# Product description

**Product description and description of use:**

This EPD describes the potential environmental impacts of 1 $m^2$ of glass wool insulation, ISOVER Robust TP ≥ 90 mm, with a thermal resistance equal to 1,00 $m^2K/W$

The intended use of this EPD is to communicate scientifically based environmental information for construction products, for the purpose of assessing the environmental performance of buildings.

ISOVER glass wool products are CE-labelled according to EN 13162 (2012) "*Thermal Insulation Products for Buildings. Factory made mineral wool (MW) Products. Specification*", and EN 13172 (2011) "*Thermal Insulation Products – Evaluation of Conformity*"

The production site of Saint-Gobain Denmark A/S, ISOVER in Vamdrup, Denmark, uses a small amount of natural and abundant raw materials (sand, soda, limestone, feldspar) and a high share of recycled glass cullets (more than 50 % of external glass cullets). This material is converted by using fusion and fiberizing techniques to produce glass wool. The products obtained come in the form of "mineral wool slabs, rolls or lamellas" consisting of a soft, airy structure.

On Earth, naturally, the best insulator is dry immobile air at 10 °C: its thermal conductivity factor, expressed in λ, is 0,025 W/(mK) (watts per meter Kelvin degree). The thermal conductivity of mineral wool is close to immobile air as its lambda varies from 0,030 W/(mK) for the most efficient, to 0,040 W/(mK) to the least efficient.

With its entangled structure, glass wool is a porous material that traps the air, making it one of the best insulating materials. The porous and elastic structure of the wool also absorbs airborne noise, impact noise and offers acoustic correction inside premises.
Glass wool containing incombustible materials does not react to fire.

Glass wool insulation is used in buildings as well as industrial facilities. It ensures a high level of comfort and minimizes carbon dioxide ($CO_2$) emissions by preventing heat loss through roofs, walls, floors, pipes and boilers. It reduces noise and protects homes and industrial facilities against fire.

Correctly installed glass wool products and solutions do not require maintenance, and last throughout the lifetime of the building (which is set at 60 years as a default value in the model), or as long as the insulated building component is a part of the building.

**Technical data/physical characteristics:**

The thermal resistance of the product: 1,00 $m^2K/W$
The thermal conductivity of the product: 0,038 W/(mK)
Reaction to fire: Euroclass A2-s1, d0

**Description of the main product components and/or materials:**

| | | |
|---|---|---|
| Mineral wool | 92-100 % | (REACH registration number 01-2119472313-44-0039) |
| Binder | ≤ 8 % | |

