CA Building Products Twin-Therm® Roof System

(CA 32 1000R external & CA 17 1000L Liner roof profiles, 0.18W/m^{2}K U-value reference product)

Environmental Product Declaration

Owner of the Declaration: CA Group Ltd, County Durham, DL14 9SF
Programme Operator: Tata Steel UK Limited, 18 Grosvenor Place, London, SW1X 7HS

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CA Building Products Twin-Therm® Roof (0.18W/m^{2}K U-value)
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-2025-034
Date of Issue: 15th December 2025
Valid until: 19th March 2030

Owner of the Declaration: CA Group Ltd, County Durham, DL14 9SF
Programme Operator: Tata Steel UK Limited, 18 Grosvenor Place, London, SW1X 7HS

The CEN standard EN 15804:2012+A2:2019/AC:2021 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: Chris Foster, Eugeos Ltd.

1 General information

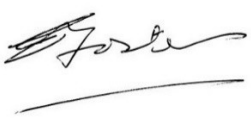
Owner of EPD	CA Group Ltd
Product & Module	Twin-Therm® Roof Series (240mm reference product)
U-value	0.18W/m^{2}K
Manufacturer	CA Building Products & Tata Steel UK
Manufacturing sites	Evenwood, Shotton, Llanwern and Port Talbot
Product applications	Construction and infrastructure
Declared unit	1m^2 of steel cladding system
Date of issue	15th December 2025
Valid until	19th March 2030

This Environmental Product Declaration (EPD) is for Twin-Therm® roof cladding system manufactured by CA Building Products in the UK, using Colorcoat HPS200 Ultra® or Colorcoat Prisma® pre-finished steel, MatriX spacer system, Therma-quilt insulation, Colorcoat® PE 15 or Colorcoat® High Reflect steel liner. Twin-Therm® insulation thicknesses range from 240-480mm. The liner gauge can be 0.4mm, 0.6mm or 0.7mm. The environmental indicators are for products manufactured at CA Building Products in Evenwood with feedstock supplied from Shotton.

The information in the Environmental Product Declaration is based on production data from 2021, 2022 and 2023.

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 V4) supporting this declaration has been independently verified according to ISO 14025 [1,2,3,4,5,6,7].

Third party verifier



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2 Product information

2.1 Product Description

Twin-Therm® roof is a site assembled cladding system that is fully walkable and provides a tested Class 'B' Non-Fragile assembly when fixed and sealed. It comprises of a Colorcoat® pre-finished steel liner, MatriX spacer system, Therma-quilt non-hygroscopic glass wool insulation, and a Colorcoat® pre-finished steel external weathering profile. Twin-Therm® Chronus® and Chronus® Ready specifications provide enhanced building adaptability, suitable for internal temperatures as low as 0°C, utilising Euroclass A1 Non-Combustible Therma-quilt insulation to EN 13501-1 [10].

The Twin-Therm® roof system is:

- Independently assessed by BDA Agrément [8]
- Designed for roof pitches ≥ 2.5° after steelwork deflection at end laps
- Fully walkable and Class 'B' Non-Fragile
- LPCB tested to LPS 1181-1 achieving Grade 'EXT-B' status [9]
- LPCB tested to LPS 1175 and can be designed to achieve SR1 and SR2 Security Ratings
- A Secured By Design (SBD) approved system

The Twin-Therm® roof system has a:

- Minimum self-curve radii of 45m
- Proven building Air Permeability as low as 0.33m^3/hr.m^2

The main results in this EPD are for the Twin-Therm® roof product with a liner gauge of 0.4mm and an insulation thickness of 240mm. The A1-A3 impacts from the variations of this product is provided in Annex A.

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 steel	Tata Steel	UK
Evenwood	Insulated cladding system	CA Building Products	UK

The process of steel coil manufacture 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 can be reheated and rolled in a hot strip mill to produce steel coil.

Tata Steel UK purchases high quality steel slabs and hot rolled coils from our own sister plants as well as external partners, which are transported to Port Talbot by ship, rail and road. The purchased slabs are reheated and rolled in the Port Talbot hot strip mill. The hot rolled coils are then transported by rail, from Port Talbot to Llanwern where they are pickled and cold rolled. Following cold rolling, the coil is then transported by train to Shotton where the strip is galvanised and coated.

