Declaration Owner

Arabian Fiber Glass Insulation Co. (AFICO)
6581 Unit No. (1), Dammam 34325-2799
Kingdom Of Saudi Arabia (KSA)
Phone: +966 13-3313333
https://www.afico.com.sa/

Products:

Glass Wool Board Insulation, unfaced, or with Aluminum Foil Reinforced Kraft Paper Laminate (FRK), Woven Glass Fabric (WGF), Aluminum Foil Woven Fiberglass Jacket (AWF), Foil Scrim (FS) or Foil Kraft Scrim (FKS) facing

Functional Unit

1 m^2·K/W of installed product (1 square meter with 1 RSI-value of insulation) with a reference service life (RSL) of 50 years

EPD Number and Period of Validity

SCS-EPD-08453
EPD Valid November 29, 2022 through November 28, 2027

Product Category Rule

Product Category Rule for Construction Products, PCR 2019:14. International EPD System, v. 1.11. February 5, 2021.

Complementary product category rules (C-PCR-005) to PCR2019:14: Thermal Insulation Products. International EPD system, December 20, 2019.

Program Operator

SCS Global Services
2000 Powell Street, Ste. 600, Emeryville, CA 94608
+1.510.452.8000 | www.SCSglobalServices.com

Declaration owner:	Arabian Fiber Glass Insulation Co. (AFICO)
Address:	6581 Unit No. (1), Dammam 34325-2799, Kingdom Of Saudi Arabia (KSA)
Declaration Number:	SCS-EPD-08453
Declaration Validity Period:	EPD Valid November 29, 2022 through November 28, 2027
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Wan Ping Chua, SCS Global Services
LCA Software and LCI database:	OpenLCA 1.10.3 software and the Ecoinvent En15804 v3.8 database
Product's Intended Application:	Thermal and acoustic insulation for indoor and outdoor use
Product RSL:	50 years
Markets of Applicability:	Global
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Grave
LCIA Method and Version:	EN 15804:2012 + A2:2019
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Thomas Gloria, PhD, Industrial Ecology Consultants
Part A Product Category Rule:	Product Category Rule for Construction Products, PCR 2019:14. International EPD System, v. 1.11. February 5, 2021.
Part A PCR Review conducted by:	International EPD System
Part B Product Category Rule:	Complementary product category rules (C-PCR-005) to PCR2019:14: Thermal Insulation Products. International EPD system, December 20, 2019.
Part B PCR Review conducted by:	International EPD System
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Thomas Gloria, PhD, Industrial Ecology Consultants
Declaration Contents:	

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, and EN15804: 2012 + A2:2019. The EPD owner has the sole ownership, liability, and responsibility for the EPD.*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.*

1. Declaration Owner and Product Description

1.1 Arabian Fiberglass Insulation Co. (AFICO)

AFICO is a manufacturer of fiberglass thermal and acoustic insulation products, based in Dammam, Kingdom of Saudi Arabia (KSA). AFICO is a joint venture company with Owens Corning USA (OC US) and Gulf insulation Group (A Zamil Industrial Subsidiary) and manufactures its products under license from Owens-Corning Fiberglass Corporate, Ohio, USA. AFICO is accredited to ISO 14001:2015, ISO 9001:2015 and ISO 45001:2018. AFICO sells its products within the Kingdom of Saudi Arabia (KSA), as well as neighboring countries in United Arab Emirates (UAE), Kuwait, Oman, Jordan, and Egypt. A small percentage of the products are also sold globally to Australia and India.

2. Product Description

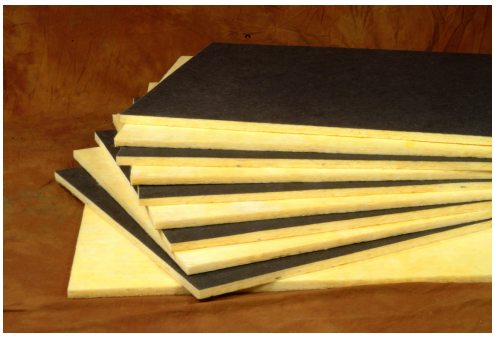
2.1 Product Description

Glass Wool Board Insulation

AFICO Board Insulation is composed of fine, stable, and uniformly textured inorganic glass fibers bonded together by a non-water soluble and fire retardant thermosetting and heat resistant resin and formed into semi-rigid and rigid rectangular boards or slabs. It is free from coarse fibers and shot due to its mineral composition.

AFICO Board Insulation is available unfaced or with one side factory applied White All Service Jacket (ASJ), Aluminum Foil Woven Fiberglass Jacket (AWF), Aluminum Foil Reinforced Kraft Paper Laminate (FRK), Woven Glass Fabric (WGF), Foil Scrim (FS) or Foil Kraft Scrim (FKS) or Aluminum Foil Woven (AWF) Fiberglass Jacket to give a pleasing appearance vapor barrier. The facings have UL fire resistant ratings.

AFICO Board Insulation is a semi-rigid and rigid glass fiber board intended for use in commercial, institutional, industrial, and residential construction as thermal and acoustical insulation for interior walls and partitions, cavity wall construction, floor, precast structures and prefabricated houses and exterior of duct work and mechanical, vessels and tanks where abuse resistance is required. The relevant UN CPC scheme is 37990 (Non-metallic mineral products n.e.c).



2.2 FURTHER INFORMATION

Further information on the product can be found on the manufacturer's website at https://www.afico.com.sa/

3. Scope of the Study

3.1 FUNCTIONS OF THE PRODUCT SYSTEM

AFICO fiberglass insulation products provide thermal and acoustic insulation and are used in outdoor and indoor settings, for commercial, industrial, and residential construction projects. Jackets/ facings made from various materials can be added to improve vapor barrier and reduce condensation during product use. Following guidance provided in the PCR, a functional unit (FU) of installed product which provides 1 m2·K/W of insulation (1 square meter with 1 RSI-value) with a reference service life (RSL) of 50 years is used. The density, thickness, and the reference flow (mass) of the Glass Wool Board Insulation product can be found in Table 1 below.

Table **2.** shows the amount of facing required (kg) per functional unit of the product.

Table 1. *The density, thickness and reference flow (in kg) of the Glass Wool Board Insulation product.*

Parameter	Glass Wool Board Insulation
Functional Unit (m^2·K/W)	1
Reference Flow (kg)	0.84
Density of reference flow (kg/m^3)	24
Thickness of reference flow (m)	0.035

Table 2. *Amount of facing required by facing type per functional unit*

Facing type	Weight of facing required (kg)
Aluminum Foil Reinforced Kraft Paper Laminate (FRK)	0.076
Woven Glass Fabric (WGF)	0.125
Aluminum Foil Woven Fiberglass Jacket (AWF)	0.155
Foil Scrim (FS)	0.079
Foil Kraft Scrim (FKS)	0.105

3.2 SCALING FACTOR

AFICO insulation products are available in a wide range of density, thickness, and insulation properties. As the results in this study are presented based on the functional unit of 1 m^2·K/W of insulation provided, Table *3* provides scaling factor for unfaced Glass Wool Board Insulation with other RSI-values as available in AFICO's line of products.

Table 3. *Scaling factor to be applied for Glass Wool Board Insulation with various thickness and density.*

RSI-value (m^2·K/W)	Thickness (mm)	Board weight (kg)	Scaling factor
0.5	15	0.63	0.75
0.7	25	0.60	0.71
1	35	0.84	1.00
1.1	38	0.92	1.10
1.4	50	1.20	1.43
2.1	75	1.80	2.14
2.8	100	2.40	2.86
3.1	112	2.69	3.20
3.5	125	3.00	3.57
4.2	150	3.60	4.29

3.3 PRODUCT MATERIAL COMPOSITION

The Glass Wool Board Insulation includes recycled glass cullet, formaldehyde, borax, silica sand, soda ash, limestone, phenol, urea, and other additives. The content declaration is displayed in Table 4, below. There are no known ingredients which are in the list of the European Chemicals Agency Candidate List of Substances of Very High Concern (SVHC).

Table 4. *The content declaration of AFICO Glass Wool Board Insulation per functional unit, shown to three significant figures.*

Raw Material	Weight (kg)	Post -consumer material, weight (%)	Renewable material, weight %
Recycled Glass cullet	0.528	98.1	0
Formaldehyde	0.101	0	0
Borax	$6.17x10^{-2}$	0	0
Silica sand	$3.54x10^{-2}$	0	0
Soda ash	$3.11x10^{-2}$	0	0
Urea	$2.79x10^{-2}$	0	0
Phenol	$2.76x10^{-2}$	0	0
Limestone	$1.55x10^{-2}$	0	0
Hydrowax oil	$4.40x10^{-3}$	0	0
Caustic soda	$3.12x10^{-3}$	0	0
Ammonium Sulfate	$3.06x10^{-3}$	0	0
Silicone	$1.08x10^{-3}$	0	0
Silane	$1.43x10^{-4}$	0	0
Packaging material	**Weight (kg)**	**Weight (%), versus the product**	
Polybags	$1.75x10^{-3}$	0.208	

Customers of AFICO also have the option of including jacket/ facing materials. The ingredients and amount in percentages incorporated into each of the seven jacketing options are shown in Table 5, based on technical specification sheets of the jacketing materials.

Table 5. *The content declaration of each AFICO insulation jacket/ facing material per functional unit. All figures shown are rounded to three significant figures.*

Material	FKS	AWF	FRK	FS	WGF
Glass Fiber	$8.14x10^{-2}$	0.155	$1.27x10^{-2}$	$6.28x10^{-2}$	0.125
Kraft paper	-	-	$6.33x10^{-2}$	-	-
Polypropylene	$2.31x10^{-2}$	-	-	$1.58x10^{-2}$	-
Aluminum foil+	$1.07x10^{-3}$	$1.55x10^{-5}$	$1.61x10^{-3}$	$4.31x10^{-3}$	-
Post-consumer weight (%)	0	0	0	0	0
Renewable material, weight (%)	0	0	81.6%	0	0

+ The technical specification sheets provided the thickness of the foil, without a mass specification. Following ASTM B 137-85 (2004) for Class I Oxide coating, the estimated weight is 4.18mg/cm2 of coating.

Biogenic carbon content of the product and packaging must be declared if the biogenic carbon containing material is 5% or more of the total mass of the product and packaging, respectively. The biogenic content of the relevant component parts is shown below.

Component Part	Biogenic Carbon Content (kg C/ Functional Unit)
FRK Facing/ Jacketing Material	$1.08x10^{-1}$

3.4 SYSTEM BOUNDARY

The system boundary includes the cradle-to-grave life cycle of AFICO Glass Wool Board Insulation, which includes all inputs required and outputs generated from each life cycle stage (production, construction, installation, and end-of-life (EOL)).

Each life cycle stage is subdivided into information modules. This module approach has been adopted by the PCR and each module is described in Table 6. A flow diagram illustrating the processes involved within each life cycle module is shown below in Figure 1.

