ZAG EPD

Environmental Product Declaration

According to ISO 14025 and EN 15804

Trimoterm façade panel

EPD number	EPD-19/0005
EPD number at ECO-Platform	00001032
EPD owner	Trimo, architectural solutions, d.o.o., Prijateljeva cesta 12, 8210 Trebnje, Slovenia
EPD Program operator	ZAG EPD
Issue date	12. 12. 2019
Valid until	11. 12. 2024

ECO PLATFORM EPD EN 15804 VERIFIED

ZAVOD ZA GRADBENIŠTVO SLOVENIJE LJUBLJANA 17

www.zag.si

General information	Commercial name
	Trimoterm façade panel
Program holder: Slovenian National Building And Civil Engineering Institute - ZAG Dimičeva 12 1000 Ljubljana Slovenia **http://www.zag.si**	**Owner of the Environmental Product Declaration:** Trimo, architectural solutions, d.o.o. Prijateljeva cesta 12 8210 Trebnje Slovenia **https://www.trimo-group.com/en**
Number of the Environmental Product Declaration: EPD-19/0005	**Declared unit:** 1m^2 of Trimoterm façade panel
This Environmental Product Declaration is based on the Product Category Rules (PCR): Part B: Requirements on the EPD for Double skin metal faced sandwich panels, 2012, Institut Bauen und Umwelt e.V.	**Scope:** A1-A3, A4, C2, C4 and D
Issue date: 12. 12. 2019 **Valid until:** 11. 12. 2024	**Verification:** The CEN standard SIST EN 15804 serves as the core Product Category Rule (PCR) Independent verification of the EPD according to EN ISO 14025 ☐ internal ☒ external
Production plant: Trimo, architectural solutions, d.o.o. Prijateljeva cesta 12 8210 Trebnje Slovenia	**Title and the handwritten signature of verificator:** *Hüdai Kara, PhD* Metsims Sustainability Consulting 4 Clear Water Place Oxford OX2 7NL, United Kingdom
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1 Product

1.1 Product description

Trimoterm fireproof façade and roof system is a high quality, versatile and environmentally friendly construction product, where the highest demands of fire resistance, sound reduction and thermal insulation are required. It offers the perfect combination of functionality and durability, whilst also supporting true architectural expression.

Available with a complete system of matching components and meeting country-specific requirements and regulations, Trimoterm is suitable for wide range of external façade and roof cladding, internal partition walls, fire walls and ceilings. With strong fire resistance, excellent thermal and sound insulation, as well as excellent hygienic characteristics, Trimoterm panels can also be successfully used in the most demanding environments, such as in the energy production and food-processing sectors as well as in the pharmaceutical industry.

Trimoterm façade element consists of two galvanised and pre-finished steel sheets bonded to a non-combustible A1 mineral wool core. All layers together make a solid element of thickness ranging from 50 mm to 250 mm. Trimoterm is available in either flat or curved options. Preinstalled gaskets prevent water to enter the system.

1.2 Technical Data

Trimoterm façade panels are manufactured according to the standard SIST EN 14509 (Self-supporting double skin metal faced insulating panels – Factory made products – Specifications).

Three different variations of Trimoterm façade panels have been considered: Trimoterm Power S, Trimoterm Power T and Trimoterm Perform R.

Trimoterm Power S façade system ensures higher structural spanning capabilities, while also achieving superior strength that is capable of withstanding high wind loads. Trimoterm Power S also enables up to 100% faster installation and durable performance. Trimoterm Power T façade and roof system guarantees extremely high thermal insulation, stable indoor climate, air quality and energy savings through reduced heat loss and lower running costs even in most demanding climate environments. Trimoterm Perform R is a high-quality façade and roof system that can be fitted to almost any building and is suitable for internal and external applications.

Three different panel thicknesses have been considered: 60 mm, 150 mm and 240mm.

Table 1: The characteristics of Trimoterm Power S façade panel

Panel thickness (mm)	60	150	240
Mass – FTV (kg/m²)	15,80	26,10	36,30
Mass – FTV HL (kg/m²)	16,00	26,30	36,50
EI Fire resistance – FTV	EI30	EI180	EI240
EI Fire resistance – FTV HL	N/A	EI180	EI240
Thermal transmittance (W/m² K)	0,66	0,28	0,18
Airborne sound insulation (C;Ctr) (dB)	30 (-2;-3)	32 (-1;-2)	32 (-1;-2)
Combustibility of insulant core	Mineral wool non-combustible Class A1		
Water permeability	Class A (1200Pa)		

Table 2: The characteristics of Trimoterm Power T façade panel

Panel thickness (mm)	60	150	240
Mass – FTV (kg/m²)	14,40	22,50	30,60
Mass – FTV HL (kg/m²)	14,60	22,70	30,80
EI Fire resistance – FTV	N/A	EI180	EI240
EI Fire resistance – FTV HL	N/A	EI180	EI240
Thermal transmittance (W/m² K)	0,60	0,26	0,16
Airborne sound insulation (C;Ctr) (dB)	N/A	30 (-1;-3)	30 (-1;-3)
Combustibility of insulant core	Mineral wool non-combustible Class A1		
Water permeability	Class A (1200Pa)		

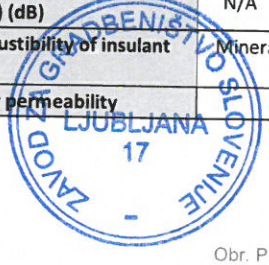


Table 3: The characteristics of Trimoterm Perform R façade panel

Panel thickness (mm)	60	150	240
Mass – FTV (kg/m²)	15,00	24,00	33,00
Mass – FTV HL (kg/m²)	15,20	24,20	33,20
EI Fire resistance – FTV	EI20	EI180	EI240
EI Fire resistance – FTV HL	EI20	EI180	EI240
Thermal transmittance (W/m² K)	0,63	0,27	0,17
Airborne sound insulation (C;Ctr) (dB)	30 (-2;-3)	32 (-1;-2)	32 (-1;-2)
Combustibility of insulant core	Mineral wool non-combustible Class A1		
Water permeability	Class A (1200Pa)		

1.3 Base materials

The basic materials for the production of Trimoterm façade panels are:

- Galvanized steel sheet
- Adhesives (isocyanate and polyol)
- Rock mineral wool
- Polyurethane sealing tape

This product does not contain materials that exceed the limits for registration within the Candidate List of substances of very high concern (SVHCs) for authorisation.