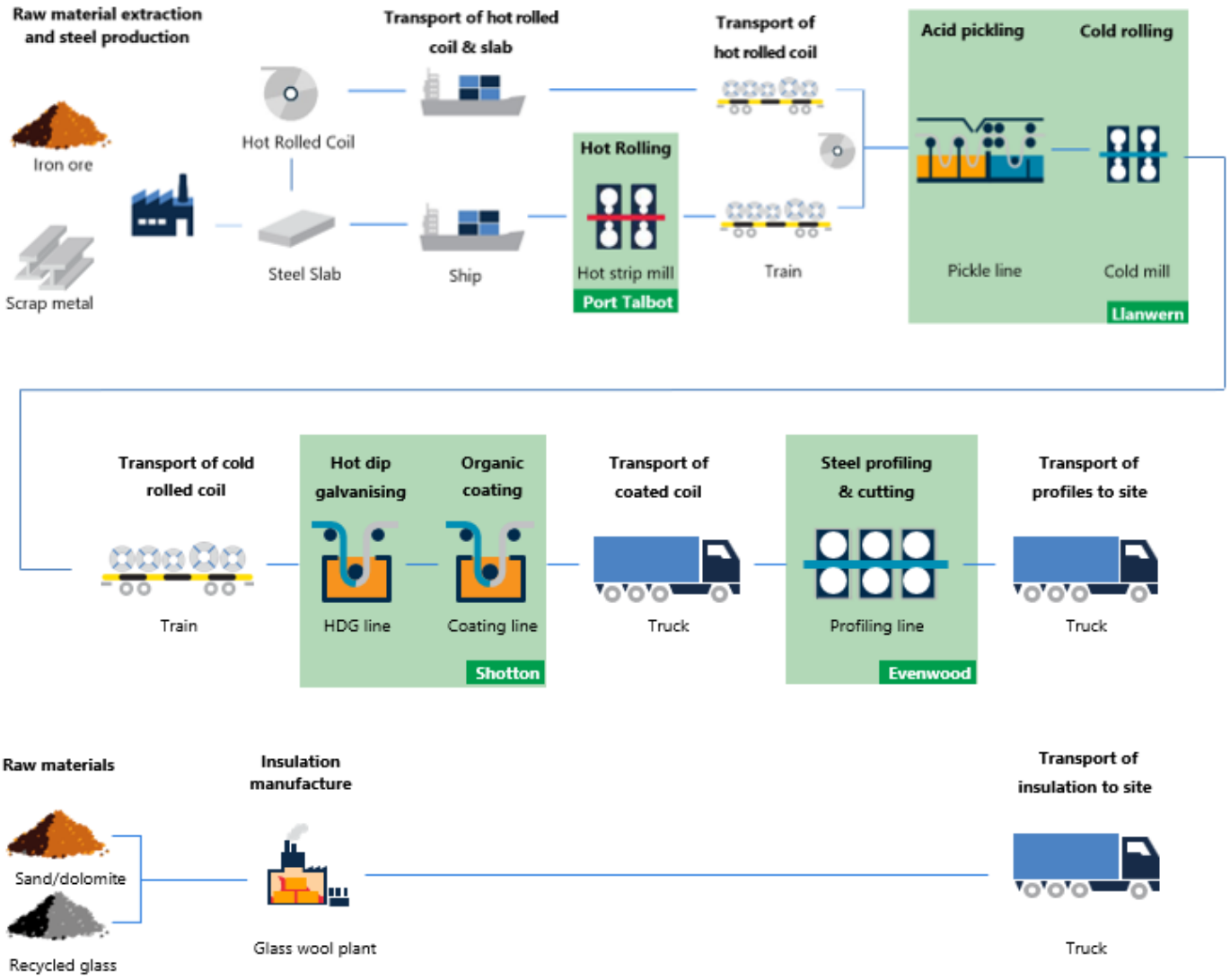
Pre-finished steel comprises of multiple paint layers and treatments which are applied to the steel in an automated and carefully controlled process with each layer of the product having a particular function.
It is the combined effect of all these layers that give the product its overall performance and ensures a material that is robust and offers the specifier a choice of colour and effect. During the organic coating
process for Colorcoat HPS200 Ultra® and Colorcoat Prisma®, a Galvalloy® 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 most 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 cladding system.

The pre-finished steel is profiled and cut into suitable lengths on a continuous production line to produce the liner and outer sheets. Steel spacer brackets and bars are formed to provide a means of attaching the outer sheet profile to the structure. They also determine the thickness of the cavity between the liner and outer profiles, into which glass wool thermal insulation is inserted during installation of the system on the building. An overview of the process from raw materials to transport of the cladding system to the construction site, is shown in Figure 1.

Tata Steel's Shotton plant in North Wales has been producing market leading products for over 125 years. The site launched a sustainability commitment in 2022, with four key themes of sustainable development, namely, reducing the site's carbon footprint, developing and producing products and services that support sustainable construction, protecting and expanding the biodiversity that co-exists on site, and maximising material efficiency and achieving zero onsite waste.

As part of its decarbonisation journey, the Shotton site purchases electricity from 100% renewable sources (including solar, wind, biomass and hydro) for its entire operation, in the form of Guarantees of Origin, reducing the site annual CO2 emissions by 16%. However, to avoid the risk of double counting the benefits of renewable electricity, Tata Steel's EPD Programme does not currently permit the use of REGOs in EPDs, and so this emission reduction is not reflected in the A1-A3 environmental indicators of this EPD

Figure 1 Process overview from raw materials to cladding product



Additionally, over 70 onsite vehicles run fully on Hydrotreated Vegetable Oil (HVO) as an alternative to conventional diesel, and some onsite vehicles have been switched to fully electric. For more information on the efforts the site has made towards achieving its' sustainability commitment, see www.colorcoat-online.com

Process data for the reheating and hot rolling of steel slab at Port Talbot, and the manufacture of the cold rolled coil at Llanwern, were gathered as part of the latest worldsteel data collection. For 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 system, process data was also collected from the manufacturing line on the CA Group site at Evenwood.

