# Statement of Verification

BREG EN EPD No.: 000644 Issue 01

This is to verify that the

**Environmental Product Declaration**

provided by:

Firth Steels Limited

BRE Global Verified EPD

is in accordance with the requirements of:

EN 15804:2012+A2:2019

and

BRE Global Scheme Document SD207

This declaration is for:

1 $m^2$ of Protex® Roof System 01 with the weight of 17.8 $kg/m^2$

## Company Address

Firth Steels Limited
Calderbank
River St
Brighouse
HD6 1LU

FirthSteels®

| | | |
|---|---|---|
| Signed for BRE Global Ltd | Emma Baker<br>Operator | 26 November 2024<br>Date of this Issue |
| 26 November 2024<br>Date of First Issue | | 25 November 2029<br>Expiry Date |

BRE Global Verified EPD



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ECO PLATFORM EPD VERIFIED

# Environmental Product Declaration

## EPD Number: 000644

## General Information

| EPD Programme Operator | Applicable Product Category Rules |
|---|---|
| BRE Global<br>Watford, Herts<br>WD25 9XX<br>United Kingdom | BRE 2023 Product Category Rules (PN 514 Rev 3.1) for Type III environmental product declaration of construction products to EN 15804:2012+A2:2019 |
| **Commissioner of LCA study** | **LCA consultant/Tool** |
| Firth Steels Limited<br>Calderbank<br>River St<br>Brighouse<br>HD6 1LU | LCA Consultant - Thomas O'Neil (Firth Steels)<br>LCA Tool - BRE LINA A2 |
| **Declared/Functional Unit** | **Applicability/Coverage** |
| 1 $m^2$ of Protex® Roof System 01 with the weight of 17.8 $kg/m^2$. | Other (please specify).Product Specific |
| **EPD Type** | **Background database** |
| Cradle to Gate with options | Ecoinvent 3.8 |

| Demonstration of Verification |
|---|
| CEN standard EN 15804 serves as the core PCR [a] |
| Independent verification of the declaration and data according to EN ISO 14025:2010<br>☐Internal ☒ External |
| (Where appropriate [b]) Third party verifier:<br>Flavie Lowres |
| a: Product category rules<br>b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4) |

| Comparability |
|---|
| Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A2:2019. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A2:2019 for further guidance |

## Information modules covered

| Product | | | Construction | | Use stage | | | | | | | End-of-life | | | | | Benefits and loads beyond the system boundary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Related to the building fabric | | | | | Related to the building | | | | | | | |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | | D |
| Raw materials supply | Transport | Manufacturing | Transport to site | Construction – Installation | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstruction demolition | Transport | Waste processing | Disposal | | Reuse, Recovery and/or Recycling potential |
| ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ | ☐ | ☑ | ☑ | ☑ | ☑ | | ☑ |

Note: Ticks indicate the Information Modules declared.

## Manufacturing site(s)

Firth Steels Limited
Calderbank
River St
Brighouse
HD6 1LU

# Construction Product:

## Product Description

Protex ® allows the ability to select a range of elements, enabling the building envelope to be constructed to a project specific design and performance. Each component within the system can be uniquely specified to suit the individual projects requirements of sustainability, fire, thermal and acoustic performance.

The Protex® Roof System 01 offers a tailor-made built up roof system combining high performance external finishes, A1 non-combustible Insulation, and a Walkable Liner profile alongside industry leading Protex® approved suppliers to offer a complete 25-year system Warranty.

The Protex® System is a multi-component roofing solution, comprised of several key elements:

- **Profiled Steel Sheets:** The system includes the N1000R Roof Profile and N1000WL Walkable Liner Profile.
- **Insulation** and **Fixings:** These components provide structure and support, integrated with the steel sheets to form the complete roof system.

**Key Features:**

- **N1000R Roof Profile:** Available with various high-performance external finishes, providing warranties of up to 40 years. The options range from embossed, textured, to smooth finishes, allowing flexibility for diverse building envelope needs.
- **N1000WL Walkable Liner Profile:** Designed to offer a Class B non-fragile working platform when fully installed, which optimises installation efficiency.

The steel sheeting for the system is manufactured at the Firth Steels Facility, while the additional components are shipped directly to the site by their respective manufacturers. There, they are assembled to form the full Protex® Roof System.
The Life Cycle Assessment (LCA) and Environmental Product Declaration (EPD) cover a full analysis of the Protex System components.
This includes:

1. The steel used to manufacture the N1000R Roof Profile and N1000WL Walkable Liner Profile.
2. Fixings, brackets, and insulation sourced from approved vendors, which are integrated with the Firth-manufactured products on-site to create the complete system.

The Protex® Roof System is available in different configurations, with depths ranging from 150mm to 430mm and insulation thicknesses from 120mm to 400mm. For the purpose of this LCA, a representative system with a depth of 310mm, insulation thickness of 280mm, and a system weight of 17.8 kg/m² was selected as a representative as this is the most popular system in the product family. An end-user table is also provided to facilitate impact calculations for other system configurations.

