-04
ADPF	MJ	5.12E+02	1.44E+01	9.19E+00	0.00E+00	3.12E+00	3.20E+00	5.06E+00	6.17E-02	-1.95E+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 SAB WB 100.1000 panels

Parameter	Unit	A1 – A3	A4	A5	B1 - B5	C1	C2	C3	C4	D
PERE	MJ	3.37E+01	4.28E-01	8.13E-01	0.00E+00	9.28E-02	9.51E-02	1.16E+00	8.09E-03	4.81E+00
PERM	MJ	6.51E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-6.51E-01
PERT	MJ	4.03E+01	4.28E-01	8.13E-01	0.00E+00	9.28E-02	9.51E-02	1.16E+00	8.09E-03	4.16E+00
PENRE	MJ	5.71E+02	1.55E+01	1.01E+01	0.00E+00	3.36E+00	3.44E+00	6.52E+00	6.88E-02	-2.00E+02
PENRM	MJ	9.15E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-9.15E+00
PENRT	MJ	6.63E+02	1.55E+01	1.01E+01	0.00E+00	3.36E+00	3.44E+00	6.52E+00	6.88E-02	-2.09E+02
SM	kg	1.78E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-7.25E+00	0.00E+00	-1.78E-02
RSF	MJ	4.61E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-4.61E-09
NRSF	MJ	7.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-7.00E-08
FW	m^3	2.74E-01	5.53E-03	4.74E-03	0.00E+00	1.20E-03	1.23E-03	2.86E-03	3.26E-04	-7.22E-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 SAB WB 100.1000 panels

Parameter	Unit	A1 – A3	A4	A5	B1 – B5	C1	C2	C3	C4	D
HWD	kg	5.16E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.16E-02
NHWD	kg	7.50E-01	0.00E+00	1.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.96E-01	-7.50E-02
RWD	kg	6.99E-03	1.27E-05	1.12E-04	0.00E+00	2.74E-06	2.81E-06	4.01E-04	8.58E-07	-6.97E-04
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	1.43E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.25E+00	0.00E+00	-1.43E-02
MER	kg	5.52E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.30E+00	0.00E+00	-5.52E-04
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E+01	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	1.65E+01	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 WB 100.1000 panels. 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).

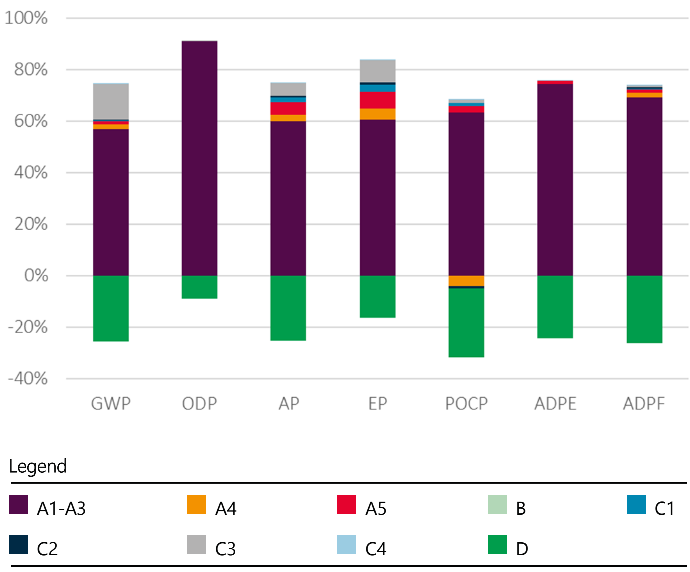
The manufacture of the cold rolled coil during stage A1-A3 is responsible for around 60% of each impact in most of the categories, specifically, the conversion of iron ore into liquid steel which is the most energy intensive part of the panel manufacturing process. The production of the main components (isocyanate and polyol) used to make the foam insulation is also a significant contributor to each environmental impact and is responsible for about 20% of the A1-A3 total. The exception to this is the Ozone Depletion Potential (ODP) indicator, where the manufacture of the foam insulation is responsible for almost 100% of the total impact in the form of tetrachloromethane.

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, together with the foam insulation manufacture, give rise to emissions of CO_2, which contributes 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 small contribution to each impact from the other life cycle stages, A4 and A5, and C1 through to C4. Of these stages, the most significant contributions are from stages C3 (waste processing) in the GWP, AP and EP indicators, and from A4 (transport to construction site) and A5 (installation of the product on the building), in the AP and EP indicators.

The main impact in the C3 stage is from the incineration for energy recovery of the foam insulation at end-of-life, which produces significant masses of carbon dioxide (GWP) and oxides of nitrogen (AP and EP) from combustion of the foam insulation.

Figure 4 LCA results for the panel system



The impacts from the A4 and A5 stages are mainly the result of nitrogen oxides emissions from the combustion of diesel fuel used in road transport (A4) and to power site machinery such as fork lift trucks, scissor lifts and cherry pickers (A5). The emission of sulphur dioxide also contributes to the Acidification Potential indicator for A5, with approximately 20% of this impact coming from the manufacture of the stainless steel screws that fix the panels to the building.

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 [23]. 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.

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.

6 References and product standards

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4. ISO 14044:2006, Environmental management - Life Cycle Assessment - Requirements and guidelines

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7. EN 15804:2012+A1:2013, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

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12. ISO 9001:2015, Quality management systems

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www.sabprofiel.com

SAB-profiel - A Tata Steel enterprise
Produktieweg 2
NL-3401 MG IJsselstein
Postbus 97
NL-3400 AB IJsselstein
T: +31 (0) 30 68 79 700
E: info@sabprofiel.nl
www.sabprofiel.com

Tata Steel UK Limited is registered in England under number 2280000 with registered office at 18 Grosvenor Place, London, SW1X 7HS

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