EPD - ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

PUBLISHER	Bau EPD GmbH, A-1070 Wien, Seidengasse 13/3, www.bau-epd.at
PROGRAMME OPERATOR	Bau EPD GmbH, A-1070 Wien, Seidengasse 13/3, www.bau-epd.at
OWNER OF THE DECLARATION	SAINT-GOBAIN ISOVER AUSTRIA GmbH
DECLARATION NUMBER	EPD-ISOVER-2014-1-ECOINVENT
DEKLARATIONSNUMMER ECOPLATFORM	ECO EPD Ref. No. 00000053
ISSUE DATE	08.05.2014
VALID TO	08.05.2019

Mineral insulation materials made of glass wool

Saint-Gobain ISOVER Austria GmbH

General information

Product name ISOVER glass wool-insulation in the form of slabs and felt rolls	**Declared Product / Declared Unit** ISOVER insulation materials made of glass wool are used for thermal insulation as well as acoustic and fire protection in building constructions. The products are made of recycling glass and other basic materials, typical for glass industry. A binder on the basis of phenol-formaldehyde resin is used. The EPD represents the average of all glass wool insulation materials produced by Saint-Gobain ISOVER Austria GmbH in the production site Stockerau (Austria) in the year 2010. The weighted average density is 16.5 kg/m³ for glass wool insulation materials without aluminium coating, the weighted average thermal conductivity is 0.037 W/mK. For ISOVER Lamella-Mats with reinforced alu foil (LAM/ANB) the nominal density of a mat is 23 kg/m³. One cubic metre of insulation material (m³) was defined as declared unit. **Range of validity** The average data published in this EPD are representative for all ISOVER products produced on the site in Stockerau (Austria). About 90 % of these products are sold in Austria. The owner of the declaration is liable for the underlying information and evidence; the Bau EPD GmbH is not liable with respect to manufacturer information, life cycle assessment data and evidences.
Declaration number EPD-ISOVER-2014-1	
Declaration data ☐ Specific data ☒ Average data	
Declaration based on: PCR Mineral insulation materials from glass wool PCR-Code: 2.22.2.1 Version 05 – 2014-04-30 (PCR tested and approved by the independent expert committee = PKR-Gremium)	
Type of Declaration as per EN 15804 From cradle to grave	**Data base, Software, Version** Ecoinvent v.2.2, SimaPro 7.3.3.
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Note:
EPDs from similar product groups from different programmes might not be comparable.

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1 Product / System description

1.1 General product description

ISOVER insulation materials made from glass wool are used for thermal insulation as well as acoustic and fire protection in building constructions. Glass wool belongs to the group of artificial mineral wools which consists of undirected, vitreous (silicate) fibres with more than 18 % oxides of sodium, potassium, calcium, magnesium and barium (EU-directive 97/69/EG). The products are made from recycling glass and other basic materials typical for glass industry. A binder on the basis of phenol-formaldehyde resin is used. During the time of the project a modification to improve the environmental performance of the binder was applied.
The EPD represents the average of all glass wool insulation products produced by Saint-Gobain ISOVER Austria GmbH in the production site in Stockerau (Austria) in the year 2010.

The weighted average density is 16.5 kg/m³ for unfaced glasswool products, the weighted average thermal conductivity 0.037 W/mK.

The ISOVER Lamella-Mats with reinforced alu foil (LAM/ANB) were calculated separately. The nominal density of these mats is 23 kg/m³.

1.2 Placing and provision on the market

For placing ISOVER glass wool insulation materials on the market of construction products the following rules are applied:

- ÖNORM EN 13162 " Thermal insulation products for buildings - Factory made mineral wool (MW) products - Specification "
- CE-mark (EC certificate of conformity, System 1 , see http://www.isover.at/ Downloads)
- Declaration of performance

Up-to-date declarations of performance for all products of Saint-Gobain ISOVER Austria GmbH can be downloaded from the website www.isover.at as PDF documents.
The Austrian documentation requirements on formaldehyde class E1 are fulfilled in compliance with ÖNORM EN 13986 (2005:04) and documented with testing reports. The results come significantly below the limit values of the certificates Blauer Engel and Eurofins Gold (2014).

Additional European requirements:
All glass wool products manufactured by Saint-Gobain ISOVER Austria GmbH are not classified under the European Regulation directive 97/69/EG as well as regulation (EG) 1272/2008 with reference to bio-persistent fibres and are certified by EUCEB.
The Saint-Gobain ISOVER Austria GmbH is a member of the “Gütegemeinschaft Mineralwolle” and is entitled to carry the RAL quality label for mineral wool.

1.3 Application field

ISOVER glass wool insulation materials are used for all purposes in thermal and acoustic insulation. Examples can be listed as follows: thermal insulation in loft conversion, between rafters or wooden frames, in wooden walls or wooden floor constructions, non-walkable insulation of top storey ceilings, acoustic insulation in metal stud systems, flexible facing panels or suspended ceilings.

Impact sound insulation boards are used under floating floor screeds. Facade insulation panels are used as thermal insulation in ventilated facade constructions while cassette insulation panels are used in metal cassettes and beam constructions.

Table 1: Scope of application as per ÖNORM B 6000

Wall – Pillars – Columns – Floor slabs							Ceiling – Roof – Terrace									
Exterior insulation				Core insulation		Interior insulation	Exterior insulation						Interior insulation			
With ventilation	External thermal insulation compound systems (ETICS)	Laid into formwork, i.e. thermal bridges	With plaster or cladding	In cavity constructions	In lightweight elements	Masonry or concrete walls with or without rendering (coating)	Warm roof	Cold roof, loft conversion	attics, walkable or non-walkable insulation	In case of increased compressive loads, e.g. parking decks	Ceiling soffit (undersides) with plaster	Ceiling soffit (undersides) with ETICS	Under screed without requirements on impact noise protection	Under screed with requirements on impact noise protection	Suspended ceilings	Ceiling soffit, sound absorption
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

1.4 Technical data

The collection of technical data was done according to the standards required in ÖNORM EN 13162.