2.3 Technical data and specifications

The general properties of the reference product are shown in Table 2, and the property ranges of the family are in Table 3. The technical specifications of the product are presented in Table 4. The masses and weights specified in this EPD document in Table 2 may vary slightly to product specification documents distributed by CA Group.

2.4 Packaging

The profiled sheets are packaged using responsibly sourced timber. For 1m^2 of product, 0.25 kg of timber is required.

2.5 Reference service life

Steel faced cladding systems have a design life dependant on several 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 [11] 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 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 characteristic and specification (reference product)

	Twin-Therm® Roof reference product
Thickness of liner sheet (mm)	0.40
Core thickness of insulation (mm)	240
U-value (W/m^{2}K)	0.18
Cladding weight (kg/m^2)	13.62

Table 3 General characteristics and specification of the cladding (product family)

	Twin-Therm® Roof series
Thickness of outer sheet (mm)	0.70 (Class 1) [12]
Thickness of liner sheet (mm)	0.40 minimum, 0.60, 0.70 (Class 4) [12]
Core thickness of insulation (mm)	240-480
Cover width (mm)	1000
U-value (W/m^{2}K)	0.18-0.09
Cladding weight (kg/m^2)	13.62 – 19.74
CE marking	Profiled sheets to EN 14782 [13] Insulation to EN 13162 [14] Spacer system to ETA 21/0138 [15] and EAD 200012-00-0401 [29]
Certification	Certifications applicable to CA Group Evenwood site are; ISO 9001 [16], ISO 14001 [17], ISO 45001 LPCB LPS 1181 Ext-B [9] LPCB LPS 1175 SR1 and SR2 Security Ratings Kiwa BDA Agrément certification [8] Planet Mark [30] Euroclass A1 Non-Combustible Therma-quilt insulation to EN 13501-1 [10] Secured By Design (SBD) approved systems

Table 4 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 [18]
Paint coating (organic)	Colorcoat HPS200 Ultra® or three layer Colorcoat Prisma® external face Colorcoat® PE 15 internal face or Colorcoat® High Reflect All pre-finished steel products are fully REACH [19] compliant and chromate free
Certification	Certifications applicable to Tata Steel's Shotton site are; ISO 9001 [16], ISO 14001 [17], ISO 45001 [20] BES 6001 certification [21] BBA certification (Colorcoat®) [22] RC5+, Ruv4 & Ruv5, CPI5 certificates in accordance with EN 10169 [11]

2.6 Biogenic carbon content

There are no biogenic carbon containing materials in the product. The biogenic carbon content of the packaging materials is shown in Table 5.

Table 5 Biogenic carbon content at the factory gate

	CA Twin-Therm®
Biogenic carbon content (product) (kg)	0
Biogenic carbon content (packaging) (kg)	0.13

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

3 LCA methodology

3.1 Declared unit

The unit being declared is 1m^2 of cladding system and the cladding composition is detailed in Table 6. The coated steel mass in Table 6 may vary slightly to product specification documents distributed by CA Group.

3.2 Scope

This EPD considers the whole lifecycle of the product and the modules included in the LCA are;

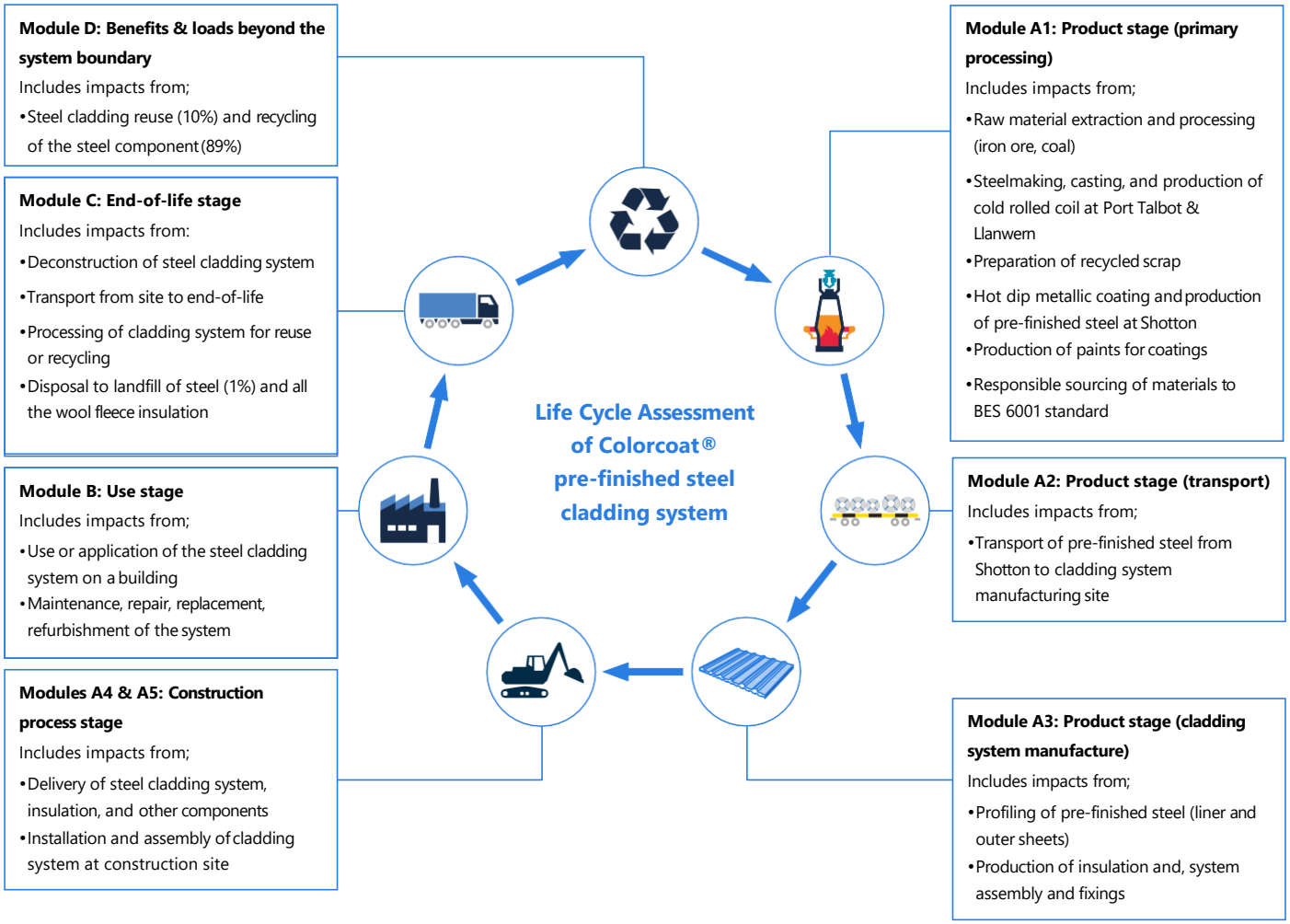
A1-A3: Production stage (Raw material supply, transport to production site, manufacturing)
A4 & A5: Production stage (Transport to the construction site and installation)
B1-B7: Use stage (related to the building fabric including maintenance, repair, replacement)
C1-4: End-of-life (Deconstruction, transport, processing for recycling & reuse and disposal)
D: Reuse, recycling and recovery

