Environmental Product Declaration | **of Mineral Wool Produced in Europe**

In accordance with EN 15804 and conforming to ISO 14025

Mineral wool (λ 035) external wall application (R=3)

Summary

Owner of the declaration

Eurima

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Declaration developed by

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Product description

The environmental product declaration complies with EN 15804 and provides environmental information relating to the life cycle of European mineral wool production (EU 27) in terms of average values for glass and stone wool. Data collection to gather necessary information for life cycle inventory (LCI) purposes was carried out at a relevant number of sites all over Europe. Five member companies of Eurima (Knauf Insulation, Paroc, Rockwool, Saint-Gobain Isover and Ursa), operating more than 50 sites across Europe, contributed to the project. All products are CE-marked according to EN 13162.

Verification statement This declaration and the rules on which it is based have been examined by an independent external expert in accordance with ISO 14025.	**Verifier** Philippe Osset Solinnen **www.solinnen.com**
Date of Review 16 April 2012	**Date of issue:** 2012 **Date of validity:** 2017

Functional unit

The analysis is based on 1m² of average European mineral wool insulation (R=3, λ= 0.035 W/mK) used for external applications.

eurima

European Insulation Manufacturers Association

Contents

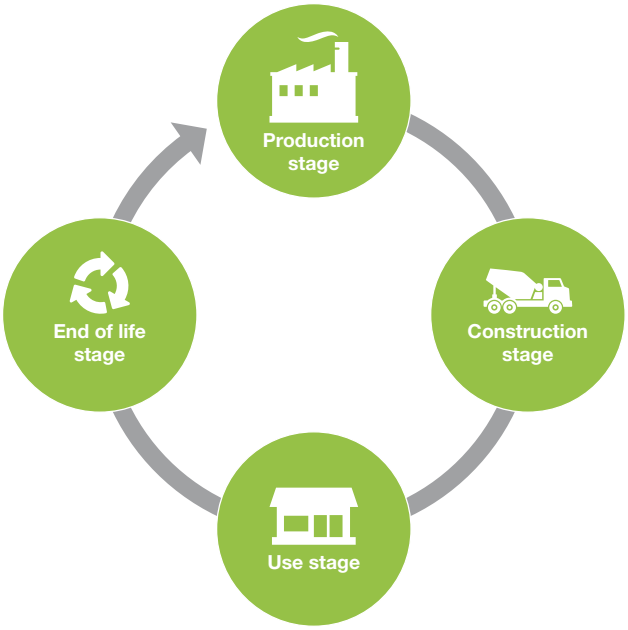
Life-Cycle Assessment

Life cycle assessment (LCA) on which this environmental product declaration (EPD) is based was developed according to the EN 15804 standard. This LCA used a ‘cradle-to-gate with options’ approach, which includes production, construction, use (except operational energy use) and end-of-life stages.

The environmental information contained in this EPD represents the average mineral wool (λ=0,035 W/mK or 035) environmental profile in Europe (EU 27) for thermal insulation in in walls (R=3.00 m²K/W). Typical construction systems considered are cavity walls, ventilated façades and timber frame constructions.

Calculations were based on data from the following companies and production sites: Knauf Insulation (BE, UK, CZ, DE, HR, SK), Paroc (FI, SE, PL, LT), Rockwool (DE, FR, NL, ES), Saint-Gobain Isover (FR, UK, DK, CH, DE, BE, PL, FI) and Ursa (BE, ES, FR). The selected sites cover more than 60% of all Eurima mineral wool sites, thus they provide a representative sample of European production.

Several products meeting the same thermal insulation requirements and using the same specification standard (EN 13162) are grouped together, as they share the same basic functionality. Individual products, while similar in terms of functionality, can have different production processes, characteristics and additional functionalities, depending on a given national and/or regional situation.



This is a generic life-cycle EPD, destined to policy evaluations and generic studies, and not to calculations of specific building environmental performances. For this reason, its results apply only to mineral wool average, not to specific products.

For example: the data can be used in average building calculations for average European situations (e.g. to show an average contribution of insulation to the total building environmental performance), but may not always be applicable to fulfil requirements for a specific building where specific national / local products are utilised. In such cases, the representativeness should be checked in relation to the goal before applying the average Eurima EPD data.

For most indicators, average glass wool and stone wool results are within a range close enough to justify an integrated generic EPD for mineral wool. In some specific cases, however, variation in the range of results between individual products can be significant, but this does not affect the generic EPD in its intended use. In addition, some range differences are explained by local and/or national situations, where additional functionalities or characteristics fulfilled by some of the products apply.

For specific calculations referring to individual glass wool or stone wool products, please refer to EPDs from Eurima members.