Table 2: Product designation codes of all ISOVER glass wool products

	Short name	Product designation code	Type of product according to	
		MW - EN 13162 - …	ÖN B 6000	
	PREMIUM PL	T4 - WS - WL(P) - MU1 - AFr5	MW - W	
Wooden constructions	PREMIUM Ro	T2 - MU1 - AFr5	MW - WL	Wooden constructions
	UNI	T2 - MU1 - AFr5	MW - WL	
	QUATTRO	T2 - MU1 - AFr5	MW - WL	
	MK-KF	T2 - MU1 - AFr5	MW - WL	
	MK-KF DUO	T2 - MU1 - AFr5	MW - WL	
	MK-HRF	T2 - MU1 - AFr5	MW - WL	
	Rollplatte	T2 - MU1 - AFr5	MW - WL	
	WDF, Domo	T2 - MU1 - AFr5	MW - WL	
	Akusto TWKF	T1 - MU1- AFr5	MW - WL	
	VSDP	T6 - CS(10)10 - TR5 - PL(5)100 - MU1 - SDx[1] - CP4[2] - AFr5	MW - WV	
	KDP	T4 - MU1- AFr5	MW - W	
	DEKO 5	T4 - MU1- AFr5	MW - W	
	DEKO 5 SV	T4 - MU1- AFr5	MW - W	

Continuation of Table 2:

	Short name	Product designation code	Type of product according to	
		MW - EN 13162 - …	ÖN B 6000	
	AP	T4 - WS - WL(P) - MU1 - AFr5	MW - W	
	TP	T4 - WS - WL(P) - MU1 - AFr5	MW - W	
	AF	T2 - WS - WL(P) - MU1 - AFr5	MW - WL	
	TF	T2 - WS - WL(P) - MU1 - AFr5	MW - WL	
	ST	T2 - WS - WL(P) - MU1 - AFr5	MW - WL	
Impact sound	TDPT	T7 - PL(5)300 - MU1 - SDx[1] - CP2 - AFr5	MW - T	Impact sound
	TDPS	T6 - PL(5)100 - MU1 - SDx[1] - CP4[3] - AFr5	MW - T	
Facades	FDP	T4 - CS(10)0,5 - TR1 - WS - WL(P) - MU1 - AFr5	MW - WF	Facades
	LP	T4 - CS(10)0,5 - TR1 - WS - WL(P) - MU1 - AFr5	MW - WF	
	TRFP	T7 - PL(5)300 - MU1 - SDx[1] - CP2 - AFr5	MW - T	
	FDPL SV	T4 - WS - WL(P) - MU1 - AFr5	MW - W	
	FDPL	T4 - WS - WL(P) - MU1 - AFr5	MW - W	
	KB	T2 - WS - WL(P) - MU1 - AFr5	MW - WL	
	MK-KB	T2 - WS - WL(P) - MU1 - AFr5	MW - WL	

[1] The value of dynamic stiffness must be indicated in steps of 1 MN/m³.
[2] VSDP 55 CP5
[3] TDPS 45 and TDPS 55 CP5

Table 3: Technical data of the declared construction product

Characterization	Value	Unit
Thermal conductivity[1]:		
For products as per ÖNORM EN 13162 and ÖNORM EN 14064-1:	0.037	
Declared thermal conductivity λ_D resp. λ_D–range	0.032 - 0.042	W/(mK)
For products as per ÖNORM EN 14303:		
Measured value λ_{dry} at selected average temperatures	0.039 - 0.111	
Nominal density[2] resp. range of nominal density for glass wool materials without aluminium coating	16.5 (12 - 105)	kg/m³
Nominal density for Lamella-Mats with reinforced aluminium foil (LAM/ANB)	23	kg/m³
Classification of fire behaviour as per ÖNORM EN 13501-1	A1 or A2-s1-d0	

1) For mineral wool no correction factors for humidity are designed.

2) Average nominal density

Specific product data sheets can be downloaded from the website of Saint-Gobain ISOVER Austria GmbH (www.isover.at).

1.5 Conditions of delivery

Forms of delivery can be compressed rolls (e.g. thermal insulation felts), mats (e.g. Lamella-Mats) and boards (e.g. impact noise insulation boards). Units of delivery and dimensions can be taken from the current price list of Saint-Gobain ISOVER Austria GmbH. The products must be stored in a weatherproof location.

2 Description of life cycle

2.1 Base materials (main components and auxiliary materials)

Table 4: Base materials and auxiliary materials

Components	Function	Mass fraction in percent
Recycling glass [1)]	Raw material for glass production	ca. 80 %
Borax pentahydrate [2)]	Raw material for glass production	ca. 8 %
Quartz Sand and felspar [3)]	Raw material for glass production	ca. 9 %
Sodium carbonate (Na_2CO_3) [4)]	Raw material for glass production	ca. 3 %
Phenol-formaldehyde-resin [5)]	Binder	< 9 %
Auxiliary materials [6)]	- Hydrophobing agents - Adhesion agents and - Auxiliary materials for coloring	Total < 1 %

1) Prepared broke from float glass production resp. prepared laminated glass from vehicles as well as bottle glass from bottle fillers. The glass solely is from Austrian origin.
2) The boron reserves to win borax pentahydrate are located in California, Argentina and Turkey. The raw borates are – depending on their place of origin – contaminated with impurities and must be prepared to borax.
3) Silica is widely spread in nature and one of the most important minerals for setting up rock in deep layers or volcanic flow rock. At the same point silica belongs to the minerals showing the highest resistance to weathering. Sands are end products of different weathering processes and have been formed in nearly all formations of earth's geological history. The extraction of silica sands is done by open surface mining (in depths down to the groundwater table) with shovel excavators. The silica sand is attrited, washed, hydroclassified and sifted.
Felspar is the second important raw mineral in glass wool production. It is created as a by-product in open surface mining of silica sand.
The silica and feldspar used in the products originate from a region around Melk (Austria).
4) Sodium carbonate is delivered from Germany and – due to long distances to natural reserves – produced from sodium chloride and limestone by the Solvay process
5) The binder contains next to phenole formaldehyde resin two other organic components in small quantities. These components are delivered from Austria and Germany. The share of binder in heavy, loadable slabs is a maximum of 9 %, considering an average nominal densitiy of 16.5 kg/m³ the share of binder is ca. 5 %.
6) Counted with the auxiliary materials other raw materials are listed, but only added in smallest amounts, as well as oils for binding of dust particles and hydrophobicity. All of these materials are delivered from the European market.

The Lamella-Mats for special applications are coated with a reinforced aluminium foil.

The delivery of the raw materials is carried out by lorry. For the borax brought from overseas the shipping transport is considered and calculated.

ISOVER glass wool insulation materials do not contain any substances of very high concern according to REACH / CLP-regulation (EG-regulation 1272/2008; see also chapter 4 „Declaration of substances of very high concern substances of very high concern").