Table 6. *A description of the life cycle phases included in the AFICO Glass Wool Board Insulation system boundary.*

Module	Module Description	Included in System Boundary	Geographical representation
A1	Raw Material extraction and upstream production, which includes generation of electricity, steam and heat from primary energy resources, also including their extraction, refining and transport; raw material extraction and processing, as well as processing of secondary material inputs (e.g., recycled or reused materials)	X	Kingdom of Saudi Arabia (SA)
A2	Transport to factory, which covers transport of raw materials and other inputs to the factory and internal transport	X	SA
A3	Manufacturing, which includes all water used in manufacturing the product; the extraction and upstream production, transport to factory, and manufacturing of product packaging; transport and treatment of all waste generated at the manufacturing facility	X	SA
A4	Transport to the building site, includes transport from the manufacturing facility to a central or intermediate storage site (if relevant) and transport to the construction site	X	SA
A5	Installation, covers installation of the product into any type of construction works. This includes any wastage of the product that occurs during installation (including the A1 to A4 inputs required for that wastage). The transport and treatment of product packaging waste. And the manufacture and transportation of ancillary materials, as well as energy or freshwater consumed, to install the product at the construction site.	X	SA
B1	Use stage, which would account for impacts occurring through use of the product. There is no resource required for the use of AFICO thermal and acoustic insulation products.	X	SA
B2 – B5	Maintenance, repair, replacement, and refurbishment; When installed correctly, thermal insulation products require no maintenance, repair, replacement, or refurbishment during the 50-year RSL, which is consistent with a building lifetime of 50 years.	X	SA
B6 – B7	Operational energy and water use. There is no resource required for the use of AFICO thermal and acoustic insulation products.	X	SA
C1	Deconstruction/demolition, which includes dismantling or demolition, of the construction product from the construction works and the energy use for this, including initial on-site sorting of the materials	X	SA
C2	Transport to waste processing or disposal, which includes the transportation of the discarded construction product as part of the waste processing, for example to a recycling site and transportation of waste, to final disposal	X	SA
C3	Waste processing for generation of secondary materials (i.e. recycling)	X	SA
C4	Disposal of waste, which includes physical pre-treatment and management of the disposal site, including provision and transport of all materials, products and related energy and water use	X	SA
D	Optional supplementary information about the potential net benefits from reuse, recycling and energy recovery beyond the system boundary of the studied product system	X	SA

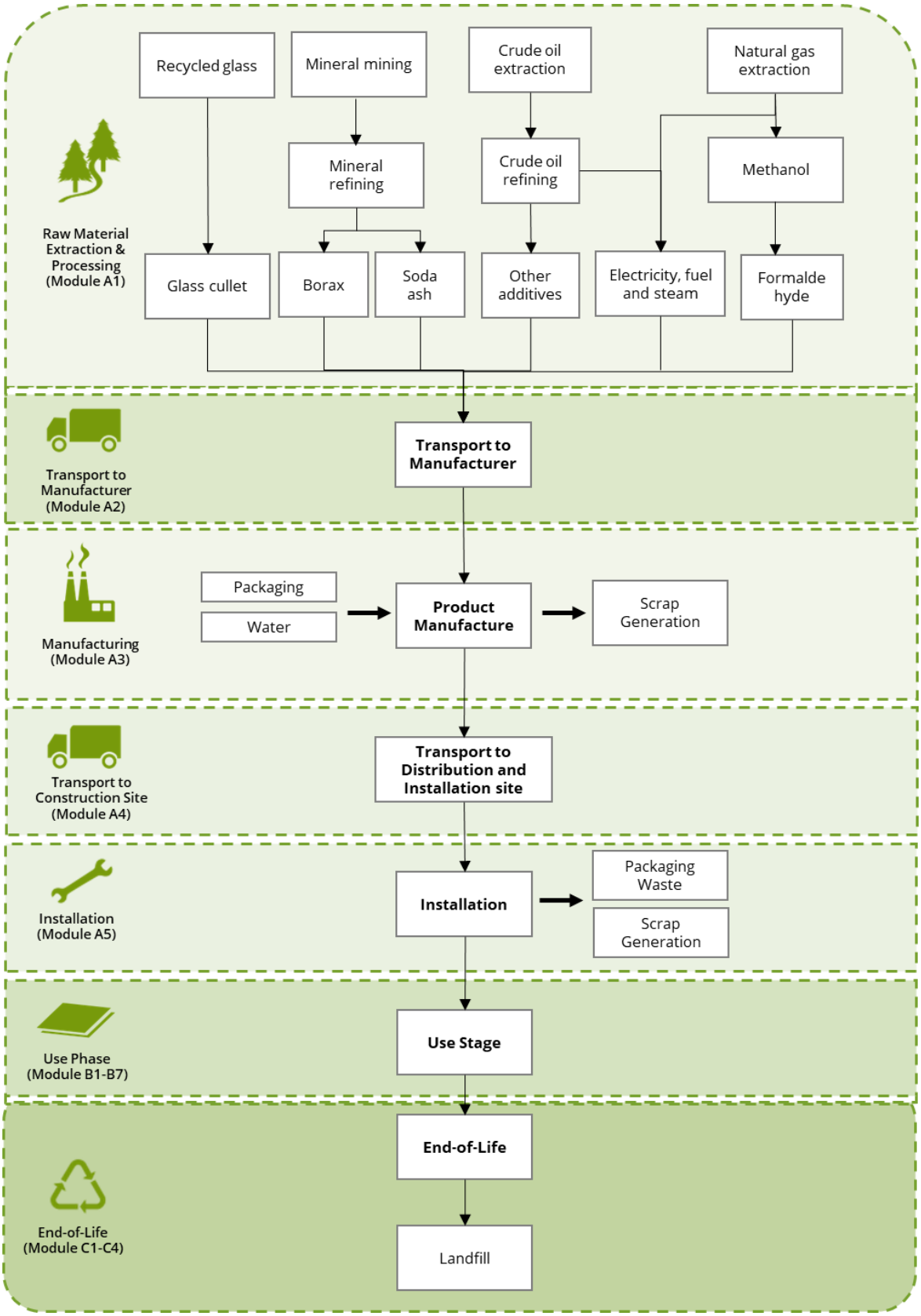


Figure 1. *Flow Diagram for the life cycle of AFICO Glass Wool Board insulation.*

4. Technical Information and Scenarios

4.1 LIFE CYCLE MODULES

Raw Material Extraction, Transport, & Manufacturing (A1-A3)

These modules include the steps required to extract, process, and transport the raw materials used to the Dammam, Kingdom of Saudia Arabia (KSA) manufacturing facility. In the A1 stage, raw material extraction accounts for the additional materials required due to the scrap generated during manufacturing, stage A3 (3%). Transport of the raw materials to is done by cargo ship and freight truck. The related technical information for the transport of the raw materials and facing are included in Table 7 and Table 8 below. The A1 stage also includes the upstream impacts associated with generation of electricity, fuel and heat.

Table 7. *The weight-distance transported per functional unit (FU), fuel utilization, and capacity utilization (percentage of vehicle's freight capacity occupied on the roundtrip) for the A2 module.*

Transport specification	Value
EURO 4, 16-32 MT Freight Lorry	
Weight-distance per FU (ton*km)	0.0401
Diesel Fuel Utilization (kg/tkm)	$3.74x10^{-2}$
Capacity Utilization (%)	37%

Table 8. *The weight-distance transported per functional unit (FU), fuel utilization, and capacity utilization (percentage of vehicle's freight capacity occupied on the roundtrip) for the A2 module of the AFICO facings.*

Transport Specifications	FKS	AWF	FRK	FS	WGF
43,000 MT Sea Container Ship					
Weight-distance per FU (ton*km)	0.706	1.04	0.511	0.531	0.315
Heavy Fuel Oil Utilization (kg/tkm)	$2.52x10^{-3}$	$2.52x10^{-3}$	$2.52x10^{-3}$	$2.52x10^{-3}$	$2.52x10^{-3}$
Capacity Utilization (%)	70%	70%	70%	70%	70%

The processing steps used to manufacture the product are described below:

- Recycled glass cullet, together with other raw materials, are melted at high temperatures (>1300°C)
- The molten glass is spun into fibers and coated with binding materials
- The spun fibers are then broken up into short fibers and interlaced/ tangled
- The tangled fibers are cured in ovens and cut/ shaped accordingly
- The finished product is packaged

These five steps require electricity, water, heat production, and light fuel oil. Nonhazardous waste is also generated, which includes 3% of product scrap, and some packaging waste, which are disposed in a nearby landfill. These inputs and outputs are recorded at a facility level, which are then allocated to each AFICO product using mass-based allocation. The electricity used at the Dammam manufacturing facility is assumed to come from the Kingdom of Saudi Arabia grid and is modeled using 2018 data from the International Energy Administration within the Ecoinvent database. Table 9 includes the quantity and energy content of manufacturing inputs and outputs as well as the mass of packaging required to package each type of fiberglass insulation product. Table 10 includes the upstream transport parameters for the packaging used for each product.

The upstream electricity used in the manufacturing process is **1.01** kg CO_2-eq/kWh (using the supplementary GWP-GHG indicator).

Table 9. *The quantity of electricity, freshwater, natural gas, and light fuel oil consumed to manufacture the insulation product as well as the mass of waste generated per functional unit (FU).*

Inputs and Outputs	Value
Electricity (kWh/FU)	$1.11x10^{-3}$
Freshwater (m^3/FU)	$3.79x10^{-3}$
Heat production (MJ/FU)*	26.1
Light Fuel Oil (kg/FU)	$3.09x10^{-3}$
Non-hazardous Waste (kg/FU)	$1.49x10^{-2}$
Hazardous Waste (kg/FU)	-

*AFICO reported heat requirements in mmBTU. These heat requirements were modeled in Ecoinvent as a natural gas boiler with condenser modulating >100kW.

Table 10. *The weight-distance transported per functional unit (FU), fuel utilization, and capacity utilization (percentage of vehicle's freight capacity occupied on the roundtrip) for the packaging used in the A3 stage.*

Transport specification	Value
EURO 4, 16-32 MT Freight Lorry	
Weight-distance per FU (ton*km)	$7.18x10^{-4}$
Diesel Fuel Utilization (kg/tkm)	$3.74x10^{-2}$
Capacity Utilization (%)	37%

Transport for disposal of all manufacturing waste is based on primary data provided by AFICO. The truck transport parameters for the waste are provided in Table 11.

Table 11. *The one-way distance, fuel utilization, and capacity utilization (percentage of vehicle's freight capacity occupied on the roundtrip) for the nonhazardous waste transported from AFICO to a nearby landfill.*

Transport specification	Value
EURO 4, 16-32 MT Freight Lorry	
One-way Distance (km)	20
Diesel Fuel Utilization (kg/tkm)	$3.74x10^{-2}$
Capacity Utilization (%)	37%
Return transport	Empty return

Transport to Installation Site (A4)

This module includes all transport from the manufacturing facility to the distribution center and installation site, based on a weighted-average sales data provided by AFICO. The technical information can be found in Table 12, based on data provided by AFICO.

Table 12. *The average one-way distance, fuel utilization, and capacity and volume capacity utilization (percentage of vehicle's freight capacity occupied on the roundtrip) for the A4 stage*

Transport Specifications	Value
EURO 4, 16-32 MT Freight Lorry	
One-way average Distance (km)	264
Diesel Fuel Utilization (kg/tkm)	$3.74x10^{-2}$
Capacity Utilization (%)	37%
Volume capacity utilization factor	1
Return transport	None. Vehicles are deployed elsewhere following transport of products
Transport, freight, sea, container ship	
One-way average Distance (km)	1538
Diesel Fuel Utilization (kg/tkm)	$2.52x10^{-2}$
Capacity Utilization (%)	70%
Volume capacity utilization factor	1
Return transport	None. Vehicles are deployed elsewhere following transport of products

Installation (A5)

Installation of the AFICO products is done primarily by hand without any additional equipment, so energy and resources required for installation are estimated to be negligible. Following the manufacturer's advice and the PCR, a material loss rate of 2% is applied to each fiberglass insulation product during installation. The A1-A4 inputs and outputs required to produce the additional product to meet the functional unit is included in this stage.

The A5 module includes the transport and treatment of waste product and product packaging at a waste disposal facility. Following secondary data, this study assumes that 100% of waste product and packaging are landfilled, with a one-way distance of 20km to a landfill facility. The same type of truck transport used in module A4 (Table 12) is used an assumed, secondary data. Table 13 includes the parameters used within the A5 module.

Table 13. *Parameters used to model module A5, product installation.*

Parameters	Value
Material Loss Rate (%)	2
Mass Product Packaging Landfilled per FU (kg)	$1.75x10^{-3}$

Use Phase (B1)

Modules B1 to B7 includes any impacts from product use. The AFICO fiberglass insulation products are not expected to have any impact in the use stage during their 50-years RSL. This includes:

- B1: No resource requirements associated with product. The assumed environmental impacts are zero.
- B2: No maintenance required during use in standard conditions and if correctly applied. The assumed environmental impacts are zero.
- B3: No repair required during use in standard conditions and if correctly applied. The assumed environmental impacts zero.
- B4: The product has an RSL of 50 years, which is as long as a building's service life. Hence, no replacement is needed, and the assumed environmental impacts are zero.
- B5: No refurbishment required during use and the assumed environmental impact are zero.
- B6: No energy use required during its operation and the assumed environmental impact are zero.
- B7: No water use required during its operation and the assumed environmental impact are zero.

