

# Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019

## ODE Starflex & Evomineral 032 Glasswool Insulation Materials

**Programme:**

The International EPD® System  
[www.environdec.com](http://www.environdec.com)

**Programme Operator:**

EPD Turkey, fully aligned  
with International EPD System

**S-P Code:**

S-P-03932

**Publication Date:**

16.06.2021

**Validity Date:**

15.06.2026

**Geographical Scope:**

Global



An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at [www.environdec.com](http://www.environdec.com)

# Programme Information

|                                                                                                |                                                                                                                                                        |                                                                                       |
|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Programme                                                                                      | The International EPD® System                                                                                                                          | EPD Turkey, managed and run by:                                                       |
|                                                                                                | EPD International AB<br>Box 210 60 SE-100 31<br>Stockholm, Sweden                                                                                      | SÜRATAM, www.suratam.org<br>Nef 09 B Blok No:7/15 34415<br>Kağıthane/Istanbul, Turkey |
|                                                                                                | www.environdec.com<br>info@environdec.com                                                                                                              | www.epdturkey.org<br>info@epdturkey.org                                               |
| Product Category Rules (PCR):                                                                  | 2019:14 Version 1.11, 2021-02-05, Construction Products and CPC 54 Construction Services, EN 15804:2012 + A2:2019 Sustainability of Construction Works |                                                                                       |
| Independent third-party verification of the declaration and data, according to ISO 14025:2006: | EPD process certification<br><br>EPD verification <b>X</b>                                                                                             |                                                                                       |
| Third party verifier:                                                                          | Professor Vladimír Kocí                                                                                                                                |                                                                                       |
| Approved by:                                                                                   | The International EPD® System                                                                                                                          |                                                                                       |
| Procedure for follow-up of data during EPD validity involves third party verifier: NO          |                                                                                                                                                        |                                                                                       |

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.



# About ODE

ODE embarked on its business journey in 1985 with contracting operations. In 1998, ODE decided to move forward in the insulation industry, one that would serve Turkey's need. Having become an importer in 1990 and a manufacturer in 1996, ODE now manufactures products in 2 main categories, Building and HVAC insulation. ODE is now among the largest manufacturers of the insulation industry with 5 state-of-the-art manufacturing facilities, over 4 thousand product varieties, and expert workforce.

We manufacture extruded polystyrene thermal insulating material under the brand of ODE Isıpan; polymer modified bituminous waterproofing blankets under the brand of ODE Membrane, glass wool products used for heat and sound insulation and fire safety under the brand of ODE Starflex; and elastomeric rubber foam insulating material under the brand of ODE R-Flex.

As its Eskişehir Manufacturing Facility comes into play, ODE which currently exports to 5 continents aims to increase its export capacity even further, and become the leader in waterproofing in Turkey.

ODE reflects its social responsibility awareness to all its operations, and is the first company in the insulation industry of Turkey to publish a "Corporate Social Responsibility Report". Furthermore, ODE has been the first among its peers to earn the internationally recognized Environmental Product Declaration (EPD) certificate which is compatible with European standards and which applies for all markets to all heat and water insulation products manufactured by ODE in its facilities in Çorlu.

Having implemented pioneering efforts toward raising public awareness of insulation and energy awareness, and taking care to be involved in projects that will hand down permanent value to the future, ODE changed its company motto to "Insulates the Future" in 2014. In knowledge of the universal responsibility of being in the global market, ODE continues to operate as a company which encourages its social stakeholders through visionary and innovative work.



*ODE Çorlu/Tekirdağ, Turkey  
Production Facilities*



*ODE Eskişehir, Turkey  
Production Facilities*

# About Product

ODE Glasswool blankets and boards are the insulating blankets and boards, used for thermal and sound insulation of buildings and HVAC ducts from outside. ODE Glasswool has products with facing and without facing.

The ODE Glasswool Blanket Group is manufactured in the thermal conductivity range of  $\lambda = 0.032\text{--}0.044\text{ W/(m.K)}$ .

The weight providing  $1\text{ m}^2\text{K/W}$  thermal insulation is  $0.77\text{ kg}$ .

## ADVANTAGES

- It is used for thermal insulation, sound insulation, acoustic design, and for the purposes of fire safety.
- Its classification as a "Class A1 Non-Combustible" (EN 13501-1) material is a very significant advantage for fire safety.\*
- It easily conforms to all types of wooden and metal roofs.
- Since it is lightweight, it is very easy to lift up to the roof and to cut and install.
- Due to the properties of glass wool, it does not tear or produce wastage during installation.
- It does not degrade, decompose, become mouldy in time.
- Thanks to its natural content, it does not degrade and is user friendly.
- It is EUCB certified as not harmful to human health.

\* Unfaced types.



