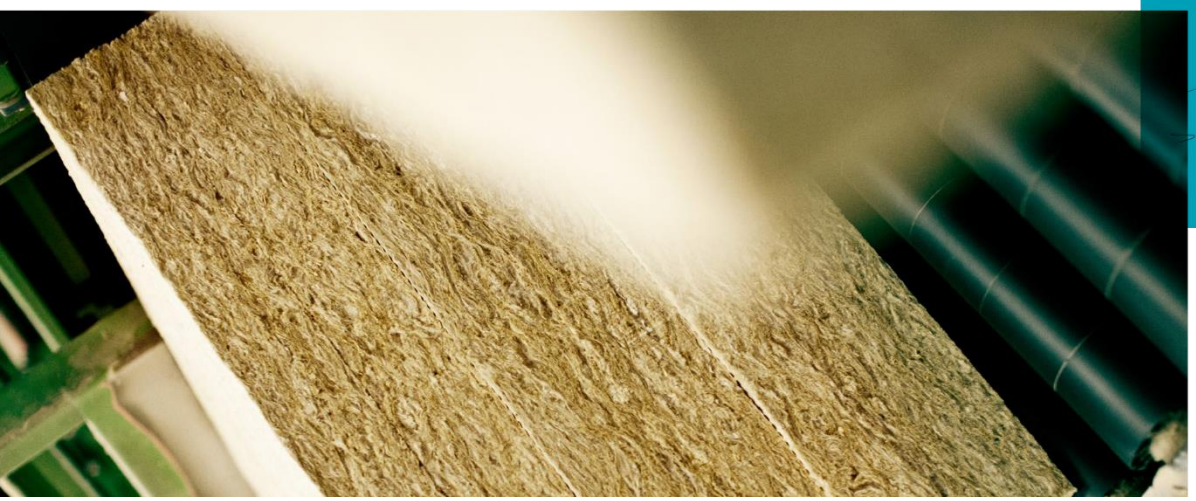
Environmental Product Declaration



ROCKWOOL®
REDAir ® FLEX ventilated facade system

EPD according to EN 15804 and ISO 14025 and 3rd party verified

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Life Cycle Assessment study:
This environmental product declaration is based on a Life Cycle Assessment (LCA) background study according to EN15804:2012+A1:2013 carried out by:

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ROCKWOOL International A/S.

Verification:

External independent verification of the LCA background report and EPD declaration.

Name and organization of verifier:	Charlotte Merlin, FORCE Technology
Date and location:	21 August 2019, Brøndby, DK.
Signature:	FORCE TECHNOLOGY

Environmental Product Declarations (EPD) may not be comparable if they do not comply with the EN15804:2012+A1: 2013 Clause 5.3

Product

Declared unit

1 square meter (m^2) of external wall thermal insulation in Europe for a period of 50 years.

The application is for a ventilated façade, including stone wool insulation, wood sub-construction, and anchors screws.

The results in this EPD refer to an insulation thickness of 175 mm. The thermal resistance -R-value of the system, including the insulation and screws, is 4.40 m^2.K/W.

Intended application of the Environmental Product Declaration

The EPD is for information supply to interested parties in Europe and customers of ROCKWOOL® interested in the environmental performance of the REDAir® FLEX system, such as architects, builders and also LCA experts and LCA database owners and other audiences that have an interest in EPDs.

The EPD is for business-to-business communication.

Product description

The REDAir® system consists of ROCKWOOL® stone wool batts that are currently produced in Doense, Denmark. The system is currently available in Denmark, Sweden and Norway.

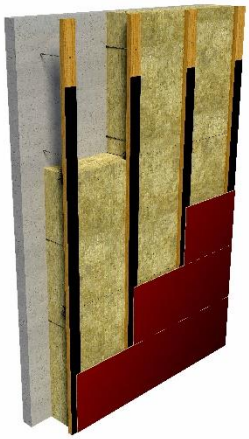


Figure 1: REDAir® FLEX system overview. The wall and cladding panels are not part of the REDAir® product offering and included only for illustration. purposes.

The stone wool batts are added to the outside of a building and are mounted using laminated veneer lumber (LVL) boards that are connected to the stone wool using metal friction plates and attached to the existing wall using metal screws.