Mineral wool (λ 035), external wall application (R=3)

Environmental Product Data for Mineral Wool Wall Insulation

product R_D=3,00 (m^2K/W)

	1	2	3	4	5	6
				cradle to gate	construction	
				modules	module	module
nr	indicator	symbol	unit	A1-A3	A4	A5
1	Global warming potential	GWP	kg CO2 equiv	4,41E+00	1,52E-01	4,85E-01
2	Depletion potential of the stratospheric ozone layer	ODP	kg CFC 11 equiv	3,57E-07	1,53E-09	4,16E-10
3	Acidification potential of land and water sources	AP	kg SO2 equiv	2,64E-02	7,06E-04	1,21E-04
4	Eutrophication potential	EP	kg (PO4)3- equiv	3,24E-03	1,54E-04	3,12E-05
5	Formation potential of tropospheric ozone photochemical oxidants	POCP	kg Ethene equiv	1,62E-03	7,62E-05	1,41E-05
6	Abiotic Resource depletion potential for elements	ADP	kg Sb equiv	9,93E-05	3,47E-09	2,13E-08
7	Abiotic depletion potential for fossil resources	ADP	MJ	6,36E+01	2,11E+00	2,53E-01
8	Use of renewable primary energy excluding primary energy resources used as raw materials	RES	MJ, net calorific value	4,73E+00	1,00E-02	2,69E-03
9	Use of renewable primary energy resources used as raw materials	RES	MJ, net calorific value	0,00E+00	0	0
10	Total use of renewable primary energy resources	RES	MJ, net calorific value	4,73E+00	1,00E-02	2,69E-03
11	Use of non-renewable primary energy excluding primary energy resources used as raw materials	RES	MJ, net calorific value	7,68E+01	2,16E+00	2,68E-01
12	Use of non-renewable primary energy used as raw materials	RES	MJ, net calorific value	0,00E+00	0	0
13	Total use of non renewable primary energy resources	RES	MJ, net calorific value	7,68E+01	2,16E+00	2,68E-01
14	Input of secondary material	RES	kg	9,40E-01	0,00E+00	0,00E+00
15	Input of renewable secondary fuels	RES	MJ	0,00E+00	0,00E+00	0,00E+00
16	Input of non renewable secondary fuels	RES	MJ	1,18E-01	0,00E+00	1,81E-06
17	Input of net fresh water	RES	kg	1,10E+01	2,63E-02	4,55E-01
18	Hazardous waste to final disposal		kg	1,47E-02	0,00E+00	1,15E-02
19	Non hazardous waste to final disposal		kg	1,16E+01	2,25E-02	8,50E-02
20	Radioactive waste to final disposal		kg	4,44E-03	1,92E-05	4,54E-06
21	Components for re-use		kg	0,00E+00	0,00E+00	0,00E+00
22	Materials for recycling		kg	0,00E+00	0,00E+00	0,00E+00
23	Materials for energy recovery		kg	0,00E+00	0,00E+00	0,00E+00
24	Exported energy (electrical energy)		MJ	0	0	0
24	Exported energy (thermal energy)		MJ	0	0	0

*MND: Module Not Declared

7	8	9	10	11	12	13	14	15
use stage	operational energy use	operational water use	end-of-life					information
module	module	module	module	module	module	module		module
B1-B5	B6	B7	C1	C2	C3	C4		D
0	MND*	0	0	2,47E-02	0	4,04E-01		-2,05E-01
0	MND*	0	0	5,01E-11	0	7,90E-10		-1,04E-08
0	MND*	0	0	1,13E-04	0	2,80E-04		-4,38E-04
0	MND*	0	0	2,57E-05	0	1,63E-04		-3,63E-05
0	MND*	0	0	1,25E-05	0	1,20E-04		-3,29E-05
0	MND*	0	0	5,29E-10	0	1,23E-09		-1,26E-08
0	MND*	0	0	3,48E-01	0	5,37E-01		-3,16E+00
0	MND*	0	0	4,66E-04	0	3,40E-02		-6,19E-02
0	MND*	0	0	0	0	0		0
0	MND*	0	0	4,66E-04	0	3,40E-02		-6,19E-02
0	MND*	0	0	3,49E-01	0	5,66E-01		-3,53E+00
0	MND*	0	0	0	0	0		0
0	MND*	0	0	3,49E-01	0	5,66E-01		-3,53E+00
0	MND*	0	0	0,00E+00	0	0,00E+00		0,00E+00
0	MND*	0	0	0,00E+00	0	0,00E+00		0,00E+00
0	MND*	0	0	0,00E+00	0	8,17E-05		0,00E+00
0	MND*	0	0	2,21E-03	0	8,70E-01		-1,13E-01
0	MND*	0	0	0,00E+00	0	3,02E-04		0,00E+00
0	MND*	0	0	8,79E-04	0	3,10E+00		-1,55E-01
0	MND*	0	0	6,26E-07	0	3,44E-06		-1,31E-04
0	MND*	0	0	0,00E+00	0	0,00E+00		0,00E+00
0	MND*	0	0	0,00E+00	0	0,00E+00		0,00E+00
0	MND*	0	0	0,00E+00	0	0,00E+00		0,00E+00
0	MND*	0	0	0	0	0		-2,55E-01
0	MND*	0	0	0	0	0		-2,60E+00

01 - Description of the Product and its Use

Mineral wool insulation (glass and stone wool) is used in buildings as well as industrial facilities. It ensures a high level of comfort, lowers energy costs, minimises carbon dioxide (CO_2) emissions, prevents heat loss through pitched roofs, walls, floors, pipes and boilers, reduces noise pollution and protects homes and industrial facilities from the risk of fire. Mineral wool products last for the average building's lifetime (which is often set at 50 years as a default), or as long as the insulated building component is part of the building.