The life cycle stages are explained in more detail in Figure 2.

Table 6 Material composition of reference cladding system per declared unit

	Material declaration
Declared unit (m^2)	1
Insulation (kg)	2.76
Steel (kg)	10.86
Fixings & brackets (kg)	0.810

Figure 2 Life Cycle Assessment of steel cladding 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 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 cladding 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 contributes 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 Sphera LCA for Experts Software System for Life Cycle Engineering (formerly GaBi) is used [23]. The LCAfE database contains consistent and documented datasets which can be viewed in the online Managed LCA Content (MLC) documentation [24].

Where possible, specific data derived from Tata Steel's own production processes 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. The steel substrate was modelled using the World Steel global average dataset

To ensure comparability of results in the LCA, the basic data of the Sphera MLC were used for energy, transportation and auxiliary materials.

3.5 Data quality

The data from the production processes of Tata Steel and CA Building Products are from 2022 and 2023, 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 Sphera MLC, and the last revision of all but three of these data sets took place less than 10 years ago. However, the contribution to impacts of these three datasets is small and relatively insignificant, and therefore, the study is based on good quality data.

3.6 Allocation

The primary steel supply is modelled using the World Steel global average dataset for BF/BOS steel slab, available in LCAfE. Consequently, it is not possible to apply a methodology to assign impacts to the production of slag and hot metal from the blast furnace, be that physical and chemical partitioning of the manufacturing process, or economic allocation. Therefore, no allocation was applied to the primary steel production processes in this study.

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 [25]. 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).

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 below in Table 7. The end-of-life percentages are taken from a Tata Steel/ EUROFER recycling and reuse survey of UK demolition contractors carried out in 2014[26].

For all indicators the characterisation factors from the EC-JRC are applied, identified by the name EN_15804, and based upon the EF Reference Package 3.1 [27]. In LCAfE, the corresponding impact assessment is used, denoted by EN 15804 +A2.

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, 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 7 Main scenario assumptions

Module	Scenario assumptions
A1 to A3 – Product stage	Steel substrate is modelled using the World Steel global average for steel slab produced by the BF/BOF steelmaking route, and manufacturing data from Tata Steel's sites at Port Talbot, Llanwern and Shotton are used, as well as data from CA Group in Evenwood
A2 – Transport to the profile manufacturing site	The Colorcoat® manufacturing facility is located on the Shotton site. The steel coils are transported from here, 260km by road on a 25 tonne payload truck. 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 25 tonne capacity truck was considered representative of a typical installation. Utilisation factors of 30% (profiles) and 14% (insulation) were assumed, to account for empty returns
A5 – Installation at construction site	Energy consumption estimated based upon published data for the erection of steel constructions in Germany [28]. The fixing screws are made from stainless steel
B1 to B7 – Use stage	This stage includes any maintenance or repair, replacement or refurbishment of the cladding systems over the life cycle. This is not required for the duration of the reference service life of the products.
C1 – Deconstruction & demolition	Energy consumption estimated based upon published data for the dismantling of steel constructions in Germany [28].
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 recycled cladding is processed in a shredder. There is no additional processing of material for reuse
C4 - Disposal	At end-of-life, 1% of the steel based upon the findings of an NFDC survey and all 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	X	X	X	X	X	X	X