1.4 Manufacturing process

Trimoterm façade panels are produced at the manufacturer's production plant in Trebnje, Slovenia. The Trimoterm production process starts with the unwinding of two coils of steel sheet in unwinding device, with the steel sheets being shaped in the profiling unit of the assembly line. The sheet profile and the side joint of the panels are produced in the profilation process, which is carried out on a rotary motion tool according to the principle of rolling endless sheet.

Next, mineral wool plates are cut and inserted into the so-called "carpet of mineral wool". The "carpet of mineral wool" is milled at the edges in a shape that adapts to the shape of the sheet joint. This forms the core of the panel, which provides the required mechanical properties of the final product.

After the profiling of the steel sheet and the preparation of mineral wool, polyurethane adhesive is applied. The adhesive is two-component and reacts above a certain temperature. Therefore, both adhesive and steel sheets are preheated before the application process. The adhesive represents the adhesion between the outer sheet and the mineral wool and between inner sheet and mineral wool.

The final stage in the assembly process is the closure of the top sheet, bottom sheet and the mineral wool by compression in a double belt, where the adhesive finally reacts and creates adhesion between all components of the finished composite. In addition, sealing is inserted in both internal and external panel joint. The final product is an endless panel, which needs to be cut to the desired length. The cutting is done with the band flying saw, which travels in synchronization with the panel.

Finally, finished panels are stacked in a package, protected with foil and prepared for transport to construction site.

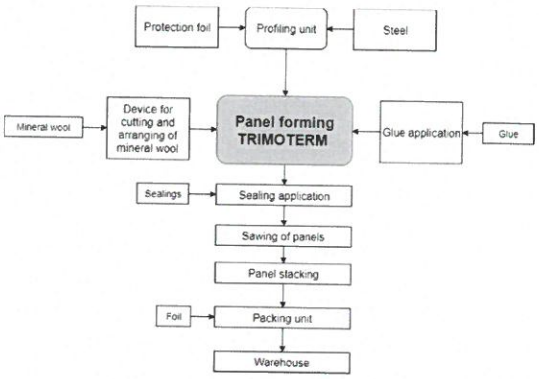


Figure 1: The schematic representation of the Trimoterm façade panel production process

1.5 Packaging

The following materials have been used for the packaging of the final product:

- Polyethylene (PE) foil
- Expanded polystyrene (EPS)
- Polypropylene (PP) tape

1.6 Further information

Further information about Trimoterm façade panels is available on the manufacturer web page:

https://www.trimo-group.com/en

2 LCA: Calculation rules

2.1 EPD classification

Type of EPD:

1a) Declaration of a specific product from a manufacturer's plant

2.2 Declared unit

The declared unit has been defined in accordance with the Product Category Rules (PCR) Part B: Requirements on the EPD for Double skin metal faced sandwich panels, which has been issued by the by the Institut Bauen und Umwelt e.V. (IBU). The following declared unit has been applied:

$1m^2$ of Trimoterm façade panel

2.3 System boundary

The system boundaries have been defined in accordance with the modular principle described in the European standard for Environmental Product Declarations (EPD) EN 15804. This LCA study is based on the cradle to gate with options principle and includes modules A1-A3, A4, C2, C4 and module D. The LCA of Trimoterm façade panel covers the following life cycle stages:

A1: raw material extraction and processing, processing of secondary material input (e.g. recycling processes);

A2: transport to the manufacturer;

A3: manufacturing;

including provision of all materials, products and related energy and water use.

A4: transport to the building site;

including provision of all materials, products and related energy and water use.

C2: transport to waste processing;

C4: disposal;

including provision of all materials, products and related energy and water use.

D: reuse, recovery and/or recycling potentials, expressed as net impacts and benefits.

The selection of the modules A1-A3, A4, C2, C4 and D, and exclusion of modules A5, B1-B7, C1 and C3 from this LCA study was based primarily on the availability, quality and reliability of data. The data used for modules A1-A3 and A4 are based on the measured quantities provided by the manufacturer, while data used for modules C2, C4 and D are based on the information provided by the Joint Research Centre (JRC) and their European Platform on Life Cycle Assessment.

In addition, the selection of modules A1-A3, A4, C2, C4 and D is also in accordance with the modules selected for the association EPD that was prepared for member companies of the European Association for Panels and Profiles (PPA – Europe). The manufacturer is a PPA – Europe member and has provided data for the development of the association EPD. Even though this PPA – Europe EPD is an average EPD that cannot be (directly) compared to the EPDs that will be issued based on this LCA study, it nonetheless provides a general guidance on what type of LCA analysis is expected within the industry.

It should be noted that the excluded modules (i.e. modules A5, B1-B7, C1 and C3) could be calculated as well. However, the calculation of these modules would be based more on assumed and simplified

data than on measured data. For example, the processing of façade panels at the end-of-life stage (i.e. module C) can be described and conceptualised. However, there has been no metric data available that would back up those processes and enable calculation of environmental impacts by means of LCA. As the requirement is to prepare a scientifically solid LCA study and thus issue quality and representative EPD, the modules A5, B1-B7, C1 and C3 have been left out from this LCA study primarily due to the lack of reliable data.