The reference in-use conditions for achieving the RSL of 50 years per functional unit are as described below:

- **Product properties:** AFICO Glass Wool Board Insulation, with or without facing.
- **Design/ installation parameters:** Following standard installation processes as recommended by AFICO, with correct application
- **Applications:** For indoor applications, everyday commercial/ industrial/ residential use without chemical exposure. RSI-value was assessed at standard 24°C mean temp, although the product can withstand a large temperature range:
    - Glass Wool Board Insulation: -4°C to 232°C

Demolition (C1)

This module includes demolition of the product from the building, including on-site sorting of the materials. Per the manufacturer's advice, the products should be dismantled by hand and no resource use is required for this module.

Waste Transport (C2)

Following secondary sources, this module includes the assumed 20 km transport of product to a landfill. The truck transport fuel and capacity utilization is the same as in Module A4 and can be found in Table 12.

Waste Processing (C3)

This module includes collection of waste fraction and processing required before the product can be reused, recycled, or recovered for energy. As the study assumes all waste is landfilled, no resource use is required for this module.

Waste Transport (C4)

This module includes the impacts from landfilling of the AFICO thermal and acoustic insulation products. It is assumed that 100% of the product is landfilled in a sanitary landfill (without energy recovery).

Benefits and loads beyond the product system boundary (D)

Information module D aims at transparency for the environmental benefits or loads resulting from reusable products, recyclable materials and/or useful energy carriers leaving a product system. In the product systems in this study, all the packaging and product at end-of-life are assumed to be landfilled, without energy recovery. Hence, the benefits in module D are assumed to be 0.

Additional information on release of dangerous substances to indoor air, soil, and water during the use stage

This product is indoor air quality certified by SCS Global Services. During the use phase, the products all have a concentration 0.5 mg/m3 or less of Total Volatile Organic Compounds (TVOC).

4.2 DATA SOURCES

Table 14. *The LCI datasets from the Ecoinvent v3.8 EN15804 (2021) database used to model the product system*

Flow	Dataset
Raw Materials (Glass Wool Products)	
Recycled Glass cullet	Glass cullet, sorted, use as secondary material
Formaldehyde	Oxidation of methanol | formaldehyde | EN15804, U - RoW
Borax	Borax production, anhydrous, powder | borax, anhydrous, powder | EN15804, U - RoW
Silica sand	Silica sand production | silica sand | EN15804, U - RoW
Soda ash	Modified Solvay process, Hou's process | soda ash, dense | EN15804, U - GLO
Urea	Urea production | urea | EN15804, U - RoW
Phenol	Phenol production | phenol | EN15804, U - RoW
Limestone	Limestone production, crushed, washed | limestone, crushed, washed | EN15804, U - RoW
Hydrowax oil	Lubricating oil production | lubricating oil | EN15804, U - RoW
Caustic soda	Chlor-alkali electrolysis, membrane cell | sodium hydroxide, without water, in 50% solution state | EN15804, U - RoW
Ammonium Sulfate	Ammonium sulfate production | ammonium sulfate | EN15804, U - RoW
Silicone	Silicone product production | silicone product | EN15804, U - RoW
Silane	Silicon hydrochloration | silicon tetrahydride | EN15804, U - GLO
Raw Materials (Facings/ Jacketing Material)	
Glass Fiber	Market for glass fibre | glass fibre | EN15804, U - GLO
Kraft paper	Market for kraft paper | kraft paper | EN15804, U - RoW
Polypropylene	Market for textile, nonwoven polypropylene | textile, nonwoven polypropylene | EN15804, U - GLO
Aluminum foil	Market for anodising, aluminium sheet | anodising, aluminium sheet | EN15804, U - GLO
Transport	
Truck Transport	transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | EN15804, U - RoW
Ship Transport	transport, freight, sea, container ship | transport, freight, sea, container ship | EN15804, U – GLO
Light Commercial Vehicle (van)	transport, freight, light commercial vehicle | transport, freight, light commercial vehicle | EN15804, U - RoW
Energy and Water	
Electricity	Market for electricity, medium voltage | electricity, medium voltage | EN15804, U - SA
Natural Gas	Heat production, natural gas, at boiler condensing modulating >100kW | heat, district or industrial, natural gas | EN15804, U - RoW
Light fuel oil	Market for light fuel oil | light fuel oil | EN15804, U - RoW
Tap water	Market for tap water | tap water | EN15804, U - RoW
Product Packaging	
Polybags	Polyethylene production, high density, granulate | polyethylene, high density, granulate | EN15804, U - RoW
	Extrusion, plastic film | extrusion, plastic film | EN15804, U - RoW
Plastic landfill	Treatment of waste polyethylene, sanitary landfill | waste polyethylene | EN15804, U - RoW
Product Waste Treatment	
Product Landfilling	Treatment of waste glass, sanitary landfill | waste glass | EN15804, U - GLO
Jacketing Landfilling	Treatment of waste glass, sanitary landfill | waste glass | EN15804, U - GLO
	Treatment of waste paperboard, sanitary landfill | waste paperboard | EN15804, U - RoW
	Treatment of waste aluminium, sanitary landfill | waste aluminium | EN15804, U - RoW
	Treatment of waste plastic, mixture, sanitary landfill | waste plastic, mixture | EN15804, U - RoW

4.3 DATA QUALITY

The data quality assessment is discussed in Table 15 below for each of the data quality parameters. No data gaps were allowed which were expected to significantly affect the outcome of the impact indicator or LCI resource results.

Table 15. *Data quality assessment of the product system.*

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 10 years old (typically 2015 or more recent). All the data used represented an average of at least one year's worth of data collection. Manufacturer-supplied data (primary data) are based on annual production for 2021.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Manufacturing and raw material data are specific to the manufacturing site. Upstream surrogate data used in the assessment represent "rest of world" operations, which is applicable to KSA. Electricity data used in the manufacturing process is specific to KSA. Data representing product disposal are based on country/ regional statistics.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Upstream production data from secondary databases are using similar technology and considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of AFICO fiberglass insulation products. No known processes or activities are excluded.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is high. All secondary inventory data are from the Ecoinvent v3.8 database and of similar quality and age. Different portions of the product life cycle are equally considered; however, it must be noted that final disposal of the product is based on assumptions of current practices in KSA.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	Data representing energy and resource use at the AFICO manufacturing facility represent an annual average and are considered of high quality due to the length of time over which these data are collected (one year), as compared to a snapshot that may not accurately reflect fluctuations in production. The Ecoinvent v3.8 database is used for secondary LCI datasets.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the AFICO insulation products is low. Actual supplier data for upstream operations was not available for all suppliers and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) and were generally geographically representative. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

4.4 ALLOCATION

This study follows the allocation guidelines of ISO 14044 and allocation rules specified in the PCR and minimized the use of allocation wherever possible.

Mass allocation was deemed the most accurate and reproducible way of calculating the energy and material requirements for the manufacture of the AFICO fiberglass thermal and acoustic insulation products. Primary data for resource use (e.g., electricity, natural gas, water) are allocated on a mass-basis as a fraction of total annual production. Pre-consumer plant cullet used in the production process was also subjected to co-product allocation by mass allocation.

The transportation from primary producer of material components (e.g., the raw materials required for manufacturing) to the manufacturing facility is based on primary data provided by AFICO, including modes, distances, and amount of material transported from each supplier. Transportation was allocated based on the mass and distance of the material transported.

4.5 CUT-OFF RULES

According to the PCR, processes contributing greater than 1% of the total mass input or primary energy usage of the unit process must be included in the inventory. In the present study, all known materials and processes were included in the life cycle inventory. Any data gaps are filled with representative data and documented.

4.6 SUMMARY OF ASSUMPTIONS

- Representative inventory data for raw materials was modeled with unit process data taken from Ecoinvent.
- Representative inventory data from Ecoinvent was used to model the production of electricity (Table 14). The KSA grid mix for the AFICO manufacturing facility is modeled based on 2018 IEA data.
- For some facing/ jacketing options, there was insufficient information provided in the technical specification sheets to model the exact amount of component materials. In such cases, secondary data used to make estimation and assumptions were documented.
- Representative inventory data from Ecoinvent was used to model all transport
- The disposal method (landfilling) of product packaging and the disposal of the product at end-of-life is based on secondary data. The transport distance for all waste is also based on secondary data, with an assumption of 20km from the point of waste generation to a landfill. Ecoinvent datasets are used to model the impacts associated with landfilling, which does not include energy recovery from landfill gas.

4.7 PERIOD UNDER REVIEW

The period of review is January 1, 2021 through December 31, 2021.

4.8 COMPARABILITY

The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.

5. LCA Results

In accordance with the PCR, the core and additional environmental impact category indicators for are reported using the characterization methods required by EN 15804:2012 + A2:2019. Note that climate change impacts from land use and land use change (LULC) are not reported separately since they account for <5% of the total climate change impacts but are still accounted for in the total climate change impact category.

Table 16 presents disclaimers regarding the declaration of relevant core and additional environmental impact indicators according to the relevant classification. Table 17 presents the name, unit, and abbreviation of all core and additional impact categories.

Table 16. Information on disclaimers for environmental indicators as required by the PCR

Classification	Indicator	Disclaimer
ILCD Type 1	Global warming potential (GWP)	none
	Depletion potential of the stratospheric ozone layer (ODP)	none
	Potential incidence of disease due to PM emissions (PM)	none
ILCD Type 2	Acidification potential, Accumulated Exceedance (AP)	none
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	none
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	none
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	none
	Formation potential of tropospheric ozone (POCP)	none
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD Type 3	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2

Disclaimer 1: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nu-clear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Disclaimer 2: The results of this environmental impact indicator shall be used with case as uncertainties on these results are high or as there is limited experience with the indicator.

Table 17. *The name, unit, and abbreviation of all core and additional impact categories required by the PCR.*

Indicator Category	Unit	Abbreviation
Climate Change – GWP-GHG	kg CO_2 eq	GWP-GHG
Climate Change - Total	kg CO_2 eq	GWP – Total
Climate Change - Biogenic	kg CO_2 eq	GWP – Biogenic
Climate Change - Fossil	kg CO_2 eq	GWP – Fossil
Photochemical ozone formation	kg NMVOC eq	POCP
Ozone Depletion	kg CFC-11 eq	ODP
Acidification	mol H^+ eq	AP
Eutrophication aquatic freshwater	kg PO_4 eq & kg P eq	EP – fw
Eutrophication aquatic marine	kg N eq	EP – m
Eutrophication terrestrial	mol N eq	EP – t
Depletion of abiotic resources – minerals and metals	kg Sb eq	ADP – mm
Depletion of abiotic resources – fossil fuels	MJ, NCV	ADP – ff
Water use	m^3 world deprived eq	WDP
Particulate matter emissions	Disease incidence	PM
Ionising radiation, human health	kBq	IRP
Ecotoxicity (freshwater)	CTUe	ETP – fw
Human toxicity, cancer effects	CTUh	HTP - c
Human toxicity, non-cancer effects	CTUh	HTP – nc
Land use related impacts / soil quality	Dimensionless	SQP

The cradle-to-grave LCIA results of the product are presented below in Table 18. Table 19 displays the absolute value of each impact indicator by life cycle stage for an unfaced product. Table 20 to Table 24 displays the absolute value of each impact indicator by life cycle stage for a product with the applicable facing types.