2.2 Production

For the production raw materials like silica sand, limestone and soda ash are used, but recycling materials in form of bottle glass from bottle fillers, car glass (windscreens) and window panes constitute the main part of the product. In ISOVER glass wool products the percentage of recycling materials is ca. 80 %. Cut scraps from the edges of the production line are brought

back into the production process. The energy demand for glass wool production is reduced significantly due to the high recycling part.

2.3 Packaging

The products are wrapped in polyethylene foil (PE-LD, 50-70 µm) and packed on reusable pallets.

2.4 Transport

As per manufacturer the radius of delivery to the client can be calculated with an average of 200 km. By compressing the rolled products in the packaging process transport capacity and therefore the impact on the environment is reduced.

2.5 Processing and installation

The application of the products is done according to current processing guidelines of the manufacturer. Advice and safety instructions can be taken from the safe use instruction sheets connected to the declarations of performance and can be downloaded under www.isover.at.

2.6 Phase of utilization

2.6.1 Phase of utilization

If installed professionally and if the phase of utilization is not disturbed, no modifications of material composition occur.

2.6.2 Environmental & health aspects during use stage

ISOVER glass wool insulation materials fulfil the emission requirements of the Blue Angel and the Eurofins Gold certificate with limitation of formaldehyde (see chapter 4.2) and all VOC emissions.

2.6.3 Reference service life (RSL)

According to latest research results the reference service life of mineral wool is not limited if the material is professionally installed and used. The RSL is equal to the service life of construction elements and buildings. The function of the insulation material is fully retained for the whole utilisation phase if it is not impacted by mechanic power or moisture.

2.7 End-of-life stage

2.7.1 Re-use and recycling

Reuse or recycling of glass wool products is technically feasible but not reasonable under the current ecological and economic conditions.

2.7.2 Thermal treatment

Thermal treatment of mineral wool due to the low calorific value is not reasonable.

2.7.3 Disposal

In compliance with the Austrian landfill directive („Deponieverordnung“), entered into force 2008-03-01, and it‘s annex 2, clause 2, list II, table. 2.1 and 2.2 mineral wool waste including any coatings are suitable to be disposed on demolition and construction waste landfills or mass waste landfills without prior analysis, intact products can be reinstalled. In other European countries the local laws must be considered. Waste disposal code: 31416 as per ÖNORM S 2100, version 2005 and EAK no. 170604 as per regulation on the European list of waste (Abfallverzeichnisverordnung- AVV) from 2001-12-10.

3 Life cycle assessment

3.1 Methodical assumptions

3.1.1 Type of EPD, system boundary

From cradle to grave.

3.1.2 Declared unit

The declared unit is 1 cubic metre of --insulation material.

Table 5: Declared unit

Characterisation	value	unit
Declared unit	1	m^3
Average density of glass wool insulation materials without aluminium coating for conversion into kg	16.5	kg/m^3
Nominal density of Lamella-Mats with reinforced aluminium foil (LAM/ANB) for conversion into kg	23.0	kg/m^3

3.1.3 Calculation of averages

The EPD represents the average of all glass wool products produced by Saint-Gobain ISOVER Austria GmbH on the production site in Stockerau in the year of 2010. All input and output masses from 2010 (without materials with aluminium coating) were divided by the production volume from the same period.

The share of ISOVER Lamella-Mats with reinforced aluminium foil (LAM/ANB) amounted to approximately 5 % of the whole output in 2010. The additional input was related to the share of this product.

In general it can be pointed out, that the used scenarios correspond in the best way with the actual situation on the production site and can be considered as representative.

A variance cannot be documented in this case for the input data is already an average of data.

3.1.4 Estimations and assumptions

Missing parameters in emission measurement like CO and NO_x emissions were completed with the data set „natural gas in industrial furnaces“. The CO_2 emissions were calculated on the basis of the energy input.

3.1.5 Cut-off criteria

The application of cut-off criteria was considered in the production stage acc. PCR Part A „General Rules for LCA assessment and requirements on the project report“.

For production all used raw materials were considered.

3.1.6 Data

The used data fulfil the following quality requirements:

- The data sets correspond with the production year 2010
- The criteria of the Austrian EPD platform for data collection, generic data and cut-off of material and energy flows were complied with.
- A data validation as per EN ISO 14044:2006 was carried out.
- The used data correspond with the yearly average of the basic year
- All essential data like energy and raw material demand, emissions, transports, packages, waste and by-products within the system boundary were provided by the manufacturer.
- The data are plausible, meaning that deviations from comparable results (other manufacturers, literature, similar products) are comprehensible.

For background data the data base Ecoinvent Version v.2.2 (2010) was chosen with reference to the PCR guidelines Part A.

3.1.7 Allocation

In 2006 data for the processing of used glass (Module 1, ancillary materials, energy and waste) were collected from a supplier. This company is a disposal company. The used glass taken over by the company is treated as waste, meaning that no loads from the previous product systems are considered.
The processing steps and the efforts for transport from the supplier to the ISOVER production site were calculated without allocation, meaning they were assigned to the recycling glass.
In the production process of ISOVER glass wool materials (Module A3) no by-products are produced.
Packaging waste generated in production that is disposed (Module A3) are treated as waste (no allocation) in the LCA, in reality it is transferred to a recycling plant.
For the generic data sets (all considered modules) the allocation rules of the data base Ecoinvent are applied.
For glass wool -insulation materials scenarios of reuse or recycling are not realistic under the current economic and technical framework conditions. Therefore the material is disposed once reaching the end-of-life status. For the disposal scenario no allocation was needed (Modules C and D).

3.1.8 Justification for exclusion of modules (not declared)

All information modules were considered.

3.2 Information on the life cycle for the assessment

Table 6: Declared life cycle stages, description of the system boundaries

PRODUCT STAGE			CON-STRUCTION PROCESS STAGE		USE STAGE							END-OF-LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Construction, installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction, demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

X = included in LCA; MND = Module not declared

Reference Service life (RSL)

Table 7: Reference service life for mineral insulation products in the LCA

Characterisation	value	unit
glass wool	50	years

3.2.1 A1-A3 Product stage

3.2.1.1 A1 Raw material supply

The energy demand for glass wool production is reduced significantly due to the high recycling part.

Used glass is the raw material with the biggest share in the products. Prepared broke from float glass production resp. bottle glass from bottle fillers, prepared laminated glass from vehicles is crushed to glass granulate in a reprocessing plant. The use of recycling glass leads to a reduction of primary energy demand (resource conservation) but also to energy savings in production: the melting of primary materials needs on average 30 % more energy than the melting of recycling glass [ISOVER 1997 b].