This EPD describes the environmental effect of 1m^2 of mineral wool insulation produced in Europe and used for external wall applications. Both glass and stone wool products are taken into account, with λ = 0.035 +/- 0.001 W/mK.

Even if the material is different, the product's thermal performance is the same with both glass and stone wool. The study evaluates (035) mineral wool without facing in wall applications, based on the defined thermal resistance of the insulation installed. Additional functionalities, like acoustics, fire or other, are not included in the functional unit.

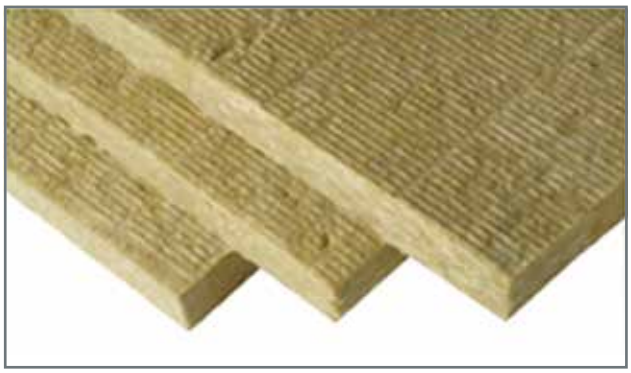
Mineral wool insulation products are CE-marked and, where needed, additionally approved for use in specific applications under European or national technical approvals. Depending on country, these products are controlled and certified by notified bodies, such as FIW/FMPA/MPA for Güteüberwachung in Germany, LNE/CSTB for ACERMI in France, AENOR in Spain, etc.

In terms of reaction to fire, un-faced mineral wool meets the requirements of Euroclass A1.

A large number of Eurima members manufacturing plants are certified according to ISO 9001 and/or ISO14001.

More information on product descriptions can be obtained from **www.eurima.org**.

Glass wool

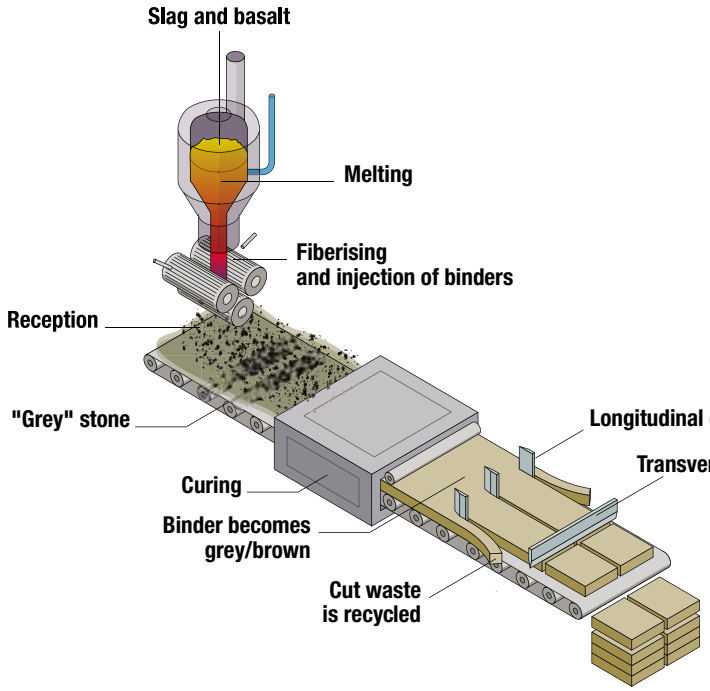


Stone wool

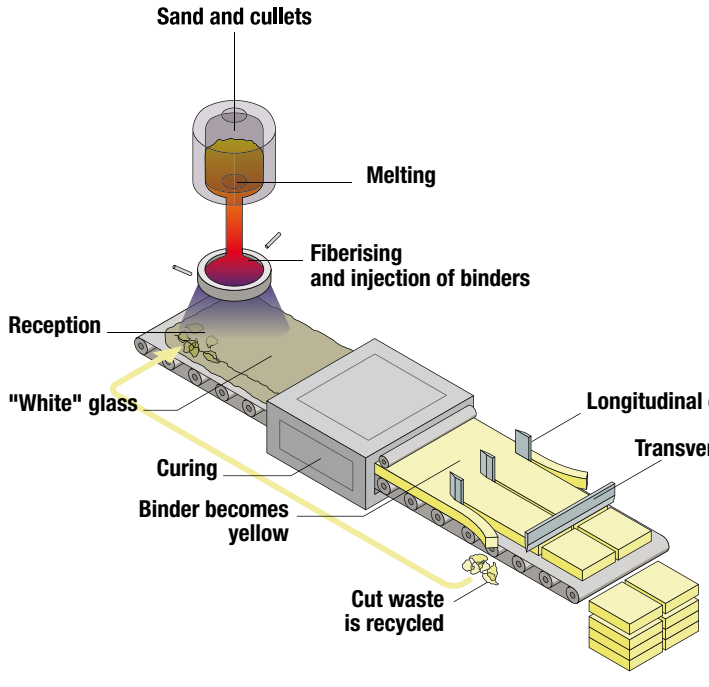
02 - Description of the Life Cycle Stages and Scenarios