Table 1: Components of the REDAir® FLEX system per m^2

Material	Weight (kg/m^2)
ROCKWOOL stone wool	10,5
LVL	2,62
Friction Plate	0,115
Screws	0,111

The system can be finished using a variety of cladding panels, such as ROCKPANEL®, but the cladding is not included in this EPD.

The system is available on the market with stone wool thicknesses of 100 – 150 – 200 – 250 mm or double-layer combinations of these up to 350 mm. Approximately 80% of the sold volume is either 150 or 200 mm. Therefore, the thickness is 175 mm on average and this theoretical thickness is chosen as the reference for the calculations in this EPD. This 175 mm corresponds to an R-value of 4.40 m^2.K/W of the system including the screws, but excluding the wall and cladding panel as they are not part of the thermal insulation associated with the REDAir® FLEX system.

The LCA results for specific thicknesses can be obtained by scaling the LCA results of the stone wool part and combining these with the LCA results of the other parts of the system. A spreadsheet with separate LCA results for each of the components is available for this purpose at ROCKWOOL®.

Product

Product specification

ROCKWOOL® stone wool is made from volcanic rock, typically basalt or dolomite, and an increasing proportion of recycled material. For the REDAir® stone wool the secondary materials are almost 20% of the mineral fraction. The mineral fibres are bound by a binder with an average binder content of 4% for the stone wool in the REDAir® FLEX system. The binder is a water-based phenol-formaldehyde resin which is polymerized during production of the final stone wool product.

LVL is made from a mix of pine and spruce in the Tver region in Russia and is Forest Stewardship Council (FSC) certified. Phenol formaldehyde is used as glue in the production of the LVL board. In order to ensure durability, the final strips are treated with components commonly used for wood preservation in housing and other buildings.

For extra durability, the anodized screws and friction plate have an extra coating (C4 Grade).

Reference service life

The reference service life of REDAir® is defined as 50 years. This is a scenario based on an assumption for a default building. REDAir® is used in both residential and commercial applications. The components from the REDAir® FLEX system do not have to be replaced in the 50-year scenario, except for the LVL and the friction plate for which one replacement is assumed in a 50-year period as a worst-case scenario[1]

The modular presentation of the LCA results in this EPD allows the user to model other scenarios. If there is no replacement during the lifetime of the building (building that lasts less than 50 years), the results for Module B4 can simply be deleted. When a user wants to model multiple rounds of maintenance (buildings that last more than 50 years), the results for module B4 can be multiplied as necessary.

1 This scenario is based on simulated ageing tests for ROCKWOOL® stone wool, European Technical Approval (ETA) documents for the components and assumptions for the LVL, as well as current practice where most often insulation material is not replaced during the lifetime of the building.

Parameter	Unit
Reference service life	50 years for the system, with one replacement of the LVL and friction plate
Declared product properties	Stone wool: EN13162-T3- DS(70,90) =MW-EN13162-T3-DS(70,90)-WS-MU1 – Lambda 33, reaction to fire Euroclass A1 (non-combustible) LVL fire treated Screws and friction plate with corrosion class C4 System ETA-13/0900 according to ETAG 034 (pending)
Design application parameters	See installation guidelines for building height limits, ventilation cavity requirements, and suitable supporting wall structures. Quantity of screws to be calculated on project basis: see online calculator for guidance on www.redair.rockwool.com Installation to be conducted in accordance with the manufacturer's installation guide. Guidance on safe and effective installation is also provided through local organizations and at the end of this EPD. Cladding to be applied in accordance with cladding manufacturer's guide.
Quality of work assumption	It is assumed that the manufacturer’s instructions are clear and followed. In case of any uncertainty, the manufacturer should be contacted for instructions.
Outdoor environment	Application will resist visual & structural weathering effects to the extent described in ETA documentation and warranty coverage. Specific project considerations should be made to account for load conditions, weight, nominal wind speeds, and terrain factors. REDAir® FLEX system may contribute to but does not assure air or water tightness to the building. Seismic conditions are not considered.
Indoor environment	ROCKWOOL REDAir BATTS meet the requirements for low emissions (M1) and requirements according to EN15251: 2007 Appendix E. ROCKWOOL REDAir BATTS are recognized by the M1 label. M1 certificates will be provided on request.
Usage conditions & maintenance	Installation is a one-time procedure. After mounting, the system shall be maintained by simple visual inspection – any movement of façade elements should be inspected and mitigated. The product will not contact water or soil, because it is encapsulated by the cladding