For product accessories, certificates and detailed information, please click or scan the QR code

# Technical Specifications

|                                           | UNIT       | Value     |
|-------------------------------------------|------------|-----------|
| Thickness                                 | mm         | 25-180    |
| Reaction to Fire                          | Euro Class | A1        |
| Thermal Conductivity ( $\lambda$ ) (10°C) | W/(m.K)    | 0.032     |
| Thermal Resistance (R)                    | (m²K)/W    | 0.75-5.60 |
| Water Vapor Permeability                  | $\mu$      | 1.1       |
| Maximum Service Temperature               | °C         | 250       |

## APPLICATION AREA

Depending on the field and purpose of application, blankets and panels with different coating materials are available at different sizes and technical properties. ODE Starflex Glasswool insulation products are mainly used for thermal insulation whereas they can be used for acoustic insulation.

## PRODUCT CONTENT

| Components | Amount, % |
|------------|-----------|
| Cullet     | 70-80     |
| Borax      | <10       |
| Sand       | <7        |
| Soda Ash   | <5        |
| Additives  | <5        |

A construction worker wearing a yellow hard hat and a safety vest is looking upwards and gesturing with his right hand. The background is a blurred construction site.

# Why do I need insulation?

The cheapest energy is the one that is unexpended. Apart from energy efficiency, there are also additional benefits of insulation construction, which are determined below.

- Insulation prevents fuel consumption, therefore decreases waste-gas emissions, which cause global warming and environmental pollution.
- Insulation provides concrete resistivity by averting concrete corrosion. Thus, it increases the durability and the safety of the building against earthquakes.
- Insulation saves %60 of the expenditure on heating & cooling the building. It assists better quality of heating during winter, and better quality of cooling during summer.
- Insulation assists on avoiding the formation of mould growth, black spots and whitcomb in houses by preventing condensation.
- Insulation raises the life standard by balancing the temperature of the building. Thus, it provides a snuggy and heathy environment in our life time ritual.
- Insulation plays crucial role in country's economy by decreasing energy dependency on other countries.

# LCA Information

## Functional Unit

1 R (m<sup>2</sup>K/W) ODE Starflex & Evomineral 032 Glasswool Insulation Materials

## Time Representativeness

2020

## Database(s) and LCA Software Used

Ecoinvent 3.6, SimaPro 9.1

|    |    |                                                       |                            |
|----|----|-------------------------------------------------------|----------------------------|
| X  | A1 | Raw Material Supply                                   | Product Stage              |
| X  | A2 | Transport                                             |                            |
| X  | A3 | Manufacturing                                         |                            |
| X  | A4 | Transport                                             | Construction Process Stage |
| X  | A5 | Construction Installation                             |                            |
| ND | B1 | Use                                                   | Use Stage                  |
| ND | B2 | Maintenance                                           |                            |
| ND | B3 | Repair                                                |                            |
| ND | B4 | Replacement                                           |                            |
| ND | B5 | Refurbishment                                         |                            |
| ND | B6 | Operational Energy Use                                |                            |
| ND | B7 | Operational Water Use                                 |                            |
| X  | C1 | Deconstruction, demolition                            | End of Life Stage          |
| X  | C2 | Transport                                             |                            |
| X  | C3 | Waste Processing                                      |                            |
| X  | C4 | Disposal                                              |                            |
| X  | D  | Future reuse, recycling or energy recovery potentials | Benefits and Loads         |