The share of Neobor®Boraxpentahydrat in the molten glass is approx. 8 %, in rolled ISOVER products finally 4.5 % of borate can be traced.
The boron reserves to win borax pentahydrate are located in California, Argentina and Turkey. The raw borates are – depending on their place of origin – contaminated with impurities and must be processed to borax.

Silica is widely spread in nature and one of the most important minerals for building rock in deep layers or volcanic flow rock. At the same point silica belongs to the minerals showing the highest resistance to weathering. Sands are end products of different weathering processes and have been formed in nearly all formations of earth's geological history. The extraction of silica sands is done by open surface mining (in depths down to the groundwater table) with shovel excavators. The silica sand is attrited, washed, hydroclassified and sifted.
Felspar is the second important raw mineral in glass wool production. It is created as a by-product in open surface mining of silica sand. The Silica and the feldspar used in the products originate from a region around Melk (Austria).
Sodium carbonate is derived from Germany and – due to long distances to natural reserves – produced from sodium chloride and limestone by the Solvay process

3.2.1.2 A2 Transport of raw materials

Transports in the upstream processes are included in the applied background data sets. The transport distances of raw materials to the production site in Stockerau were documented by the manufacturer and in some cases calculated with a route planner.

3.2.1.3 A3 Manufacturing

The delivered raw materials are stored separated in silos for the moment. In the batch house raw materials and ancillary materials are weighted on an automatic weighing device, mixed in two mixers following an exact composition and pneumatically conveyed in a closed system to the electric furnace. This furnace is heated by molybdenum electrodes with an installed capacity of 4.2 megawatt and an actual capacity of 3.1 megawatt. The average temperature in the furnace rises to 1350 °C. So-called feeder is following the furnace downstream. Through these feeders the glass flows to the spinning machines. Core part of the spinning machines are rotating spinning disks and ring-shaped outside burners heated with gas. The melted glass flows from the feeder through electrically heated platinum jets from above into the spinning machine. The fibre is formed by centrifugation through drilled disks. The fibres are pneumatically pulled down. In this process theoretical endless long glass wool fibres are formed – the average diameter is 3 - 6 µm.

During production pauses (in case of machine re-configuration or maintenance) the glass spurt is redirected and cooled with water. The glass granulate coming about in this process is brought back into the production process.

The process energy for spinning the glass is gas as well as electricity.

In the next production step the wool is sprayed with binder and finally falls in free fall onto the supporting table. From there the wool is transported by the conveyor belt to the curing oven where it is compressed to the desired thickness and density. Under a temperature of 230 °C the binder is hardened by polymerization. After that the ready glass wool is seamed, cut to the desired dimensions and wrapped to rolls or stapled in the form of boards. The cut edges are mechanically crushed and brought back into the production process.

The exhaust gases arising during the production go through a biological air purification installation. After filter values are measured once a year by an accredited testing body.

The process water is cleaned internally and brought back to the production cycle. No waste water is led into the public canalisation. The losses caused by evaporation are compensated with fresh water. Fresh water is taken from the pipe and partly from collected rainwater.

Table 8: Energy and water demand for manufacturing per m³ product

Characterisation	Quantity per m³ insulation material
Natural gas	89 MJ/m³
Energy mix Austria	135 MJ/m³
Diesel (transport within site)	2 MJ/m³
Use of fresh water from public water supply system and rain water	0.049 m³ /m³

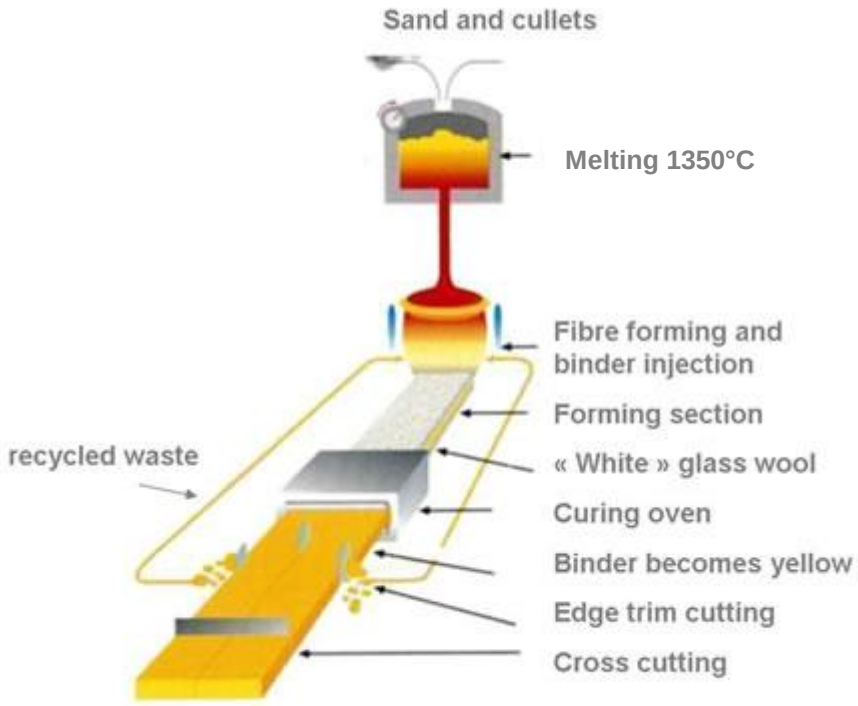
Output data declared by the manufacturer originates from the year 2010, the conversion to kg is based on the production quantity of 2010.

A measurement of emissions of clean gas was carried out.

Missing parameters in emission measurement like CO and NO_x emissions were completed with the data set „natural gas in industrial furnaces“. The CO_2 emissions were calculated on the basis of the energy input.

Waste was declared with the corresponding waste disposal codes per ton end product.

Figure 1: Flow chart of production process



3.2.2 A4-A5 Transport, assembly and installation

According to the manufacturer the delivery radius to the client can be calculated with an average of 200 km. By compressing the rolled insulation material in the packaging process the transport volumina and with that the environmental impact is reduced. The calculation considers the fact that unused space between the rolls leads to a slight reduction of the saved volume gained by compression. For the calculation of the environmental impact of the compressed roll ware shorter distances (reduced by the factor 4.3) could be taken into account. Due to the compression the loading weight of the fully loaded truck is increased by the same factor. To consider this in the key figures with a realistic approach, the transport of uncompressed material (slabs) was calculated with the loads of an empty truck and for compressed material (rolls) with the weight of a truck with an average load (fully loaded outward journey and empty return journey). For the rolled, compressed products an average bulk density of 14.25 kg/m³ was considered, for all products an average bulk density -weighed according to the shares of products - of 16.5°kg/m³ was assumed.