Life Cycle Assessment: Calculation rules

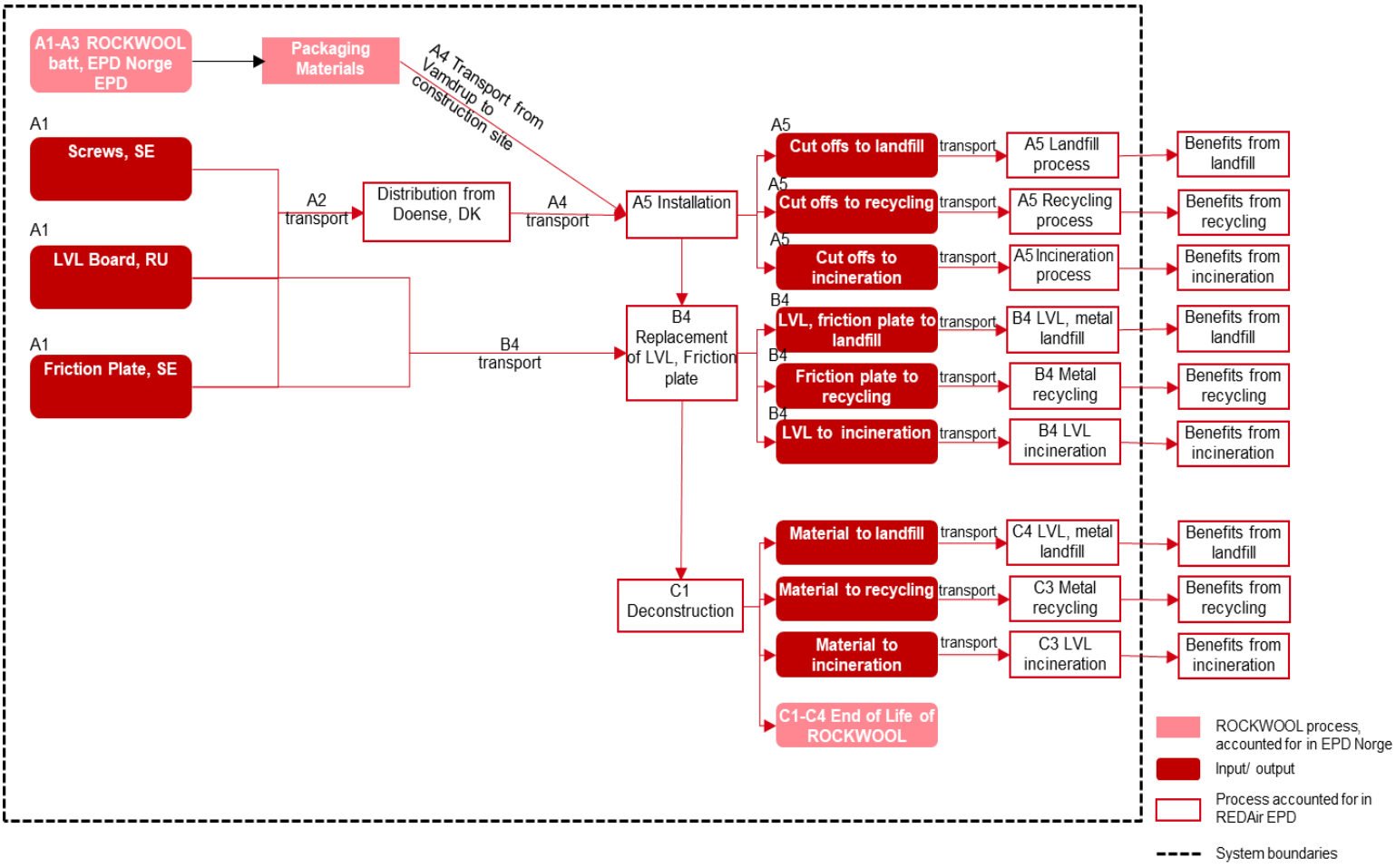
Flow diagram system boundaries

EPD type

Cradle-to-grave. Included are all relevant life cycle stages.