Table 18. *Cradle-to-grave results for all impact categories, unfaced and with facing options.*

Impact Indicator (units)	Unfaced	w/ FRK	w/ WGF	w/ AWF	w/ FS	w/ FKS
GWP-GHG (kg CO_2 eq)	3.59	3.91	3.97	4.88	4.37	4.03
GWP - Total (kg CO_2 eq)	3.65	4.00	3.97	4.90	4.38	4.03
GWP - Biogenic (kg CO_2 eq)	$2.04x10^{-3}$	3.73	3.65	3.67	3.66	3.65
GWP - Fossil (kg CO_2 eq)	3.64	0.326	0.383	1.29	0.780	0.445
POCP (kg NMVOC eq)	$8.20x10^{-3}$	3.64	3.64	3.65	3.65	3.64
ODP (kg CFC-11 eq)	$4.63x10^{-7}$	$8.20x10^{-3}$	$8.20x10^{-3}$	$8.20x10^{-3}$	$8.20x10^{-3}$	$8.20x10^{-3}$
AP (mol H^+ eq)	$1.29x10^{-2}$	$2.17x10^{-3}$	$2.85x10^{-3}$	$8.42x10^{-3}$	$4.85x10^{-3}$	$2.94x10^{-3}$
EP – fw - P (kg P eq)	$1.90x10^{-4}$	$1.31x10^{-2}$	$1.30x10^{-2}$	$1.34x10^{-2}$	$1.32x10^{-2}$	$1.31x10^{-2}$
EP – fw - PO_4 (kg PO_4 eq)	$2.62x10^{-3}$	$4.03x10^{-2}$	$4.00x10^{-2}$	$4.12x10^{-2}$	$4.06x10^{-2}$	$4.01x10^{-2}$
EP – m (kg N eq)	$2.54x10^{-2}$	$8.21x10^{-4}$	$8.22x10^{-4}$	$1.90x10^{-3}$	$1.19x10^{-3}$	$8.69x10^{-4}$
EP – t (mol N eq.)	$7.05x10^{-5}$	$7.62x10^{-3}$	$9.32x10^{-3}$	$1.96x10^{-2}$	$1.22x10^{-2}$	$9.13x10^{-3}$
ADP – mm (kg Sb eq)	4.01	$2.54x10^{-2}$	$2.54x10^{-2}$	$2.54x10^{-2}$	$2.54x10^{-2}$	$2.54x10^{-2}$
ADP – ff (MJ, NCV)	0.942	2.57	1.83	10.3	6.38	2.73
WDP (m^3 world eq. deprived)	$9.95x10^{-8}$	4.69	4.12	6.73	5.78	4.54
PM (disease incidence)	$8.97x10^{-2}$	0.942	0.942	0.942	0.942	0.942
IRP (kBq U235 eq.)	0.868	$3.13x10^{-2}$	$3.47x10^{-2}$	0.131	$7.78x10^{-2}$	$3.95x10^{-2}$
ETP – fw (CTUe)	$1.08x10^{-9}$	0.336	0.240	1.03	0.662	0.311
HTP – c (CTUh)	$4.01x10^{-8}$	0.868	0.868	0.868	0.868	0.868
HTP – nc (CTUh)	3.59	$2.11x10^{-8}$	$3.57x10^{-8}$	$9.63x10^{-8}$	$5.42x10^{-8}$	$3.20x10^{-8}$
SQP (dimensionless)	3.65	0.965	1.35	2.88	1.59	1.20

Table 19. *Unfaced Glass Wool Board Insulation LCIA results per functional unit for all EN 15804:2012+A2:2019 impact categories reported by life cycle stage. All values are rounded to three significant digits.*

Impact Categories	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP-GHG	3.59	3.27	$6.84x10^{-3}$	$7.99x10^{-3}$	0.158	0.103	0	0	$3.10x10^{-2}$	0	$7.73x10^{-3}$	0
GWP - Total	3.65	3.33	$6.90x10^{-3}$	$8.91x10^{-3}$	0.160	0.105	0	0	$3.16x10^{-2}$	0	$7.90x10^{-3}$	0
GWP - Biogenic	$2.04x10^{-3}$	$7.70x10^{-4}$	$1.15x10^{-5}$	$8.00x10^{-4}$	$2.50x10^{-4}$	$6.08x10^{-5}$	0	0	$5.38x10^{-5}$	0	$9.20x10^{-5}$	0
GWP - Fossil	3.64	3.32	$6.89x10^{-3}$	$8.10x10^{-3}$	0.160	0.105	0	0	$3.15x10^{-2}$	0	$7.80x10^{-3}$	0
POCP	$8.20x10^{-3}$	$6.48x10^{-3}$	$3.63x10^{-5}$	$2.88x10^{-5}$	$1.06x10^{-3}$	$3.30x10^{-4}$	0	0	$1.80x10^{-4}$	0	$7.68x10^{-5}$	0
ODP	$4.63x10^{-7}$	$4.02x10^{-7}$	$1.50x10^{-9}$	$1.38x10^{-9}$	$3.44x10^{-8}$	$1.49x10^{-8}$	0	0	$6.16x10^{-9}$	0	$2.65x10^{-9}$	0
AP	$1.29x10^{-2}$	$1.10x10^{-2}$	$3.50x10^{-5}$	$5.20x10^{-5}$	$1.16x10^{-3}$	$4.20x10^{-4}$	0	0	$1.80x10^{-4}$	0	$7.02x10^{-5}$	0
EP- fw - P	$1.90x10^{-4}$	$1.60x10^{-4}$	$5.22x10^{-7}$	$6.58x10^{-6}$	$1.15x10^{-5}$	$8.64x10^{-6}$	0	0	$4.77x10^{-6}$	0	$7.97x10^{-7}$	0
EP - fw - PO_4	$5.83x10^{-4}$	$4.91x10^{-4}$	$1.60x10^{-6}$	$2.02x10^{-5}$	$3.54x10^{-5}$	$2.65x10^{-5}$	0	0	$1.46x10^{-5}$	0	$2.45x10^{-6}$	0
EP - m	$2.62x10^{-3}$	$1.95x10^{-3}$	$1.19x10^{-5}$	$8.61x10^{-5}$	$3.50x10^{-4}$	$1.50x10^{-4}$	0	0	$5.26x10^{-5}$	0	$2.49x10^{-5}$	0
EP - t	$2.54x10^{-2}$	$1.93x10^{-2}$	$1.30x10^{-4}$	$1.30x10^{-4}$	$3.89x10^{-3}$	$1.04x10^{-3}$	0	0	$5.80x10^{-4}$	0	$2.70x10^{-4}$	0
ADP - mm	$7.05x10^{-5}$	$6.76x10^{-5}$	$2.27x10^{-8}$	$6.48x10^{-8}$	$5.01x10^{-7}$	$1.83x10^{-6}$	0	0	$4.35x10^{-7}$	0	$2.45x10^{-8}$	0
ADP - ff	4.01	3.43	$1.18x10^{-2}$	$5.88x10^{-2}$	0.259	0.158	0	0	$7.47x10^{-2}$	0	$1.79x10^{-2}$	0
WDP	0.942	0.876	$5.00x10^{-4}$	$1.87x10^{-2}$	$1.11x10^{-2}$	$2.29x10^{-2}$	0	0	$3.57x10^{-3}$	0	$9.09x10^{-3}$	0
PM	$9.95x10^{-8}$	$7.81x10^{-8}$	$4.92x10^{-10}$	$6.35x10^{-10}$	$1.09x10^{-8}$	$5.00x10^{-9}$	0	0	$3.04x10^{-9}$	0	$1.43x10^{-9}$	0
IRP	$8.97x10^{-2}$	$7.02x10^{-2}$	$4.70x10^{-4}$	$8.60x10^{-4}$	$1.08x10^{-2}$	$4.15x10^{-3}$	0	0	$2.46x10^{-3}$	0	$8.40x10^{-4}$	0
ETP - fw	0.868	0.750	$3.33x10^{-3}$	$8.16x10^{-3}$	$7.28x10^{-2}$	$2.45x10^{-2}$	0	0	$8.17x10^{-3}$	0	$1.56x10^{-3}$	0
HTP - c	$1.08x10^{-9}$	$8.82x10^{-10}$	$2.20x10^{-12}$	$2.17x10^{-11}$	$5.37x10^{-11}$	$6.93x10^{-11}$	0	0	$4.61x10^{-11}$	0	$4.85x10^{-12}$	0
HTP - nc	$4.01x10^{-8}$	$3.27x10^{-8}$	$1.42x10^{-10}$	$8.82x10^{-10}$	$3.11x10^{-9}$	$2.00x10^{-9}$	0	0	$1.18x10^{-9}$	0	$1.25x10^{-10}$	0
SQP	4.33	1.13	$8.44x10^{-2}$	$3.12x10^{-2}$	1.80	0.311	0	0	0.232	0	0.741	0

Table 20. *Glass Wool Board Insulation with FRK facing LCIA results per functional unit for all EN 15804:2012+A2: 2019 impact categories reported by life cycle stage. All values are rounded to three significant digits.*

Impact Categories	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP-GHG	3.91	3.55	$1.16x10^{-2}$	$7.99x10^{-3}$	0.197	0.103	0	0	$3.39x10^{-2}$	0	$9.28x10^{-3}$	0
GWP - Total	4.06	3.56	$1.17x10^{-2}$	$8.91x10^{-3}$	0.199	0.105	0	0	$3.45x10^{-2}$	0	0.136	0
GWP - Biogenic	$8.98x10^{-2}$	$-3.81x10^{-2}$	$1.17x10^{-5}$	$8.00x10^{-4}$	$3.12x10^{-4}$	$6.08x10^{-5}$	0	0	$5.87x10^{-5}$	0	0.127	0
GWP - Fossil	3.97	3.60	$1.17x10^{-2}$	$8.10x10^{-3}$	0.199	0.105	0	0	$3.44x10^{-2}$	0	$9.35x10^{-3}$	0
POCP	$9.63x10^{-3}$	$7.52x10^{-3}$	$1.47x10^{-4}$	$2.88x10^{-5}$	$1.28x10^{-3}$	$3.30x10^{-4}$	0	0	$1.96x10^{-4}$	0	$1.22x10^{-4}$	0
ODP	$4.89x10^{-7}$	$4.18x10^{-7}$	$2.45x10^{-9}$	$1.38x10^{-9}$	$4.21x10^{-8}$	$1.49x10^{-8}$	0	0	$6.71x10^{-9}$	0	$2.92x10^{-9}$	0
AP	$1.51x10^{-2}$	$1.28x10^{-2}$	$1.91x10^{-4}$	$5.20x10^{-5}$	$1.38x10^{-3}$	$4.20x10^{-4}$	0	0	$1.96x10^{-4}$	0	$8.79x10^{-5}$	0
EP- fw - P	$3.70x10^{-4}$	$3.33x10^{-4}$	$6.81x10^{-7}$	$6.58x10^{-6}$	$1.73x10^{-5}$	$8.64x10^{-6}$	0	0	$5.20x10^{-6}$	0	$1.20x10^{-6}$	0
EP - fw - PO_4	$1.14x10^{-3}$	$1.02x10^{-3}$	$2.09x10^{-6}$	$2.02x10^{-5}$	$5.31x10^{-5}$	$2.65x10^{-5}$	0	0	$1.60x10^{-5}$	0	$1.21x10^{-4}$	0
EP - m	$3.25x10^{-3}$	$2.35x10^{-3}$	$5.03x10^{-5}$	$8.61x10^{-5}$	$4.15x10^{-4}$	$1.50x10^{-4}$	0	0	$5.73x10^{-5}$	0	$6.39x10^{-5}$	0
EP - t	$3.04x10^{-2}$	$2.31x10^{-2}$	$5.57x10^{-4}$	$1.30x10^{-4}$	$4.61x10^{-3}$	$1.04x10^{-3}$	0	0	$6.32x10^{-4}$	0	$2.70x10^{-4}$	0
ADP - mm	$7.73x10^{-5}$	$7.38x10^{-5}$	$2.90x10^{-8}$	$6.48x10^{-8}$	$1.04x10^{-6}$	$1.83x10^{-6}$	0	0	$4.75x10^{-7}$	0	$9.02x10^{-3}$	0
ADP - ff	6.58	5.89	$1.51x10^{-2}$	$5.88x10^{-2}$	0.350	0.158	0	0	$8.15x10^{-2}$	0	$1.90x10^{-2}$	0
WDP	1.62	1.54	$6.54x10^{-4}$	$1.87x10^{-2}$	$1.55x10^{-2}$	$2.29x10^{-2}$	0	0	$3.89x10^{-3}$	0	$9.09x10^{-3}$	0
PM	$1.21x10^{-7}$	$9.56x10^{-8}$	$6.37x10^{-10}$	$6.35x10^{-10}$	$1.46x10^{-8}$	$5.00x10^{-9}$	0	0	$3.31x10^{-9}$	0	$1.76x10^{-4}$	0
IRP	0.121	$9.78x10^{-2}$	$7.47x10^{-4}$	$8.60x10^{-4}$	$1.37x10^{-2}$	$4.15x10^{-3}$	0	0	$2.68x10^{-3}$	0	$1.61x10^{-3}$	0
ETP - fw	1.11	0.984	$3.99x10^{-3}$	$8.16x10^{-3}$	$8.29x10^{-2}$	$2.45x10^{-2}$	0	0	$8.91x10^{-3}$	0	$1.56x10^{-3}$	0
HTP - c	$1.62x10^{-9}$	$1.35x10^{-9}$	$4.80x10^{-12}$	$2.17x10^{-11}$	$1.11x10^{-10}$	$6.93x10^{-11}$	0	0	$5.03x10^{-11}$	0	$1.81x10^{-10}$	0
HTP - nc	$6.02x10^{-8}$	$5.10x10^{-8}$	$1.72x10^{-10}$	$8.82x10^{-10}$	$4.56x10^{-9}$	$2.00x10^{-9}$	0	0	$1.29x10^{-9}$	0	$6.94x10^{-2}$	0
SQP	5.29	1.71	$8.61x10^{-2}$	$3.12x10^{-2}$	2.09	0.311	0	0	0.253	0	0.741	0