2.1 Production stage

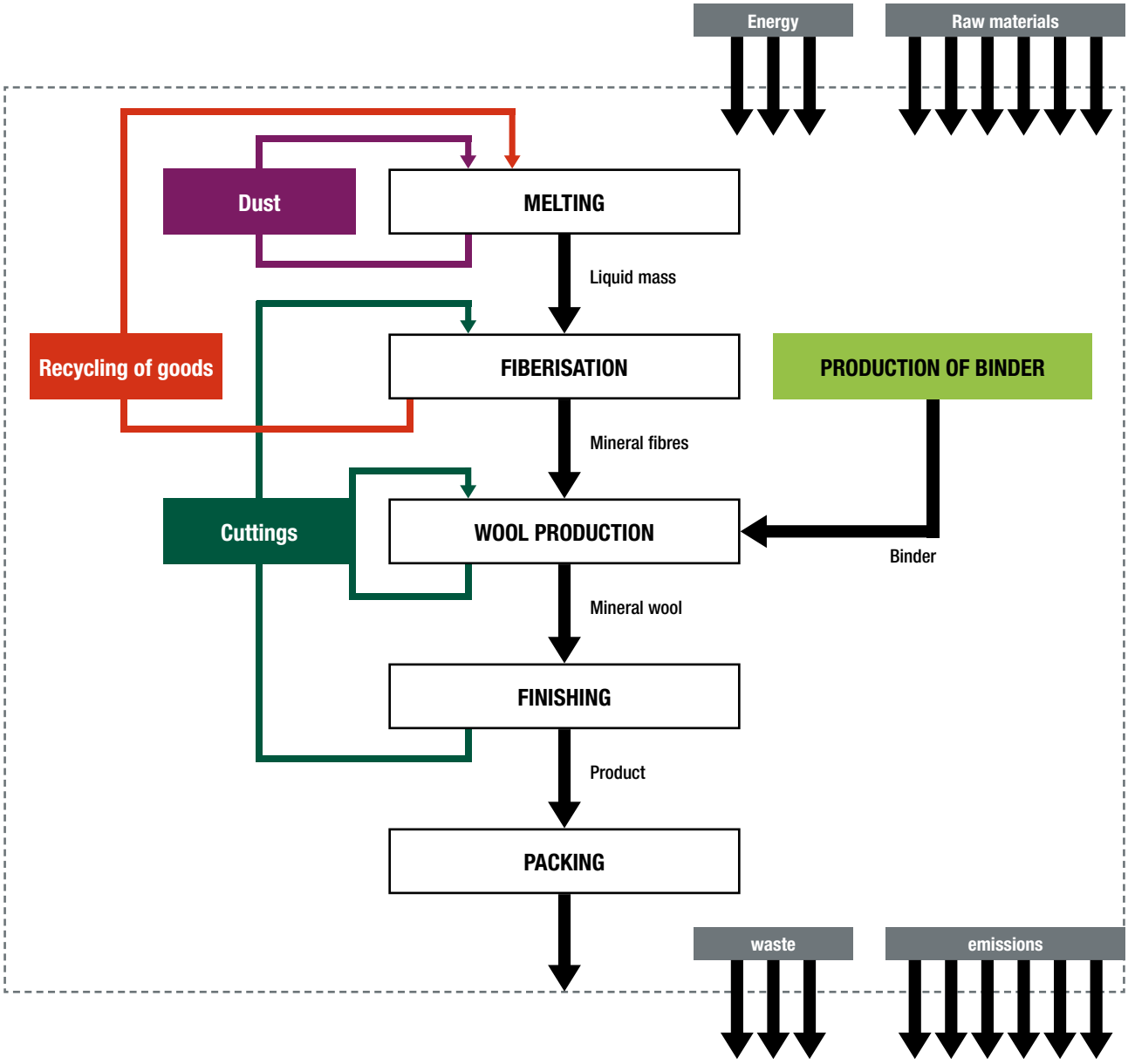
Stone Wool



Glass Wool



Processes at plant:



General explanation of the production stage

A1 and A2: Raw material supply and transport

The raw material supply covers production of all binder components and sourcing (quarry) of raw materials for fibre production, e.g. sand and borax for glass wool and basalt and diabase for stone wool. Besides these raw materials, recycled materials (glass cullet, stone wool briquettes) are also used as input.

The main product components are inorganic minerals (sand, stone) and a low percentage of organic binder. Mineral wool is free from substances of very high concern (SVHC).