The schematic representation of system boundaries can be seen in Figure 2.

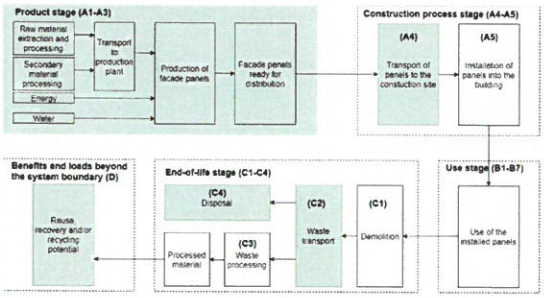


Figure 2: Schematic representation of the system boundaries, with the considered modules being highlighted in green

2.4 Cut-off rules

The exclusion of inputs and outputs has been conducted in accordance with the cut-off rules defined in the standard EN 15804:

- All inputs and outputs to the studied system have been included in the calculation, for which data are available;
- In case of insufficient input data or data gaps for a unit process, the cut-off criteria has been 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of that unit process. The total of neglected input flows per module has been a maximum of 5% of energy usage and mass.

2.5 Background data

The LCA analysis has been conducted with the GaBi ts modelling software (version 9.2.0.58), which has been developed by thinkstep AG in collaboration with the University of Stuttgart. All processes have been modelled based on the inventory data given in the GaBi Professional database.

2.6 Data quality

The quality of the data used for calculations within the LCA analysis corresponds to the requirements of EN 15804:

- Generic data have been checked for plausibility;
- Data sets are complete according to the system boundary within the limits set by the criteria for the exclusion of inputs and outputs;
- Data is as current as possible. Data sets used for calculations represent a reference year within 10 years for generic data and 5 years for producer specific data;
- The reference year refers to the year which the overall inventory best represents, considering the age/representativeness of the various specific and background data included, i.e. not automatically the year of modelling, calculation or publication year. Validity refers to the date to which the inventory is still judged sufficiently valid with the documented technological and geographical representativeness;
- All datasets are based on 1 year averaged data;
- The time period over which inputs to and outputs from the system has been accounted for is 100 years from the year for which the data set is deemed representative.

The data collection has been based on the questionnaire prepared by the Slovenian National Building and Civil Engineering Institute (ZAG), with

further detailed information being discussed in person and via emails with the manufacturer. The technological representativeness of any generic data has been checked in the literature. The geographical representativeness and the reference period of all considered datasets have also been checked. The final mass balance has also been checked.

2.7 Period under review

The reference year for data collection is 2018.

2.8 Allocation

For the product stage (i.e. modules A1-A3), the total consumption of energy and water for the production of $1m^2$ of façade panel has been provided by the manufacturer. The provided values of energy and water consumption for the production of $1m^2$ of façade panel have been obtained by proportionally distributing the total consumption of energy and water based on the overall quantity of the produced panels.

2.9 Comparability

EPD of construction products may not be comparable, if they do not comply with EN 15804.

3 LCA: Results

Table 4: The selected phases of the LCA study

SYSTEM BOUNDARY																
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
Raw material supply	Transport	Manufacturing	Transport	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
☒	☒	☒	☒	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	☒	MNA	☒	☒
The modules of the product lifecycle, which are included in EPD are marked by "X", modules not included are marked with a "**MNA**" = module not assessed																

3.1 Indicators of environmental impacts

According to the standard EN 15804, the environmental impacts are presented with seven indicators (see Table 5).

Table 5: Abbreviations and units of indicators of environmental impacts

Indicators of environmental impacts	Abbreviation	Unit
global warming potential	GWP	kg CO_2 eq.
ozone decomposition potential	ODP	kg CFC 11 eq.
acidification of soil and water	AP	kg SO_2 eq.
eutrophication	EP	kg $(PO_4)^{3-}$ eq.
photochemical ozone creation potential	POCP	kg Ethene eq.
use of abiotic (natural) resources - raw materials	ADP el.	kg Sb eq.
use of abiotic resources - fossil fuels	ADP fos.	MJ, net calorific value

The environmental impact indicators for the considered Trimoterm façade panels are shown in Table 6, Table 7 and

Table 8.

Table 6: Indicators of environmental impacts per 1m² of Trimoterm Power S façade panel

		A1-A3			A4			C2			C4			D		
		Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)		
Indicator	Unit	60	150	240	60	150	240	60	150	240	60	150	240	60	150	240
ADP el.	[kg Sb eq.]	9,56E-05	9,78E-05	1,00E-04	1,14E-07	2,84E-07	4,55E-07	3,44E-09	8,60E-09	1,38E-08	3,95E-08	9,87E-08	1,58E-07	1,04E-06	1,04E-06	1,04E-06
ADP fos.	[MJ]	4,14E+02	5,69E+02	7,61E+02	1,59E+01	3,99E+01	6,38E+01	5,29E-01	1,32E+00	2,12E+00	1,50E+00	3,75E+00	6,00E+00	1,24E+02	1,24E+02	1,24E+02
AP	[kg SO_2 eq.]	1,12E-01	2,02E-01	2,84E-01	2,40E-03	6,01E-03	9,63E-03	2,55E-05	6,38E-05	1,02E-04	6,42E-04	1,61E-03	2,57E-03	3,77E-02	3,77E-02	3,77E-02
EP	[kg $(PO_4)^{3-}$ eq.]	1,40E-02	2,80E-02	3,99E-02	5,93E-04	1,49E-03	2,38E-03	5,01E-06	1,25E-05	2,00E-05	7,28E-05	1,82E-04	2,91E-04	3,29E-03	3,29E-03	3,29E-03
GWP	[kg CO_2 eq.]	3,53E+01	5,29E+01	6,74E+01	1,20E+00	2,98E+00	4,78E+00	3,71E-03	9,28E-03	1,48E-02	1,08E-01	2,69E-01	4,30E-01	1,59E+01	1,59E+01	1,59E+01
ODP	[kg CFC 11 eq.]	1,48E+07	4,97E+07	8,46E-07	4,07E-16	1,02E-15	1,63E-15	9,71E+18	2,43E+17	3,88E+17	6,29E-16	1,57E-15	2,52E-15	1,01E-13	1,01E-13	1,01E-13
POCP	[kg Ethene eq.]	1,38E-02	1,80E-02	2,70E-02	4,93E-05	1,23E-04	1,97E-04	3,56E-06	8,90E-06	1,42E-05	4,93E-05	1,23E-04	1,97E-04	4,93E-03	4,93E-03	4,93E-03