Table 21. *Glass Wool Board Insulation with WGF facing LCIA results per functional unit for all EN 15804:2012+A2:2019 impact categories reported by life cycle stage. All values are rounded to three significant digits.*

Impact Categories	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP-GHG	3.97	3.58	$9.81x10^{-3}$	$7.99x10^{-3}$	0.223	0.103	0	0	$3.57x10^{-2}$	0	$8.89x10^{-3}$	0
GWP - Total	4.03	3.63	$9.87x10^{-3}$	$8.91x10^{-3}$	0.224	0.105	0	0	$3.63x10^{-2}$	0	$9.08x10^{-3}$	0
GWP - Biogenic	$3.11x10^{-3}$	$1.71x10^{-3}$	$1.16x10^{-5}$	$8.00x10^{-4}$	$3.53x10^{-4}$	$6.08x10^{-5}$	0	0	$6.18x10^{-5}$	0	$1.06x10^{-4}$	0
GWP - Fossil	4.02	3.63	$9.85x10^{-3}$	$8.10x10^{-3}$	0.224	0.105	0	0	$3.62x10^{-2}$	0	$8.96x10^{-3}$	0
POCP	$1.01x10^{-2}$	$7.90x10^{-3}$	$1.04x10^{-4}$	$2.88x10^{-5}$	$1.42x10^{-3}$	$3.30x10^{-4}$	0	0	$2.06x10^{-4}$	0	$8.83x10^{-5}$	0
ODP	$4.98x10^{-7}$	$4.22x10^{-7}$	$2.09x10^{-9}$	$1.38x10^{-9}$	$4.70x10^{-8}$	$1.49x10^{-8}$	0	0	$7.07x10^{-9}$	0	$3.04x10^{-9}$	0
AP	$1.58x10^{-2}$	$1.34x10^{-2}$	$1.31x10^{-4}$	$5.20x10^{-5}$	$1.52x10^{-3}$	$4.20x10^{-4}$	0	0	$2.06x10^{-4}$	0	$8.07x10^{-5}$	0
EP – fw - P	$2.91x10^{-4}$	$2.51x10^{-4}$	$6.20x10^{-7}$	$6.58x10^{-6}$	$2.10x10^{-5}$	$8.64x10^{-6}$	0	0	$5.48x10^{-6}$	0	$9.16x10^{-7}$	0
EP – fw – PO_4	$8.94x10^{-4}$	$7.70x10^{-4}$	$1.90x10^{-6}$	$2.02x10^{-5}$	$6.45x10^{-5}$	$2.65x10^{-5}$	0	0	$1.68x10^{-5}$	0	$6.15x10^{-6}$	0
EP - m	$3.25x10^{-3}$	$2.44x10^{-3}$	$3.56x10^{-5}$	$8.61x10^{-5}$	$4.57x10^{-4}$	$1.50x10^{-4}$	0	0	$6.04x10^{-5}$	0	$6.53x10^{-5}$	0
EP - t	$3.21x10^{-2}$	$2.45x10^{-2}$	$3.93x10^{-4}$	$1.30x10^{-4}$	$5.07x10^{-3}$	$1.04x10^{-3}$	0	0	$6.66x10^{-4}$	0	$2.70x10^{-4}$	0
ADP - mm	$1.15x10^{-4}$	$1.12x10^{-4}$	$2.66x10^{-8}$	$6.48x10^{-8}$	$1.39x10^{-6}$	$1.83x10^{-6}$	0	0	$5.00x10^{-7}$	0	$2.67x10^{-3}$	0
ADP - ff	5.84	5.10	$1.38x10^{-2}$	$5.88x10^{-2}$	0.409	0.158	0	0	$8.59x10^{-2}$	0	$1.93x10^{-2}$	0
WDP	1.05	0.972	$5.95x10^{-4}$	$1.87x10^{-2}$	$1.83x10^{-2}$	$2.29x10^{-2}$	0	0	$4.10x10^{-3}$	0	$9.09x10^{-3}$	0
PM	$1.24x10^{-7}$	$9.55x10^{-8}$	$5.81x10^{-10}$	$6.35x10^{-10}$	$1.71x10^{-8}$	$5.00x10^{-9}$	0	0	$3.49x10^{-9}$	0	$1.25x10^{-4}$	0
IRP	0.124	$9.93x10^{-2}$	$6.41x10^{-4}$	$8.60x10^{-4}$	$1.57x10^{-2}$	$4.15x10^{-3}$	0	0	$2.83x10^{-3}$	0	$1.07x10^{-3}$	0
ETP - fw	1.02	0.882	$3.74x10^{-3}$	$8.16x10^{-3}$	$8.94x10^{-2}$	$2.45x10^{-2}$	0	0	$9.39x10^{-3}$	0	$1.56x10^{-3}$	0
HTP - c	$1.47x10^{-9}$	$1.16x10^{-9}$	$3.80x10^{-12}$	$2.17x10^{-11}$	$1.49x10^{-10}$	$6.93x10^{-11}$	0	0	$5.30x10^{-11}$	0	$2.35x10^{-11}$	0
HTP - nc	$7.48x10^{-8}$	$6.47x10^{-8}$	$1.61x10^{-10}$	$8.82x10^{-10}$	$5.50x10^{-9}$	$2.00x10^{-9}$	0	0	$1.36x10^{-9}$	0	0.110	0
SQP	5.68	1.86	$8.54x10^{-2}$	$3.12x10^{-2}$	2.28	0.311	0	0	0.267	0	0.741	0

Table 22. *Glass Wool Board Insulation with AWF facing LCIA results per functional unit for all EN 15804:2012+A2:2019 impact categories reported by life cycle stage. All values are rounded to three significant digits.*

Impact Categories	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP-GHG	4.88	4.46	$1.66x10^{-2}$	$7.99x10^{-3}$	0.238	0.103	0	0	$3.68x10^{-2}$	0	$9.43x10^{-3}$	0
GWP - Total	4.95	4.54	$1.67x10^{-2}$	$8.91x10^{-3}$	0.240	0.105	0	0	$3.74x10^{-2}$	0	$9.62x10^{-3}$	0
GWP - Biogenic	$2.23x10^{-2}$	$2.09x10^{-2}$	$1.18x10^{-5}$	$8.00x10^{-4}$	$3.77x10^{-4}$	$6.08x10^{-5}$	0	0	$6.38x10^{-5}$	0	$1.16x10^{-4}$	0
GWP - Fossil	4.93	4.51	$1.67x10^{-2}$	$8.10x10^{-3}$	0.239	0.105	0	0	$3.73x10^{-2}$	0	$9.50x10^{-3}$	0
POCP	$1.30x10^{-2}$	$1.05x10^{-2}$	$2.61x10^{-4}$	$2.88x10^{-5}$	$1.51x10^{-3}$	$3.30x10^{-4}$	0	0	$2.13x10^{-4}$	0	$9.23x10^{-5}$	0
ODP	$5.50x10^{-7}$	$4.70x10^{-7}$	$3.44x10^{-9}$	$1.38x10^{-9}$	$5.00x10^{-8}$	$1.49x10^{-8}$	0	0	$7.29x10^{-9}$	0	$3.17x10^{-9}$	0
AP	$2.14x10^{-2}$	$1.86x10^{-2}$	$3.54x10^{-4}$	$5.20x10^{-5}$	$1.60x10^{-3}$	$4.20x10^{-4}$	0	0	$2.12x10^{-4}$	0	$8.49x10^{-5}$	0
EP – fw - P	$6.76x10^{-4}$	$6.33x10^{-4}$	$8.45x10^{-7}$	$6.58x10^{-6}$	$2.33x10^{-5}$	$8.64x10^{-6}$	0	0	$5.65x10^{-6}$	0	$1.02x10^{-6}$	0
EP – fw – PO_4	$2.08x10^{-3}$	$1.94x10^{-3}$	$2.60x10^{-6}$	$2.02x10^{-5}$	$7.15x10^{-5}$	$2.65x10^{-5}$	0	0	$1.74x10^{-5}$	0	$7.46x10^{-6}$	0
EP - m	$4.33x10^{-3}$	$3.43x10^{-3}$	$9.03x10^{-5}$	$8.61x10^{-5}$	$4.83x10^{-4}$	$1.50x10^{-4}$	0	0	$6.23x10^{-5}$	0	$7.95x10^{-5}$	0
EP - t	$4.24x10^{-2}$	$3.39x10^{-2}$	$1.00x10^{-3}$	$1.30x10^{-4}$	$5.35x10^{-3}$	$1.04x10^{-3}$	0	0	$6.87x10^{-4}$	0	$2.70x10^{-4}$	0
ADP - mm	$1.32x10^{-4}$	$1.28x10^{-4}$	$3.54x10^{-8}$	$6.48x10^{-8}$	$1.60x10^{-6}$	$1.83x10^{-6}$	0	0	$5.16x10^{-7}$	0	$5.23x10^{-3}$	0
ADP - ff	14.3	13.5	$1.86x10^{-2}$	$5.88x10^{-2}$	0.444	0.158	0	0	$8.85x10^{-2}$	0	$1.97x10^{-2}$	0
WDP	3.65	3.58	$8.13x10^{-4}$	$1.87x10^{-2}$	$2.01x10^{-2}$	$2.29x10^{-2}$	0	0	$4.23x10^{-3}$	0	$9.09x10^{-3}$	0
PM	$1.77x10^{-7}$	$1.46x10^{-7}$	$7.87x10^{-10}$	$6.35x10^{-10}$	$1.86x10^{-8}$	$5.00x10^{-9}$	0	0	$3.60x10^{-9}$	0	$1.77x10^{-4}$	0
IRP	0.220	0.194	$1.04x10^{-3}$	$8.60x10^{-4}$	$1.69x10^{-2}$	$4.15x10^{-3}$	0	0	$2.91x10^{-3}$	0	$1.26x10^{-3}$	0
ETP - fw	1.81	1.66	$4.68x10^{-3}$	$8.16x10^{-3}$	$9.34x10^{-2}$	$2.45x10^{-2}$	0	0	$9.68x10^{-3}$	0	$1.56x10^{-3}$	0
HTP - c	$3.25x10^{-9}$	$2.92x10^{-9}$	$7.51x10^{-12}$	$2.17x10^{-11}$	$1.71x10^{-10}$	$6.93x10^{-11}$	0	0	$5.47x10^{-11}$	0	$3.96x10^{-11}$	0
HTP - nc	$1.35x10^{-7}$	$1.25x10^{-7}$	$2.04x10^{-10}$	$8.82x10^{-10}$	$6.07x10^{-9}$	$2.00x10^{-9}$	0	0	$1.40x10^{-9}$	0	0.143	0
SQP	7.21	3.23	$8.79x10^{-2}$	$3.12x10^{-2}$	2.39	0.311	0	0	0.275	0	0.741	0

Table 23. *Glass Wool Board Insulation with FS facing LCIA results per functional unit for all EN 15804:2012+A2:2019 impact categories reported by life cycle stage. All values are rounded to three significant digits.*