Table 9: Description of the scenario "Transport to the building site (A4)" as per table 7 in ÖNORM EN 15804

Parameters to describe the transport to the building site (A4)	Quantity per m³ insulation material
Average transport distance	200 km
vehicle type, Commission Directive 2007/37/EC (European Emission Standard)	-
Fuel type and average consumption of vehicle	12.9 l/100 km
Maximum transport mass	-
Capacity utilisation (including empty returns)	46 %
Bulk density of transported products	14.25 kg/m³ for compressed products 16.5 kg/m³ for all products
Volume capacity utilisation factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaged products)	≥ 1

Table 10: Description of the scenario „Installation of the product in the building (A5)" as per table 8 in ÖNORM EN 15804

Parameters to describe the installation of the product in the building (A5)	Quantity per m³ insulation material
Ancillary materials for installation (specified by material);	None *)
Water use	-
Other resource use	-
Electricity demand	-
Other energy carrier(s): …….	-
Wastage of materials on the building site before waste processing, generated by the product's installation (specified by type)	5 % glass wool clippings
Output materials (specified by type) as result of waste processing at the building site e.g. of collection for recycling, for energy recovery, disposal (specified by route)	accumulating packaging: • wood, foil made from PE and PP (thermal treatment) • Paper and metal (Recycling)
Direct emissions to ambient air, soil and water	-

*) The possible use of drills, pegs or adhesives was not considered, because in this EPD the average over the whole product range was calculated and most products can be tucked by hand between timber rafters.

3.2.3 B1-B7 Use stage

In the life cycle stages B1 to B7 no negative impact on the LCA of the product is given. The positive impacts on the LCA of the building by reducing the heat demand are not under the scope of the product analysis.

3.2.4 C1-C4 End-of-life stage

The glass wool insulation material normally can be deconstructed easily by hand, without considerable use of energy. Emissions relevant for the LCA do not occur. For the disposal of the glass wool on construction waste or mass waste landfills the Ecoinvent data set "Disposal, building, mineral wool, to final disposal/CH S" was consulted. The transport to the landfill (C2) is already included in this data set.

Table 11: Description of the scenario „Disposal of the product (C1 to C4)“ acc. table 12 in ÖNORM EN 15804

Parameters for End-of-Life stage (C1-C4)	value	Quantity per m³ insulation material
Collection process specified by type	-	kg collected separately
	-	kg collected with mixed construction waste
Recovery system specified by type	-	kg for re-use
	-	kg for recycling
	-	kg for energy recovery
Disposal specified by type	16,5	kg product or material for final deposition

3.2.5 D Potential of reuse and recycling

Reuse or recycling of glass wool products is technically feasible but does not take place under the current ecological and economic conditions.

Table 12: Description of the scenario for „reuse, recovery and recycling potential (D)“

Parameters of module loads and benefits (D)	Quantity per m³ insulation material
Materials for re-use or recycling as per A4-A5	0
Materials for re-use or recycling as per B2-B5	0
Materials for re-use or recycling as per C1-C4	0

3.3 Declaration of environmental indicators

Table 13: Parameters to describe the environmental impact of uncoated ISOVER glass wool products per m³

Para-meter	Unit in equiv.	A1-A3	A4		A5	B1-B7	C1	C2	C3	C4	D
			Rolled products	slabs							
GWP	kg CO_2	31,9	0,338	1,20	2,67	0	0	0,0480	0	0,117	0
ODP	kg CFC-11	3,38E-06	4,67E-08	1,44E-07	1,72E-07	0	0	7,78E-09	0	3,51E-08	0
AP	kg SO_2	8,86E-02	1,68E-03	5,95E-03	4,59E-03	0	0	2,63E-04	0	6,96E-04	0
EP	kg PO_4^{3-}	5,31E-02	4,37E-04	1,43E-03	2,87E-03	0	0	6,85E-05	0	1,70E-04	0
POCP	kg C_2H_4	7,66E-02	3,02E-03	1,14E-02	4,13E-03	0	0	4,80E-04	0	1,28E-03	0
ADPE	kg Sb	3,46E-03	1,44E-06	4,87E-06	1,73E-04	0	0	2,16E-07	0	2,42E-07	0
ADPF	MJ H_u	478	4,31	15,7	24,2	0	0	0,711	0	2,95	0
Legend		GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources									

Table 14: Parameters to describe the use of resources of uncoated ISOVER glass wool products per m³

Para-meter	Unit	A1-A3	A4		A5	B1-B7	C1	C2	C3	C4	D
			Rolled products	boards							
PERE	MJ H_u	90,9	0,0775	0,264	4,55	0	0	0,00931	0	0,0242	0
PERM	MJ H_u	1,27	0	0	0,0633	0	0	0	0	0	0
PERT	MJ H_u	92,2	0,0775	0,264	4,61	0	0	0,00931	0	0,0242	0
PENRE	MJ H_u	531	4,66	16,9	26,9	0	0	0,752	0	3,06	0
PENRM	MJ H_u	12,1	0	0	0,603	0	0	0	0	0	0
PENRT	MJ H_u	543	4,66	16,9	27,5	0	0	0,752	0	3,06	0
SM	kg	12,1	0	0,000	0,603	0	0	0	0	0	0
RSF	MJ H_u	0	0	0	0	0	0	0	0	0	0
NRSF	MJ H_u	0	0	0	0	0	0	0	0	0	0
FW	m^3	4,58E-02	1,47E-04	5,23E-04	2,36E-03	0	0	2,74E-5	0	3,11E-4	0
Legend		PERE = Renewable primary energy as energy carrier; PERM = Renewable primary energy resources as material utilization; PERT = Total use of renewable primary energy resources; PENRE = Non-renewable primary energy as energy carrier; PENRM = Non-renewable primary energy as material utilization; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of fresh water									

Table 15: Parameters describing the waste categories of uncoated ISOVER glass wool products per m³

Para-meter	Unit	A1-A3	A4		A5	B1-B7	C1	C2	C3	C4	D
			Rolled products	slabs							
HWD	kg	8,13E-04	3,37E-06	1,53E-05	6,77E-05	0	0	6,93E-07	0	1,20E-06	0
NHWD	kg	2,37	0,01403	0,0561	0,957	0	0	0,00528	0	16,5	0
RWD	kg	1,24E-03	7,43E-06	2,97E-05	6,60E-05	0	0	1,01E-06	0	2,64E-06	0
Legend		HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed									

Table 16: Parameters describing the potential of waste treatment and recovery in end-of-life stage of uncoated ISOVER glass wool products per m³