Table 7: Indicators of environmental impacts per 1m² of Trimoterm Power T façade panel

		A1-A3			A4			C2			C4			D		
		Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)		
Indicator	Unit	60	150	240	60	150	240	60	150	240	60	150	240	60	150	240
ADP el.	[kg Sb eq.]	9,50E-05	9,68E-05	9,86E-05	8,52E-08	2,13E-07	3,41E-07	2,58E-09	6,45E-09	1,03E-08	2,96E-08	7,40E-08	1,18E-07	1,04E-06	1,04E-06	1,04E-06
ADP fos.	[MJ]	3,68E+02	4,98E+02	6,29E+02	1,20E+01	2,99E+01	4,78E+01	3,97E-01	9,92E-01	1,59E+00	1,13E+00	2,81E+00	4,50E+00	-1,24E+02	-1,24E+02	-1,24E+02
AP	[kg SO_2 eq.]	1,08E-01	1,69E-01	2,30E-01	1,81E-03	4,51E-03	7,21E-03	1,91E-05	4,78E-05	7,65E-05	4,82E-04	1,20E-03	1,93E-03	-3,77E-02	-3,77E-02	-3,77E-02
EP	[kg $(PO_4)^{3-}$ eq.]	1,45E-02	2,34E-02	3,23E-02	4,46E-04	1,11E-03	1,78E-03	3,76E-06	9,39E-06	1,50E-05	5,46E-05	1,37E-04	2,18E-04	-3,29E-03	-3,29E-03	-3,29E-03
GWP	[kg CO_2 eq.]	3,82E+01	4,87E+01	5,92E+01	8,96E-01	2,24E+00	3,59E+00	2,78E-03	6,96E-03	1,11E-02	8,07E-02	2,02E-01	3,23E-01	-1,59E+01	-1,59E+01	-1,59E+01
ODP	[kg CFC-11 eq.]	9,08E-08	3,52E-07	6,13E-07	3,06E-16	7,64E-16	1,22E-15	7,28E-18	1,82E-17	2,91E-17	4,72E-16	1,18E-15	1,89E-15	1,01E-13	1,01E-13	1,01E-13
POCP	[kg Ethene eq.]	7,57E-03	1,40E-02	2,08E-02	-6,06E-04	-1,52E-03	-2,43E-03	2,67E-06	6,68E-06	1,07E-05	3,70E-05	9,24E-05	1,48E-04	-4,93E-03	-4,93E-03	-4,93E-03

Table 8: Indicators of environmental impacts per 1m² of Trimoterm Perform R façade panel

		A1-A3			A4			C2			C4			D		
		Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)		
Indicator	Unit	60	150	240	60	150	240	60	150	240	60	150	240	60	150	240
ADP el.	[kg Sb eq.]	9,52E-05	9,71E-05	9,91E-05	2,41E-07	3,84E-07	3,84E-07	2,87E-09	7,17E-09	1,15E-08	3,29E-08	8,23E-08	1,32E-07	1,04E-06	1,04E-06	1,04E-06
ADP fos.	[MJ]	3,77E+02	5,21E+02	6,67E+02	3,39E+01	5,38E+01	5,38E+01	4,41E-01	1,10E+00	1,76E+00	1,25E+00	3,13E+00	5,00E+00	-1,24E+02	-1,24E+02	-1,24E+02
AP	[kg SO_2 eq.]	1,12E-01	1,80E-01	2,48E-01	5,12E-03	8,12E-03	8,12E-03	2,13E-05	5,31E-05	8,50E-05	5,35E-04	1,34E-03	2,14E-03	-3,77E-02	-3,77E-02	-3,77E-02
EP	[kg $(PO_4)^{3-}$ eq.]	1,52E-02	2,51E-02	3,50E-02	1,26E-03	2,01E-03	2,01E-03	4,18E-06	1,04E-05	1,67E-05	6,07E-05	1,52E-04	2,43E-04	-3,29E-03	-3,29E-03	-3,29E-03
GWP	[kg CO_2 eq.]	3,90E+01	5,06E+01	6,23E+01	2,53E+00	4,04E+00	4,04E+00	3,09E-03	7,73E-03	1,24E-02	8,97E-02	2,24E-01	3,59E-01	-1,59E+01	-1,59E+01	-1,59E+01
ODP	[kg CFC-11 eq.]	1,10E-07	4,00E-07	6,91E-07	8,66E-16	1,38E-15	1,38E-15	8,09E-18	2,02E-17	3,24E-17	5,24E-16	1,31E-15	2,10E-15	1,01E-13	1,01E-13	1,01E-13
POCP	[kg Ethene eq.]	8,03E-03	1,52E-02	2,26E-02	-1,72E-03	-2,73E-03	-2,73E-03	2,97E-06	7,42E-06	1,19E-05	4,11E-05	1,03E-04	1,64E-04	-4,93E-03	-4,93E-03	-4,93E-03

3.2 Indicators of raw material use

The results of the raw materials use are in accordance with the standard EN 15804, shown with ten indicators (see Table 9). Indicators include the use of renewable and non-renewable energy, the use of renewable and non-renewable material resources and the use of water.