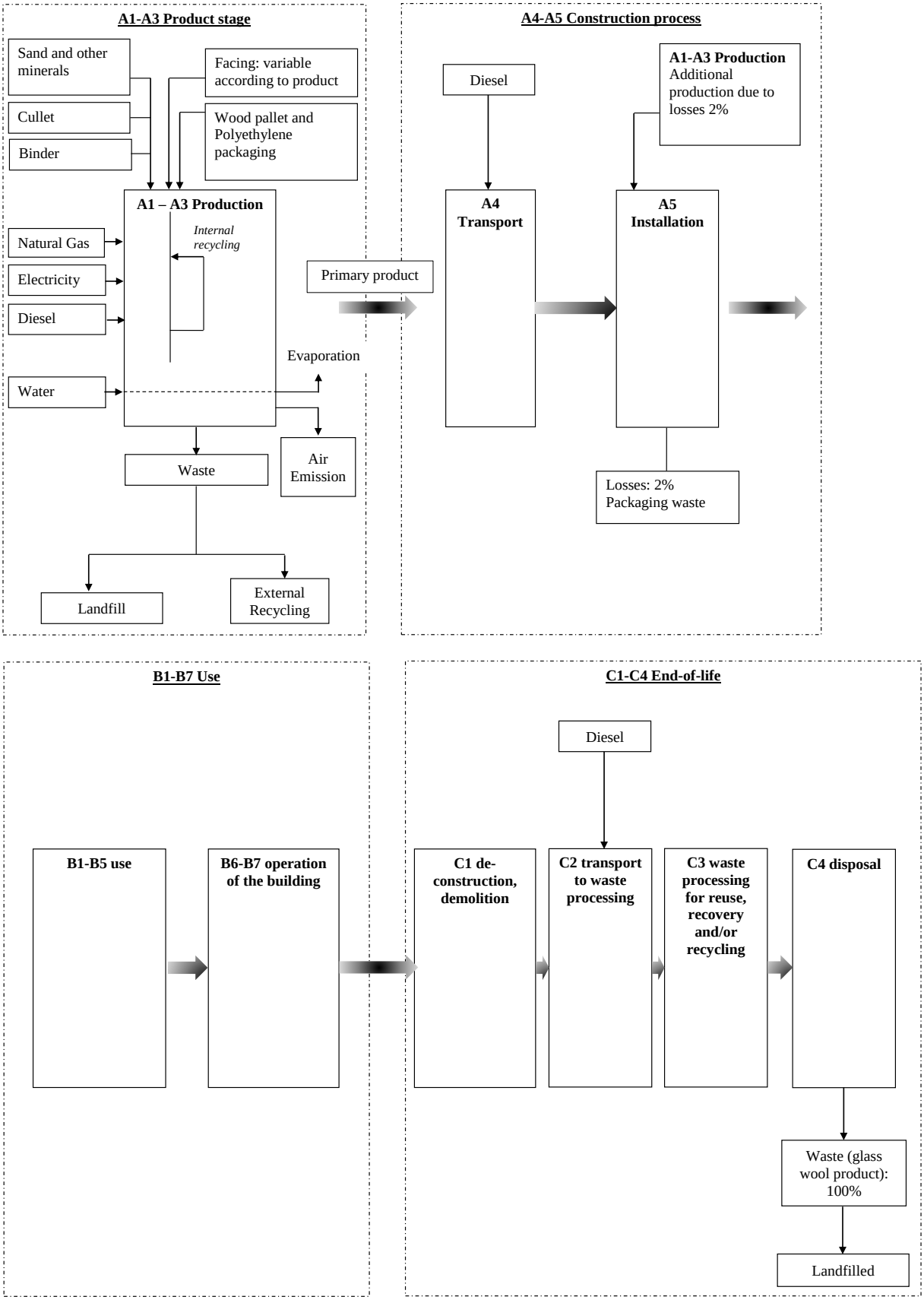
**Description of the main components and/or materials for 1 $m^2$ of product with a thermal resistance of 1 $m^2K/W$ for the calculation of the EPD:**

| PARAMETER | VALUE |
|---|---|
| **Quantity of mineral wool** | 3 kg |
| **Thickness of mineral wool** | 38 mm |
| **Surfacing** | None |
| **Packaging for the transportation and distribution** | Polyethylene with and without print: 24 g/$m^2$ |
| **Product used for the Installation** | None |

# LCA calculation information

| | |
|---|---|
| **FUNTIONAL UNIT** | Providing a thermal insulation on 1 $m^2$ with a thermal resistance of equals 1 $m^2K/W$ |
| **SYSTEM BOUNDARIES** | Cradle to Grave |
| **REFERENCE SERVICE LIFE (RSL)** | 60 years<br>(with correct installation, the product has same RSL as the building component) |
| **CUT-OFF RULES** | See detailed explanation page 10 |
| **ALLOCATIONS** | See detailed explanation page 10 |
| **ELECTRICITY USED FOR THE MANUFACTORING PROCESS** | Renewable electricity mix (reference year 2018)<br>GO's from LOS, contracted 2018 – 2020, to be prolonged to be valid at least equal to the validity of this EPD. |
| **GEOGRAPHICAL COVERAGE AND TIME PERIOD** | Denmark, 2018 |
| **GREENHOUSE GAS EMISSION FROM ELECTRICITY** | Which equals 0,035 kg $CO_2$ equiv /kWh |

## *Flow diagram of the Life Cycle*



| System boundaries (X = included, MND = Module not declared) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product stage | | | Construction installation stage | | Use stage | | | | | | | End of life stage | | | | | Beyond the system boundaries |
| Raw materials | Transport | Manufacturing | Transport | Construction installation stage | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | De-construction demolition | Transport | Waste processing | Disposal | | Reuse-Recovery-Recycling-potential |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | | D |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | MND |

## Product stage, A1- A3

**Description of the stage:**

The product stage of the mineral wool products is subdivided into 3 modules A1, A2 and A3 respectively “Raw material supply”, “transport” and “manufacturing”.