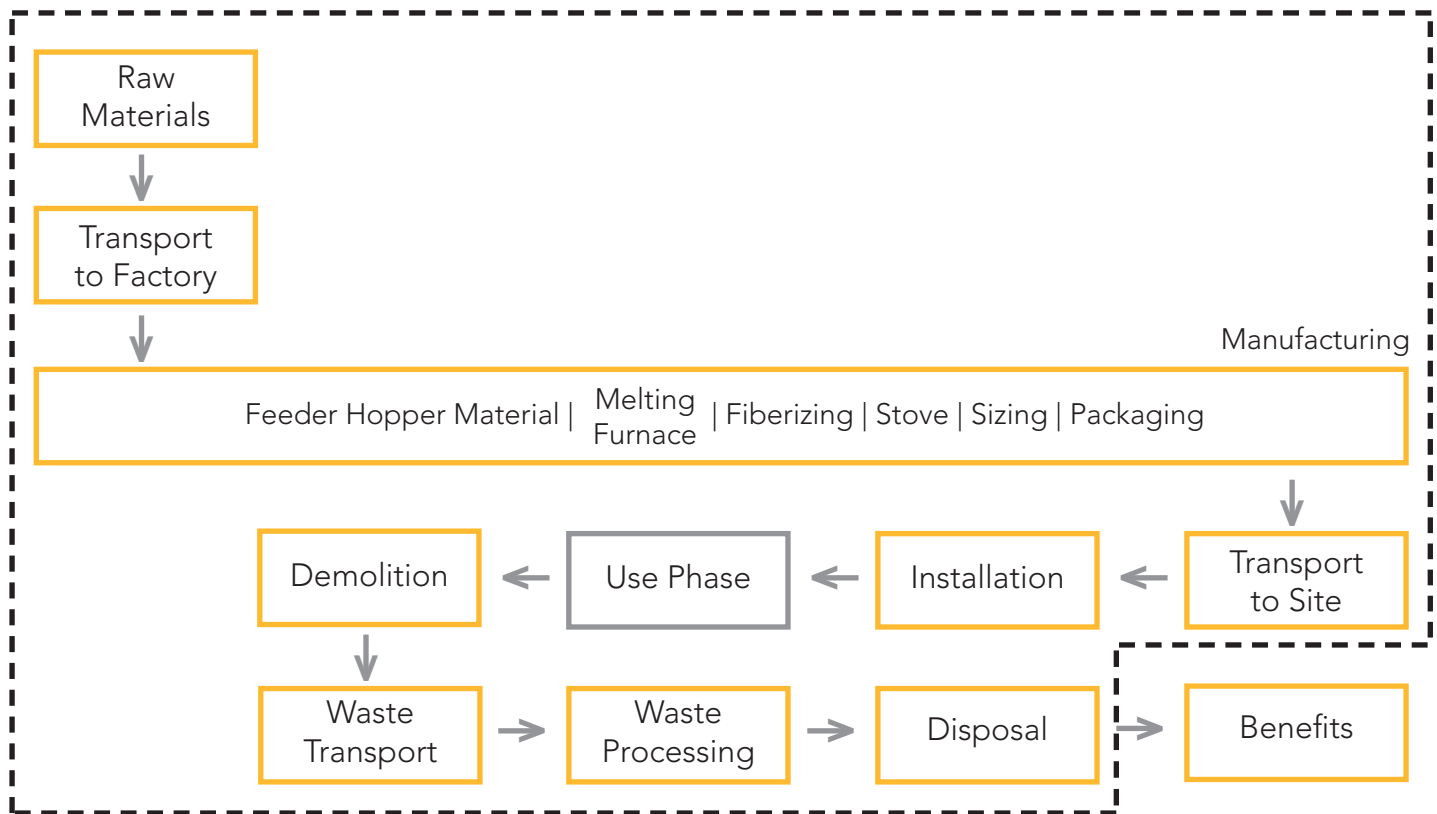
X = Included in LCA, ND = Not Declared

The EPD evaluates the environmental impacts of 1 m<sup>2</sup>K/W ODE Starflex & Evomineral 032 Glasswool products and during the modeling, all values are taken into account for this unit.

The inventory for the LCA study is based on the 2020 production figures for Starflex and Evomineral 032 Glasswool by ODE.

The system boundaries in tabular form for all modules are shown in the table left. This EPD's system boundary is cradle to grave. The system boundary covers A1 - A3 Product Stages, A4-A5 Construction Process Stage and C1-C4 End of Life Stage.

# System Boundary



## A1: Raw Material Supply

ODE Glaswool products production starts with raw materials, mainly locally sourced but some transported from other parts of the world. Environmental impacts during the production of all raw materials are reflected in this EPD.

## A2: Transport to Factory

Transport is relevant for delivery of raw materials to the plant and internal transport within the manufacturing plant for each product.

## A3 : Manufacturing

Manufacture of glasswool products are starts with feeder continues with melting silica sand at high temperatures and making it fibres. Both natural gas and electricity are consumed

during the production of glasswool insulation materials. Electricity consumed within the packaging process is also considered in manufacturing stages.

## A4 : Transport to Site

Manufactured products are sent to customers in different parts of the world. 200 km of road transport and 2000 km (1243 miles) of sea transport are assumed for transportation to clients or to the construction site.

## A5 : Installation

Glasswool products are direct applied to the surface. For installation of glasswool products, 100g/m<sup>2</sup> plastic fixing pin using is assumed.



**C1 : Demolition**

It is assumed that there is no energy use during uninstalation process. This stage is usually done by manpower.

**C2 : Waste Transport**

Average distance from demolition site to final destination is assumed as 100 km.

**C3 : Waste Processing**

There is no need for any waste process.

