

Declaration Owner

Saudi Rock Wool
Street No. 59, Al Kharj Industrial City,
P.O. Box 145, Riyadh 11383,
Kingdom of Saudi Arabia
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Product
Rockwool Panels -
EPD represents delivery of product to customers globally.

Functional Unit
The functional unit is 1 m² of insulation material with an average thermal resistance RSI = 1 m²K/W

EPD Number and Period of Validity
SCS-EPD-08281
EPD Valid September 29, 2022 through September 28, 2027

Product Category Rule
PCR 2019:14 Construction products (EN 15804:A2) (1.11), Prepared by IVL Swedish Environmental Research Institute, EPD International Secretariat.

PCR 2019:14-c-PCR-005 c-PCR-005 Thermal Insulation products (EN 16783) (2019-12-20).

Program Operator
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Declaration Owner:	Saudi Rock Wool
Address:	Street No. 59, Al Kharj Industrial City, P.O. Box 145, Riyadh 11383, Kingdom of Saudi Arabia
Declaration Number:	SCS-EPD-08281
Declaration Validity Period:	EPD Valid September 29, 2022 through September 28, 2027
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Ramin Ghamkhar, Ph.D.; Beth Cassese, SCS Global Services
LCA Software and LCI database:	OpenLCA 1.10.3 and the Ecoinvent v3.8, EN 15804 add-on database
Product RSL:	50 Years
Markets of Applicability:	Middle East
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, Ph.D., Industrial Ecology Consultants
Product Category Rule:	PCR 2019:14 Construction products (EN 15804:A2) (1.11). Prepared by IVL Swedish Environmental Research Institute, EPD International Secretariat.
PCR Review conducted by:	The Technical Committee of the International EPD® System. A full list of members available on www.environdec.com. The review panel may be contacted via info@environdec.com.
Complementary Product Category Rule:	PCR 2019:14-c-PCR-005 c-PCR-005 Thermal Insulation products (EN 16783) (2019-12-20)
Part B PCR Review conducted by:	Technical Committee CEN/TC88
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Thomas Gloria, Ph.D., Industrial Ecology Consultants
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Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, ISO 21930 (EN 15804+A2:2019 takes precedent in cases where these two standards differ), PCR 2019:14, c-PCR-005, EN 15804+A2:2019, and EN 16783:2017.*

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.*

In accordance with ISO 21930:2017, EPDs are comparable only if they comply with the core PCR, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

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1. Declaration Owner and Product Description

1.1 Saudi Rock Wool

Saudi Rock Wool Factory (SRWF) is a member of (GIG) Gulf Insulation Group and a Subsidiary of Zamil Industrial Investment Company (Zamil Industrial). Saudi Rock Wool Factory Co. provides the local and international market with numerous thermal insulation, construction, and industrial materials.

As part of SRWF commitment to quality, the company performs regular product testing, both locally and internationally, against the highest standards levels. SRWF has ISO, DCL and CE Certificates. SRWF Products are classified as A1 (Non-Combustible) by Warrington, BRE and Pavus accredited fire laboratories. Additionally, products are approved by Dubai Municipality as HCFC free and listed as Green Building Materials.

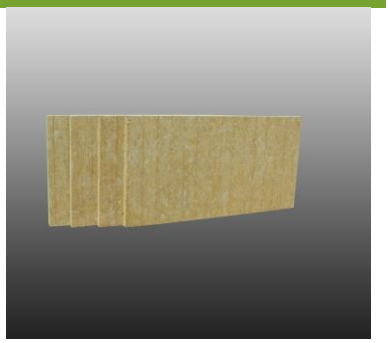
1.2 Product Description

Rockwool Panel

The product is made from molten basalt rocks spun to fine fibers and bonded with thermosetting Binder to form rockwool slabs. Insulation is none facing or faced with reflective vapor retarder Aluminium foil or Black Fiber Glass veil from one side, based on required application.

The Material has good thermal, fire resistant, and acoustical properties. it complies with the requirements of ASTM C612 and EN13162 used for building and industrial application.

The UN CPC code is 43.29.11, Insulation Works and the UNSPSC code is 30140000.



1.3 FURTHER INFORMATION

Further information on the product can be found on the manufacturer's website at http://saudirockwool.com/.

2. Scope of the Study

2.1 FUNCTIONS OF THE PRODUCT SYSTEM

The Saudi Rock Wool insulation products provide the primary function of thermal insulation. According to ISO 14044 [1], the functional unit is "the quantified performance of a product system, for use as a reference unit." For this EPD, the functional unit for this analysis is defined as:

1 m² of thermal insulation product with a thickness that gives an average thermal resistance RSI = 1 m²K/W and with a reference service life of 50 years (packaging included) [2,3].