Impact Categories	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP-GHG	4.37	4.00	$1.18x10^{-2}$	$7.99x10^{-3}$	0.199	0.103	0	0	$3.40x10^{-2}$	0	$1.03x10^{-2}$	0
GWP - Total	4.44	4.07	$1.19x10^{-2}$	$8.91x10^{-3}$	0.201	0.105	0	0	$3.46x10^{-2}$	0	$1.05x10^{-2}$	0
GWP - Biogenic	$1.39x10^{-2}$	$1.25x10^{-2}$	$1.17x10^{-5}$	$8.00x10^{-4}$	$3.15x10^{-4}$	$6.08x10^{-5}$	0	0	$5.89x10^{-5}$	0	$1.05x10^{-4}$	0
GWP - Fossil	4.42	4.05	$1.19x10^{-2}$	$8.10x10^{-3}$	0.200	0.105	0	0	$3.45x10^{-2}$	0	$1.04x10^{-2}$	0
POCP	$1.09x10^{-2}$	$8.84x10^{-3}$	$1.51x10^{-4}$	$2.88x10^{-5}$	$1.29x10^{-3}$	$3.30x10^{-4}$	0	0	$1.97x10^{-4}$	0	$8.53x10^{-5}$	0
ODP	$5.12x10^{-7}$	$4.41x10^{-7}$	$2.49x10^{-9}$	$1.38x10^{-9}$	$4.24x10^{-8}$	$1.49x10^{-8}$	0	0	$6.73x10^{-9}$	0	$2.92x10^{-9}$	0
AP	$1.78x10^{-2}$	$1.55x10^{-2}$	$1.97x10^{-4}$	$5.20x10^{-5}$	$1.39x10^{-3}$	$4.20x10^{-4}$	0	0	$1.97x10^{-4}$	0	$7.81x10^{-5}$	0
EP – fw - P	$4.87x10^{-4}$	$4.51x10^{-4}$	$6.87x10^{-7}$	$6.58x10^{-6}$	$1.75x10^{-5}$	$8.64x10^{-6}$	0	0	$5.22x10^{-6}$	0	$9.34x10^{-7}$	0
EP – fw – PO_4	$1.50x10^{-3}$	$1.38x10^{-3}$	$2.11x10^{-6}$	$2.02x10^{-5}$	$5.38x10^{-5}$	$2.65x10^{-5}$	0	0	$1.60x10^{-5}$	0	$3.84x10^{-5}$	0
EP - m	$3.62x10^{-3}$	$2.80x10^{-3}$	$5.18x10^{-5}$	$8.61x10^{-5}$	$4.18x10^{-4}$	$1.50x10^{-4}$	0	0	$5.75x10^{-5}$	0	$5.36x10^{-5}$	0
EP - t	$3.49x10^{-2}$	$2.76x10^{-2}$	$5.74x10^{-4}$	$1.30x10^{-4}$	$4.63x10^{-3}$	$1.04x10^{-3}$	0	0	$6.34x10^{-4}$	0	$2.70x10^{-4}$	0
ADP - mm	$9.74x10^{-5}$	$9.39x10^{-5}$	$2.92x10^{-8}$	$6.48x10^{-8}$	$1.06x10^{-6}$	$1.83x10^{-6}$	0	0	$4.76x10^{-7}$	0	$3.21x10^{-3}$	0
ADP - ff	10.4	9.70	$1.52x10^{-2}$	$5.88x10^{-2}$	0.354	0.158	0	0	$8.18x10^{-2}$	0	$1.89x10^{-2}$	0
WDP	2.71	2.63	$6.60x10^{-4}$	$1.87x10^{-2}$	$1.57x10^{-2}$	$2.29x10^{-2}$	0	0	$3.91x10^{-3}$	0	$9.09x10^{-3}$	0
PM	$1.45x10^{-7}$	$1.19x10^{-7}$	$6.42x10^{-10}$	$6.35x10^{-10}$	$1.48x10^{-8}$	$5.00x10^{-9}$	0	0	$3.32x10^{-9}$	0	$9.66x10^{-5}$	0
IRP	0.167	0.144	$7.58x10^{-4}$	$8.60x10^{-4}$	$1.39x10^{-2}$	$4.15x10^{-3}$	0	0	$2.69x10^{-3}$	0	$1.22x10^{-3}$	0
ETP - fw	1.44	1.31	$4.02x10^{-3}$	$8.16x10^{-3}$	$8.33x10^{-2}$	$2.45x10^{-2}$	0	0	$8.94x10^{-3}$	0	$1.56x10^{-3}$	0
HTP - c	$2.40x10^{-9}$	$2.14x10^{-9}$	$4.91x10^{-12}$	$2.17x10^{-11}$	$1.14x10^{-10}$	$6.93x10^{-11}$	0	0	$5.05x10^{-11}$	0	$2.76x10^{-11}$	0
HTP - nc	$9.33x10^{-8}$	$8.42x10^{-8}$	$1.73x10^{-10}$	$8.82x10^{-10}$	$4.62x10^{-9}$	$2.00x10^{-9}$	0	0	$1.29x10^{-9}$	0	$7.35x10^{-2}$	0
SQP	5.92	2.32	$8.62x10^{-2}$	$3.12x10^{-2}$	2.10	0.311	0	0	0.254	0	0.741	0

Table 24. *Glass Wool Board Insulation with FKS facing LCIA results per functional unit for all EN 15804:2012+A2:2019 impact categories reported by life cycle stage. All values are rounded to three significant digits.*

Impact Categories	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP-GHG	4.03	3.65	$1.35x10^{-2}$	$7.99x10^{-3}$	0.212	0.103	0	0	$3.50x10^{-2}$	0	$1.12x10^{-2}$	0
GWP - Total	4.09	3.70	$1.35x10^{-2}$	$8.91x10^{-3}$	0.214	0.105	0	0	$3.56x10^{-2}$	0	$1.14x10^{-2}$	0
GWP - Biogenic	$4.23x10^{-3}$	$2.85x10^{-3}$	$1.17x10^{-5}$	$8.00x10^{-4}$	$3.36x10^{-4}$	$6.08x10^{-5}$	0	0	$6.06x10^{-5}$	0	$1.04x10^{-4}$	0
GWP - Fossil	4.09	3.70	$1.35x10^{-2}$	$8.10x10^{-3}$	0.214	0.105	0	0	$3.55x10^{-2}$	0	$1.13x10^{-2}$	0
POCP	$1.01x10^{-2}$	$7.88x10^{-3}$	$1.89x10^{-4}$	$2.88x10^{-5}$	$1.36x10^{-3}$	$3.30x10^{-4}$	0	0	$2.02x10^{-4}$	0	$8.73x10^{-5}$	0
ODP	$4.96x10^{-7}$	$4.22x10^{-7}$	$2.81x10^{-9}$	$1.38x10^{-9}$	$4.50x10^{-8}$	$1.49x10^{-8}$	0	0	$6.92x10^{-9}$	0	$2.98x10^{-9}$	0
AP	$1.59x10^{-2}$	$1.34x10^{-2}$	$2.51x10^{-4}$	$5.20x10^{-5}$	$1.46x10^{-3}$	$4.20x10^{-4}$	0	0	$2.02x10^{-4}$	0	$7.95x10^{-5}$	0
EP – fw - P	$3.24x10^{-4}$	$2.85x10^{-4}$	$7.41x10^{-7}$	$6.58x10^{-6}$	$1.95x10^{-5}$	$8.64x10^{-6}$	0	0	$5.37x10^{-6}$	0	$9.28x10^{-7}$	0
EP – fw – PO_4	$9.96x10^{-4}$	$8.76x10^{-4}$	$2.28x10^{-6}$	$2.02x10^{-5}$	$5.98x10^{-5}$	$2.65x10^{-5}$	0	0	$1.65x10^{-5}$	0	$5.44x10^{-5}$	0
EP - m	$3.30x10^{-3}$	$2.43x10^{-3}$	$6.50x10^{-5}$	$8.61x10^{-5}$	$4.40x10^{-4}$	$1.50x10^{-4}$	0	0	$5.92x10^{-5}$	0	$5.99x10^{-5}$	0
EP - t	$3.19x10^{-2}$	$2.42x10^{-2}$	$7.20x10^{-4}$	$1.30x10^{-4}$	$4.88x10^{-3}$	$1.04x10^{-3}$	0	0	$6.52x10^{-4}$	0	$2.70x10^{-4}$	0
ADP - mm	$9.76x10^{-5}$	$9.39x10^{-5}$	$3.13x10^{-8}$	$6.48x10^{-8}$	$1.25x10^{-6}$	$1.83x10^{-6}$	0	0	$4.90x10^{-7}$	0	$2.95x10^{-3}$	0
ADP - ff	6.74	6.02	$1.64x10^{-2}$	$5.88x10^{-2}$	0.385	0.158	0	0	$8.41x10^{-2}$	0	$1.91x10^{-2}$	0
WDP	1.47	1.40	$7.12x10^{-4}$	$1.87x10^{-2}$	$1.72x10^{-2}$	$2.29x10^{-2}$	0	0	$4.02x10^{-3}$	0	$9.09x10^{-3}$	0
PM	$1.25x10^{-7}$	$9.80x10^{-8}$	$6.92x10^{-10}$	$6.35x10^{-10}$	$1.61x10^{-8}$	$5.00x10^{-9}$	0	0	$3.42x10^{-9}$	0	$1.14x10^{-4}$	0
IRP	0.129	0.105	$8.53x10^{-4}$	$8.60x10^{-4}$	$1.49x10^{-2}$	$4.15x10^{-3}$	0	0	$2.77x10^{-3}$	0	$1.28x10^{-3}$	0
ETP - fw	1.09	0.955	$4.24x10^{-3}$	$8.16x10^{-3}$	$8.67x10^{-2}$	$2.45x10^{-2}$	0	0	$9.19x10^{-3}$	0	$1.56x10^{-3}$	0
HTP - c	$1.63x10^{-9}$	$1.34x10^{-9}$	$5.80x10^{-12}$	$2.17x10^{-11}$	$1.33x10^{-10}$	$6.93x10^{-11}$	0	0	$5.19x10^{-11}$	0	$2.74x10^{-11}$	0
HTP - nc	$7.11x10^{-8}$	$6.14x10^{-8}$	$1.84x10^{-10}$	$8.82x10^{-10}$	$5.12x10^{-9}$	$2.00x10^{-9}$	0	0	$1.33x10^{-9}$	0	$9.33x10^{-2}$	0
SQP	5.53	1.81	$8.67x10^{-2}$	$3.12x10^{-2}$	2.20	0.311	0	0	0.261	0	0.741	0

The EN 15804:2012+A2:2019 impact methods for Global Warming Potential (GWP) follows the IPCC 2013 – 100-year global warming potential method, which assess global warming potential within a 100-year time frame. Results shown above are based on that time frame. However, the EN15804:2012+A2:2019 standard also states that the degradation of a product's biogenic carbon content in a solid waste disposal site, declared as GWP-biogenic, shall be calculated without time limit. Based on this assumption, the biogenic content will be fully released.

This assumption relates to the product with FRK facing, which contains kraft paper. The model was re-ran with the assumption of full release of biogenic content and the results are shown in Table 25.