Table 9: Abbreviations and units of indicators of raw material use

Indicators of raw material use	Abbreviation	Unit
use of renewable primary energy, excluding raw material	PERE	MJ, net calorific value
use of renewable primary energy, including raw material	PERM	MJ, net calorific value
sharing of renewable primary energy	PERT	MJ, net calorific value
use of non-renewable primary energy, excluding raw materials	PENRE	MJ, net calorific value
use of non-renewable primary energy sources, including raw materials	PENRM	MJ, net calorific value
sharing of primary non-renewable energy	PENRT	MJ, net calorific value
use of secondary materials	SM	kg
use of renewable secondary fuels	RSF	MJ, net calorific value
use of non-renewable secondary fuels	NRSF	MJ, net calorific value
use fresh drinking water	FW	kg

The indicators of the use of raw materials for the considered Trimoterm façade panels are shown in Table 10, Table 11 and Table 12.

Table 10: Indicators of raw material use per 1m² of Trimoterm Power S façade panel

		A1-A3			A4			C2			C4			D		
		Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)		
Indicator	Unit	60	150	240	60	150	240	60	150	240	60	150	240	60	150	240
PERE	[MJ]	3,45E+00	5,10E+00	8,14E+00	2,23E+00	3,69E+00	5,15E+00	3,16E-02	7,90E-02	1,26E-01	1,97E-01	4,93E-01	7,89E-01	1,37E+01	1,37E+01	1,37E+01
PERM	[MJ]	1,37E+01	1,48E+01	1,67E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	[MJ]	1,71E+01	1,99E+01	2,48E+01	2,23E+00	3,69E+00	5,15E+00	3,16E-02	7,90E-02	1,26E-01	1,97E-01	4,93E-01	7,89E-01	1,37E+01	1,37E+01	1,37E+01
PENRE	[MJ]	4,71E+02	6,50E+02	8,74E+02	3,93E+01	6,50E+01	9,08E+01	5,70E-01	1,43E+00	2,28E+00	1,67E+00	4,18E+00	6,69E+00	-1,21E+02	-1,21E+02	-1,21E+02
PENRM	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	[MJ]	4,71E+02	6,50E+02	8,74E+02	3,93E+01	6,50E+01	9,08E+01	5,70E-01	1,43E+00	2,28E+00	1,67E+00	4,18E+00	6,69E+00	-1,21E+02	-1,21E+02	-1,21E+02
SM	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
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	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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	[kg]	4,41E+01	6,02E+01	8,11E+01	2,56E+00	4,23E+00	5,91E+00	5,32E-02	1,33E-01	2,13E-01	3,90E-01	9,76E-01	1,56E+00	-1,22E+01	-1,22E+01	-1,22E+01

Table 11: Indicators of raw material use per 1m² of Trimoterm Power T façade panel

		A1-A3			A4			C2			C4			D		
		Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)		
Indicator	Unit	60	150	240	60	150	240	60	150	240	60	150	240	60	150	240
PERE	[MJ]	1,94E+00	3,69E+00	4,84E+00	1,99E+00	3,08E+00	4,18E+00	2,37E-02	5,93E-02	9,48E-02	1,48E-01	3,70E-01	5,91E-01	1,37E+01	1,37E+01	1,37E+01
PERM	[MJ]	1,37E+01	1,48E+01	1,67E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	[MJ]	1,56E+01	1,85E+01	2,15E+01	1,99E+00	3,08E+00	4,18E+00	2,37E-02	5,93E-02	9,48E-02	1,48E-01	3,70E-01	5,91E-01	1,37E+01	1,37E+01	1,37E+01
PENRE	[MJ]	4,18E+02	5,70E+02	7,24E+02	3,50E+01	5,43E+01	7,36E+01	4,28E-01	1,07E+00	1,71E+00	1,25E+00	3,14E+00	5,02E+00	-1,21E+02	-1,21E+02	-1,21E+02
PENRM	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	[MJ]	4,18E+02	5,70E+02	7,24E+02	3,50E+01	5,43E+01	7,36E+01	4,28E-01	1,07E+00	1,71E+00	1,25E+00	3,14E+00	5,02E+00	-1,21E+02	-1,21E+02	-1,21E+02
SM	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
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	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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	[kg]	3,90E+01	5,29E+01	6,71E+01	2,28E+00	3,54E+00	4,79E+00	3,99E-02	9,97E-02	1,60E-01	2,93E-01	7,32E-01	1,17E+00	-1,22E+01	-1,22E+01	-1,22E+01

Table 12: Indicators of raw material use per 1m² of Trimoterm Perform R façade panel