The aggregation of the modules A1, A2 and A3 is a possibility considered by the EN 15804:2012+2013:A1 standard. This rule is applied in this EPD.

### *A1, Raw material supply*

This module takes into account the extraction and processing of all raw materials and energy which occur upstream to the studied manufacturing process.

Specifically, the raw material supply covers production of binder components and sourcing (quarry) of raw materials for fiber production, e.g. sand and borax for glass wool. Besides these raw materials, glass cullet is also used as input.

**About cullet:** The main raw material for the production of glass insulation material is cullets or/and sand. Only specific cleaning activities and transport is included for the cullets – and thus not the impacts from the full life cycle of glass. The reason is that cullets are considered a waste product and not initially produced for the purpose of glass wool insulation production.
The only activities included are:

- Magnetic separation of metallic piece
- Separation of other piece-crushing of glass (<20 mm)
- Separation of bottle cap crushing (<2 mm) sieving
- Transport

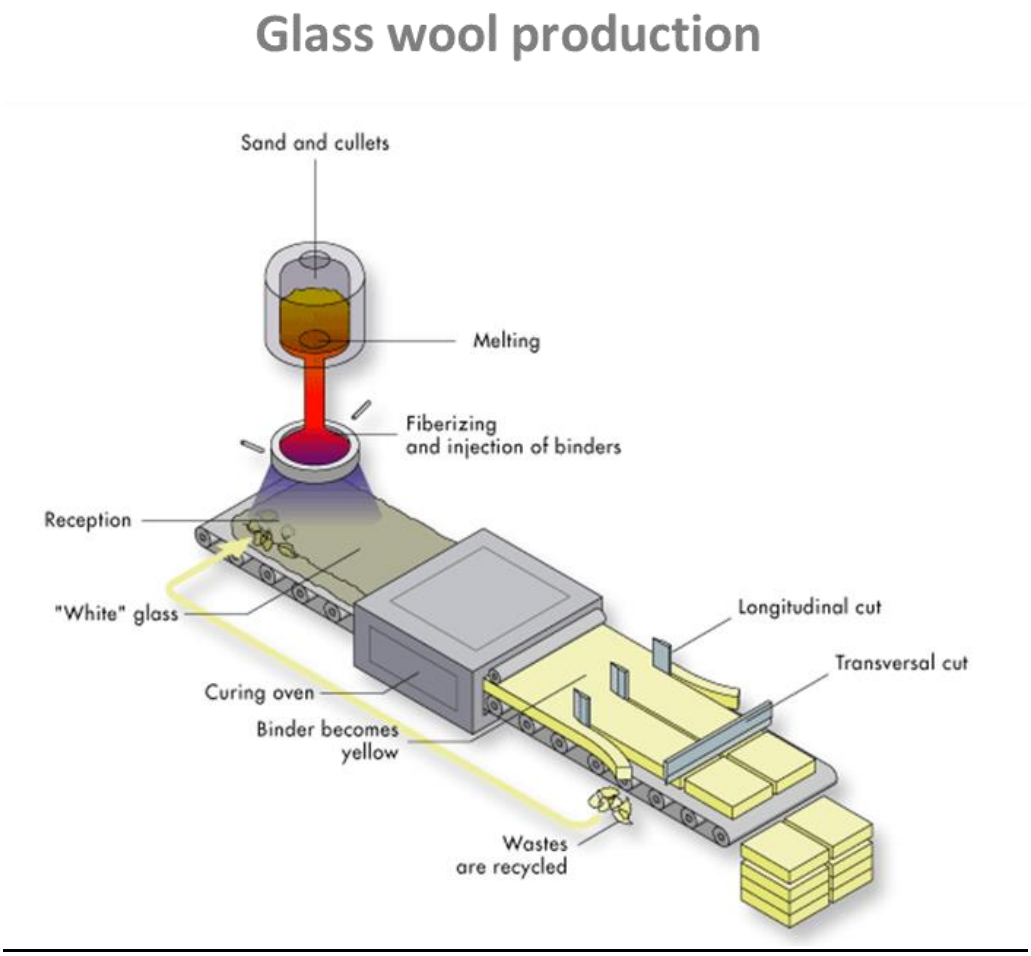
### *A2, Transport to the manufacturer*

The raw materials are transported to the manufacturing site. In our case, the modeling includes: road and boat transportations (specific values) of each raw material.

### *A3, Manufacturing*

This module covers glass wool fabrication, including melting and fiberizing (see process flow diagram). In addition, the production of packaging material is taking into account at this stage.

*Manufacturing process flow diagram*




## Construction process stage, A4- A5

**Description of the stage:**

The construction process is divided into 2 modules: A4, transport to the building site and A5, installation in the building.

**Description of scenarios and additional technical information:**

***A4, Transport to the building site:***

This module includes transport from the production gate to the building site.
Transport is calculated on the basis of a scenario with the parameters described in the following table.

| PARAMETER | VALUE |
|---|---|
| **Fuel type and consumption of vehicle or vehicle type used for transport e.g. long distance truck, boat, etc.** | Average truck trailer with a 24t payload, diesel consumption 38 liters for 100 km |
| **Distance** | 125 km |
| **Capacity utilisation (including empty returns)** | 21 % of the capacity in weight<br>30 % of empty returns capacity in weight |