**C4 : Disposal**

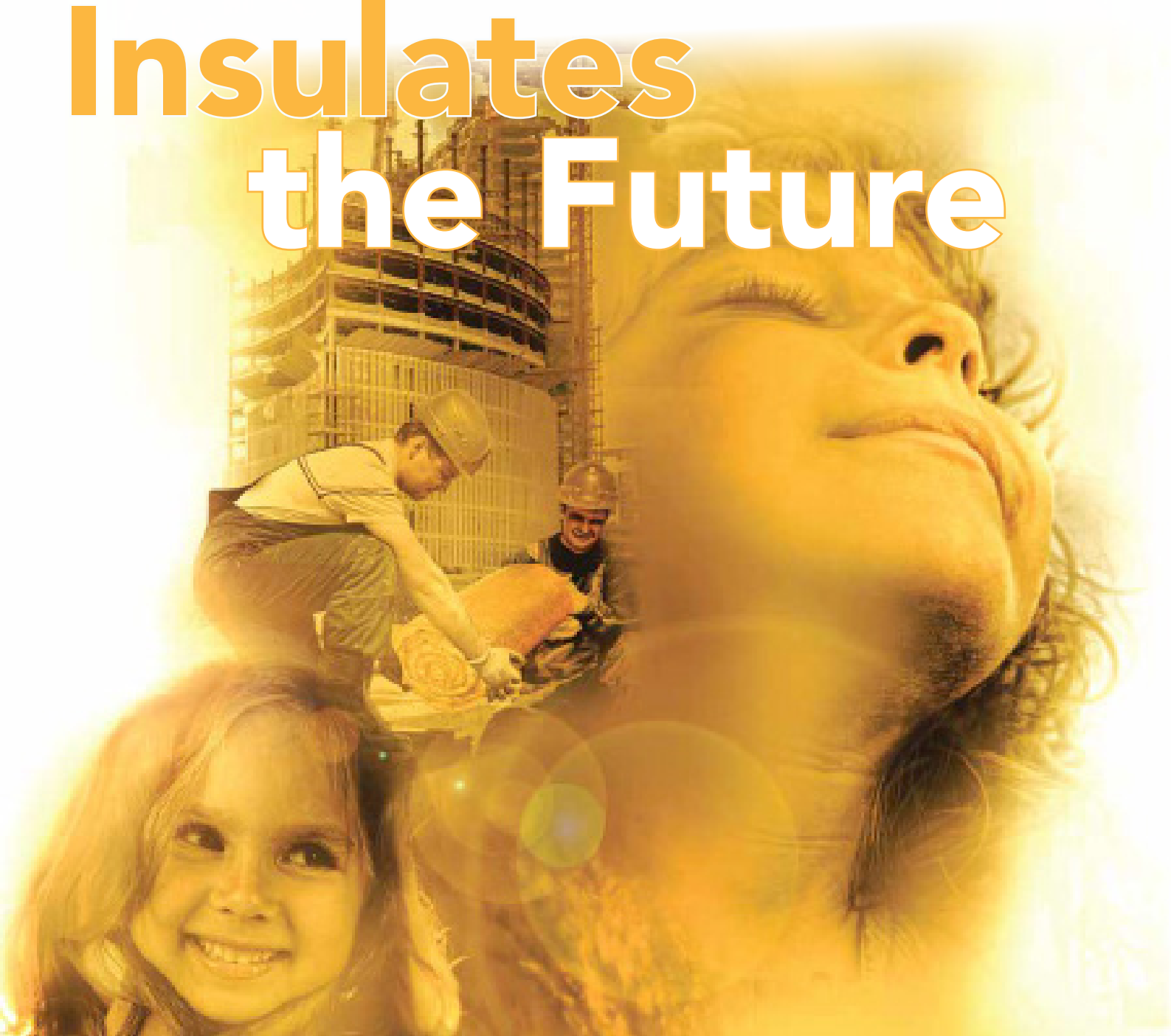
For XPS products, relevant disposal scenarios

are modelled by taking into consideration the fate of the construction and packaging wastes. All construction products disposed into a landfill, which is modelled as such in this LCA. Packaging waste is assumed to end up at packaging recycling.

**D : Benefits & Loads**

There is no potential benefit as the products go completely to the landfill at the end of life. Only the benefit from packaging recycling is taken into account in this LCA model.

# Insulates the Future



# More Information

## **Allocations**

There are no co-products in the production of ODE. Hence, there is no need for co-product allocation. Transport is allocated according to tonnages for almost all raw materials bought by ODE. For the manufacturing of product, no allocation for energy consumption or water consumption was made as the product specific data was available.

Water consumption, energy consumption and raw material transportation were weighted according to 2020 production figures.

In addition, hazardous and non-hazardous waste amounts were also allocated from the 2020 total waste generation.

## **Cut-Off Criteria**

1% cut-off rule is applied to raw materials less than 1% in the composition but making sure their total is below this threshold.

## **REACH Regulation**

No substances included in the Candidate List of Substances of Very High Concern for authorization under the REACH regulations are present in this product either above the threshold for registration with the European Chemicals Agency or above 0.1 % (wt/wt).

## **LCA Modelling, Calculation and Data Quality**

The results of the LCA with the indicators as per EPD requirement are given in the LCA result tables. All energy calculations were obtained using Cumulative Energy Demand (LHV) methodology, while fresh water use is calculated with selected inventory flows in SimaPro according to the PCR.

The SimaPro 9.1 LCA software and the Ecoinvent 3.6 LCA database were used to calculate the environmental impacts. Ecoinvent database were used as generic background data source.

The regional energy datasets were used for all energy calculations.

## **Geographical Scope**

The geographical scope of this EPD is global.

## **Comperability**

A comparison or an evaluation of EPD data is only possible where EN 15804 has been followed, and the same building context and product-specific characteristics of performance are taken into account and the same stages have been included in the system boundary. According to EN 15804, EPD of construction products may not be comperable if they do not comply with the standards.