Para-meter	Unit	A1-A3	A4		A5	B1-B7	C1-C4	D
			Rolled products	slabs				
CRU	kg	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0	0
Legend		CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electric energy; EET = Exported thermal energy						

Table 17: Parameters describing the environmental impact of ISOVER Lamella-Mats with reinforced aluminium foil (LAM/ANB) per m³

Parameter	Unit in equiv.	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP	kg CO_2	64,1	0,473	4,71	0	0	0,0672	0	0,164	0
ODP	kg CFC-11	5,85E-06	6,54E-08	2,97E-07	0	0	1,09E-08	0	4,92E-08	0
AP	kg SO_2	2,12E-01	2,35E-03	1,08E-02	0	0	3,69E-04	0	9,75E-04	0
EP	kg PO_4^{3-}	1,06E-01	6,11E-04	5,58E-03	0	0	9,59E-05	0	2,38E-04	0
POCP	kg C_2H_4	1,53E-01	4,22E-03	8,08E-03	0	0	6,72E-04	0	1,79E-03	0
ADPE	kg Sb	4,15E-03	2,02E-06	2,07E-04	0	0	3,02E-07	0	3,39E-07	0
ADPF	MJ H_u	917	6,04	46,3	0	0	1,00	0	4,13	0
Legend	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources									

Table 18: Parameters describing the resource use of ISOVER Lamella-Mats with reinforced aluminium foil (LAM/ANB) per m³

Para-meter	Einheit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
PERE	MJ H_u	173	0,109	8,68	0	0	0,0130	0	0,0338	0
PERM	MJ H_u	1,77	0	0,0886	0	0	0	0	0	0
PERT	MJ H_u	175	0,109	8,77	0	0	0,0130	0	0,0338	0
PENRE	MJ H_u	1040	6,53	52,4	0	0	1,05	0	4,29	0
PENRM	MJ H_u	16,9	0	0,845	0	0	0	0	0	0
PENRT	MJ H_u	1057	6,53	53,3	0	0	1,05	0	4,29	0
SM	kg	16,9	0	0,845	0	0	0	0	0	0
RSF	MJ H_u	0	0	0	0	0	0	0	0	0
NRSF	MJ H_u	0	0	0	0	0	0	0	0	0
FW	m^3	9,67E-02	2,05E-04	4,93E-03	0	0	3,83E-05	0	4,36E-04	0
Legend	PERE = Renewable primary energy as energy carrier; PERM = Renewable primary energy resources as material utilization; PERT = Total use of renewable primary energy resources; PENRE = Non-renewable primary energy as energy carrier; PENRM = Non-renewable primary energy as material utilization; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of fresh water									

Table 19: Parameters describing the waste categories of ISOVER Lamella-Mats with reinforced aluminium foil (LAM/ANB) per m³

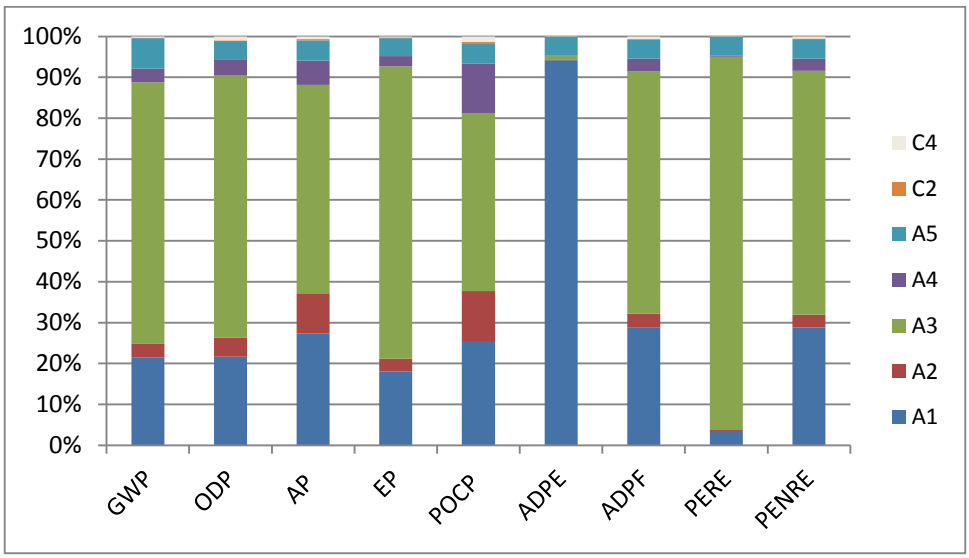
Para-meter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
HWD	kg	1,53E-02	4,71E-06	9,47E-05	0	0	9,70E-07	0	1,69E-06	0
NHWD	kg	5,98	0,0196	1,34	0	0	0,00739	0	23,1	0
RWD	kg	2,95E-03	1,04E-05	9,24E-05	0	0	1,41E-06	0	3,70E-06	0
Legend	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed									

Table 20: Parameters describing the potential of waste treatment and recovery of ISOVER Lamella-Mats with reinforced aluminium foil (LAM/ANB) per m³

Parameter	Einheit	A1-A3	A4-A5	B1-B7	C1-C4	D
CRU	kg	0	0	0	0	0
MFR	kg	0	0	0	0	0
MER	kg	0	0	0	0	0
EEE	MJ	0	0	0	0	0
EET	MJ	0	0	0	0	0
Legende	CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electric energy; EET = Exported thermal energy					

3.4 Interpretation of the LCA results

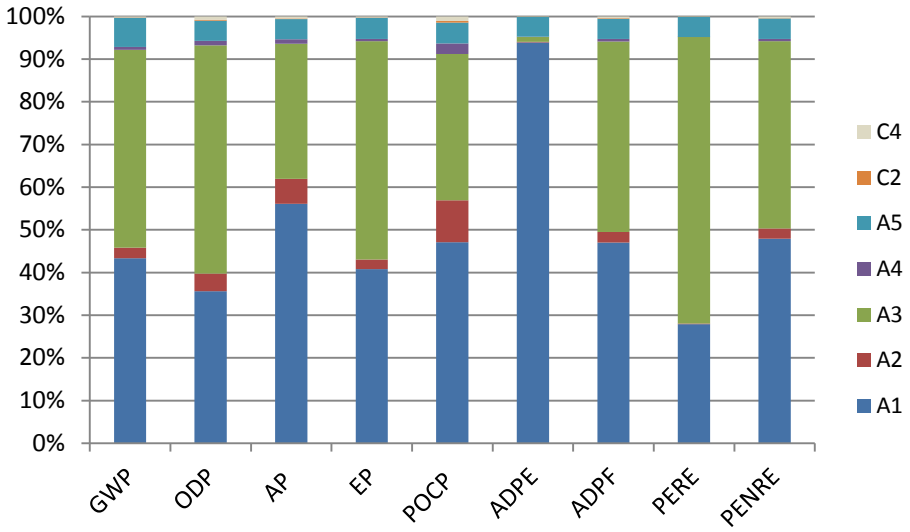
Figure 2: The load components in different life cycle stages of the complete life cycle of uncoated ISOVER glass wool products