The rest of the use modules, apart from B4 replacement are not considered relevant and the emissions are considered zero.

They do not use energy (B6) or water (B7) during use of the building.



Description and modelling of scenarios

Modules A1–A3 Production stage

The production of stone wool for the REDAir® system takes place in the ROCKWOOL plant in Doense Denmark. Average Nordic data, based on the published ROCKWOOL EPD in the EPD-Norge are used for the stone wool part. Primary data was collected for the financial year 2017 (one-year average).

LVL is made using FSC certified pine and spruce wood. All production and transportation steps are within the system boundaries as defined in EN16485 PCR for wood [FprEN 16485:2013], including impregnation and treatment. All materials used are approved in the EU for use in the protection of external used wood products.

Packaging of screws and steel is excluded due to its low contribution to the final mass of the system (less than 1%). Packaging of the LVL is already included as part of the selected dataset from GaBi. The packaging of the mineral wool follows the assumptions, as they are found under the generic EPD in EPD Norge.

Apart from stone wool, the rest of the materials are put together in an order in Vamdrup, Denmark ready for transportation to regional distribution centres. Wooden blocks are used to support them. The amount of wood and plastic is small compared to the packaging of the mineral wool and is therefore excluded from the calculations.

Module A4 transport to site

The REDAir® system components, with the exception of stone wool, are directly delivered to the project site (Scandinavia), or indirectly through central distribution locations. The stone wool part arrives from the factory in Doense separately.
For the modelling of transport, all the system components with the exception of stone wool are included. The final impacts result from the aggregation of the latter together with the impacts from the stone wool transport, as documented in the Nordic EPD, available in EPD Norge.

The average weighted distance, based on the Nordic markets is 639 km. In the table below, the average distance per country is presented. This is weighted out, based on the market share in each country. For the transport of stone wool and the relevant scenarios please refer to the assumptions outlined in EPD Norge.

Table 2: Country-specific distances

Country	Distance (km)
Denmark	250
Sweden	900
Norway	840

The transport of the material, with the exception of stone wool, is modelled as a simple mass based transport. The truck is assumed to be Euro-6 with a 22t maximum payload and 85% capacity utilisation (including empty returns).

Module A5 Installation stage

The installation requires the use of hand-held tools, some of which are power tools and consume electricity. The power tool energy cost is calculated for an average square meter of the mounted systems on the wall. This is modelled using national grid mix data weighted for the market shares (see Table 3).

Table 3: EN15804 installation considerations

Parameter	Unit
Ancillary materials for installation (specified by material)	No other materials are needed in addition to the ones included in the REDAir® FLEX system
Water use	None
Other resource use	Power tools, cutting knives and drills. They are considered as capital goods. Use is included
Quantitative description of energy type (regional mix) and consumption during the installation process	0.0284 kWh/m^2
Wastage of materials on the building site before waste processing, generated by the product's installation (specified by type)	2% of mineral wool, LVL, friction plates and screws
Output materials (specified by type) as result of waste processing at the building site	See Table 4 with building waste scenarios
Direct emissions to ambient air, soil and water	None

Cut sections of stone wool can be used elsewhere. The LVL boards are cut and the remainder can be used to start the next series. Extra screws would typically be used up for extra strengthening, saved for the next project, or recycled. The same applies to the friction plates. Estimated waste for all components is 2%.

ROCKWOOL® stone wool can either be recycled or landfilled. In all the markets where REDAir® is provided (Norway, Sweden and Denmark) ROCKWOOL® has a recycling service in place. In that case the stone wool is returned to ROCKWOOL® for recycling.

The wood will be sorted out and incinerated with energy recovery or landfilled in a low percentage. The incineration is assumed to have an efficiency of less than 60%, which means that the incineration is regarded as a waste treatment. Screws and friction plates will be recycled as iron or landfilled in a small percentage. Since REDAir® is typically easy to dismantle, a scenario of sorting and recycling is very likely to occur if the infrastructure is present.