# **LCA**

# **Results**

| Environmental Impacts for 1 m³KW ODE Starflex & Evomineral 032 Glaswool Insulation Materials (Without Facing) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |          |          |    |          |    |          |           |
|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----|----------|----|----------|-----------|
| Impact Category                                                                                               | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A1-A2-A3 | A4       | A5       | C1 | C2       | C3 | C4       | D         |
| GWP - Fossil                                                                                                  | kg CO <sub>2</sub> eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1.47     | 0.048    | 0.859    | 0  | 0.013    | 0  | 0.046    | -0.013    |
| GWP - Biogenic                                                                                                | kg CO <sub>2</sub> eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.011    | 8.45E-6  | 0.003    | 0  | 5.14E-6  | 0  | 0.69     | 324E-6    |
| GWP - Luluc                                                                                                   | kg CO <sub>2</sub> eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.007    | 22.0E-6  | 617E-9   | 0  | 4.80E-6  | 0  | 13.9E-6  | -10.1E-6  |
| GWP - Total                                                                                                   | kg CO <sub>2</sub> eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1.49     | 0.048    | 0.863    | 0  | 0.013    | 0  | 0.737    | -0.013    |
| ODP                                                                                                           | kg CFC-11 eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 156E-9   | 10.2E-9  | 248E-12  | 0  | 2.90E-9  | 0  | 2.78E-9  | -423E-12  |
| AP                                                                                                            | mol H+ eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.006    | 0.001    | 0.004    | 0  | 55.5E-6  | 0  | 138E-6   | -57.4E-6  |
| EP - Freshwater                                                                                               | kg P eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.001    | 3.37E-6  | 44.4E-6  | 0  | 1.12E-6  | 0  | 12.6E-6  | -3.93E-6  |
| *EP - Freshwater                                                                                              | kg PO <sub>4</sub> eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.002    | 10.3E-6  | 136E-6   | 0  | 3.43E-6  | 0  | 38.7E-6  | -12.0E-6  |
| EP - Marine                                                                                                   | kg N eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.001    | 157E-6   | 0.001    | 0  | 16.3E-6  | 0  | 0.001    | -11.3E-6  |
| EP - Terrestrial                                                                                              | mol N eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.011    | 0.002    | 0.007    | 0  | 178E-6   | 0  | 376E-6   | -116E-6   |
| POCP                                                                                                          | kg NMVOC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.003    | 470E-6   | 0.002    | 0  | 54E-6    | 0  | 270E-6   | -52.6E-6  |
| ADPE                                                                                                          | kg Sb eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 9.14E-6  | 986E-9   | 291E-9   | 0  | 351E-9   | 0  | 115E-9   | -125E-9   |
| ADPF                                                                                                          | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 23.8     | 0.68     | 12.6     | 0  | 0.197    | 0  | 0.262    | -0.368    |
| WDP                                                                                                           | m³ depriv.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1.07     | 0.002    | 0.971    | 0  | 0.001    | 0  | 0.009    | -0.010    |
| PM                                                                                                            | disease inc.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 48.9E-9  | 2.75E-9  | 30.2E-9  | 0  | 923E-12  | 0  | 1.63E-9  | -450E-12  |
| IR                                                                                                            | kBq U-235 eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.061    | 0.003    | 113E-6   | 0  | 0.001    | 0  | 0.002    | -0.001    |
| ETP - FW                                                                                                      | CTUe                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 18.6     | 0.553    | 1.11     | 0  | 0.173    | 0  | 3.95     | -0.157    |
| HTTP - C                                                                                                      | CTUh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 656E-12  | 19.4E-12 | 82.2E-12 | 0  | 4.47E-12 | 0  | 24.6E-12 | -3.91E-12 |
| HTTP - NC                                                                                                     | CTUh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 9.76E-9  | 531E-12  | 1.56E-9  | 0  | 174E-12  | 0  | 1.23E-9  | -108E-12  |
| SQP                                                                                                           | Pt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2.44     | 0.358    | 0.012    | 0  | 0.133    | 0  | 0.470    | -0.058    |
| Acronyms                                                                                                      | GWP-total: Climate change, GWP-fossil: Climate change- fossil, GWP-biogenic: Climate change - biogenic, GWP-luluc: Climate change - land use and transformation, ODP: Ozone layer depletion, AP: Acidification terrestrial and freshwater, EP-freshwater: Eutrophication freshwater, EP-marine: Eutrophication marine, EP-terrestrial: Eutrophication terrestrial, POCP: Photochemical oxidation, ADPE: Abiotic depletion - elements, ADPF: Abiotic depletion - fossil resources, WDP: Water scarcity, PM: Respiratory inorganics - particulate matter, IR: Ionising radiation, ETP-FW: Ecotoxicity freshwater, HTP-c: Cancer human health effects, HTP-nc: Non-cancer human health effects, SQP: Land use related impacts, soil quality. |          |          |          |    |          |    |          |           |
| Legend                                                                                                        | A1: Raw Material Supply, A2: Transport, A3: Manufacturing, A1-A2-A3: Sum of A1, A2 and A3, A4:Transport to Site, A5: Installation, C1: Demolition, C2: Waste Transport, C3: Waste Processing, C4: Disposal, D: Benefits and Loads.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |          |          |    |          |    |          |           |