## Technical Information of the Protex® Roof System range

| Property | Value, Unit |
|---|---|
| Acoustic Performance Range | 33 - 53 db |
| Thermal Performance Range | 0.39 - 0.11 W/m²K |
| Suitable for Roof Pitch | ≥ 4° |
| External Coating Corrosion Classification | Up to RC5+ |
| External Coating UV Classification | Up to RUV 5 |
| LPCB Certification LPS1181 EXT-B (Subject to system specification) | |
| Class B - Non-fragile N1000WL Liner Profile | |

*For more information, please contact the Firth steels technical team or please visit PRX-RS-01 - Firth Steels. To know the steel and insulation properties please contact the Firth steels technical team.*

Protex® Roof System 01.

Data based on 1800mm Rail Centres & 1000mm Bracket Centres. Insulation 0.04W/mK Min Thermal Performance. Our calculations in this EPD are based on the external material being coated in XP40

## Main Product Contents of the Protex® Roof System Range

| Material/Chemical Input | % |
|---|---|
| Profiled Steel | 70-75 |
| Insulation | 20-25 |
| Brackets and Fixings Steel | <6 |

## Manufacturing Process

The steel used to make the profiles is received from a supplier outside the UK. In the steel manufacturing plant, iron ore is processed into sinter, which is a material used in the blast furnace. The sintered iron ore and coke are fed into the blast furnace, where they undergo a chemical reaction to produce molten iron. The molten iron is then converted into steel through various processes, including the addition of alloying elements. The cast steel is passed through hot rolling mills to create steel strips, which can be used for various applications.

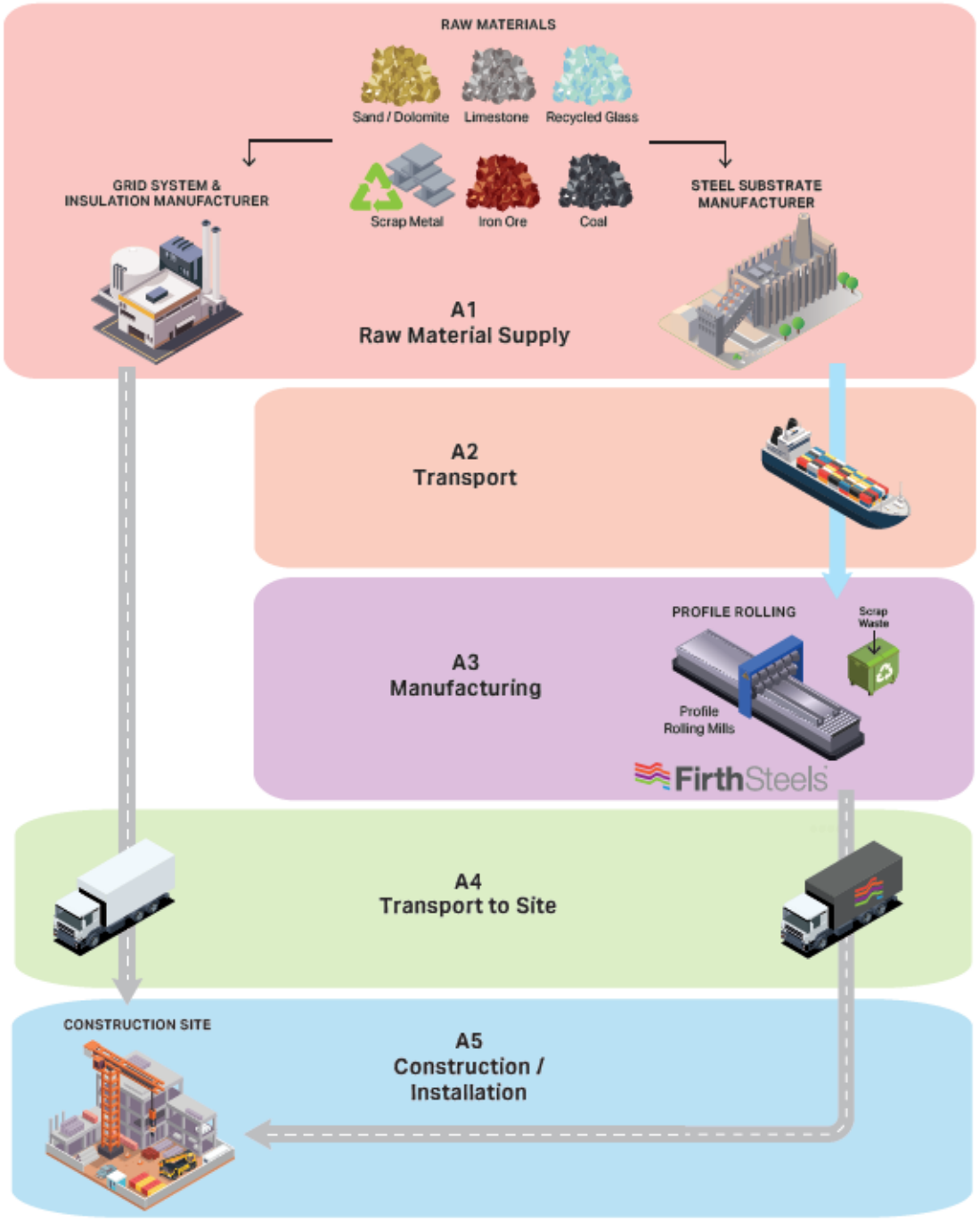
The roll forming process for manufacturing steel profiles involves several key steps to transform steel strips into functional and aesthetically pleasing profiled sheets. Initially, a coil of steel is fed into the roll forming machine. This machine consists of a series of roll stands, each equipped with rollers designed to incrementally form the steel strip into the desired profile.