Table 4 considers the following scenarios for the treatment of the building waste, based on assumptions from the Danish context.

Table 4: Building waste scenarios

Material	Landfill (%, distance)	Recycling (%, distance)	Incineration (%, distance)
Wood	5%, 50 km	95%, 150 km	
Metal	5%, 50 km		95%, 100 km

Module B4 Use stage - Replacement
In the 50 years' lifespan of a building, one replacement of LVL and friction plate is assumed. This EPD includes the material use and electricity consumption for the use of power tools (as defined for the installation above), and doubles the electricity use in order to model both the deconstruction and the repeated installation (see Table 5).

Table 5: EN 15804 module B4 considerations

Parameter	Unit
Replacement cycle	LVL and friction plate every 25 years
Energy input during maintenance	• 0.0284kWh/m^2 for deconstruction • 0.0284kWh/m^2 for repeated installation
Exchange of worn parts during product's life cycle	None

Module C1-C4 End-of life
The deconstruction is modelled similarly to the installation scenario. The transport distances and waste processing and landfill scenarios are identical to the building waste scenario as defined above in Table 4. ROCKWOOL® stone wool can be disposed of as non-hazardous waste.

Module D Benefits and loads beyond the system boundary
In Module D the loads and benefits are reported for the products that result from waste treatment over the life cycle, steel recycling and thermal energy recovery from combustion of wood and plastic packaging. The allocation of combustion impacts is based on a physical classification of the mass flows or calorific values.

Cut-off criteria

Data sets are complete according to cut-off rules of EN15804 (inclusion of all material and energy inputs >1%, inclusion of all materials with potential environmental impact and <5% of the total energy use and mass neglected). The most notable cut-off based on these criteria is the use of product labels and the packaging of screws and friction plate.

Data quality

The quality of the data of this specific EPD is assessed as good and appropriate. The data gathering approach for all EPDs is assessed as good and appropriate by the external verifier.

For secondary data sources ROCKWOOL uses the data available in the latest version of GaBi database. The GaBi databases used are the Professional Database 2017, the extension database XIV: construction materials and some tailor made datasets specifically for ROCKWOOL which are delivered from GaBi as supplementary to the above (mainly for some binder ingredients and stones). Ecoinvent data from Ecoinvent version 3.3 was used only in cases where no data was available in the GaBi databases. The age of the secondary data is therefore considered sufficient.

Data was collected consistently and based on the financial year 2017. Adjusted secondary LCIs are taken from the GaBi database.

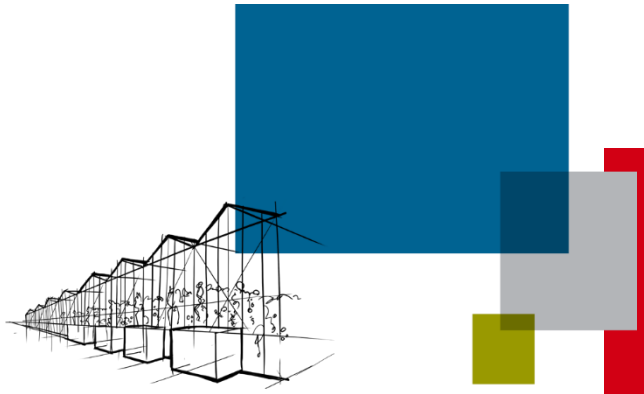
Life Cycle Assessment: Rules

Limitations

Results provided relate to the average thickness of the current market – 175 mm. Please contact ROCKWOOL® if you need figures for specific thicknesses.

Description of the system boundaries (x=included, INA = Indicator not assessed)

Production stage			Construction stage		Use stage							End-of-life stage				Benefits and loads beyond the system boundaries
Raw materials	Transport	Manufacturing	Transport	Assembly	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	INA	INA	INA	x	INA	INA	INA	x	x	x	x	x



ROCKWOOL® REDAir® FLEX ventilated facade system

1 square meter (m^2) of external wall thermal insulation in Europe for a period of 50 years. The results in this EPD are related to an insulation thickness of 175 mm. The R-value of the system, including the insulation and screws, is 4.40 m^2.K/W.