*\*This indicator has been calculated as "kg P eq" as required in the characterization model. (EUTREND model, Struijs et al, 2009b, as implemented in ReCiPe; <http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>)*



| Resource Use for 1 m²K/W 1 m³K/W ODE Starflex & Evomineral 032 Glaswool Insulation Materials (Without Facing) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |        |       |    |         |    |        |          |
|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------|-------|----|---------|----|--------|----------|
| Impact Category                                                                                               | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A1-A2-A3 | A4     | A5    | C1 | C2      | C3 | C4     | D        |
| PERE                                                                                                          | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1.67     | 0.007  | 0.133 | 0  | 0.002   | 0  | 0.011  | -0.016   |
| PERM                                                                                                          | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| PERT                                                                                                          | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1.67     | 0.007  | 0.133 | 0  | 0.002   | 0  | 0.011  | -0.016   |
| PENRE                                                                                                         | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 23.8     | 0.678  | 12.6  | 0  | 0.197   | 0  | 0.262  | -0.368   |
| PENRM                                                                                                         | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| PENRT                                                                                                         | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 23.8     | 0.678  | 12.6  | 0  | 0.197   | 0  | 0.262  | -0.368   |
| SM                                                                                                            | kg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| RSF                                                                                                           | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| NRSF                                                                                                          | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| FW                                                                                                            | m³                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.005    | 102E-6 | 0.017 | 0  | 34.0E-6 | 0  | 241E-6 | -47.0E-6 |
| Waste & Output Flows for 1 m²K/W ODE Starflex & Evomineral 032 Glaswool Insulation Materials (Without Facing) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |        |       |    |         |    |        |          |
| Impact Category                                                                                               | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A1-A2-A3 | A4     | A5    | C1 | C2      | C3 | C4     | D        |
| HWD                                                                                                           | kg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 81.0E-6  | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| NHWD                                                                                                          | kg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.087    | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| RWD                                                                                                           | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| CRU                                                                                                           | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| MFR                                                                                                           | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| MER                                                                                                           | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| EE (Electrical)                                                                                               | kg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| EE (Thermal)                                                                                                  | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| Acronyms                                                                                                      | PERE: Use of renewable primary energy excluding resources used as raw materials, PERM: Use of renewable primary energy resources used as raw materials, PERT: Total use of renewable primary energy, PENRE: Use of non-renewable primary energy excluding 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, SM: Secondary material, RSF: Renewable secondary fuels, NRSF: Non-renewable secondary fuels, FW: Net use of fresh water, HWD: Hazardous waste disposed, NHWD: Non-hazardous waste disposed, RWD: Radioactive waste disposed, CRU: Components for reuse, MFR: Material for recycling, MER: Materials for energy recovery, EE (Electrical): Exported energy electrical, EE (Thermal): Exported energy, Thermal. |          |        |       |    |         |    |        |          |
| Legend                                                                                                        | A1: Raw Material Supply, A2: Transport, A3: Manufacturing, A1-A2-A3: Sum of A1, A2 and A3, A4: Transport to Site, A5: Installation, C1: Demolition, C2: Waste Transport, C3: Waste Processing, C4: Disposal, D: Benefits and Loads.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |        |       |    |         |    |        |          |