X = Included in LCA; MND = module not declared

Environmental impact:

1m² of CA Twin-Therm® roof (CA 32 1000R external & CA 17 1000L Liner roof profiles, 0.18W/m²K U-value reference product)

Parameter	Unit	A1 – A3	A4	A5	B1 – B7	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	3.68E+01	6.26E-01	6.71E-02	0.00E+00	1.68E-01	1.12E-01	1.14E-01	1.23E-01	-1.70E+01
GWP-fossil	kg CO_2 eq	3.76E+01	6.28E-01	7.36E-02	0.00E+00	1.95E-01	1.13E-01	1.15E-01	1.23E-01	-1.71E+01
GWP-biogenic	kg CO_2 eq	-7.60E-01	-2.54E-03	-6.49E-03	0.00E+00	-2.73E-02	-4.57E-04	-1.18E-03	-5.14E-04	9.21E-02
GWP-luluc	kg CO_2 eq	5.98E-03	2.64E-05	1.51E-05	0.00E+00	3.97E-05	4.75E-06	5.51E-04	5.51E-04	-2.37E-03
ODP	kg CFC11 eq	4.29E-07	9.84E-14	1.39E-12	0.00E+00	2.82E-13	1.77E-14	2.64E-12	3.80E-13	-1.21E-08
AP	mol H^+ eq	1.53E-01	7.47E-04	2.05E-04	0.00E+00	6.83E-04	1.61E-04	3.74E-04	7.83E-04	-4.33E-02
EP-freshwater	kg P eq	3.32E-04	1.32E-07	1.17E-07	0.00E+00	3.66E-07	2.37E-08	4.03E-07	4.62E-05	-2.81E-05
EP-marine	kg N eq	2.47E-02	2.90E-04	6.42E-05	0.00E+00	1.90E-04	6.63E-05	6.94E-05	1.81E-04	-7.34E-03
EP-terrestrial	mol N eq	3.02E-01	3.29E-03	6.96E-04	0.00E+00	2.09E-03	7.44E-04	7.43E-04	1.99E-03	-6.77E-02
POCP	kg NMVOC eq	8.37E-02	8.17E-04	2.10E-04	0.00E+00	7.64E-04	1.72E-04	1.99E-04	5.69E-04	-2.88E-02
ADP-minerals&metals	kg Sb eq	7.01E-04	2.03E-08	1.88E-08	0.00E+00	2.95E-08	3.66E-09	4.18E-08	8.09E-09	-1.36E-04
ADP-fossil	MJ net calorific value	4.85E+02	8.31E+00	3.21E+00	0.00E+00	1.29E+01	1.50E+00	2.35E+00	1.92E+00	-1.77E+02
WDP	m^3 world eq deprived	4.32E+01	8.55E-04	3.86E-03	0.00E+00	3.80E-03	1.54E-04	2.27E-02	1.52E-02	-4.38E+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

Resource use:

1m² of CA Twin-Therm® roof (CA 32 1000R external & CA 17 1000L Liner roof profiles, 0.18W/m²K U-value reference product)

Parameter	Unit	A1 – A3	A4	A5	B1 – B7	C1	C2	C3	C4	D
PERE	MJ	6.42E+01	4.73E-01	1.22E+00	0.00E+00	5.72E-01	8.52E-02	6.72E-01	3.03E-01	1.37E+00
PERM	MJ	3.22E+00	0.00E+00	5.22E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.55E-01
PERT	MJ	6.75E+01	4.73E-01	1.22E+00	0.00E+00	5.72E-01	8.52E-02	6.72E-01	3.03E-01	1.11E+00
PENRE	MJ	4.77E+02	8.31E+00	3.21E+00	0.00E+00	1.29E+01	1.50E+00	2.35E+00	1.92E+00	-1.76E+02
PENRM	MJ	1.17E+01	0.00E+00	8.75E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-9.28E-01
PENRT	MJ	4.85E+02	8.31E+00	3.21E+00	0.00E+00	1.29E+01	1.50E+00	2.35E+00	1.92E+00	-1.77E+02
SM	kg	1.27E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.09E-01
RSF	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
NRSF	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
FW	m^3	2.87E+00	4.81E-05	4.09E-04	0.00E+00	1.63E-04	8.66E-06	9.67E-04	4.59E-04	-1.70E+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 = Input 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 CA Twin-Therm® roof (CA 32 1000R external & CA 17 1000L Liner roof profiles, 0.18W/m²K U-value reference product)

Parameter	Unit	A1 – A3	A4	A5	B1 – B7	C1	C2	C3	C4	D
HWD	kg	6.67E-03	4.01E-10	2.53E-09	0.00E+00	7.39E-10	7.21E-11	2.16E-08	4.75E-10	-5.28E-04
NHWD	kg	1.92E+00	6.70E-04	2.95E-02	0.00E+00	1.23E-03	1.21E-04	1.29E-03	8.40E+00	1.62E+00
RWD	kg	1.09E-02	1.19E-05	1.53E-04	0.00E+00	4.01E-05	2.14E-06	2.98E-04	2.50E-05	-4.92E-04
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	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
MER	kg	2.43E-01	0.00E+00	5.13E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.92E-02
EEE	MJ	6.67E-03	4.01E-10	2.53E-09	0.00E+00	7.39E-10	7.21E-11	2.16E-08	4.75E-10	-5.28E-04
EET	MJ	1.92E+00	6.70E-04	2.95E-02	0.00E+00	1.23E-03	1.21E-04	1.29E-03	8.40E+00	1.62E+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