Table 25. *Glass Wool Board Insulation with FRK facing GWP-Total and GWP-Biogenic LCIA results per functional unit calculated without time limit for biogenic carbon. Results in module C4 are affected. All results are shown to three significant figures.*

Impact Categories	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP - Total	4.12	3.56	$1.17x10^{-2}$	$8.91x10^{-3}$	0.199	0.105	0	0	$3.45x10^{-2}$	0	0.199	0
GWP - Biogenic	0.153	$-3.81x10^{-2}$	$1.17x10^{-5}$	$8.00x10^{-4}$	$3.12x10^{-4}$	$6.08x10^{-5}$	0	0	$5.87x10^{-5}$	0	0.190	0

6. LCI Results

The following life cycle inventory (LCI) parameters specified by the PCR are shown in Table 26 below. The LCI results by module for the product unfaced, and with the relevant facing types are reported in Tables Table 27 through Table 32

Table 26. *The full name, abbreviation, and unit of additional LCI indicators required by the PCR.*

Resources	Unit	Waste and Outflows	Unit
PERE: Renewable primary resources used as energy carrier (fuel)	MJ, LHV	**FW:** Use of net freshwater resources	m^3
PERM: Renewable primary resources with energy content used as material	MJ, LHV	**HWD:** Hazardous waste disposed	kg
PERT: Total use of renewable primary energy resource	MJ, LHV	**NHWD:** Non-hazardous waste disposed	kg
PENRE: Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	**RWD** Radioactive waste disposed	kg
PENRM: Non-renewable primary resources with energy content used as material	MJ, LHV	**CRU:** Components for re-use	kg
PENRT: Total use of non-renewable primary energy resources	MJ, LHV	**MFR:** Materials for recycling	kg
SM: Secondary materials	MJ, LHV	**MER:** Materials for energy recovery	kg
RSF: Renewable secondary fuels	MJ, LHV	**EE:** Recovered energy exported from the product system	MJ, LHV
NRSF: Non-renewable secondary fuels	MJ, LHV	-	-

Table 27. *Unfaced Glass Wool Board Insulation LCI results per functional unit for all required EN 15804:2012+A2:2019 LCI indicators reported by life cycle stage. All values are rounded to three significant digits.*

Indicator	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4
PERE(MJ)	0.452	0.396	$8.40x10^{-4}$	$7.00x10^{-3}$	$1.86x10^{-2}$	$1.84x10^{-2}$	0	0	$9.08x10^{-3}$	0	$1.51x10^{-3}$
PERM (MJ)	0.131	0.113	$3.40x10^{-4}$	$2.20x10^{-3}$	$7.59x10^{-3}$	$5.17x10^{-3}$	0	0	$2.00x10^{-3}$	0	$7.30x10^{-4}$
PERT (MJ)	0.582	0.509	$1.18x10^{-3}$	$9.20x10^{-3}$	$2.62x10^{-2}$	$2.36x10^{-2}$	0	0	$1.11x10^{-2}$	0	$2.24x10^{-3}$
PENRE (MJ)	4.63	3.96	$1.30x10^{-2}$	$7.16x10^{-2}$	0.287	0.185	0	0	$8.93x10^{-2}$	0	$2.05x10^{-2}$
PENRM (MJ)	58.5	54.1	$9.15x10^{-2}$	$7.69x10^{-2}$	2.10	1.54	0	0	0.382	0	0.177
PENRT (MJ)	63.1	58.1	0.104	0.148	2.39	1.72	0	0	0.471	0	0.197
SM (kg)	0.596	0.581	$7.20x10^{-5}$	$6.80x10^{-4}$	$1.65x10^{-3}$	$1.24x10^{-2}$	0	0	$6.60x10^{-4}$	0	$2.30x10^{-4}$
RSF (MJ)	$4.08x10^{-3}$	$3.37x10^{-3}$	$1.02x10^{-5}$	$5.54x10^{-5}$	$2.30x10^{-4}$	$2.30x10^{-4}$	0	0	$1.60x10^{-4}$	0	$2.12x10^{-5}$
NRSF (MJ)	$8.93x10^{-3}$	$7.73x10^{-3}$	$1.85x10^{-5}$	$1.00x10^{-4}$	$4.10x10^{-4}$	$4.00x10^{-4}$	0	0	$2.30x10^{-4}$	0	$4.20x10^{-5}$
FW	$2.66x10^{-2}$	$2.05x10^{-2}$	$1.23x10^{-5}$	$4.87x10^{-3}$	$2.70x10^{-4}$	$6.30x10^{-4}$	0	0	$8.58x10^{-5}$	0	$2.20x10^{-4}$
HWD (kg)	0.974	0.817	$2.69x10^{-3}$	$1.54x10^{-2}$	$5.96x10^{-2}$	$4.78x10^{-2}$	0	0	$2.78x10^{-2}$	0	$4.07x10^{-3}$
NWHD (kg)	1.08	$3.69x10^{-2}$	$5.14x10^{-3}$	$1.76x10^{-2}$	0.110	$5.42x10^{-2}$	0	0	$1.37x10^{-2}$	0	0.842
RWD (kg)	$4.50x10^{-4}$	$3.70x10^{-4}$	$1.46x10^{-6}$	$7.39x10^{-6}$	$3.30x10^{-5}$	$2.04x10^{-5}$	0	0	$1.18x10^{-5}$	0	$2.64x10^{-6}$
CRU (kg)	0	0	0	0	0	0	0	0	0	0	0
MFR (kg)	$1.21x10^{-2}$	$9.36x10^{-3}$	$5.23x10^{-5}$	$2.40x10^{-4}$	$1.21x10^{-3}$	$6.60x10^{-4}$	0	0	$4.50x10^{-4}$	0	$9.05x10^{-5}$
MER (MJ)	$4.02x10^{-3}$	$2.66x10^{-3}$	$2.84x10^{-5}$	$1.00x10^{-4}$	$6.70x10^{-4}$	$2.90x10^{-4}$	0	0	$2.10x10^{-4}$	0	$5.42x10^{-5}$
EE (MJ)	0	0	0	0	0	0	0	0	0	0	0

Table 28. *Glass Wool Board Insulation with FRK Facing LCI results per functional unit for all required EN 15804:2012+A2:2019 LCI indicators reported by life cycle stage. All values are rounded to three significant digits.*

Indicator	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4
PERE(MJ)	0.712	0.644	$1.12x10^{-3}$	$7.00x10^{-3}$	$2.96x10^{-2}$	$1.84x10^{-2}$	0	0	$9.90x10^{-3}$	0	$2.63x10^{-3}$
PERM (MJ)	2.42	2.40	$4.72x10^{-4}$	$2.20x10^{-3}$	$1.00x10^{-2}$	$5.17x10^{-3}$	0	0	$2.18x10^{-3}$	0	$9.65x10^{-4}$
PERT (MJ)	3.13	3.04	$1.59x10^{-3}$	$9.20x10^{-3}$	$3.97x10^{-2}$	$2.36x10^{-2}$	0	0	$1.21x10^{-2}$	0	$3.59x10^{-3}$
PENRE (MJ)	7.63	6.83	$1.67x10^{-2}$	$7.16x10^{-2}$	0.394	0.185	0	0	$9.74x10^{-2}$	0	$3.13x10^{-2}$
PENRM (MJ)	60.5	55.6	0.149	$7.69x10^{-2}$	2.58	1.54	0	0	0.416	0	0.196
PENRT (MJ)	68.2	62.4	0.166	0.148	2.97	1.72	0	0	0.514	0	0.228
SM (kg)	0.611	0.594	$1.14x10^{-4}$	$6.80x10^{-4}$	$2.43x10^{-3}$	$1.24x10^{-2}$	0	0	$7.20x10^{-4}$	0	$2.82x10^{-4}$
RSF (MJ)	$7.73x10^{-3}$	$6.81x10^{-3}$	$1.40x10^{-5}$	$5.54x10^{-5}$	$4.08x10^{-4}$	$2.30x10^{-4}$	0	0	$1.75x10^{-4}$	0	$3.46x10^{-5}$
NRSF (MJ)	$2.05x10^{-2}$	$1.89x10^{-2}$	$2.56x10^{-5}$	$1.00x10^{-4}$	$6.75x10^{-4}$	$4.00x10^{-4}$	0	0	$2.51x10^{-4}$	0	$6.13x10^{-5}$
FW	$4.25x10^{-2}$	$3.63x10^{-2}$	$1.60x10^{-5}$	$4.87x10^{-3}$	$3.75x10^{-4}$	$6.30x10^{-4}$	0	0	$9.35x10^{-5}$	0	$2.46x10^{-4}$
HWD (kg)	1.62	1.43	$3.51x10^{-3}$	$1.54x10^{-2}$	$9.32x10^{-2}$	$4.78x10^{-2}$	0	0	$3.03x10^{-2}$	0	$6.12x10^{-3}$
NWHD (kg)	1.20	$6.61x10^{-2}$	$5.25x10^{-3}$	$1.76x10^{-2}$	0.127	$5.42x10^{-2}$	0	0	$1.49x10^{-2}$	0	0.919
RWD (kg)	$7.23x10^{-4}$	$6.26x10^{-4}$	$2.15x10^{-6}$	$7.39x10^{-6}$	$4.70x10^{-5}$	$2.04x10^{-5}$	0	0	$1.29x10^{-5}$	0	$3.82x10^{-6}$
CRU (kg)	0	0	0	0	0	0	0	0	0	0	0
MFR (kg)	$1.97x10^{-2}$	$1.64x10^{-2}$	$9.02x10^{-5}$	$2.40x10^{-4}$	$1.73x10^{-3}$	$6.60x10^{-4}$	0	0	$4.91x10^{-4}$	0	$1.21x10^{-4}$
MER (MJ)	$4.85x10^{-3}$	$3.18x10^{-3}$	$5.31x10^{-5}$	$1.00x10^{-4}$	$9.30x10^{-4}$	$2.90x10^{-4}$	0	0	$2.29x10^{-4}$	0	$6.02x10^{-5}$
EE (MJ)	0	0	0	0	0	0	0	0	0	0	0

Table 29. *Glass Wool Board Insulation with WGF Facing LCI results per functional unit for all required EN15804:2012+A2:2019 LCI indicators reported by life cycle stage. All values are rounded to three significant digits.*

Indicator	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4
PERE(MJ)	0.704	0.629	$1.01x10^{-3}$	$7.00x10^{-3}$	$3.68x10^{-2}$	$1.84x10^{-2}$	0	0	$1.04x10^{-2}$	0	$1.73x10^{-3}$
PERM (MJ)	0.186	0.164	$4.21x10^{-4}$	$2.20x10^{-3}$	$1.16x10^{-2}$	$5.17x10^{-3}$	0	0	$2.30x10^{-3}$	0	$8.38x10^{-4}$
PERT (MJ)	0.890	0.792	$1.43x10^{-3}$	$9.20x10^{-3}$	$4.84x10^{-2}$	$2.36x10^{-2}$	0	0	$1.27x10^{-2}$	0	$2.57x10^{-3}$
PENRE (MJ)	6.96	6.10	$1.53x10^{-2}$	$7.16x10^{-2}$	0.464	0.185	0	0	0.103	0	$2.36x10^{-2}$
PENRM (MJ)	62.2	56.9	0.127	$7.69x10^{-2}$	2.88	1.54	0	0	0.439	0	0.203
PENRT (MJ)	69.1	63.0	0.142	0.148	3.35	1.72	0	0	0.541	0	0.227
SM (kg)	0.610	0.592	$9.82x10^{-5}$	$6.80x10^{-4}$	$2.94x10^{-3}$	$1.24x10^{-2}$	0	0	$7.58x10^{-4}$	0	$2.65x10^{-4}$
RSF (MJ)	$9.44x10^{-3}$	$8.41x10^{-3}$	$1.26x10^{-5}$	$5.54x10^{-5}$	$5.22x10^{-4}$	$2.30x10^{-4}$	0	0	$1.84x10^{-4}$	0	$2.43x10^{-5}$
NRSF (MJ)	$1.50x10^{-2}$	$1.33x10^{-2}$	$2.28x10^{-5}$	$1.00x10^{-4}$	$8.46x10^{-4}$	$4.00x10^{-4}$	0	0	$2.64x10^{-4}$	0	$4.82x10^{-5}$
FW	$3.00x10^{-2}$	$2.37x10^{-2}$	$1.46x10^{-5}$	$4.87x10^{-3}$	$4.43x10^{-4}$	$6.30x10^{-4}$	0	0	$9.86x10^{-5}$	0	$2.53x10^{-4}$
HWD (kg)	1.52	1.30	$3.19x10^{-3}$	$1.54x10^{-2}$	0.115	$4.78x10^{-2}$	0	0	$3.19x10^{-2}$	0	$4.68x10^{-3}$
NWHD (kg)	1.27	$7.14x10^{-2}$	$5.21x10^{-3}$	$1.76x10^{-2}$	0.138	$5.42x10^{-2}$	0	0	$1.57x10^{-2}$	0	0.967
RWD (kg)	$7.57x10^{-4}$	$6.52x10^{-4}$	$1.89x10^{-6}$	$7.39x10^{-6}$	$5.60x10^{-5}$	$2.04x10^{-5}$	0	0	$1.36x10^{-5}$	0	$3.03x10^{-6}$
CRU (kg)	0	0	0	0	0	0	0	0	0	0	0
MFR (kg)	$2.22x10^{-2}$	$1.85x10^{-2}$	$7.56x10^{-5}$	$2.40x10^{-4}$	$2.07x10^{-3}$	$6.60x10^{-4}$	0	0	$5.17x10^{-4}$	0	$1.04x10^{-4}$
MER (MJ)	$4.93x10^{-3}$	$3.09x10^{-3}$	$4.36x10^{-5}$	$1.00x10^{-4}$	$1.10x10^{-3}$	$2.90x10^{-4}$	0	0	$2.41x10^{-4}$	0	$6.23x10^{-5}$
EE (MJ)	0	0	0	0	0	0	0	0	0	0	0