| **Bulk density of transported products** | 78 kg/m$^3$ (uncompressed density) |
| **Weight capacity utilisation factor** | 0,415 (by default) |

***A5, Installation into the building:***

This module includes:

- Wastage of products: 2 %. These losses are landfilled (landfill model for glass, see chapter End-of-life)
- Additional production processes to compensate for the loss
- Processing of packaging wastes: they are 100 % collected and modeled as recovered matter.

This module does not include:

- Energy for installation of the insulation, as the installation is done manually, and do not require energy.

| PARAMETER | VALUE |
|---|---|
| **Wastage of materials on the building site before waste processing, generated by the product's installation (specified by type)** | 2 % |
| **Output materials (specified by type) as results of waste processing at the building site e.g. of collection for recycling, for energy recovering, disposal (specified by route)** | Packaging wastes are 100 % collected and modeled as recovered matter<br><br>Glass wool losses are landfilled |

## Use stage (excluding potential savings), B1- B7

**Description of the stage:**

The use stage is divided into the following modules:

- B1: Use
- B2: Maintenance
- B3: Repair
- B4: Replacement
- B5: Refurbishment
- B6: Operational energy use
- B7: Operational water use

**Description of scenarios and additional technical information:**

Once installation is complete, no actions or technical operations are required during the use stages until the end-of-life stage. Therefore, glass wool insulation products have no impact (excluding potential energy savings) on this stage.

## Influence of particular thicknesses

The results in the tables of this EPD refer to ISOVER Robust TP ≥ 90 mm with a thickness of 38 mm for a functional unit of 1 m² with a thermal resistance equals to 1,00 $m^2K/W$

This EPD includes a range of thicknesses between 90 mm and 150 mm.
For every thickness, use a multiplication factor in order to obtain the environmental performance of every thickness. Using the thickness factor will for some indicators give higher values than calculated for the specific thickness in GaBi.

In order to calculate the multiplication factors, a reference unit has been selected (value of R= 1,00 $m^2K/W$ for 38 mm). Multiplication factors are obtained by making the LCA calculations for all thicknesses, including packaging.