No additives like fire retardants are needed to ensure or improve the fire safety of mineral wool, as the mineral composition provides a non-combustible product. Neither is there a need to add substances to keep the insulation free from mould and insects.

Transport of raw materials:

Data on transport of the different raw materials to the manufacturing plant are collected and modelled for each plant individually. Means of transport include truck, train and ship, and for this European fuel averages are applied.

A3: Manufacture

Manufacture covers all processes linked to production, which comprises various related operations besides on-site activities, including melting, fiberisation, wool production, finishing, packaging and internal transportation.

The manufacturing process also yields data on the combustion of refinery products, such as diesel and gasoline, related to the production process.

Use of electricity, fuels and auxiliary materials in the production of glass and stone wool products is taken into account too. The environmental profile of these energy carriers is modelled for average European conditions.

Packaging-related flows in the production process and all up-stream packaging are included in the manufacturing module, i.e. wooden pallets and PE-LD film (cradle-to-gate).

Apart from production of packaging material, the supply and transport of packaging material are also considered in the LCA model. In accordance with EN 15804, they are reported and allocated to the (sub-) module where the packaging is applied. Data on packaging waste created during this step are then generated.

It is assumed that packaging waste generated in the course of production and up-stream processes is 100% collected and incinerated based on a multi-input and multi-output process specific to the elementary composition of the waste.

Mineral wool is compressed in packaging, so costs and environmental impacts of transport are reduced.

Energy products of incineration (e.g. steam, electricity, metals) are credited using European production averages (e.g. the European grid mix for power).

2.2 Construction stage

The construction stage is divided into transportation to the construction site and the installation process.

A4: Transport

The average transportation distance for Europe is calculated according to information provided by companies.

Transport is calculated on the basis of a scenario with an average truck trailer with a 27t payload. For the final glass wool product, a loading ratio of between 11% and 22% is set depending on the gathered information from industry. For stone wool products, a loading ratio of 30% is assumed for a 27t truck trailer. Some plants may have their own truck fleet, but the model only considers outbound traffic, since inbound refers to other product transport.

A5: Construction installation process

Installation is assumed to take place manually, thus machine or energy expenditures are considered to be zero (negligible).

During installation, construction waste is estimated by Eurima to be 2%. These losses are landfilled.

Within module A5, site-related packaging waste processing is included in the LCA. In accordance with EN 15804, end-of-life of packaging materials is reported and allocated to the (sub-) module where it arises.

It is assumed that packaging materials as leftovers of installed products are 100% collected and incinerated based on a multi-input and multi-output process specific to the elementary composition of the waste. This scenario does not reflect the state of the art in all contributing countries, since many still landfill and some recycle, but such scenarios have an impact of less than 1%.

Energy products of incineration (e.g. steam, electricity, metals) are credited using European production averages (e.g. the European grid mix for power).

2.3 Use 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 the use stage

Once installed and in place during the use phase, the product does not require any energy or material input to keep it in working order. Furthermore, it is not exposed to the indoor atmosphere of the building, nor is it in contact with circulating water or the ground.

Mineral wool does not require any maintenance (which would, in any case, be technically impossible in its intended use of wall insulation). In addition, due to the product's durability and difficulty accessing it once installed, any maintenance, repair, replacement or restoration are irrelevant for thermal insulation purposes in the specified applications. Declared product performances (under CE marking) therefore assume a working life that equals or exceeds the building's lifetime. For this reason, no environmental loads are attributed to any of the modules between **B1** and **B5**.

As for stage **B6**, mineral wool makes a major contribution to the thermal performance of a building and thus affects its operational energy use. Indeed, the main product characteristic of mineral wool is its thermal performance: declared thermal resistance Rd [m^2K/W]. For the EPD, in accordance with EN 15804, thermal resistance Rd is considered to be relevant technical information, but no further environmental aspects or impacts can be quantified. The effect of this thermal resistance and its contribution to energy use in a building depend on many influencing parameters of other parts of the building and other applicable scenarios.

From an environmental perspective, the **use stage** is the most important life cycle phase for mineral wool products, as these products affect the use phase of the entire building through their thermal insulation properties. Considering non-renewable primary energy consumption, in case of thermal renovation of an existing (reference) building from no insulation to the minimum level required, savings made during the use phase (heating based on natural gas) amortise the burdens of the production stage, construction stage and end-of-life stage in a matter of months. In case of improvement from minimum insulation standards to high-performance insulation levels for a new build (reference) building, amortisation may take a few years.

Regarding **B7**, thermal insulation does not have any impact on water use or water consumption of the building during the use stage of the product or throughout the lifetime of the building.

2.4 End-of-life stage

For the end-of-life stage of mineral wool insulation products, landfill is considered to be the worst case scenario.

Product end-of-life includes the following modules:

C1: Deconstruction
Requirements for deconstruction of a building and selective dismantling differ considerably across Europe. National implementation of the Waste Framework Directive 2009/98/EC in future might change this situation.