Table 30. *Glass Wool Board Insulation with AWF Facing LCI results per functional unit for all required EN15804:2012 +A2:2019 LCI indicators reported by life cycle stage. All values are rounded to three significant digits.*

Indicator	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4
PERE(MJ)	1.56	1.48	$1.41x10^{-3}$	$7.00x10^{-3}$	$4.11x10^{-2}$	$1.84x10^{-2}$	0	0	$1.08x10^{-2}$	0	$1.95x10^{-3}$
PERM (MJ)	0.536	0.512	$6.10x10^{-4}$	$2.20x10^{-3}$	$1.26x10^{-2}$	$5.17x10^{-3}$	0	0	$2.37x10^{-3}$	0	$9.45x10^{-4}$
PERT (MJ)	2.10	1.99	$2.02x10^{-3}$	$9.20x10^{-3}$	$5.37x10^{-2}$	$2.36x10^{-2}$	0	0	$1.31x10^{-2}$	0	$2.89x10^{-3}$
PENRE (MJ)	16.9	15.9	$2.06x10^{-2}$	$7.16x10^{-2}$	0.506	0.185	0	0	0.106	0	$2.64x10^{-2}$
PENRM (MJ)	66.6	61.0	0.209	$7.69x10^{-2}$	3.07	1.54	0	0	0.452	0	0.212
PENRT (MJ)	83.5	77.0	0.229	0.148	3.58	1.72	0	0	0.558	0	0.238
SM (kg)	0.647	0.630	$1.58x10^{-4}$	$6.80x10^{-4}$	$3.25x10^{-3}$	$1.24x10^{-2}$	0	0	$7.82x10^{-4}$	0	$2.81x10^{-4}$
RSF (MJ)	$2.20x10^{-2}$	$2.09x10^{-2}$	$1.79x10^{-5}$	$5.54x10^{-5}$	$5.93x10^{-4}$	$2.30x10^{-4}$	0	0	$1.90x10^{-4}$	0	$2.67x10^{-5}$
NRSF (MJ)	$5.74x10^{-2}$	$5.56x10^{-2}$	$3.30x10^{-5}$	$1.00x10^{-4}$	$9.51x10^{-4}$	$4.00x10^{-4}$	0	0	$2.72x10^{-4}$	0	$5.27x10^{-5}$
FW	$9.12x10^{-2}$	$8.48x10^{-2}$	$1.99x10^{-5}$	$4.87x10^{-3}$	$4.84x10^{-4}$	$6.30x10^{-4}$	0	0	$1.02x10^{-4}$	0	$2.63x10^{-4}$
HWD (kg)	3.48	3.25	$4.36x10^{-3}$	$1.54x10^{-2}$	0.128	$4.78x10^{-2}$	0	0	$3.29x10^{-2}$	0	$5.23x10^{-3}$
NWHD (kg)	1.40	0.155	$5.36x10^{-3}$	$1.76x10^{-2}$	0.144	$5.42x10^{-2}$	0	0	$1.62x10^{-2}$	0	1.00
RWD (kg)	$1.66x10^{-3}$	$1.55x10^{-3}$	$2.87x10^{-6}$	$7.39x10^{-6}$	$6.15x10^{-5}$	$2.04x10^{-5}$	0	0	$1.40x10^{-5}$	0	$3.28x10^{-6}$
CRU (kg)	0	0	0	0	0	0	0	0	0	0	0
MFR (kg)	$4.73x10^{-2}$	$4.33x10^{-2}$	$1.30x10^{-4}$	$2.40x10^{-4}$	$2.28x10^{-3}$	$6.60x10^{-4}$	0	0	$5.33x10^{-4}$	0	$1.11x10^{-4}$
MER (MJ)	$6.67x10^{-3}$	$4.68x10^{-3}$	$7.87x10^{-5}$	$1.00x10^{-4}$	$1.20x10^{-3}$	$2.90x10^{-4}$	0	0	$2.49x10^{-4}$	0	$6.49x10^{-5}$
EE (MJ)	0	0	0	0	0	0	0	0	0	0	0

Table 31. *Glass Wool Board Insulation with FS Facing LCI results per functional unit for all required EN15804:2012+A2:2019 LCI indicators reported by life cycle stage. All values are rounded to three significant digits.*

Indicator	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4
PERE(MJ)	1.12	1.05	$1.13x10^{-3}$	$7.00x10^{-3}$	$3.01x10^{-2}$	$1.84x10^{-2}$	0	0	$9.93x10^{-3}$	0	$1.79x10^{-3}$
PERM (MJ)	0.404	0.383	$4.77x10^{-4}$	$2.20x10^{-3}$	$1.01x10^{-2}$	$5.17x10^{-3}$	0	0	$2.19x10^{-3}$	0	$8.55x10^{-4}$
PERT (MJ)	1.52	1.43	$1.61x10^{-3}$	$9.20x10^{-3}$	$4.02x10^{-2}$	$2.36x10^{-2}$	0	0	$1.21x10^{-2}$	0	$2.64x10^{-3}$
PENRE (MJ)	12.2	11.4	$1.69x10^{-2}$	$7.16x10^{-2}$	0.398	0.185	0	0	$9.77x10^{-2}$	0	$2.42x10^{-2}$
PENRM (MJ)	63.9	58.9	0.151	$7.69x10^{-2}$	2.60	1.54	0	0	0.418	0	0.195
PENRT (MJ)	76.1	70.3	0.168	0.148	2.99	1.72	0	0	0.515	0	0.219
SM (kg)	0.627	0.611	$1.16x10^{-4}$	$6.80x10^{-4}$	$2.46x10^{-3}$	$1.24x10^{-2}$	0	0	$7.22x10^{-4}$	0	$2.58x10^{-4}$
RSF (MJ)	$1.46x10^{-2}$	$1.36x10^{-2}$	$1.42x10^{-5}$	$5.54x10^{-5}$	$4.15x10^{-4}$	$2.30x10^{-4}$	0	0	$1.75x10^{-4}$	0	$2.47x10^{-5}$
NRSF (MJ)	$3.93x10^{-2}$	$3.78x10^{-2}$	$2.58x10^{-5}$	$1.00x10^{-4}$	$6.86x10^{-4}$	$4.00x10^{-4}$	0	0	$2.51x10^{-4}$	0	$4.84x10^{-5}$
FW	$6.83x10^{-2}$	$6.21x10^{-2}$	$1.61x10^{-5}$	$4.87x10^{-3}$	$3.79x10^{-4}$	$6.30x10^{-4}$	0	0	$9.39x10^{-5}$	0	$2.43x10^{-4}$
HWD (kg)	2.50	2.31	$3.54x10^{-3}$	$1.54x10^{-2}$	$9.45x10^{-2}$	$4.78x10^{-2}$	0	0	$3.04x10^{-2}$	0	$4.78x10^{-3}$
NWHD (kg)	1.25	0.106	$5.25x10^{-3}$	$1.76x10^{-2}$	0.127	$5.42x10^{-2}$	0	0	$1.49x10^{-2}$	0	0.925
RWD (kg)	$1.17x10^{-3}$	$1.07x10^{-3}$	$2.18x10^{-6}$	$7.39x10^{-6}$	$4.76x10^{-5}$	$2.04x10^{-5}$	0	0	$1.29x10^{-5}$	0	$3.03x10^{-6}$
CRU (kg)	0	0	0	0	0	0	0	0	0	0	0
MFR (kg)	$3.28x10^{-2}$	$2.95x10^{-2}$	$9.17x10^{-5}$	$2.40x10^{-4}$	$1.75x10^{-3}$	$6.60x10^{-4}$	0	0	$4.92x10^{-4}$	0	$1.02x10^{-4}$
MER (MJ)	$5.58x10^{-3}$	$3.90x10^{-3}$	$5.40x10^{-5}$	$1.00x10^{-4}$	$9.40x10^{-4}$	$2.90x10^{-4}$	0	0	$2.30x10^{-4}$	0	$5.98x10^{-5}$
EE (MJ)	0	0	0	0	0	0	0	0	0	0	0

Table 32. *Glass Wool Board Insulation with FKS Facing LCI results per functional unit for all required EN15804:2012+A2:2019 LCI indicators reported by life cycle stage. All values are rounded to three significant digits.*

Indicator	Total	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4
PERE(MJ)	0.762	0.689	$1.23x10^{-3}$	$7.00x10^{-3}$	$3.39x10^{-2}$	$1.84x10^{-2}$	0	0	$1.02x10^{-2}$	0	$1.78x10^{-3}$
PERM (MJ)	0.256	0.234	$5.23x10^{-4}$	$2.20x10^{-3}$	$1.10x10^{-2}$	$5.17x10^{-3}$	0	0	$2.25x10^{-3}$	0	$8.41x10^{-4}$
PERT (MJ)	1.02	0.923	$1.75x10^{-3}$	$9.20x10^{-3}$	$4.48x10^{-2}$	$2.36x10^{-2}$	0	0	$1.25x10^{-2}$	0	$2.62x10^{-3}$
PENRE (MJ)	7.96	7.13	$1.81x10^{-2}$	$7.16x10^{-2}$	0.435	0.185	0	0	0.100	0	$2.39x10^{-2}$
PENRM (MJ)	63.1	57.9	0.171	$7.69x10^{-2}$	2.76	1.54	0	0	0.429	0	0.199
PENRT (MJ)	71.1	65.1	0.189	0.148	3.19	1.72	0	0	0.530	0	0.223
SM (kg)	0.612	0.595	$1.31x10^{-4}$	$6.80x10^{-4}$	$2.73x10^{-3}$	$1.24x10^{-2}$	0	0	$7.43x10^{-4}$	0	$2.63x10^{-4}$
RSF (MJ)	$9.65x10^{-3}$	$8.66x10^{-3}$	$1.54x10^{-5}$	$5.54x10^{-5}$	$4.76x10^{-4}$	$2.30x10^{-4}$	0	0	$1.80x10^{-4}$	0	$2.48x10^{-5}$
NRSF (MJ)	$2.01x10^{-2}$	$1.85x10^{-2}$	$2.83x10^{-5}$	$1.00x10^{-4}$	$7.77x10^{-4}$	$4.00x10^{-4}$	0	0	$2.58x10^{-4}$	0	$4.84x10^{-5}$
FW	$3.94x10^{-2}$	$3.32x10^{-2}$	$1.74x10^{-5}$	$4.87x10^{-3}$	$4.15x10^{-4}$	$6.30x10^{-4}$	0	0	$9.65x10^{-5}$	0	$2.48x10^{-4}$
HWD (kg)	1.67	1.47	$3.82x10^{-3}$	$1.54x10^{-2}$	0.106	$4.78x10^{-2}$	0	0	$3.13x10^{-2}$	0	$4.74x10^{-3}$
NWHD (kg)	1.25	$7.32x10^{-2}$	$5.29x10^{-3}$	$1.76x10^{-2}$	0.133	$5.42x10^{-2}$	0	0	$1.54x10^{-2}$	0	0.947
RWD (kg)	$8.03x10^{-4}$	$7.00x10^{-4}$	$2.42x10^{-6}$	$7.39x10^{-6}$	$5.24x10^{-5}$	$2.04x10^{-5}$	0	0	$1.33x10^{-5}$	0	$3.05x10^{-6}$
CRU (kg)	0	0	0	0	0	0	0	0	0	0	0
MFR (kg)	$2.29x10^{-2}$	$1.94x10^{-2}$	$1.05x10^{-4}$	$2.40x10^{-4}$	$1.93x10^{-3}$	$6.60x10^{-4}$	0	0	$5.06x10^{-4}$	0	$1.04x10^{-4}$
MER (MJ)	$5.01x10^{-3}$	$3.22x10^{-3}$	$6.25x10^{-5}$	$1.00x10^{-4}$	$1.03x10^{-3}$	$2.90x10^{-4}$	0	0	$2.36x10^{-4}$	0	$6.12x10^{-5}$
EE (MJ)	0	0	0	0	0	0	0	0	0	0	0

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