		A1-A3			A4			C2			C4			D		
		Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)		
Indicator	Unit	60	150	240	60	150	240	60	150	240	60	150	240	60	150	240
PERE	[MJ]	2,14E+00	4,29E+00	5,74E+00	2,07E+00	3,29E+00	4,50E+00	2,63E-02	6,58E-02	1,05E-01	1,64E-01	4,11E-01	6,57E-01	1,37E+01	1,37E+01	1,37E+01
PERM	[MJ]	1,37E+01	1,48E+01	1,67E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	[MJ]	1,58E+01	1,91E+01	2,24E+01	2,07E+00	3,29E+00	4,50E+00	2,63E-02	6,58E-02	1,05E-01	1,64E-01	4,11E-01	6,57E-01	1,37E+01	1,37E+01	1,37E+01
PENRE	[MJ]	4,29E+02	5,98E+02	7,69E+02	3,64E+01	5,79E+01	7,93E+01	4,75E-01	1,19E+00	1,90E+00	1,39E+00	3,48E+00	5,57E+00	-1,21E+02	-1,21E+02	-1,21E+02
PENRM	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	[MJ]	4,29E+02	5,98E+02	7,69E+02	3,64E+01	5,79E+01	7,93E+01	4,75E-01	1,19E+00	1,90E+00	1,39E+00	3,48E+00	5,57E+00	-1,21E+02	-1,21E+02	-1,21E+02
SM	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
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	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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	[kg]	4,00E+01	5,55E+01	7,11E+01	2,37E+00	3,77E+00	5,16E+00	4,43E-02	1,11E-01	1,77E-01	3,25E-01	8,13E-01	1,30E+00	-1,22E+01	-1,22E+01	-1,22E+01

3.3 Other indicators of environmental impacts

According to the standard EN 15804, the results for other environmental information (waste disposal data) are presented with three indicators, and the results of the output flows from the system are based on four indicators (see Table 13).

Table 13: Abbreviations and units of other indicators of environmental impacts

Indicators for other environmental information	**Abbreviation**	**Units**
disposal of hazardous waste	HWD	kg
disposal of non-hazardous waste	NHWD	kg
disposal of radioactive waste	RWD	kg
Output flow indicators	**Abbreviation**	**Units**
constituents suitable for re-use	CRU	kg
constituents suitable for re-use	MFR	kg
materials for renewable energy	MER	kg
energy emitted	EE	MJ on the energy carrier

Indicators for other environmental information and output flow indicators for the considered Trimoterm façade panels are shown in Table 14, Table 15 and Table 16.

Table 14: Other indicators of environmental impacts per 1m² of Trimoterm Power S façade panel

		A1-A3			A4			C2			C4			D		
		Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)		
Indicator	Unit	60	150	240	60	150	240	60	150	240	60	150	240	60	150	240
HWD	[kg]	2,29E-05	2,27E-05	2,27E-05	2,09E-06	3,46E-06	4,82E-06	2,95E-08	7,38E-08	1,18E-07	2,65E-08	6,62E-08	1,06E-07	1,72E-07	1,72E-07	1,72E-07
NHWD	[kg]	1,62E+00	2,51E+00	3,41E+00	2,46E-03	4,07E-03	5,68E-03	4,48E-05	1,12E-04	1,79E-04	7,21E+00	1,80E+01	2,88E+01	-2,54E-01	-2,54E-01	-2,54E-01
RWD	[kg]	4,03E-03	8,25E-03	1,28E-02	4,36E-05	7,21E-05	1,01E-04	1,09E-06	2,72E-06	4,35E-06	2,06E-05	5,15E-05	8,24E-05	2,61E-03	2,61E-03	2,61E-03
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	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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

Table 15: Other indicators of environmental impacts per 1m² of Trimoterm Power S façade panel

		A1-A3			A4			C2			C4			D		
		Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)		
Indicator	Unit	60	150	240	60	150	240	60	150	240	60	150	240	60	150	240
HWD	[kg]	2,29E-05	2,29E-05	2,29E-05	1,86E-06	2,89E-06	3,91E-06	2,21E-08	5,54E-08	8,86E-08	1,98E-08	4,96E-08	7,94E-08	1,72E-07	1,72E-07	1,72E-07
NHWD	[kg]	1,47E+00	2,29E-05	2,81E+00	2,19E-03	3,40E-03	4,61E-03	3,36E-05	8,40E-05	1,34E-04	5,41E+00	1,35E+01	2,16E+01	-2,54E-01	-2,54E-01	-2,54E-01
RWD	[kg]	3,17E-03	2,14E+00	9,72E-03	3,88E-05	6,02E-05	8,16E-05	8,16E-07	2,04E-06	3,27E-06	1,54E-05	3,86E-05	6,18E-05	2,61E-03	2,61E-03	2,61E-03
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	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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

Table 16: Other indicators of environmental impacts per 1m² of Trimoterm Power S façade panel

		A1-A3			A4			C2			C4			D		
		Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)			Panel thickness (mm)		
Indicator	Unit	60	150	240	60	150	240	60	150	240	60	150	240	60	150	240
HWD	[kg]	2,29E-05	2,29E-05	2,29E-05	1,94E-06	3,08E-06	4,21E-06	2,46E-08	6,15E-08	9,84E-08	2,21E-08	5,51E-08	8,82E-08	1,72E-07	1,72E-07	1,72E-07
NHWD	[kg]	1,52E+00	2,26E+00	3,01E+00	2,28E-03	3,62E-03	4,97E-03	3,73E-05	9,33E-05	1,49E-04	6,01E+00	1,50E+01	2,40E+01	-2,54E-01	-2,54E-01	-2,54E-01
RWD	[kg]	3,41E-03	7,05E-03	1,07E-02	4,04E-05	6,41E-05	8,79E-05	9,07E-07	2,27E-06	3,63E-06	1,72E-05	4,29E-05	6,86E-05	2,61E-03	2,61E-03	2,61E-03
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	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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	[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	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

4 Interpretation of results

Trimoterm Power S façade panel

Figure 3: The relative contributions of different life cycle stages (i.e. modules A1-A3, A4, C2, C4 and D) to the environmental impact of Trimoterm Power S façade panels

It can be seen from Figure 3 that the product stage (i.e. modules A1-A3) contributes the most to the environmental impact of the considered Trimoterm Power S façade panels. For example, the product stage represents on average 72,28% of the total environmental impact in terms of GWP, 99,98% of the total environmental impact in terms of ODP, 80,01% of the total environmental impact in terms of AP, 83,26% of the total environmental impact in terms of EP, 72,86% of the total environmental impact in terms of POCP, 98,56% of the total environmental impact in terms of ADP el. and 76,98% of the total environmental impact in terms of ADP fos.