In order to obtain the environmental performance associated with the specific product and thickness, the results expressed in this EPD must be multiplied by its corresponding multiplication factor.

| PRODUCT THICKNESS (mm) | THERMAL RESISTANCE | MULTIPLICATION FACTOR |
|---|---|---|
| 38 | 1,00 | 1,00 |
| 90 | 2,37 | 2,37 |
| 100 | 2,63 | 2,64 |
| 115 | 3,03 | 3,06 |
| 120 | 3,16 | 3,19 |
| 150 | 3,95 | 4,0 |

## Influence of transportation to others countries

The results of stage A4 (transportation of product) in the table of this EPD refer to transportation in Denmark. This product might also be delivered to the countries in the table below. In order to adapt the impact of transportation in the A4 column, figures from the current EPD shall be multiply by the multiplication factors below.

| COUNTRY | AVERAGE DISTANCE | MULTIPLICATION FACTOR |
|---|---|---|
| Denmark | 125 km (truck) | 1,00 |
| Norway | 777 km (truck) 100 km (boat) | 6,36 |
| Sweden | 761 km (truck), 10 km (boat) | 6,09 |
| Finland | 389 (truck), 1225 km (boat) | 4,70 |

Transport include transportation to ISOVER plant, and average distance from plant to building site.

## ENVIRONMENTAL IMPACTS

| Parameters | Product stage | Construction process stage | | Use stage | | | | | | | End-of-life stage | | | | D Reuse, recovery, recycling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A1 / A2 / A3 | A4 Transport | A5 Installation | B1 Use | B2 Maintenance | B3 Repair | B4 Replacement | B5 Refurbishment | B6 Operational energy use | B7 Operational water use | C1 Deconstruction / demolition | C2 Transport | C3 Waste processing | C4 Disposal | |
| Global Warming Potential (GWP) - *kg $CO_2$ equiv/FU* | 2,13E+00 | 3,02E-02 | 5,77E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,00E+00 | 1,71E-02 | 0 | 4,64E-02 | 0 |
| | **The global warming potential of a gas refers to the total contribution to global warming resulting from the emission of one unit of that gas relative to one unit of the reference gas, carbon dioxide, which is assigned a value of 1.** | | | | | | | | | | | | | | |
| Ozone Depletion (ODP) *kg CFC-11 equiv/FU* | 2,01E-07 | 4,61E-18 | 4,02E-11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,00E+00 | 1,49E-14 | 0 | 2,59E-16 | 0 |
| | **Destruction of the stratospheric ozone layer which shields the earth from ultraviolet radiation harmful to life. This destruction of ozone is caused by the breakdown of certain chlorine and/or bromine containing compounds (chlorofluorocarbons or halons), which break down when they reach the stratosphere and then catalytically destroy ozone molecules.** | | | | | | | | | | | | | | |
| Acidification potential (AP) *kg $SO_2$ equiv/FU* | 2,08E-02 | 1,27E-04 | 4,81E-06 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,00E+00 | 7,18E-05 | 0 | 2,65E-04 | 0 |
| | **Acid depositions have negative impacts on natural ecosystems and the man-made environment incl. buildings. The main sources for emissions of acidifying substances are agriculture and fossil fuel combustion used for electricity production, heating and transport.** | | | | | | | | | | | | | | |
| Eutrophication potential (EP) *kg $(PO_4)^{3-}$ equiv/FU* | 4,64E-03 | 3,12E-05 | 1,08E-06 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,00E+00 | 1,74E-05 | 0 | 3,00E-05 | 0 |
| | **Excessive enrichment of waters and continental surfaces with nutrients, and the associated adverse biological effects.** | | | | | | | | | | | | | | |
| Photochemical ozone creation (POPC) *kg Ethene equiv/FU* | 1,19E-03 | 4,66E-06 | 2,65E-07 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,00E+00 | 2,66E-06 | 0 | 2,18E-05 | 0 |
| | **Chemical reactions brought about by the light energy of the sun. The reaction of nitrogen oxides with hydrocarbons in the presence of sunlight to form ozone is an example of a photochemical reaction.** | | | | | | | | | | | | | | |
| Abiotic depletion potential for non-fossil resources (ADP-elements) - *kg Sb equiv/FU* | 3,20E-04 | 4,01E-10 | 6,39E-08 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,00E+00 | 2,32E-10 | 0 | 1,58E-08 | 0 |
| Abiotic depletion potential for fossil resources (ADP-fossil fuels) - *MJ/FU* | 3,06E+01 | 4,20E-01 | 8,23E-03 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,00E+00 | 2,39E-01 | 0 | 6,18E-01 | 0 |
| | **Consumption of non-renewable resources, thereby lowering their availability for future generations.** | | | | | | | | | | | | | | |