Requirements for deconstruction of a building and selective dismantling differ considerably across Europe. National implementation of the Waste Framework Directive 2009/98/EC in future might change this situation.

The possibility to selectively dismantle thermal insulation products varies depending on the type of building element. Nevertheless, the contribution of insulation to environmental loads resulting from deconstruction and/or dismantling is assumed to be very small and therefore negligible.

C2: Transport
Transport is calculated on the basis of a scenario with an average truck trailer carrying a 27t payload. Transport distances of the final product to landfill are estimated by companies and averaged (30km to 100km).

C3: Waste processing
There are already a number of examples of products being reprocessed at end-of-life, but as the take-back chain is not yet consolidated in Europe, the most unfavourable situation is assumed, where no reuse, recovery or recycling is applied for the discarded product and it is simply landfilled.

C4: Disposal
Since waste collection systems are different across Europe, reliable data on collection rates are not available. In case of the European EPD, it is assumed that the collection rate is 100%, since landfilling inevitably takes place, whether collected or deposited as waste loss.

Mineral wool waste is classed as 'non-hazardous waste' in the European list of waste products, under code 170604 'Insulation materials other than those mentioned in 170601 and 170603' (Directive 2000/532/EC).

The landfill scenario for mineral wool is based on its average material composition provided by industry. Mineral wool consists of at minimum of 95% inert material. The remaining 5% is made up of binder components, which vary between companies or even plants within companies.

2.5 Benefits and loads beyond the system boundary (D module)

Post-consumer recycling scenarios are not considered within this EPD. Credits resulting from waste incineration (A5) are reported in this module.

Power and thermal energy for European boundary conditions are taken into account.

03 - Life Cycle Assessment of Mineral Wool Insulation

3.1 Functional unit

This study evaluates 1m^2 of average European mineral wool insulation (λ 035) used in external wall applications (R=3).

3.2 System boundaries

The following table displays the considered modules (marked with x).

System boundaries, check box (x = included in LCA)			
Production stage	Raw material supply (extraction, processing, recycled material)	A1	X
	Transport to manufacturer	A2	X
	Manufacturing	A3	X
Construction stage	Transport to building site	A4	X
	Installation in building	A5	X
Use stage	Use/application	B1	X
	Maintenance	B2	X
	Repair	B3	X
	Replacement	B4	X
	Refurbishment	B5	X
	Operational energy use	B6	
	Operational water use	B7	X
End-of-life stage	Deconstruction/ demolition	C1	X
	Transport to end-of-life	C2	X
	Waste processing for reuse, recovery or recycling	C3	X
	Disposal	C4	X
Beyond product system	Reuse, recovery or recycling potential	D	

3.3 Cut-off rules

In the assessment, all significant parameters from gathered production data are considered, i.e. all raw material used per formulation, utilised thermal energy, internal fuel and electric power consumption, direct production waste, and all available emission measurements. Unusually, this study also takes into account some material flows of less than 1w-% and energy flows with a proportion of less than 1 energy-%, but this does not significantly influence the final results.

It can be assumed that the total sum of omitted processes does not exceed 5% of the impact categories. In accordance with EN 15804, machines and facilities (capital goods) required for and during production are excluded, as is transportation of employees.

3.4 Data quality

Mineral wool production is modelled on one-year data collection from the five participating companies, with 25 contributing sites in total. The selected sites cover more than 60% of all Eurima mineral wool sites, thus providing a representative sample of European production. Quantifications of input and output of energy and materials are directly derived from annual production data from 2008. The participating companies manufacture the bulk of mineral wool products in Europe. Import activities are not covered by the study.

Background information is taken from the GaBi 4 professional database, available at www.documentation.gabi-software.com. Utilised data are no older than 8 years. In terms of the goal of the study, data quality is classed as good for all major materials.

3.5 Impact assessment indicators

Impact assessment calculations are made in full accordance with EN 15804.

04 - Technical Information and Scenarios

A4 - Transport to building site

Parameter	Parameter expressed by functional unit
Used transport vehicle	Average truck trailer with a 27t payload
Utilisation capacity (including fully loaded return trips)	Truck fleet, outbound considered only

A5 - Installation process

Parameter	Parameter expressed by functional unit
Auxiliary materials for installation	Not applicable
Consumption of other resources	Not applicable
Quantitative description of the type of energy and consumption rate during the installation process	Not applicable
Waste at the construction site generated from installation of the product	2%
Material output as a result of waste management processes at the installation site, e.g. compilation for recycling, energy recovery and final disposal	Waste management process for packaging materials
Emissions to air, soil and water	Not applicable

B6-7 - Operational energy and water use

Parameter	Parameter expressed by functional unit
Type of energy, e.g. electricity, natural gas, heat source for district	Not applicable
Output	Not applicable
Fresh water net consumption	Not applicable
Characteristic performance (energy efficiency, emissions, etc)	Not applicable
Reference service lifetime (RSL)	Depends on the lifetime of a building and component, 50 years as a default