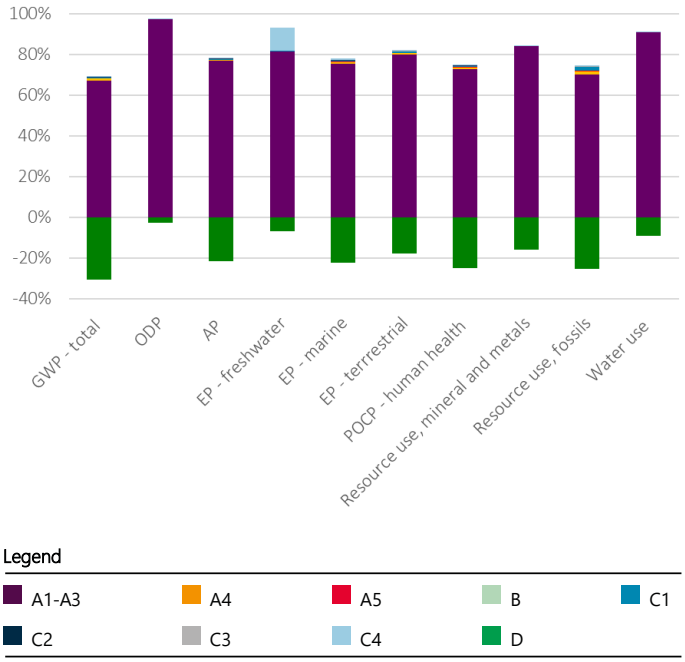
Figure 3 shows the relative contribution per life cycle stage for each of the seven environmental impact categories for 1m^2 of CA Building Products Twin-Therm® roof system. Each column represents 100% of the total impact score, which is why all the columns have been set with the same length. A burden 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 67% 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 cladding product manufacturing process. The manufacture of the glass wool insulation is also a significant contributor to each environmental impact and is generally responsible for 15% of the A1-A3 total., along with around 16% for galvanising and coating. The exceptions to this are the Ozone Depletion Potential and Eutrophication Potential (freshwater) indicators, where the manufacture of the paint that coats the steel is responsible for almost 100% of the total impact, mainly from the emission of halons (ODP) and phosphates (EP-fw).

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 wool insulation manufacture, give rise to emissions of CO_2 which contribute over 94% of the Global Warming Potential (GWP), and sulphur oxides, which are responsible for 65% of the impact in the Acidification Potential (AP) category. In addition, oxides of nitrogen are emitted which contribute 36% of the A1-A3 Acidification Potential, and almost all of the Eutrophication Potential (EP-marine and EP-terrestrial). Freshwater Eutrophication potential is contributed mostly by Phosphates (72%). This is mainly from the coating processes. The combined emissions of nitrogen oxides (66%) and carbon monoxide (16%) all contribute to the Photochemical Ozone indication (POCP).

Figure 3 clearly indicates the relatively small contribution to each impact from the other life cycle stages considered. Of these stages, the most significant contributions are from stages A4 (transport to construction site) in GWP and all the Eutrophication indicators, and C4 (disposal) in the Eutrophication (EP) Potential (freshwater) and Fossil Resource Use indicator, mainly from emissions of phosphorus (and nitrogen oxides) from the combustion of diesel fuel used to power road transport (A4) as well as insulation and plastic landfilling (C4). The emission of sulphur dioxide also contributes to the Acidification Potential indicator for A5, with approximately 20% of the total impact coming from the manufacture of the stainless-steel screws that fix the cladding systems to the building.

Figure 3 LCA results for the reference cladding system



Module D values are largely derived using World Steel'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 panels are modelled with a credit given as if they were re-melted in an Electric Arc Furnace and substituted by the same amount of steel produced in a Blast Furnace [25]. The specific emissions that represent the burden in A1-A3, are essentially the same as those responsible for the impact benefits in Module D. It is important that the life cycle of the steel product is considered here, because in most cases, the Module D credit provides significant benefits in terms of reducing the whole life environmental impacts.