Progressive Shaping: As the strip moves through the sequence of roll stands, each set of rollers forms it slightly more than the previous one. This gradual process prevents distortion and ensures the metal's structural integrity.

Cutting: After the steel has been shaped, it is cut to predetermined lengths according to the requirements of the specific project.

Construction: A twin skin cladding system is constructed onsite by first installing a liner sheet to act as the internal skin. This is followed by fitting insulation and grid system, The external sheet is then fit into place which is the second metal sheet treated for weather resistance. The process is completed with appropriate flashings and sealants to ensure a secure and weatherproof finish.

## Process flow diagram




FirthSteels

## Construction Installation

**Equipment Used**

**Scaffolding**: To provide safe access to the roof.
**Cranes:** For lifting heavy materials such as the external cladding sheets to the roof.
**Power Tools**: Nibblers and Adjustable Screw Guns for installing sheets and fixings.
**Sealant Guns**: For applying sealants at joints and edges to ensure watertightness.
***Note: The electricity/energy used to operate the crane at the construction site is not included in the analysis, as it is outside the scope of the LCA, and the energy consumed by the power tools is included in the analysis as detailed below. Sealant guns do not require any electricity to operate.***

**Installation**

**Internal Liner Installation:** The internal liner is installed first, providing an initial weather resistant layer over the roof structure. It's secured with fasteners, and Laps are sealed by using butyl tape to prevent moisture ingress.
**Grid System Setup:** A supporting steel grid system is then installed.
**Insulation:** Glass wool insulation is laid within the grid, cut to fit as necessary and the waste from the insulation off cuts are effectively negligible.
**External Cladding:** The external cladding sheets are positioned and secured to the grid system. This layer provides the primary weather protection and aesthetic finish.

The product will be installed using electrical hand tools and adhesives following the installation guidelines. The energy and adhesive attributed to constructing the Protex® Roof System 01 is included in the analysis which will be 0.000617 kWh.
***Note: For more information, please contact Firth steels technical team***

## Use Information

Once the product is constructed there are no inputs required to ensure the product is functional therefore there will be no emissions. Further, the product is classified as maintenance free, mainly to be cleaned down during rainfall therefore is negligible and it won't consume any water or electricity to function during the service life.

## End of Life

**Deconstruction:** The product will be deconstructed in a reverse methodical order as it was constructed, using electrical hand tools. Carefully disassembling the product to preserve material integrity. The energy attributed to deconstructing the Protex® Roof System 01 compared to the overall demolition will be effectively negligible. As a result, no impacts are attributed to module C1. In this scenario it is assumed as a 100% recovery rate of the product at its end of life, and the recovered product will be sent to the waste processing facility.

**Sorting and waste processing:** Separating materials by type for proper recycling processes, metals are melted and reformed into new products, according to the BRE PCR EN15804 A2, the processing of waste steel at the waste processing facility involves a 95% recycling rate, with 5% considered as natural loss during the recycling process. Insulation materials, depending on their type, may be reused or placed in landfill. In this analysis, the insulation material, it is assumed as 100% will be landfilled.
Note: The energy required sort waste at the processing facility is not included in the LCA analysis, as it is assumed to be negligible.

# Life Cycle Assessment Calculation Rules

## Declared / Functional unit description.

1 $m^2$ of Protex® Roof System 01 with the weight of 17.8 kg/m2.

## System boundary

This is a cradle-to-gate with options LCA, detailing the upstream processing of the steel profiles at the Firth Steel factory (A1-A3) includes the transportation of steel from the supplier's factory to the Firth manufacturing plant (A2), along with the transportation distances for ancillary materials to support the production process and packaging used to pack the completed profile product (A2). The quantity of ancillary materials, packaging, energy and water consumption, as well as production and non-production waste, is accounted for in A1-A3. The manufacturing impacts of insulation and fixings/brackets produced at the supplier's factory are included in A1.

The transportation of the manufactured steel profiles from the Firth Steel factory, and the transport of insulation materials, fixings, and brackets to the construction site (A4). It also includes the installation of the Protex system on-site (A5), use stage impacts (B1-B5), end-of-life stages (C1-C4), and Module D, in accordance with EN 15804:2012+A2:2019 and the BRE 2023 Product Category Rules (PN 514 Rev 3.1).

## Data sources, quality, and allocation

The datasets are derived from Ecoinvent v3.8, and the LCA tool used was BRE LINA A2. The Protex roof system consists of an external and internal skin. The system uses the approved components sourced directly through our Protex approved supply partners to offer a competitive system solution.