| Environmental Impacts for 1 m²KW ODE Starflex & Evomineral 032 Glaswool Insulation Materials (With Aluminium Foil Facing) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          |          |          |    |          |    |          |           |
|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----|----------|----|----------|-----------|
| Impact Category                                                                                                           | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A1-A2-A3 | A4       | A5       | C1 | C2       | C3 | C4       | D         |
| GWP - Fossil                                                                                                              | kg CO <sub>2</sub> eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2.02     | 0.048    | 0.859    | 0  | 0.013    | 0  | 0.052    | -0.013    |
| GWP - Biogenic                                                                                                            | kg CO <sub>2</sub> eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.011    | 8.45E-6  | 0.003    | 0  | 5.14E-6  | 0  | 0.77     | 324E-6    |
| GWP - Luluc                                                                                                               | kg CO <sub>2</sub> eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.008    | 22.0E-6  | 617E-9   | 0  | 4.80E-6  | 0  | 15.5E-6  | -10.1E-6  |
| GWP - Total                                                                                                               | kg CO <sub>2</sub> eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2.04     | 0.048    | 0.863    | 0  | 0.013    | 0  | 0.823    | -0.013    |
| ODP                                                                                                                       | kg CFC-11 eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 181E-9   | 10.2E-9  | 248E-12  | 0  | 2.90E-9  | 0  | 3.10E-9  | -423E-12  |
| AP                                                                                                                        | mol H+ eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0.009    | 0.001    | 0.004    | 0  | 55.5E-6  | 0  | 154E-6   | -57.4E-6  |
| EP - Freshwater                                                                                                           | kg P eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.001    | 3.37E-6  | 44.4E-6  | 0  | 1.12E-6  | 0  | 14.1E-6  | -3.93E-6  |
| *EP - Freshwater                                                                                                          | kg PO <sub>4</sub> eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.002    | 10.3E-6  | 136E-6   | 0  | 3.43E-6  | 0  | 43.2E-6  | -12.0E-6  |
| EP - Marine                                                                                                               | kg N eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.002    | 157E-6   | 0.001    | 0  | 16.3E-6  | 0  | 0.002    | -11.3E-6  |
| EP - Terrestrial                                                                                                          | mol N eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.018    | 0.002    | 0.007    | 0  | 178E-6   | 0  | 420E-6   | -116E-6   |
| POCP                                                                                                                      | kg NMVOC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0.005    | 470E-6   | 0.002    | 0  | 54E-6    | 0  | 302E-6   | -52.6E-6  |
| ADPE                                                                                                                      | kg Sb eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 280E-6   | 986E-9   | 291E-9   | 0  | 351E-9   | 0  | 128E-9   | -125E-9   |
| ADPF                                                                                                                      | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 29.3     | 0.678    | 12.6     | 0  | 0.197    | 0  | 0.293    | -0.368    |
| WDP                                                                                                                       | m³ depriv.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1.20     | 0.002    | 0.971    | 0  | 0.001    | 0  | 0.010    | -0.010    |
| PM                                                                                                                        | disease inc.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 87.5E-9  | 2.75E-9  | 30.2E-9  | 0  | 923E-12  | 0  | 1.81E-9  | -450E-12  |
| IR                                                                                                                        | kBq U-235 eq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.083    | 0.003    | 113E-6   | 0  | 0.001    | 0  | 0.002    | -0.001    |
| ETP - FW                                                                                                                  | CTUe                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 34.5     | 0.553    | 1.11     | 0  | 0.173    | 0  | 4.41     | -0.157    |
| HTTP - C                                                                                                                  | CTUh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1.39E-9  | 19.4E-12 | 82.2E-12 | 0  | 4.47E-12 | 0  | 27.5E-12 | -3.91E-12 |
| HTTP - NC                                                                                                                 | CTUh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 23.9E-9  | 531E-12  | 1.56E-9  | 0  | 174E-12  | 0  | 1.37E-9  | -108E-12  |
| SQP                                                                                                                       | Pt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3.72     | 0.358    | 0.012    | 0  | 0.133    | 0  | 0.525    | -0.058    |
| Acronyms                                                                                                                  | GWP-total: Climate change, GWP-fossil: Climate change- fossil, GWP-biogenic: Climate change - biogenic, GWP-luluc: Climate change - land use and transformation, ODP: Ozone layer depletion, AP: Acidification terrestrial and freshwater, EP-freshwater: Eutrophication freshwater, EP-marine: Eutrophication marine, EP-terrestrial: Eutrophication terrestrial, POCP: Photochemical oxidation, ADPE: Abiotic depletion - elements, ADPF: Abiotic depletion - fossil resources, WDP: Water scarcity, PM: Respiratory inorganics - particulate matter, IR: Ionising radiation, ETP-FW: Ecotoxicity freshwater, HTP-c: Cancer human health effects, HTP-nc: Non-cancer human health effects, SQP: Land use related impacts, soil quality. |          |          |          |    |          |    |          |           |
| Legend                                                                                                                    | A1: Raw Material Supply, A2: Transport, A3: Manufacturing, A1-A2-A3: Sum of A1, A2 and A3, A4:Transport to Site, A5: Installation, C1: Demolition, C2: Waste Transport, C3: Waste Processing, C4: Disposal, D: Benefits and Loads.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |          |          |    |          |    |          |           |

*\*This indicator has been calculated as "kg P eq" as required in the characterization model. (EUTREND model, Struijs et al, 2009b, as implemented in ReCiPe; <http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml>)*