Environmental impact

	Production stage	Construction stage		Use stage							End-of-life stage				
Parameter	A1-A3	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 De-construction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	D Benefits and loads beyond the boundaries of the system
Global warming potential (GWP) kg CO2 eqv	9,71E+00	1,39E+00	1,49E+00	INA	INA	INA	2,19E+00	INA	INA	INA	1,76E-03	6,42E-02	4,23E+00	3,81E-01	-4,17E+00
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 potential (ODP) kg CFC11 eqv	3,13E-08	4,33E-13	2,09E-09	INA	INA	INA	-4,85E-13	INA	INA	INA	4,99E-17	1,31E-14	3,19E-15	1,66E-13	-5,96E-13
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 eqv	7,13E-02	1,26E-03	1,79E-03	INA	INA	INA	8,55E-03	INA	INA	INA	3,07E-06	5,94E-05	6,22E-04	1,02E-03	-8,33E-03
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 PO4 3- eqv	1,18E-02	2,65E-04	3,80E-04	INA	INA	INA	1,76E-03	INA	INA	INA	5,02E-07	1,29E-05	1,10E-04	1,55E-04	-8,15E-04
Excessive enrichment of waters and continental surfaces with nutrients, and the associated adverse biological effects.															
Photochemical ozone creation (POCP) kg Ethene eqv	4,38E-03	6,92E-06	1,39E-04	INA	INA	INA	3,26E-04	INA	INA	INA	2,82E-07	-7,48E-07	7,65E-05	1,30E-04	-8,77E-04
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 eqv	2,42E-05	1,12E-07	5,14E-07	INA	INA	INA	6,29E-07	INA	INA	INA	1,67E-09	5,05E-09	6,05E-08	6,07E-08	-6,34E-07
Abiotic depletion potential for fossil resources (ADP-fossils) MJ	1,81E+02	1,91E+01	5,33E+00	INA	INA	INA	3,83E+01	INA	INA	INA	1,46E-02	8,76E-01	1,59E+00	2,26E+00	-6,45E+01
Consumption of non-renewable resources, thereby lowering their availability for future generations.															

Resource use

	Production stage	Construction stage		Use stage							End-of-life stage				
Parameter	A1-A3	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 De-construction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	D Benefits and loads beyond the boundaries of the system
Use of renewable primary energy excluding renewable primary energy resources used as raw materials - MJ/FU	7,06E+01	9,73E-01	1,09E+01	INA	INA	INA	9,40E+01	INA	INA	INA	1,27E-01	4,67E-02	4,84E+01	2,66E-01	-1,31E+01
Use of renewable primary energy resources used as raw materials - MJ/FU	6,35E+01	0,00E+00	-8,48E+00	INA	INA	INA	3,52E+00	INA	INA	INA	0,00E+00	0,00E+00	-4,78E+01	0,00E+00	0,00E+00
Total use of renewable primary energy resources - MJ/FU	1,34E+02	9,73E-01	2,40E+00	INA	INA	INA	9,75E+01	INA	INA	INA	1,27E-01	4,67E-02	5,79E-01	2,66E-01	-1,31E+01
Use of non-renewable primary energy excluding nonrenewable primary energy resources used as raw materials - MJ/FU	1,42E+02	1,91E+01	2,83E+00	INA	INA	INA	3,73E+01	INA	INA	INA	4,57E-02	8,79E-01	7,89E+00	2,35E+00	-7,62E+01
Use of non-renewable primary energy resources used as raw materials - MJ/FU	4,72E+01	0,00E+00	-2,38E-01	INA	INA	INA	3,52E+00	INA	INA	INA	0,00E+00	0,00E+00	-5,97E+00	0,00E+00	0,00E+00
Total use of non-renewable primary energy resources - MJ/FU	1,89E+02	1,91E+01	2,59E+00	INA	INA	INA	4,08E+01	INA	INA	INA	4,57E-02	8,79E-01	1,92E+00	2,35E+00	-7,62E+01
Use of secondary materials - kg/FU	3,00E-01	0,00E+00	0,00E+00	INA	INA	INA	0,00E+00	INA	INA	INA	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-8,68E-02
Use of renewable secondary fuels - MJ/FU	0,00E+00	0,00E+00	0,00E+00	INA	INA	INA	0,00E+00	INA	INA	INA	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of non-renewable secondary fuels - MJ/FU	0,00E+00	0,00E+00	0,00E+00	INA	INA	INA	0,00E+00	INA	INA	INA	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Net use of fresh water - m3/FU	6,92E-02	2,41E-03	3,17E-03	INA	INA	INA	2,88E-02	INA	INA	INA	1,79E-04	8,33E-05	1,04E-02	4,49E-04	-2,14E-02