The other life cycle stage that has a more significant impact on the environmental burden associated with the life cycle of the considered Trimoterm Power S façade panels is the construction stage (i.e. module A4). For example, module A4 represents on average 3,94% of the total environmental impact in terms of GWP, 2,29% of the total environmental impact in terms of AP, 4,33% of the total environmental impact in terms of EP and 4,98% of the total environmental impact in terms of ADP fos. On the other hand, it can be seen from Figure 3 that modules C2 and C4 exert a minimal environmental burden in terms of the considered environmental impact categories.

Figure 3 also shows that module A4 has a positive environmental impact in terms of POCP, where it presents 7,10% of the total impact in terms of the photochemical ozone creation potential. The photochemical ozone is generated by sunlight-initiated oxidation of volatile organic compounds (VOC) and carbon monoxide (CO) in the presence of nitrogen oxides (NO_x). The volatile organic compounds react differently with different oxidants (e.g. ozone, NO_2 etc.) and therefore can either have negative or positive effects on the ozone formation. The negative value of the transport in terms of the POCP is related to the separation of the NO_x emissions in the NO_2 and NO emissions, with NO and O_3 (ozone) reacting to NO_2 and O_2 during the night time and thus leading to the reduction of the POCP.

A potential environmental benefit has been calculated for benefits and loads beyond the system boundary stage (i.e. module D) for all considered environmental impact categories. It can be seen from Figure 3 that there is a potential

benefit due to the reusing/recycling of the metal sheets, which can be obtained during the end-of-life stage of Trimoterm Power S façade panels. A potential environmental benefit can be seen in terms of the following impact categories: 23,41% of the total impact in terms of GWP, 17,06% of the total impact in terms of AP, 11,84% of the total impact in terms of EP, 19,58% of the total impact in terms of POCP and 17,41% of the total impact in terms of ADP fos.

Trimoterm Power T façade panel

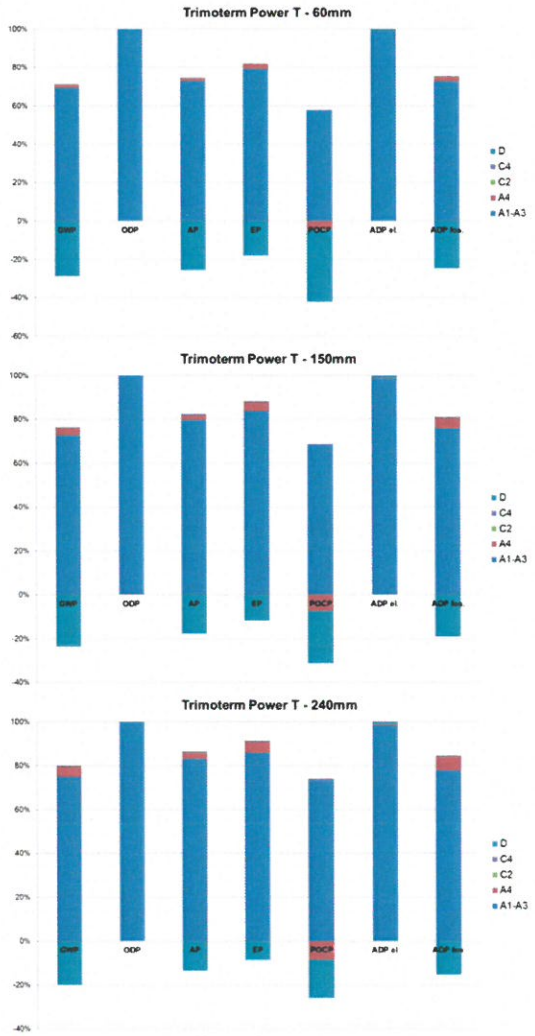


Figure 4: The relative contributions of different life cycle stages (i.e. modules A1-A3, A4, C2, C4 and D) to the environmental impact of Trimoterm Power T façade panels

It can be seen from Figure 4 that the product stage (i.e. modules A1-A3) contributes the most to the environmental impact of the considered Trimoterm Power T façade panels. For example, the product stage represents on average 72,35% of the total environmental impact in terms of GWP, 99,97% of the total environmental impact in terms of ODP, 78,52% of the total environmental impact in terms of AP, 82,98% of the total environmental impact in terms of EP, 72,86% of the total environmental impact in terms of POCP, 98,64% of the total environmental impact in terms of ADP el. and 75,51% of the total environmental impact in terms of ADP fos.