In this EPD, the quantity used in the data collection form represents the total quantity of steel used for the manufacturing of the external, internal steel skin, grid system and the quantity of A1 Non-combustible insulation used over the period of one year for the making the Protex® Roof System 01, from 01/08/2022 to 31/07/2023. The Protex system consists of 70-75% profiles, 20-25% insulation, and less than 6% brackets and fixings made of steel. Of the 70-75% steel, Firth Steel sources 50% from a supplier to produce profiles and the supplier has provided a verified EPD for the steel product, registered with EPD International (EPD Registration No: S-P-07698). This third-party verified EPD calculates the environmental impacts for 1 metric ton of steel using the ecoinvent 3.8 dataset and complies with the EN 15804 A2 PCR standards. The remaining 50% of the steel is sourced from another supplier, for which the ecoinvent 3.8 generic hot dip galvanised steel dataset is used in the modelling. Additionally, for the insulation, by using the manufacturers production data, the LCA analysis has been conducted in LINA A2 and the results are fed into the LINA background and used as an A1 raw material in this EPD. Consequently, the manufacturing impacts for stages A1-A3 were standardised to 1 kg and entered into the LINA tool as raw material impacts (A1). Additional impacts from the transportation of steel from the supplier to the Firth Steels factory (A2), as well as further steel processing (A3), have also been calculated in this LCA. Since the EPD scope is to assess the Protex® Roof System 01, the manufacturing impacts of insulation, brackets, and fixings are treated as raw material(A1) in the LCA and included alongside the Firth profiles processing for stages A1-A3 and the quantity of insulation and Fixings and Brackets used for the whole system during the period of one year has been obtained from the supplier.

In this EPD, the Protex® Roof System has a depth of 310mm and an insulation thickness of 280mm has a weight of 17.8 kg/$m^2$ has been modelled as a representative as this is the most popular system in the product family. The system also available in different thicknesses and insulation options, please see the annex section. To enable the impact of the other systems the end-user guidance table with the calculation guidance is provided in the Annex section. Other products are manufactured in addition to all components; therefore, the allocation of electricity and water consumption and discharge are required, and this has been done according to the provisions of BRE PCR PN514 and EN 15804 by using the $m^2$ production quantity. the data entry, it was determined that the mass balance was within tolerance and therefore no uplifting of input materials was necessary. Figures for the raw materials, ancillary materials and packaging were from actual usages.

Secondary data has been obtained for all other upstream and downstream processes that are beyond the control of the manufacturer (i.e., raw material production) from the ecoinvent 3.8 database. All ecoinvent datasets are

complete within the context used and conform to the system boundary and the criteria for the exclusion of inputs and outputs, according to the requirements specified in EN15804 A2.

| ISO14044 guidance. Quality Level | Geographical representativeness | Technical representativeness | Time representativeness |
|---|---|---|---|
| Very Good | Data from area under study. | Data from processes and products under study. Same state of technology applied as defined in goal and scope (i.e., identical technology). | There is approximately 1-2 years between the Ecoinvent LCI reference year, and the time period for which the LCA was undertaken. |

Specific UK datasets have been selected from the Ecoinvent LCI for this LCA. Firth Steel was powered by the National Grid electricity alongside onsite solar power electricity, therefore the national grid electricity dataset "Electricity – GB (kWh)" has been used for the LCA modelling (Ecoinvent 3.8). The GWP carbon footprint for using 1 kWh of electricity, GB kWh is 0.239 $kgCO_2e/kWh$ and for the 1 kWh of solar PV, GB kWh is 0.077 is kgCO2e/kWh. Further, the manufacturer uses Natural gas for office heating, so therefore Natural gas, at industrial furnace (kWh) has been used and the GWP carbon footprint for using 1kWh of the UK natural gas is 0.232 $kgCO_2eq$. The quality level of time representativeness is also Very Good as the background LCI datasets are based on ecoinvent v3.8 which was compiled in 2021. Therefore, there is less than 5 years between the ecoinvent LCI reference year and the time period for which the LCA was undertaken.

## Cut-off criteria

All processes associated with the manufacturing process have been included. All inputs or outputs have been included and all raw materials, packaging and transport, energy, water use, and wastes, are included, and there is no emission to air, water, and soil during the product production therefore it is not included in the analysis. In addition, the waste from the insulation off cuts are effectively negligible and it is not included in the analysis. Upstream extraction and/or processing of inputs are included within the use of the background datasets within LINA. Furthermore, at the end of life, the energy required to deconstruct the product and to sort waste at the processing facility is not included in the analysis, as it is assumed to be negligible.