## RESOURCE USE

| Parameters | Product stage | Construction process stage | | Use stage | | | | | | | End-of-life stage | | | | D Reuse, recovery, recycling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A1 / A2 / A3 | A4 Transport | A5 Installation | B1 Use | B2 Maintenance | B3 Repair | B4 Replacement | B5 Refurbishment | B6 Operational energy use | B7 Operational water use | C1 Deconstruction / demolition | C2 Transport | C3 Waste processing | C4 Disposal | |
| Use of renewable primary energy excluding renewable primary energy resources used as raw materials - *MJ/FU* | 3,71E+01 | 9,6E-03 | 7,5E-03 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,2E-03 | 0 | 8,1E-02 | 0 |
| Use of renewable primary energy used as raw materials *MJ/FU* | 6,74E-03 | 0 | 1,4E-06 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) - *MJ/FU* | 3,71E+01 | 9,6E-03 | 7,5E-03 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,2E-03 | 0 | 8,1E-02 | 0 |
| Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials - *MJ/FU* | 3,24E+01 | 4,2E-01 | 8,6E-03 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,4E-01 | 0 | 6,4E-01 | 0 |
| Use of non-renewable primary energy used as raw materials - *MJ/FU* | 9,80E-01 | 0 | 2,0E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) - *MJ/FU* | 3,34E+01 | 4,2E-01 | 8,8E-03 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,4E-01 | 0 | 6,4E-01 | 0 |
| Use of secondary material *kg/FU* | 1,87E+00 | 0 | 3,7E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Use of renewable secondary fuels - *MJ/FU* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Use of non-renewable secondary fuels - *MJ/FU* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Use of net fresh water - *$m^3$/FU* | 2,97E-02 | 3,2E-06 | 6,0E-06 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,0E-06 | 0 | 1,6E-04 | 0 |

## WASTE CATEGORIES

| Parameters | Product stage | Construction process stage | | Use stage | | | | | | | End-of-life stage | | | | D Reuse, recovery, recycling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A1 / A2 / A3 | A4 Transport | A5 Installation | B1 Use | B2 Maintenance | B3 Repair | B4 Replacement | B5 Refurbishment | B6 Operational energy use | B7 Operational water use | C1 Deconstruction / demolition | C2 Transport | C3 Waste processing | C4 Disposal | |
| Hazardous waste disposed *kg/FU* | 8,21E-08 | 1,51E-09 | 2,57E-11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,00E+00 | 8,58E-10 | 0 | 1,09E-08 | 0 |
| Non-hazardous waste disposed *kg/FU* | 1,71E-02 | 5,10E-06 | 6,02E-04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,00E+00 | 3,17E-06 | 0 | 2,97E+00 | 0 |
| Radioactive waste disposed *kg/FU* | 2,88E-05 | 4,91E-07 | 9,79E-09 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,00E+00 | 2,79E-07 | 0 | 8,48E-06 | 0 |

## OUTPUT FLOWS

| Parameters | Product stage | Construction process stage | | Use stage | | | | | | | End-of-life stage | | | | D Reuse, recovery, recycling |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A1 / A2 / A3 | A4 Transport | A5 Installation | B1 Use | B2 Maintenance | B3 Repair | B4 Replacement | B5 Refurbishment | B6 Operational energy use | B7 Operational water use | C1 Deconstruction / demolition | C2 Transport | C3 Waste processing | C4 Disposal | |
| Components for re-use *kg/FU* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Materials for recycling *kg/FU* | 6,39E-02 | 0 | 2,41E-02 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Materials for energy recovery *kg/FU* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Exported energy *MJ/FU* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