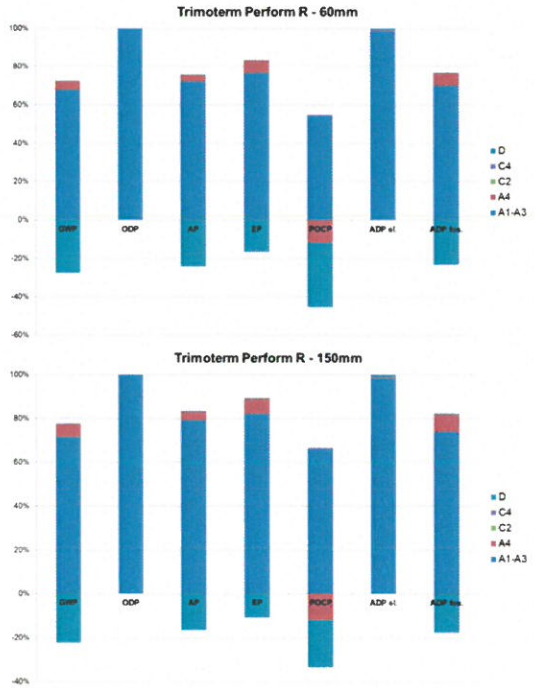
The other life cycle stage that has a more significant impact on the environmental burden associated with the life cycle of the considered Trimoterm Power T façade panels is the construction stage (i.e. module A4). For example, module A4 represents on average 3,17% of the total environmental impact in terms of GWP, 1,98% of the total environmental impact in terms of AP, 3,71% of the total environmental impact in terms of EP and on average 4,28% of the total environmental impact in terms of ADP fos. On the other hand, it can be seen from Figure 4 that modules C2 and C4 exert a minimal environmental burden in terms of the considered environmental impact categories.

Figure 4 also shows that module A4 has a positive environmental impact in terms of POCP, where it presents 6,84% of the total impact in terms of the photochemical ozone creation potential. The photochemical ozone is generated by sunlight-initiated oxidation of volatile organic compounds (VOC) and carbon monoxide (CO) in the presence of nitrogen oxides (NO_x). The volatile organic compounds react differently with different oxidants (e.g. ozone, NO_3 etc.) and therefore can either have negative or positive effects on the ozone formation. The negative value of the transport in terms of the POCP is related to the separation of the NO_x emissions in the NO_2 and NO emissions, with NO and O_3 (ozone) reacting to NO_2

and O_2 during the night time and thus leading to the reduction of the POCP.

A potential environmental benefit has been calculated for benefits and loads beyond the system boundary stage (i.e. module D) for all considered environmental impact categories. It can be seen from Figure 4 that there is a potential benefit due to the reusing/recycling of the metal sheets, which can be obtained during the end-of-life stage of Trimoterm Power T façade panels. A potential environmental benefit can be seen in terms of the following impact categories: 24,18% of the total impact in terms of GWP, 18,94% of the total impact in terms of AP, 12,82% of the total impact in terms of EP, 26,29% of the total impact in terms of POCP and 19,66% of the total impact in terms of ADP fos.

Trimoterm Perform R façade panel



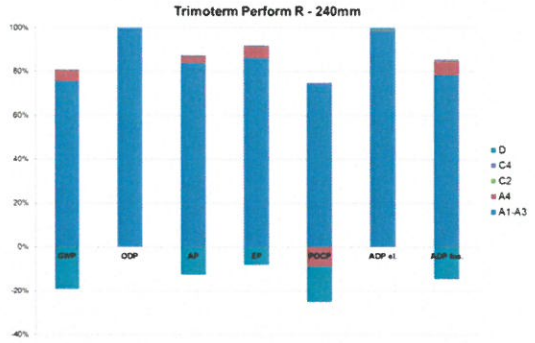


Figure 5: The relative contributions of different life cycle stages (i.e. modules A1-A3, A4, C2, C4 and D) to the environmental impact of Trimoterm Perform R façade panels

It can be seen from Figure 5 that the product stage (i.e. modules A1-A3) contributes the most to the environmental impact of the considered Trimoterm Perform R façade panels. For example, the product stage represents on average 71,62% of the total environmental impact in terms of GWP, 99,96% of the total environmental impact in terms of ODP, 78,40% of the total environmental impact in terms of AP, 81,70% of the total environmental impact in terms of EP, 64,97% of the total environmental impact in terms of POCP, 98,52% of the total environmental impact in terms of ADP el. and 74,19% of the total environmental impact in terms of ADP fos.

The other life cycle stage that has a more significant impact on the environmental burden associated with the life cycle of the considered Trimoterm Perform R façade panels is the construction stage (i.e. module A4). For example, module A4 represents on average 5% of the total environmental impact in terms of GWP, 3,20% of the total environmental impact in terms of AP, 5,96% of the total environmental impact in terms of EP and on average 6,76% of the total environmental impact in terms of ADP fos. On the other hand, it can be seen from Figure 5 that modules C2 and C4 exert a minimal environmental burden in terms of the considered environmental impact categories.

also shows that module A4 has a positive environmental impact in terms of POCP, where it presents 10,84% of the total impact in terms of the photochemical ozone creation potential. The photochemical ozone is generated by sunlight-initiated oxidation of volatile organic compounds (VOC) and carbon monoxide (CO) in the presence of nitrogen oxides (NO_x). The volatile organic compounds react differently with different oxidants (e.g. ozone, NO_2 etc.) and therefore can either have negative or positive effects on the ozone formation. The negative value of the transport in terms of the POCP is related to the separation of the NO_x emissions in the NO_2 and NO emissions, with NO and O_3 (ozone) reacting to NO_2 and O_2 during the night time and thus leading to the reduction of the POCP.

A potential environmental benefit has been calculated for benefits and loads beyond the system boundary stage (i.e. module D) for all considered environmental impact categories. It can be seen from Figure 5 that there is a potential benefit due to the reusing/recycling of the metal sheets, which can be obtained during the end-of-life stage of Trimoterm Perform R façade panels. A potential environmental benefit can be seen in terms of the following impact categories: 23,07% of the total impact in terms of GWP, 17,83% of the total impact in terms of AP, 11,84% of the total impact in terms of EP, 23,73% of the total impact in terms of POCP and 18,84% of the total impact in terms of ADP fos.

5 References

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The data specified in the EPD are calculated on the basis of the data provided by the manufacturer. In the event that the manufacturer's information is incorrect, calculations do not apply.