| Resource Use for 1 m²K/W 1 m²K/W ODE Starflex & Evomineral 032 Glaswool Insulation Materials Materials (With Aluminium Foil Facing) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |        |       |    |         |    |        |          |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------|-------|----|---------|----|--------|----------|
| Impact Category                                                                                                                     | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A1-A2-A3 | A4     | A5    | C1 | C2      | C3 | C4     | D        |
| PERE                                                                                                                                | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2.33     | 0.007  | 0.133 | 0  | 0.002   | 0  | 0.013  | -0.016   |
| PERM                                                                                                                                | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| PERT                                                                                                                                | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2.33     | 0.007  | 0.133 | 0  | 0.002   | 0  | 0.013  | -0.016   |
| PENRE                                                                                                                               | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 29.3     | 0.678  | 12.6  | 0  | 0.197   | 0  | 0.293  | -0.368   |
| PENRM                                                                                                                               | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| PENRT                                                                                                                               | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 29.3     | 0.678  | 12.6  | 0  | 0.197   | 0  | 0.293  | -0.368   |
| SM                                                                                                                                  | kg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| RSF                                                                                                                                 | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| NRSF                                                                                                                                | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| FW                                                                                                                                  | m³                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.010    | 102E-6 | 0.017 | 0  | 34.0E-6 | 0  | 269E-6 | -47.0E-6 |
| Waste & Output Flows for 1 m²K/W ODE Starflex & Evomineral 032 Glaswool Insulation Materials Materials (With Aluminium Foil Facing) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |        |       |    |         |    |        |          |
| Impact Category                                                                                                                     | Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | A1-A2-A3 | A4     | A5    | C1 | C2      | C3 | C4     | D        |
| HWD                                                                                                                                 | kg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 81.0E-6  | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| NHWD                                                                                                                                | kg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.087    | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| RWD                                                                                                                                 | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| CRU                                                                                                                                 | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| MFR                                                                                                                                 | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| MER                                                                                                                                 | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| EE (Electrical)                                                                                                                     | kg                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| EE (Thermal)                                                                                                                        | MJ                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0      | 0     | 0  | 0       | 0  | 0      | 0        |
| Acronyms                                                                                                                            | PERE: Use of renewable primary energy excluding resources used as raw materials, PERM: Use of renewable primary energy resources used as raw materials, PERT: Total use of renewable primary energy, PENRE: Use of non-renewable primary energy excluding 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, SM: Secondary material, RSF: Renewable secondary fuels, NRSF: Non-renewable secondary fuels, FW: Net use of fresh water, HWD: Hazardous waste disposed, NHWD: Non-hazardous waste disposed, RWD: Radioactive waste disposed, CRU: Components for reuse, MFR: Material for recycling, MER: Materials for energy recovery, EE (Electrical): Exported energy electrical, EE (Thermal): Exported energy, Thermal. |          |        |       |    |         |    |        |          |
| Legend                                                                                                                              | A1: Raw Material Supply, A2: Transport, A3: Manufacturing, A1-A2-A3: Sum of A1, A2 and A3, A4: Transport to Site, A5: Installation, C1: Demolition, C2: Waste Transport, C3: Waste Processing, C4: Disposal, D: Benefits and Loads.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |        |       |    |         |    |        |          |

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/SimaPro/ SimaPro LCA Package, Pré Consultants, the Netherlands, [www.pre-sustainability.com](http://www.pre-sustainability.com)

# Contact Informations

|                               |                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                             |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Programme                     | <p>EPD registered through fully aligned regional programme:<br/>EPD Turkey:<br/><a href="http://www.epdturkey.org">www.epdturkey.org</a></p>  <p>ENVIRONMENTAL PRODUCT DECLARATIONS</p>                          | <p>The International EPD® System<br/><a href="http://www.environdec.com">www.environdec.com</a></p>  <p>THE INTERNATIONAL EPD® SYSTEM</p> |
| Programme operator            | <p>EPD Turkey:<br/>SÜRATAM – Turkish Centre for Sustainable Production Research &amp; Design<br/>Nef 09 B Blok No:7/15,<br/>34415 Kagithane / Istanbul, TURKEY</p> <p><a href="http://www.epdturkey.org">www.epdturkey.org</a><br/><a href="mailto:info@epdturkey.org">info@epdturkey.org</a></p> | <p>EPD International AB<br/>Box 210 60<br/>SE-100 31 Stockholm, Sweden</p> <p><a href="http://www.environdec.com">www.environdec.com</a><br/><a href="mailto:info@environdec.com">info@environdec.com</a></p>               |
| Owner of the declaration      |  <p>ODE Industry and Trade Inc.<br/>Piyale Paşa Bulvarı Ortadoğu Plaza<br/>K.12 34384 Okmeydanı</p> <p>Şişli / İstanbul/Turkey</p>                                                                             | <p>Contact: Derya Gürbüz Ilgaz<br/>Quality Manager<br/>Phone: +90 212 210 49 06</p> <p><a href="http://www.ode.com.tr">www.ode.com.tr</a><br/><a href="mailto:ode@ode.com.tr">ode@ode.com.tr</a></p>                        |
| LCA practitioner & EPD Design |  <p>Turkey:<br/>Lalegül Sok. No:7/18 Kagithane<br/>34415 4. Levent – Istanbul, Turkey<br/>+90 212 281 13 33</p>                                                                                                | <p>United Kingdom:<br/>4 Clear Water Place<br/>Oxford OX2 7NL, UK<br/>0 800 722 0185</p> <p><a href="http://www.metsims.com">www.metsims.com</a><br/><a href="mailto:info@metsims.com">info@metsims.com</a></p>             |
| 3rd party verifier            |                                                                                                                                                                                                                | <p>Professor Vladimír Kocí<br/>LCA Studio<br/>Šárecká 5, 16000<br/>Prague 6 - Czech Republic<br/><a href="http://www.lcastudio.cz">www.lcastudio.cz</a></p>                                                                 |





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