6 References and product standards

1. Tata Steel's EN 15804 verified EPD programme, General programme instructions, V2 January 2022

2. Tata Steel's EN 15804 verified EPD programme, Product Category Rules Part 1, V2 January 2022

3. Tata Steel's EN 15804 verified EPD programme, Product Category Rules Part 2 – Steel Cladding Systems, V2 June 2022

4. ISO 14044:2006+A2:2020, Environmental management - Life Cycle Assessment - Requirements and guidelines

5. ISO 14025:2006, Environmental labels and declarations - Type III environmental declarations - Principles and procedures

6. ISO 14040:2006+A1:2020, Environmental management - Life Cycle Assessment - Principles and framework

7. EN 15804:2012+A2:2019/AC:2021, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

8. Kiwa BDA Agrément product certification, Kiwa Building Products

9. Loss Prevention Certification Board (LPCB), LPS 1181-1, External envelope fire performance grade Ext-B

10. EN 13501-1:2018, Fire classification of construction products and building elements. Classification using data from reaction

11. EN 10169:2022, Continuously organic coated (coil coated) steel flat products

12. EN 508-1:2014, Roofing and cladding products from metal sheet. Specification for self-supporting of steel, aluminium or stainless steel sheet – Part 1: Steel

13. EN 14782:2006, Self-supporting metal sheet for roofing, external cladding and internal lining

14. EN 13162:2008, Thermal insulation products for buildings – factory made mineral wool (MW) products

15. ETA 21/0138, European Technical Assessment for spacer systems

16. ISO 9001:2015, Quality management systems

17. ISO 14001:2015, Environmental management systems

18. EN 10346:2015, Continuously hot-dip coated steel flat products for cold forming

19. REACH, EU regulation for Registration, evaluation, authorisation and restriction of chemicals

20. ISO 45001:2018, Occupational health and safety management systems. Requirements with guidance for use

21. BES 6001, Responsible sourcing of construction products

22. BBA Certification, British Board of Agrément product certification

23. Sphera; LCA for Experts: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2025

24. Documentation of LCA for Experts: Software-System and Database for Life Cycle Engineering. Copyright, TM. Stuttgart, Echterdingen, 1992-2025 http://documentation.gabi-software.com

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26. Sansom M and Avery N, Reuse and recycling rates of UK steel demolition arisings, Proceedings of the Institution of Civil Engineers Engineering Sustainability 167, June 2014, Issue ES3, (Tata Steel/ EUROFER survey of members of the National Federation of Demolition Contractors (NFDC) for 'Profiled sheet cladding')

27. EC -JRC, EN 15804 Reference Package, https://eplca.jrc.ec.europa.eu/LCDN/EN15804.xhtml

28. Siebers R. (2021), Dissertation: Development of sustainability key figures for the value chain stages – erection and dismantling – in steel construction, Bergische Universität Wuppertal

29. EAD 200012-00-0401, European Assessment Document for spacer systems

30. CA Group Planet Mark Business Certified

Annex A

Environmental impact (A1-A3):

1m² of CA Twin-Therm® roof – Varying Insulation thicknesses for 0.4mm liner gauge (CA 17 1000L)

Parameter	Unit	240mm	260mm	280mm	300mm
U-value	W/m²K	0.18	0.16	0.15	0.14
Mass of Cladding System	(kg)	13.47	13.70	13.93	14.16
GWP-total	kg CO_2 eq	3.68E+01	3.71E+01	3.74E+01	3.77E+01
GWP-fossil	kg CO_2 eq	3.75E+01	3.79E+01	3.83E+01	3.86E+01
GWP-biogenic	kg CO_2 eq	-7.60E-01	-8.17E-01	-8.74E-01	-9.31E-01
GWP-luluc	kg CO_2 eq	5.98E-03	6.00E-03	6.01E-03	6.02E-03
ODP	kg CFC11 eq	4.29E-07	4.52E-07	4.75E-07	4.98E-07
AP	mol H^+ eq	1.54E-01	1.58E-01	1.62E-01	1.67E-01
EP-freshwater	kg P eq	3.31E-04	3.33E-04	3.35E-04	3.37E-04
EP-marine	kg N eq	2.47E-02	2.50E-02	2.53E-02	2.56E-02
EP-terrestrial	mol N eq	3.02E-01	3.09E-01	3.16E-01	3.24E-01
POCP	kg NMVOC eq	8.37E-02	8.45E-02	8.54E-02	8.63E-02
ADP-minerals&metals	kg Sb eq	7.01E-04	7.01E-04	7.02E-04	7.02E-04
ADP-fossil	MJ net calorific value	4.85E+02	4.90E+02	4.96E+02	5.01E+02
WDP	m^3 world eq deprived	4.33E+01	4.33E+01	4.33E+01	4.34E+01

1m² of CA Twin-Therm® roof – Varying Insulation thicknesses for 0.6mm liner gauge (CA 17 1000L)