B2-4 - Maintenance, repair, replacement

Parameter	Parameter expressed by functional unit
Maintenance, e.g. cleaning agent, type of surfactant	Not applicable
Maintenance cycle	Not applicable
Energy input for the maintenance process	Not applicable
Fresh water net consumption during maintenance or repair	Not applicable
Inspection, maintenance or repair process	Not applicable
Inspection, maintenance or repair cycle	Not applicable
Auxiliary materials, e.g. lubrication	Not applicable
Component replacement during the product life cycle	Not applicable
Energy input during maintenance and type of energy used, e.g. electricity/amount	Not applicable
Energy input during repair, renovation and replacement processes (where applicable)	Not applicable
Material loss during maintenance or repair	Not applicable
Product reference lifetime as a basis for calculation of the number of replacements required	Depends on the lifetime of a building and component, 50 years as a default

C1-4 - End-of-life

Parameter	Parameter expressed by functional unit of components, products or materials
Compilation process	Not applicable
Recycling system	Not considered in this study
Final disposal	Landfill

05 - Additional Information

5.1 Indoor air

- Use of mineral wool insulation does not contribute significantly to volatile organic compound (VOC) or formaldehyde indoor air concentrations. Mineral wool products are not normally used in direct contact with indoor air, so their contribution to indoor air quality is very limited. Several tests conducted by independent expert laboratories in numerous countries and by Eurima members have shown that mineral wool products are an insignificant source of formaldehyde within buildings and therefore not a risk to the health of occupants or installers. A large number of Eurima members' products meet the requirements of the Finnish M1 classification (www.rts.fi/M1).

- Reference study: 'Formaldehyde in the Indoor Environment', Tunga Salthammer, Sibel Mentese and Rainer Marutzky, Chem. Rev., 2010, 110 (4), pp 2536–2572. Link: http://pubs.acs.org/doi/abs/10.1021/cr800399g.

More information can be obtained from individual Eurima members.

5.2 Fibres

EU classification

- Mineral wool fibres produced by Eurima members have been classified as non-hazardous under REACH (Regulation (EC) No 1907/2006 of the European Parliament and Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals) and the Globally Harmonised System (GHS).

- They are registered with REACH under the following definition: 'Man-made vitreous (silicate) fibres with random orientation with alkaline oxide and alkali earth oxide ($Na_2O+K_2O+CaO+MgO+BaO$) content greater than 18% by weight and fulfilling one of the Note Q conditions'. The requirement of the European regulation (Note Q) ensures that the fibres have low biopersistence, so that possible inhaled fibres are quickly removed from the lungs. They are classed as non-hazardous under both REACH and the GHS.

- A list of plants producing certified fibres and more information about the certification process are available at www.euceb.org

International classification

- The International Agency for Research on Cancer (IARC), part of the World Health Organisation, revised its classification of mineral wool fibres in October 2001, including them in Group 3 as an agent 'not classifiable as to its carcinogenicity to humans'.

5.3 Handleability

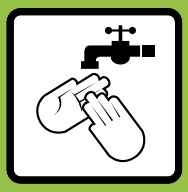
- Due to the well known mechanical effect of coarse fibres, mineral wool products may cause temporary skin itching. Mineral wool fibres cannot cause a chemical or allergic reaction, however.

- To diminish the mechanical effect of coarse fibres and avoid unnecessary exposure to mineral wool dust, information on good practices is available on the packaging of all mineral wool products with pictograms and/or written tips (see below). Safe use instruction sheets similar to safety data sheets are also available from each producer.

"When installing insulation in unventilated spaces, wear a suitable disposable face mask. When handling products, cover any exposed skin. Wear goggles when working with products overhead. Dispose of waste in accordance with local regulations. Clean the area using vacuum equipment. If itching occurs, it may be alleviated by rinsing in cold water prior to washing."

"The mechanical effect of fibres in contact with skin may cause temporary itching"

Cover exposed skin. When working in unventilated areas, wear a disposable face mask.



Rinse hands in cold water before washing.

Clean the area using vacuum equipment.