Legend	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources PERE = Renewable primary energy as energy carrier; PENRE = Non-renewable primary energy as energy carrier

Regarding the LCA of ISOVER glass wool insulation materials without aluminium coating over the whole life cycle, the production (A3) is causing the highest load in all considered parameters, except the Abiotic depletion potential for non-fossil resources (ADPE). For the depletion of non-fossil resources the production of raw materials is the essential accountable factor. The share of loads caused by disposal is minor measured against the loads of whole life cycle. The installation has an impact on the environmental parameters due to the 5 % accruing clippings. The emissions caused by the transport of raw materials (A2) are responsible for loads between 5 and 10 % in the impact categories potential for generation of tropospheric ozone photochemical oxidants (POCP) and Acidification potential of land and water. In the figure above the transport of all products compressed rolls and non-compressed products with an average nominal density of 16.5 kg/m³ was considered.

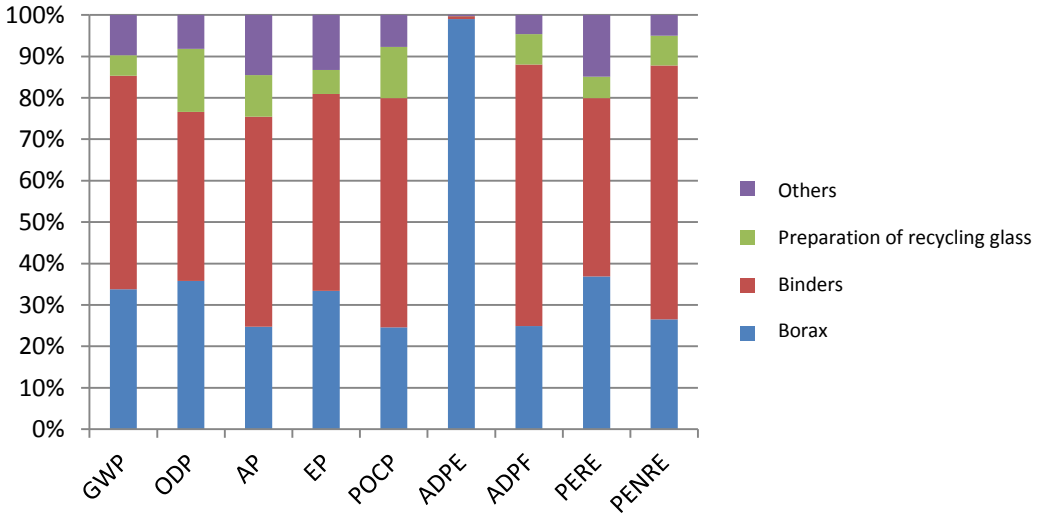
Figure 3: The load components in different life cycle stages of the complete life cycle of ISOVER Lamella-Mats with reinforced alu foil (LAM/ANB)



Legend	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources PERE = Renewable primary energy as energy carrier; PENRE = Non-renewable primary energy as energy carrier

Regarding the Lamella-Mats the production of raw materials for the armed foil made from pure aluminium is responsible for the division of the load into nearly equal shares considering raw material extraction (A1) and manufacturing (A3). Only regarding the Abiotic depletion potential for non-fossil resources (ADPE), the raw material extraction (A1) causes the main part of the loads due to the share of borax. Compared to figure 2 (glass wool products without aluminium coating) it is apparent that the transport causes significantly lower loads. The reason is that here exclusively the compressed mats were considered.

Figure 4: Shares of different raw materials in the whole raw material supply (A1) of uncoated ISOVER glass wool production

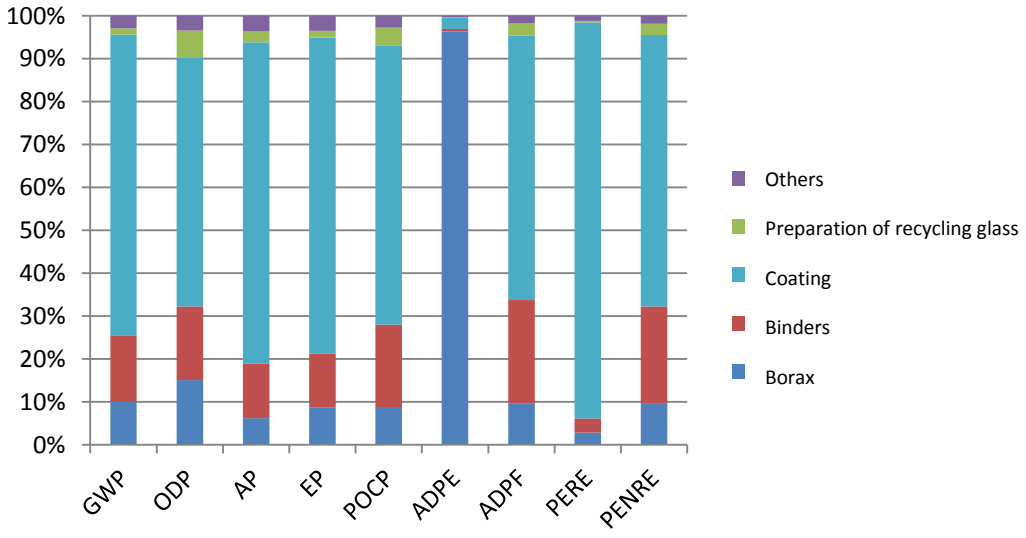


Legend	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources PERE = Renewable primary energy as energy carrier; PENRE = Non-renewable primary energy as energy carrier

Regarding the shares of load of different raw materials in glass wool insulation materials without aluminium coating in Figure 4 the binder has the highest share in all impact categories except considering the Abiotic depletion potential for non-fossil

resources (ADPE). Borax also shows an essential impact and causes nearly 100 % of the Abiotic depletion for non-fossil resources (ADPE). Interestingly the preparation of recycling glass is still responsible for a relatively big part of loads.