Parameter	Unit	240mm	260mm	280mm	300mm	320mm	360mm	380mm	420mm	480mm
U-value	W/m²K	0.18	0.16	0.15	0.14	0.13	0.12	0.11	0.1	0.09
Mass of Cladding System	(kg)	15.23	15.46	15.69	15.92	16.15	16.61	16.84	17.30	17.99
GWP-total	kg CO_2 eq	4.17E+01	4.20E+01	4.24E+01	4.27E+01	4.30E+01	4.36E+01	4.39E+01	4.46E+01	4.55E+01
GWP-fossil	kg CO_2 eq	4.25E+01	4.29E+01	4.32E+01	4.36E+01	4.40E+01	4.47E+01	4.51E+01	4.59E+01	4.70E+01
GWP-biogenic	kg CO_2 eq	-7.72E-01	-8.29E-01	-8.86E-01	-9.43E-01	-1.00E+00	-1.11E+00	-1.17E+00	-1.28E+00	-1.46E+00
GWP-luluc	kg CO_2 eq	6.73E-03	6.74E-03	6.76E-03	6.77E-03	6.78E-03	6.81E-03	6.82E-03	6.85E-03	6.89E-03
ODP	kg CFC11 eq	4.29E-07	4.52E-07	4.75E-07	4.98E-07	5.21E-07	5.67E-07	5.90E-07	6.36E-07	7.05E-07
AP	mol H^+ eq	1.67E-01	1.72E-01	1.76E-01	1.81E-01	1.85E-01	1.94E-01	1.98E-01	2.07E-01	2.20E-01
EP-freshwater	kg P eq	3.35E-04	3.37E-04	3.39E-04	3.41E-04	3.43E-04	3.46E-04	3.48E-04	3.52E-04	3.57E-04
EP-marine	kg N eq	2.77E-02	2.80E-02	2.83E-02	2.85E-02	2.88E-02	2.94E-02	2.97E-02	3.03E-02	3.12E-02
EP-terrestrial	mol N eq	3.32E-01	3.39E-01	3.46E-01	3.53E-01	3.61E-01	3.75E-01	3.82E-01	3.97E-01	4.18E-01
POCP	kg NMVOC eq	9.39E-02	9.48E-02	9.57E-02	9.65E-02	9.74E-02	9.91E-02	1.00E-01	1.02E-01	1.04E-01
ADP-minerals&metals	kg Sb eq	7.10E-04	7.11E-04	7.11E-04	7.11E-04	7.12E-04	7.13E-04	7.13E-04	7.14E-04	7.15E-04
ADP-fossil	MJ net calorific value	5.44E+02	5.50E+02	5.55E+02	5.61E+02	5.66E+02	5.77E+02	5.83E+02	5.94E+02	6.10E+02
WDP	m^3 world eq deprived	4.37E+01	4.38E+01	4.38E+01	4.39E+01	4.39E+01	4.40E+01	4.40E+01	4.41E+01	4.42E+01

1m² of CA Twin-Therm® roof – Varying Insulation thicknesses for 0.7mm liner gauge (CA 32 1000RL)

Parameter	Unit	240mm	260mm	280mm	300mm	320mm	340mm	360mm	400mm	440mm	480mm
U-value	W/m^2K	0.18	0.17	0.16	0.15	0.14	0.13	0.12	0.11	0.1	0.09
Mass of Cladding System	(kg)	16.83	17.06	17.29	17.52	17.75	17.98	18.21	18.67	19.13	19.59
GWP-total	kg CO_2 eq	4.63E+01	4.66E+01	4.69E+01	4.72E+01	4.75E+01	4.78E+01	4.82E+01	4.88E+01	4.94E+01	5.01E+01
GWP-fossil	kg CO_2 eq	4.70E+01	4.74E+01	4.78E+01	4.82E+01	4.85E+01	4.89E+01	4.93E+01	5.00E+01	5.08E+01	5.15E+01
GWP-biogenic	kg CO_2 eq	-7.83E-01	-8.40E-01	-8.97E-01	-9.54E-01	-1.01E+00	-1.07E+00	-1.12E+00	-1.24E+00	-1.35E+00	-1.47E+00
GWP-luluc	kg CO_2 eq	7.42E-03	7.43E-03	7.45E-03	7.46E-03	7.47E-03	7.49E-03	7.50E-03	7.53E-03	7.56E-03	7.58E-03
ODP	kg CFC11 eq	4.35E-07	4.58E-07	4.81E-07	5.04E-07	5.27E-07	5.50E-07	5.73E-07	6.19E-07	6.65E-07	7.11E-07
AP	mol H^+ eq	1.81E-01	1.85E-01	1.89E-01	1.94E-01	1.98E-01	2.03E-01	2.07E-01	2.16E-01	2.25E-01	2.33E-01
EP-freshwater	kg P eq	3.50E-04	3.52E-04	3.54E-04	3.56E-04	3.57E-04	3.59E-04	3.61E-04	3.65E-04	3.68E-04	3.72E-04
EP-marine	kg N eq	3.05E-02	3.07E-02	3.10E-02	3.13E-02	3.16E-02	3.19E-02	3.22E-02	3.28E-02	3.34E-02	3.39E-02
EP-terrestrial	mol N eq	3.60E-01	3.67E-01	3.74E-01	3.81E-01	3.88E-01	3.96E-01	4.03E-01	4.17E-01	4.32E-01	4.46E-01
POCP	kg NMVOC eq	1.03E-01	1.04E-01	1.05E-01	1.06E-01	1.07E-01	1.08E-01	1.09E-01	1.10E-01	1.12E-01	1.14E-01
ADP-minerals&metals	kg Sb eq	7.42E-04	7.42E-04	7.42E-04	7.43E-04	7.43E-04	7.44E-04	7.44E-04	7.45E-04	7.46E-04	7.46E-04
ADP-fossil	MJ net calorific value	5.99E+02	6.05E+02	6.10E+02	6.16E+02	6.21E+02	6.27E+02	6.32E+02	6.43E+02	6.54E+02	6.65E+02
WDP	m^3 world eq deprived	4.57E+01	4.57E+01	4.58E+01	4.58E+01	4.58E+01	4.59E+01	4.59E+01	4.60E+01	4.61E+01	4.61E+01

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