## LCA Results - Protex® Roof System 01 with the weight of 17.8 kg/m$^2$

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

| Parameters describing environmental impacts | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | GWP-total | GWP-fossil | GWP-biogenic | GWP-luluc | ODP | AP | EP-freshwater |
| | | | kg $CO_2$ eq | kg $CO_2$ eq | kg $CO_2$ eq | kg $CO_2$ eq | kg CFC11 eq | mol $H^+$ eq | kg $(PO_4)^{3-}$ eq |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG | AGG | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG | AGG | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG | AGG | AGG | AGG | AGG |
| | Total (Consumption grid) | A1-3 | 4.81E+01 | 4.83E+01 | -2.55E-01 | 2.98E-02 | 2.28E-06 | 4.03E-01 | 1.13E-02 |
| Construction process stage | Transport | A4 | 1.29E+00 | 1.29E+00 | 1.10E-03 | 5.05E-04 | 2.98E-07 | 5.22E-03 | 8.28E-05 |
| | Construction | A5 | 5.60E-01 | 2.25E-01 | 3.05E-01 | 2.90E-02 | 3.31E-08 | 1.27E-03 | 2.38E-04 |
| Use stage | Use | B1 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Maintenance | B2 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Repair | B3 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Replacement | B4 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Refurbishment | B5 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Operational energy use | B6 | MND | MND | MND | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND | MND | MND | MND |
| **74% of recycling, 26% to landfill** | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 1.48E-01 | 1.48E-01 | 1.26E-04 | 5.81E-05 | 3.42E-08 | 6.00E-04 | 9.53E-06 |
| | Waste processing | C3 | 7.75E-01 | 7.74E-01 | 2.73E-04 | 7.73E-05 | 1.65E-07 | 8.05E-03 | 2.40E-05 |
| | Disposal | C4 | 5.72E-01 | 5.71E-01 | 3.93E-04 | 4.48E-05 | 1.32E-08 | 3.71E-04 | 6.20E-06 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -2.17E+01 | -2.17E+01 | 6.80E-02 | -6.15E-03 | -8.67E-07 | -7.88E-02 | -8.58E-03 |

GWP-total = Global warming potential, total;
GWP-fossil = Global warming potential, fossil;
GWP-biogenic = Global warming potential, biogenic;
GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
AP = Acidification potential, accumulated exceedance; and
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

| Parameters describing environmental impacts | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | EP-marine | EP-terrestrial | POCP | ADP-mineral &metals | ADP-fossil | WDP | PM |
| | | | kg N eq | mol N eq | kg NMVOC eq | kg Sb eq | MJ, net calorific value | $m^3$ world eq deprived | disease incidence |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG | AGG | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG | AGG | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG | AGG | AGG | AGG | AGG |
| | Total (Consumption grid) | A1-3 | 6.57E-02 | 1.31E+00 | 1.99E-01 | 9.48E-04 | 5.70E+02 | 1.41E+01 | 3.32E-06 |
| Construction process stage | Transport | A4 | 1.57E-03 | 1.72E-02 | 5.26E-03 | 4.47E-06 | 1.94E+01 | 8.75E-02 | 1.11E-07 |
| | Construction | A5 | 4.14E-04 | 2.63E-03 | 8.94E-04 | 3.62E-06 | 5.34E+00 | 3.35E-01 | 1.32E-08 |
| Use stage | Use | B1 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Maintenance | B2 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Repair | B3 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Replacement | B4 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Refurbishment | B5 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Operational energy use | B6 | MND | MND | MND | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND | MND | MND | MND |
| **74% of recycling, 26% to landfill** | | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+0 | 0.00E+00 | 0.00E+0 | 0.00E+0 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 1.81E-04 | 1.98E-03 | 6.05E-04 | 5.14E-07 | 2.24E+00 | 1.01E-02 | 1.28E-08 |
| | Waste processing | C3 | 3.56E-03 | 3.90E-02 | 1.07E-02 | 3.98E-07 | 1.06E+01 | 2.46E-02 | 2.16E-07 |
| | Disposal | C4 | 2.56E-03 | 1.37E-03 | 5.18E-04 | 1.39E-07 | 1.02E+00 | 4.56E-02 | 7.34E-09 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -1.87E-02 | -1.98E-01 | -1.09E-01 | -1.64E-05 | -2.20E+02 | -1.56E+00 | -1.45E-06 |

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
EP-terrestrial = Eutrophication potential, accumulated exceedance;
POCP = Formation potential of tropospheric ozone;
ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;
ADP-fossil = Depletion potential of the stratospheric ozone layer;
WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
PM = Particulate matter.

## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

| Parameters describing environmental impacts | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | IRP | ETP-fw | HTP-c | HTP-nc | SQP |
| | | | kBq $U^{235}$ eq | CTUe | CTUh | CTUh | dimensionless |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG | AGG | AGG |
| | Total (Consumption grid) | A1-3 | 2.55E+00 | 8.13E+02 | 1.32E-07 | 7.59E-07 | 1.59E+02 |
| Construction process stage | Transport | A4 | 9.99E-02 | 1.52E+01 | 4.91E-10 | 1.59E-08 | 1.34E+01 |
| | Construction | A5 | 2.85E-02 | 6.75E+00 | 1.72E-10 | 4.57E-09 | 2.52E+00 |
| Use stage | Use | B1 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Maintenance | B2 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Repair | B3 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Replacement | B4 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Refurbishment | B5 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Operational energy use | B6 | MND | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND | MND |
| **74% of recycling, 26% to landfill** | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 1.15E-02 | 1.75E+00 | 5.65E-11 | 1.83E-09 | 1.54E+00 |
| | Waste processing | C3 | 4.79E-02 | 6.21E+00 | 2.40E-10 | 4.51E-09 | 1.35E+00 |
| | Disposal | C4 | 4.83E-03 | 1.28E+00 | 3.28E-11 | 7.03E-10 | 2.38E+00 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -3.89E-01 | -6.50E+02 | -1.16E-07 | -4.46E-07 | -4.29E+01 |

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; and
SQP = Potential soil quality index.

## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

| Parameters describing resource use, primary energy | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | PERE | PERM | PERT | PENRE | PENRM | PENRT |
| | | | MJ | MJ | MJ | MJ | MJ | MJ |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG | AGG | AGG | AGG |
| | Total (Consumption grid) | A1-3 | 2.88E+01 | 1.28E+01 | 5.77E+01 | 5.74E+02 | 8.61E+00 | 9.40E+02 |
| Construction process stage | Transport | A4 | 2.74E-01 | 0.00E+00 | 2.74E-01 | 1.91E+01 | 0.00E+00 | 1.91E+01 |
| | Construction | A5 | -1.11E+00 | 2.19E+00 | 1.09E+00 | 2.57E+00 | 1.96E+00 | 4.53E+00 |
| Use stage | Use | B1 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Maintenance | B2 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Repair | B3 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Replacement | B4 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Refurbishment | B5 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Operational energy use | B6 | MND | MND | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND | MND | MND |
| **74% of recycling, 26% to landfill** | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 3.15E-02 | 0.00E+00 | 3.15E-02 | 2.20E+00 | 0.00E+00 | 2.20E+00 |
| | Waste processing | C3 | 5.95E-02 | 0.00E+00 | 5.95E-02 | 1.04E+01 | 0.00E+00 | 1.04E+01 |
| | Disposal | C4 | 1.80E-02 | 0.00E+00 | 1.80E-02 | -1.40E+02 | 1.41E+02 | 1.00E+00 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -4.52E+00 | 0.00E+00 | -4.52E+00 | -2.17E+02 | 0.00E+00 | -2.17E+02 |

PERE = Use of renewable primary energy excluding renewable primary energy 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 resource

## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

| Parameters describing resource use, secondary materials and fuels, use of water | | | | | | |
|---|---|---|---|---|---|---|
| | | | SM | RSF | NRSF | FW |
| | | | kg | MJ net calorific value | MJ net calorific value | $m^3$ |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG | AGG |
| | Total (Consumption grid) | A1-3 | 5.94E+00 | 2.36E-06 | 0.00E+00 | 3.54E-01 |
| Construction process stage | Transport | A4 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.17E-03 |
| | Construction | A5 | 1.65E-05 | 3.37E-09 | 0.00E+00 | 7.91E-03 |
| Use stage | Use | B1 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Maintenance | B2 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Repair | B3 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Replacement | B4 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Refurbishment | B5 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Operational energy use | B6 | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND |
| **74% of recycling, 26% to landfill** | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 2.49E-04 |
| | Waste processing | C3 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 6.06E-04 |
| | Disposal | C4 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.07E-03 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 0.00E+00 | 0.00E+00 | 0.00E+00 | -3.78E-02 |

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

| Other environmental information describing waste categories | | | | | |
|---|---|---|---|---|---|
| | | | HWD | NHWD | RWD |
| | | | kg | kg | kg |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG |
| | Total (Consumption grid) | A1-3 | 6.10E+00 | 3.63E+01 | 1.38E-03 |
| Construction process stage | Transport | A4 | 2.14E-02 | 3.81E-01 | 1.32E-04 |
| | Construction | A5 | 1.78E-02 | 3.72E-01 | 1.38E-05 |
| Use stage | Use | B1 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Maintenance | B2 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Repair | B3 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Replacement | B4 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Refurbishment | B5 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Operational energy use | B6 | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND |
| **74% of recycling, 26% to landfill** | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 2.47E-03 | 4.38E-02 | 1.51E-05 |
| | Waste processing | C3 | 1.40E-02 | 9.79E-02 | 7.33E-05 |
| | Disposal | C4 | 1.96E-03 | 3.68E+00 | 6.11E-06 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | -2.00E+00 | -4.12E+01 | -2.33E-04 |

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed

## LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

| Other environmental information describing output flows – at end of life | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | CRU | MFR | MER | EE | Biogenic carbon (product) | Biogenic carbon (packaging) |
| | | | kg | kg | kg | MJ per energy carrier | kg C | kg C |
| Product stage | Raw material supply | A1 | AGG | AGG | AGG | AGG | AGG | AGG |
| | Transport | A2 | AGG | AGG | AGG | AGG | AGG | AGG |
| | Manufacturing | A3 | AGG | AGG | AGG | AGG | AGG | AGG |
| | Total (Consumption grid) | A1-3 | 0.00E+00 | 4.53E-02 | 9.57E-04 | 6.51E-04 | 3.23E-03 | -1.39E-01 |
| Construction process stage | Transport | A4 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Construction | A5 | 0.00E+00 | 1.72E03 | 2.49E-11 | 2.69E-6 | 5.65E-03 | 0.00E+00 |
| Use stage | Use | B1 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Maintenance | B2 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Repair | B3 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Replacement | B4 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Refurbishment | B5 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 | 0.00e+0 |
| | Operational energy use | B6 | MND | MND | MND | MND | MND | MND |
| | Operational water use | B7 | MND | MND | MND | MND | MND | MND |
| **74% of recycling, 26% to landfill** | | | | | | | | |
| End of life | Deconstruction, demolition | C1 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Transport | C2 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Waste processing | C3 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| | Disposal | C4 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Potential benefits and loads beyond the system boundaries | Reuse, recovery, recycling potential | D | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