Waste categories

	Production stage	Construction stage		Use stage							End-of-life stage				
Parameter	A1-A3	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 De-construction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	D Benefits and loads beyond the boundaries of the system
Hazardous waste disposed - kg	4,20E-06	1,01E-06	1,92E-08	INA	INA	INA	7,76E-07	INA	INA	INA	6,54E-11	4,72E-08	1,47E-09	3,54E-08	-3,08E-08
Non-hazardous waste disposed - kg	1,99E+00	1,47E-03	8,16E-02	INA	INA	INA	1,66E-01	INA	INA	INA	1,14E-04	6,87E-05	2,99E-02	1,03E+01	-4,20E-02
Radioactive waste disposed - kg	2,06E-03	2,70E-05	1,77E-04	INA	INA	INA	9,68E-04	INA	INA	INA	1,29E-05	1,20E-06	1,31E-04	3,19E-05	-4,19E-03

* There is never radioactive waste from a ROCKWOOL plant (A3), but potentially in its upstream chain (A1 & A2), which is not taken into account here.

Output flows

	Production stage	Construction stage		Use stage							End-of-life stage				
Parameter	A1-A3	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 De-construction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	D Benefits and loads beyond the boundaries of the system
Component for re-use - kg	0,00E+00	0,00E+00	0,00E+00	INA	INA	INA	0,00E+00	INA	INA	INA	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of renewable primary Materials for recycling - kg	0,00E+00	0,00E+00	2,99E-01	INA	INA	INA	1,11E-01	INA	INA	INA	0,00E+00	0,00E+00	4,88E-01	0,00E+00	0,00E+00
Materials for energy recovery - kg	0,00E+00	0,00E+00	0,00E+00	INA	INA	INA	0,00E+00	INA	INA	INA	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported electrical energy - MJ	0,00E+00	0,00E+00	1,23E+00	INA	INA	INA	6,17E+00	INA	INA	INA	0,00E+00	0,00E+00	0,00E+00	6,05E+00	0,00E+00
Exported thermal energy - MJ	0,00E+00	0,00E+00	3,55E+00	INA	INA	INA	1,09E+01	INA	INA	INA	0,00E+00	0,00E+00	0,00E+00	1,07E+01	INA

Other Information

Dangerous substances

REDAir® FLEX system insulation materials do not contain substances of very high concern (SVHC) according to the EU-REACH candidate list http://echa.europa.eu/candidate- list-table. For more information on the insulation a ROCKWOOL® Safe Use Instruction Sheet (SUIS) is available upon request.

The REDAir® FLEX system LVL boards are impregnated with flame retardant in order to maintain their durability during use. All materials used are approved in the EU for the intended use for the protection of external used wood products. The LVL board does not require labelling or classification according to REACH. For more information a Safety Data Sheet is available upon request.

For the friction plate and screws no specific hazards are known to ROCKWOOL®.

Instruction for safe installation

LVL board:
When cutting LVL boards use gloves, goggles and protection against wood dust by using a filter mask suited for protection against wood dust. A Safety Data Sheet is available upon request.

Stone wool:
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.
To diminish the mechanical effect of coarse fibres and prevent 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).

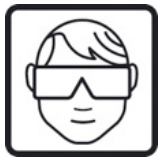

Cover exposed skin. When working in unventilated area wear disposable face mask.


Clean area using vacuum equipment.


Waste should be disposed of according to local regulations.


Rinse in cold water before washing.


Ventilate working area if possible.


Wear goggles when working overhead.

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