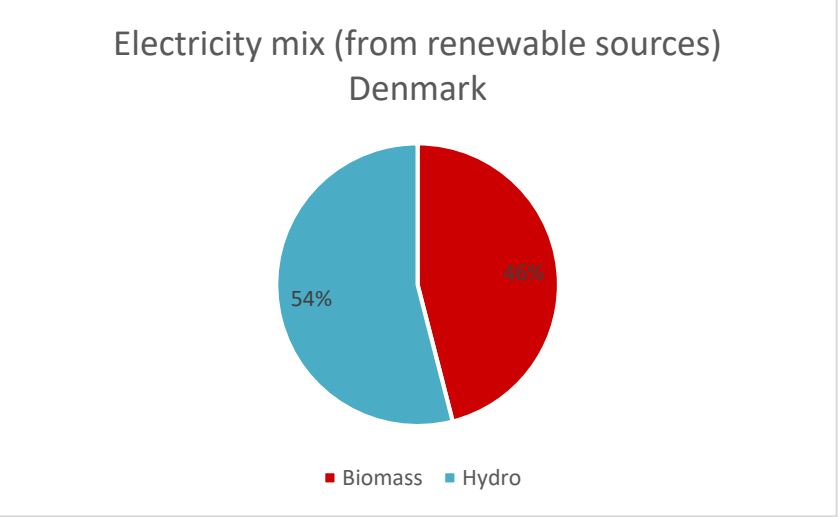
# Additional information

## Additional Norwegian requirements

### *Greenhouse gas emissions from the use of electricity in the manufacturing phase*

The LCA calculation has been made taking into account the fact that during the manufacturing process it is used 100% renewable electricity. This 100% renewable electricity bought is evidenced by Guarantee of Origin certificates (GOs) from LOS, valid from 2018 to 2020. Will be prolonged to be valid at least equal to the validity of this EPD.

| TYPE OF INFORMATION | DESCRIPTION |
|---|---|
| Location | Representative of average production in Denmark |
| Geographical representativeness description | Split of energy sources in Denmark<br>- Hydro: 54%<br>- Biomass: 46% |
| Reference year | 2018 |
| Type of data set | Cradle to gate from Thinkstep database |
| Source | Gabi database from International Energy Agency -2013<br>Guarantee of Origin certificates (GOs) - 2018 |




The dataset used to model the renewable electricity mix used for these calculations come from thinkstep and ecoinvent database.

| DATA SOURCE | AMOUNT | UNIT |
|---|---|---|
| thinkstep (2018) and ecoinvent 3.1 (2014) | 0,035 | kg $CO_2$ equiv /KWh |

### *Indoor environment*

The EPD does not give any information on release of regulated dangerous substances to indoor air, because the national regulation in Denmark does not require any verification and declaration of release of regulated dangerous substances today.

### *Dangerous substances*

The product contains no substances given from the REACH Candidate list (of 15.01.2018)
(REACH registration number 01-2119472313-44-0039)

# Bibliography


- Product-Category Rules:
  - NPCR Construction products and services – Part A (2017)
  - NPCR 012 Thermal insulation products – Part B (2018)
- Environmental labels and declarations - Type III environmental declarations -Principles and procedures (ISO 14025:2006)
- Environmental management - Life cycle assessment – Requirements and guidelines (ISO 14044:2006)
- Sustainability of construction works - Environmental product declaration - Core rules for the product category of construction products (EN 15804:2012+2013:A1)
- Sustainability in building construction - Environmental declaration of building products (ISO 21930:2017)
- LCA report Saint-Gobain ISOVER 2019, author: Saint-Gobain + Saint-Gobain Denmark A/S
- Ecoinvent database V3.1 (2014)
- GaBi 8.7 - database (2018)
- Guarantee of Origin certificates (GOs) from LOS, issued to Saint-Gobain (2018)



| | | | |
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