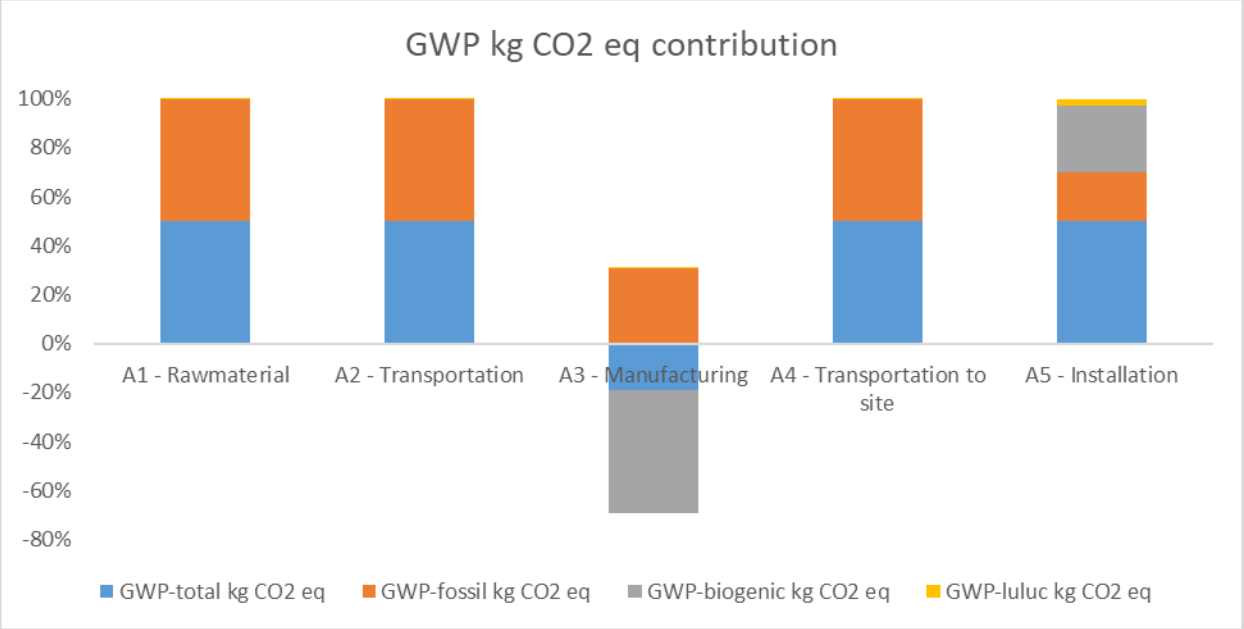
## Scenarios and additional technical information

| Scenarios and additional technical information | | | |
|---|---|---|---|
| Scenario | Parameter | Units | Results |
| A4 – Transport to the building site | This is calculated by taking all the Protex® jobs within the given calendar year and taking an average distance to site from the Firth Steels manufacturing facility. In addition, the transportation of Insulation and Brackets & fixings from the supplier manufacturing site to the construction site was received from the supplier. | | |
| | Fuel type / Vehicle type | Lorry, 16-32 metric ton | Diesel |
| | Transportation of Protex profiles | km | 123 |
| | Transportation of Brackets and fixing | km | 191.5 |
| | Transportation of Insulation | km | 120.2 |
| | Capacity utilisation (incl. empty returns) | % | 40 |
| | Fuel consumption | l/km | 0.238 |
| | Bulk density of steel profiles | kg/m$^3$ | 7850 |
| | Bulk density of Insulation material | Kg/m$^3$ | 13 |
| | Bulk density of brackets and fixings | Kg/m$^3$ | 7850 |
| A5 – Installation in the building | The product is constructed using electrical hand tools. In the LCA analysis, the amount of electricity used to install the product is not included.<br><br>There is not expected to be any product waste as the product is manufactured to given cut lengths some of the packing waste during the installation resulted. | | |
| | Wood waste to recycling | kg | 0.2 |
| | Shrink Film - Polyethylene (PE) waste to recycling | kg | 0.0015 |
| | Protective film - Polyethylene (PE) waste to recycling | kg | 0.0002 |
| | Plastic Strapping - Polyethylene (PE) waste to recycling | kg | 0.0002 |
| B1 -B5 – Use stage | Once the product is constructed there are no inputs required to ensure the product is functional therefore there will be no emissions. Further, the product is classified as maintenance free, mainly to be cleaned down during rainfall therefore is negligible and it won't consume any water or electricity to function during the service life. | | |
| Reference service life | 25 years | | |
| LCA study period | 25 years | | |
| C1 to C4<br>End of life, | The product will be deconstructed in a reverse methodical order as it was constructed, using electrical hand tools. Carefully disassembling the product to preserve material integrity. The energy attributed to deconstructing the Protex® Roof System 01 compared to the overall demolition will be effectively negligible. As a result, no impacts are attributed to module C1. In this scenario it is assumed as a 100% recovery rate of the product at its end of life, and the recovered product will be sent to the waste processing facility. | | |
| C2- Transportation | 50km by road has been modelled for module C2 as a typical distance from the demolition site to the disposal unit. However, end-users of the EPD can use this information to calculate the impacts of a bespoke transport distance for module C2 if required | | |
| | Road transport | km | 50 |