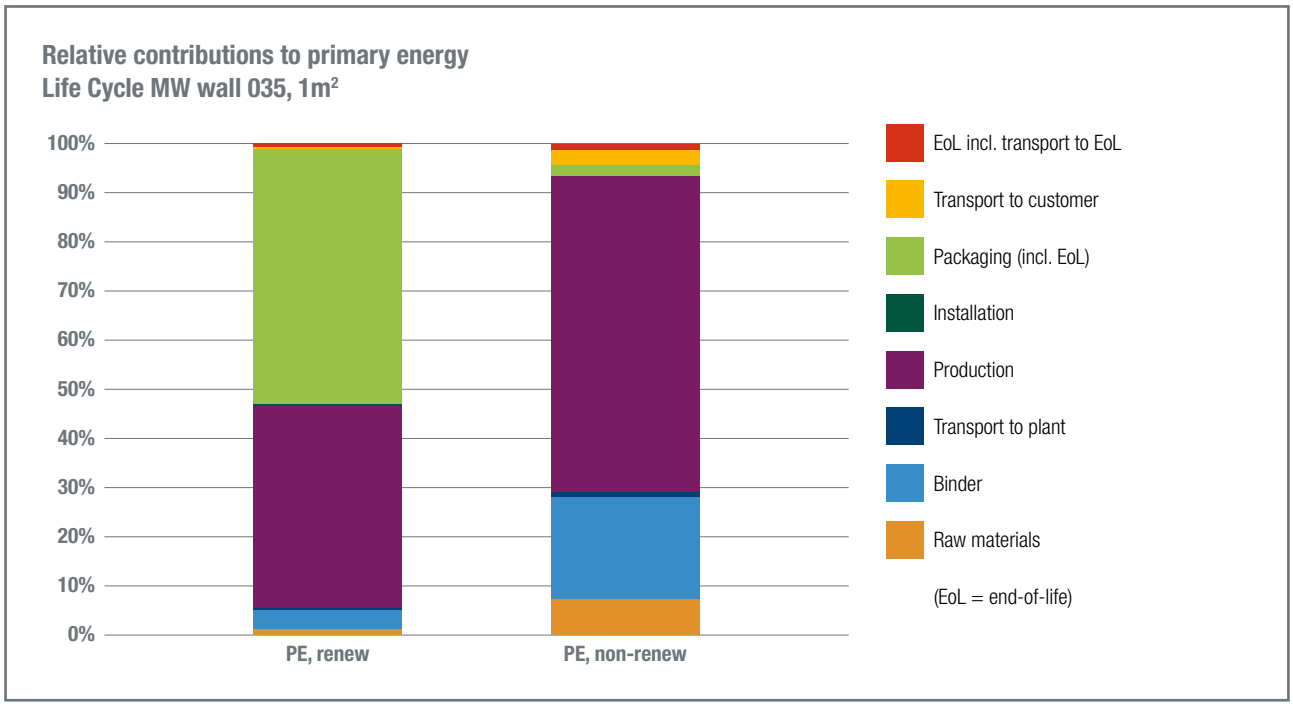
Ventilate the working area if possible.

Dispose of waste according to local regulations.

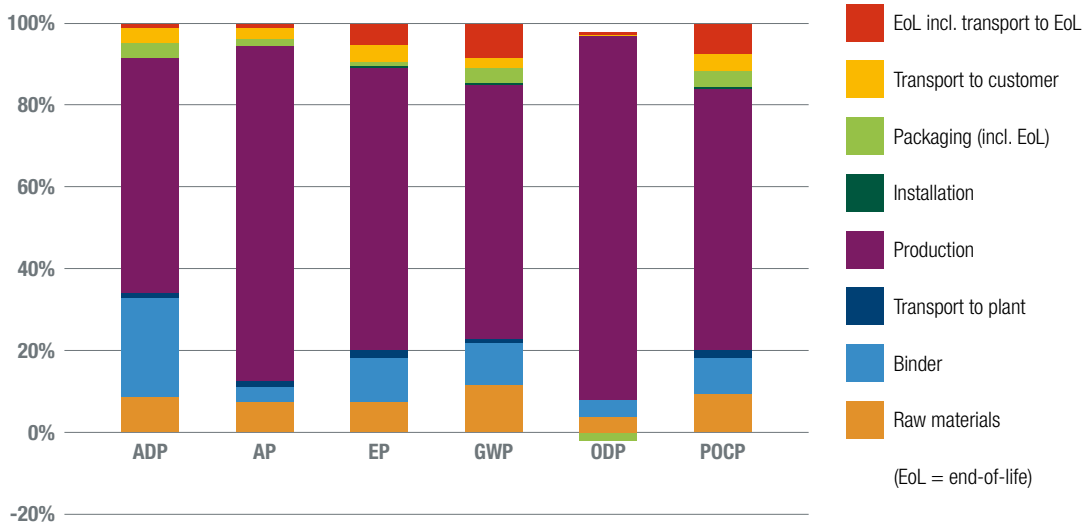
Wear goggles when working with products overhead.

06 - Annex: Interpretation of Results

The following graphics explain the contribution of each life cycle phase to the various indicators.



Relative contributions to environmental impact categories - Life Cycle MW wall 035, 1m²



When considering LCA results without taking into account operational energy use, the production stage is the most dominating phase during the life cycle. As shown above, use of non-renewable primary energy and impact categories are largely dominated by the production stage or cradle-to-gate (A1-A3), which includes raw materials, binders, transport to plant and production. Within production, energy consumption and associated emissions have the greatest impact.

In detail, modules A1-A3 have the highest non-renewable primary energy demands. When considering the whole life cycle, about 25% of primary energy is used for binder production and another 65% in the consumption of coke, natural gas and oil as energy carriers directly at the plant, including energy carriers for electricity production.

The main generator of global warming potential (GWP) is CO_2, with more than 60% resulting from the combustion of all energy carriers at the plant, especially coke in case of stone wool production and natural gas in case of glass wool production, including upstream processes in the electricity supply chain.

Notes

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