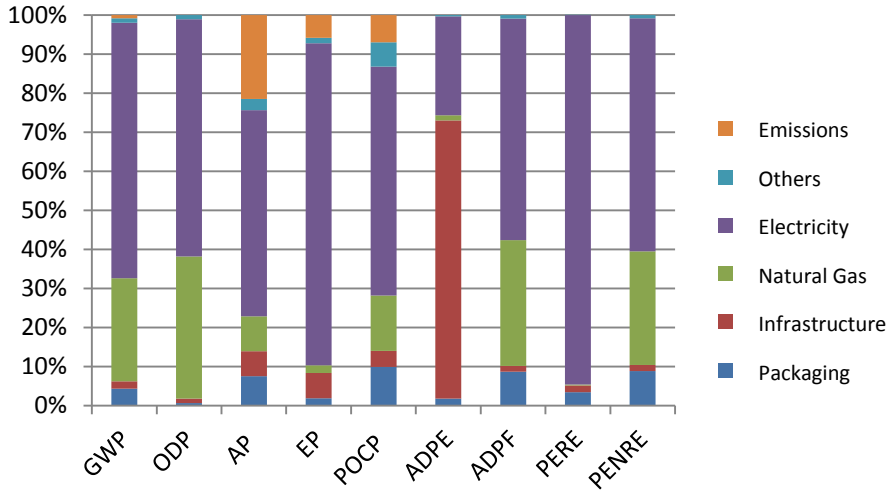
Figure 5: Shares of different raw materials in the whole raw material supply (A1) of ISOVER Lamella-Mats with reinforced alminium foil (LAM/ANB)



Legend	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non- fossil resources; ADPF = Abiotic depletion potential for fossil resources PERE = Renewable primary energy as energy carrier; PENRE = Non-renewable primary energy as energy carrier

In Figure 5: the shares of loads considering raw material supply of ISOVER Lamella-Mats with reinforced aluminium foil (LAM/ANB) are described. It is evident, that the coating causes significantly more than 50 % of the loads except considering the impact category ADPD, where the extraction of the raw material borax is overbalancing.

Figure 6: Polluters of the loads in manufacturing (A3) of ISOVER glass wool insulation materials



Legend	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources PERE = Renewable primary energy as energy carrier; PENRE = Non-renewable primary energy as energy carrier

The manufacturing of glass wool products with and without aluminium coating were not separately gathered.
The shares of loads of the energy carriers were to be expected in this magnitude, as the highest use of energy is based on electricity. The Austrian energy mix has a high hydropower share leading to the high share of renewable primary energy use.

The share of loads in more than one impact categories caused by the packaging is surprisingly high, dominated in the packaging loads of the foil. The manufacturing and the production plant (infrastructure) are of big influence on the Abiotic depletion potential for non-fossil resources due to the intensive use of materials.

4 Dangerous substances and emissions into indoor air and environment

4.1 Declaration of substances of very high concern

No hazardous substances or materials with properties as per table 21 are used.

Table 21: Declaration of substances of very high concern

Properties of hazardous materials as per EG-regulation 1272/2008 (CLP regulation)	Chemical characterisation (CAS-Number)
Carcinogenic Cat. 1A or 1B (H350, H350i):	Not relevant
Mutagenic Cat. 1A or 1B (H340):	Not relevant
Toxic for reproduction Cat. 1A rder1B (H360F, H360D, H360FD, H360Fd, H360Df):	Not relevant
PBT (persistent, bio-accumulative and toxic) (REACH, annex XIII):	Not relevant
vPvB (very persistent and very bio-accumulative) (REACH, annex XIII):	Not relevant
Substances of very high concern (SVHV):	Not relevant

4.2 Formaldehyde emission

Table 22: Formaldehyde emission

characterisation	value	unit
Formaldehyde emission as per Eurofins Gold	5.6 µg/m³ - loading 1; 8.1 µg/m³ - loading 0,4	Limit Value: 10 µg/m³
Formaldehyde-emission acc. to ÖNORM EN 13986 (2005:04) and testing standard EN 717 (28 days) compare test report Holzforschung 2011:	< 0.01 ppm	Limit Value: 0.1 ppm

The limit value of 0.1 ppm as per requirements of Baustoffliste ÖE is hereby met and significantly undergone.

4.3 Exoneration criteria as per CLP regulation

Glass wool belongs to the group of artificial mineral wools which consist of undirected, vitreous (silicate) fibres with more than 18 % alkali and alkaline earth compounds (EG-regulation 1272/2008 (CLP-regulation), annex VI, table 3.1. „List of harmonised classification and labelling of hazardous substances“, Index-No. 650-016-00-2). Production and use of products made from bio-persistent mineral fibres is prohibited.
All glass wool products manufactured by Saint-Gobain ISOVER Austria GmbH are excluded from classification as per EU directive 97/69/EG as well as regulation (EG) 1272/2008 with reference to bio-persistent fibres and are certified by EUCEB since 2013 (Report EUCEB 2013).
The Saint-Gobain ISOVER Austria GmbH is a member of the “Gütegemeinschaft Mineralwolle” and is entitled to carry the RAL quality label for products from mineral wool.

Advice and safety instructions can be taken from the safe use instruction sheet connected to the declarations and can be downloaded under www.isover.at.

5 References

EUCEB-Certificate EUCEB Secretariat, Saint-Gobain ISOVER Austria AG Plant Stockerau Glass Wool AA1 und P, Certificate N°348 und 349, 9.10.2013

Eurofins 2014 Indoor Air Comfort Prüfbericht gemäß Vergabegrundlage für das Eurofins Indoor Air Comfort Gold Label, Version 3.1, Berichte Nr. 392-2013-00084501 und 392-2013-00084502, Report January 2014

ISOVER 1997 b ISOVER: Environmental report, Lausanne, 1997

Holzforschung Austria, 2011 Testing Report Auftragsnummer 2109/2011-HC, Report from 18.11.2011

Rules and standards:

ÖNORM EN 13162:2012 Thermal insulation products for buildings - Factory made mineral wool (MW) products - Specification

ÖNORM EN ISO 14040:2009-10 Environmental management - Life cycle assessment -- Principles and framework (ISO 14040:2006)

ÖNORM EN ISO 14044:2006-10 Environmental management - Life cycle assessment -- Requirements and guidelines

ÖNORM EN ISO 14025:2010-07 Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures (ISO 14025: 2010)

ÖNORM EN 15804 Sustainability of construction works - environmental product declarations. Core rules for the product category of construction products, version: 2012-04-01

General Principles and Guidelines
Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Background Report. Bau-EPD GmbH, in current version

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