| Scenarios and additional technical information | | | |
|---|---|---|---|
| Scenario | Parameter | Units | Results |
| C3 – preprocessing | Separating materials by type for proper recycling processes, metals are melted and reformed into new products. Insulation materials, depending on their type, may be reused, or processed for energy recovery or placed in landfill.<br><br>The separation processes have not been included in module C3 because it is assumed to be very small and are effectively negligible.<br><br>In this LCA analysis, the industrial average has been used in the waste processing scenario. According to EN15804 A2 PCR, the end-of-life scenario for roofing products made of steel involves a 95% recycling rate, with 5% considered as natural loss during the recycling process. Additionally, for the insulation material, it is assumed as 100% will be landfilled. | | |
| | 95% of steel to recycling | kg | 13.45 |
| C4 – Disposal | Steel 5% of total weight is lost in recycling as a natural loss and 100% of insultation waste will be landfilled | | |
| | 100% of insulation material to landfill | kg | 3.64 |
| | 5% Steel waste to landfill | kg | 0.71 |
| Module D | Benefits and loads beyond the system boundary" (module D) accounts for the environmental benefits and loads resulting from Iron and steel that is used as raw material in the EAF or BOF and that is collected for recycling at end of life. These benefits and loads are calculated by excluding the pre-existing recycled steel that is used in the primary process.<br><br>When calculating the benefits of recycling the steel, it's important to avoid double-counting. 51% of the steel was obtained from a third-party supplier, using 100% virgin steel. The remaining 49% of the steel used the ecoinvent 3.8 database, where hot-dipped galvanized steel sheet has 19% pre-existing recycled content. Therefore, only 91% of the virgin material can be considered in the Benefits and Loads Beyond the System Boundary calculation. | | |
| | Steel to recycling | kg | 12.85 |

## Interpretation of results

The product consists of 78% steel and 22% insulation material by weight. Most environmental impacts arise from upstream manufacturing, with steel contributing the highest impact across all indicators. The chart provides a breakdown of the Global Warming Potential (GWP) from various categories and emission sources, measured in kilograms of $CO_2$ equivalent. Stage A1 (raw material) accounts for nearly all emissions, with a minor contribution from A2 (transportation). Stage A3 (manufacturing) shows a significant negative value, indicating a reduction in $CO_2$ equivalent emissions from biogenic sources due to the use of wooden batons for packaging. The carbon stored in the pallets is expected to be released at installation (A5). In A4 transportation), there are some impacts during the transportation of the final product to the construction installation site.



## Individual product calculations

The Protex® Roof System 01 is designed to be easily configured at different system depths depending on the thermal performance required. The referenced configuration utilises a system depth of 310 mm, with an insulation layer of 280 mm, and has a total system weight of 17.8 kg/m². It is important to note that variations in thermal performance are attributed to alterations in the insulation volume, while the impact attributable to the steel components remains negligible therefore unchanged across different configurations. The Life Cycle Assessment (LCA) results for all the configuration available for the system are documented in the provided tables, detailing the A1 and aggregated A1-A3 impacts relative to the depth of insulation implemented. This data facilitates an understanding of the environmental implications associated with different insulation depths within the system.

| Total System Depth (mm) | Bracket / Insulation Thickness (mm) | Thermal Performance ($W/m^2K$) | System Weight ($Kg/m^2$) | A1-A3 kg CO2 eq / $m^2$ |
|---|---|---|---|---|
| 150 | 120 | 0.39 | 15.8 | 4.52E+01 |
| 170 | 140 | 0.33 | 16.0 | 4.55E+01 |
| 190 | 160 | 0.28 | 16.3 | 4.59E+01 |
| 210 | 180 | 0.25 | 16.5 | 4.62E+01 |
| 230 | 200 | 0.22 | 16.8 | 4.66E+01 |
| 250 | 220 | 0.20 | 17.1 | 4.69E+01 |
| 270 | 240 | 0.18 | 17.3 | 4.73E+01 |
| 290 | 260 | 0.18 | 17.6 | 4.76E+01 |
| 310 | 280 | 0.16 | 17.8 | 4.81E+01 |
| 330 | 300 | 0.15 | 18.1 | 4.84E+01 |
| 350 | 320 | 0.14 | 18.4 | 4.87E+01 |
| 370 | 340 | 0.13 | 18.6 | 4.91E+01 |
| 390 | 360 | 0.13 | 18.9 | 4.94E+01 |
| 410 | 380 | 0.12 | 19.1 | 4.98E+01 |
| 430 | 400 | 0.11 | 19.4 | 5.01E+01 |

## References


BSI. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products. BS EN 15804:2012+A2:2019. London, BSI, 2019.

BSI. Environmental labels and declarations – Type III Environmental declarations – Principles and procedures. BS EN ISO 14025:2010 (exactly identical to ISO 14025:2006). London, BSI, 2010.

BSI. Environmental management – Life cycle assessment – Principles and framework. BS EN ISO 14040:2006. London, BSI, 2006.

BSI. Environmental management – Life cycle assessment – requirements and guidelines. BS EN ISO 14044:2006. London, BSI, 2006