According to the PCR [7], the EPD shall include the functional unit, and conversion factor to mass. As the Saudi Rock Wool products achieve an R-value of 1 m²K/W at the average weight of 2.69 kg and the required thickness for 3.41 cm, the functional unit for Saudi Rock Wool products are calculated as below:

Table 1. *Functional Unit Properties for Saudi Rock Wool Rockwool Panels.*

Name	Value	Unit
Functional Unit	1 m² of insulation material with a thickness that gives an average thermal resistance RSI = 1 m²K/W	
Mass of Reference Flow	2.69	kg
Thickness to achieve Functional Unit (at RSI=1)	0.0341	m

	3.41	cm

To determine the environmental impacts at each RSI and thickness value, scaling factors can be used. The scaling factors are based on the density and thickness of the Saudi Rock Wool insulation products and can be used to determine the impacts for each RSI value based on the functional unit. To calculate the environmental impact potential per square meter of product, multiply the results presented for the base functional unit by the scaling factor shown on Table below for the specific RSI value.

Table 2. *Scaling Factors to determine environmental impact potentials of Rock Wool Panel at different RSI values.*

RSI (m^2.K/W)	Thickness (mm)	Weight per square meter (kg/m^2)	Density (kg/m^3)	Weight (kg) per RSI	Scaling Factor
0.73	25	2.5	100	3.42	**0.93**
1.47	50	2.5	50	1.70	**0.93**
2.2	75	4.8	64	2.18	**1.78**
2.94	100	10	100	3.40	**3.72**
4.41	150	12	80	2.72	**4.46**

2.2 PRODUCT MATERIAL COMPOSITION

The rockwool panels are made primarily from molten basalt rocks, spun to fine fibers. Other material components of the Saudi Rock Wool rockwool panels are limestone, binder, facing materials, foundry coke, ammonia, and emulsion oil. The material composition of rockwool panels (packaging included) is displayed in **Table *3***, below. In addition, the provenience of the materials post-consumer and use of renewable materials is presented as part of the content declaration per the PCR's [7] guidelines. There are no known SVHCs to declare.

Table 3. *Material component summary and reference flow for the Saudi Rock Wool Rockwool Panels.*

Material	Total Input	Total Used in Final Product	Unit	Post-consumer material, %	Renewable material, %
Product Chemical/Material					
Basalt Rock	2.14	2.04	kg	5%	0%
Limestone	0.55	0.52	kg	0%	0%
Binder	0.13	0.13	kg	5%	0%
Facing Material	0.16	0.15	m^2	0%	0%
Ammonia	0.01	0.01	kg	0%	0%
Emulsion Oil	0.01	0.01	kg	0%	0%
Packaging					
Plastic Shrink Film	$1.19x10^{-3}$	$1.19x10^{-3}$	kg	0%	0%
Product Reference Flow, Panels:	2.69		kg	N/A	N/A

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2.3 SYSTEM BOUNDARY

The system boundary includes the cradle-to-grave life cycle of Saudi Rock Wool rockwool panel, 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 4**. A flow diagram illustrating the processes involved within each life cycle module is shown below in **Figure 1**.

Table 4. *A description of the life cycle phases included in the Saudi Rock Wool rockwool panel system boundary.*

Module	Module description from the PCR	Unit Processes Included in Scope	Included In system boundary	Geographical Representation
A1	Extraction and processing of raw materials; any reuse of products or materials from previous product systems; processing of secondary materials; generation of electricity from primary energy resources; energy, or other, recovery processes from secondary fuels	Extraction and processing of raw materials for the insulation board components.	**X**	SA
A2	Transport (to the manufacturer)	Transport of component materials to the manufacturing facilities	**X**	SA
A3	Manufacturing, including ancillary material production	Manufacturing of products and packaging (incl. upstream unit processes*)	**X**	
A4	Transport (to the construction site)	Transport of product (including packaging) to the construction site	**X**	SA
A5	Construction-installation process	Impacts from the installation of product are assumed negligible. Only impacts from packaging disposal are included in this phase	**X**	SA
B1	Product use	There are no impacts from the use of the insulation in a building setting.	**X**	SA
B2	Product maintenance	Maintenance of products over the 50-year ESL, including periodic cleaning. Impacts from product maintenance are assumed negligible	**X**	SA
B3	Product repair	The products are not expected to require repair over its lifetime	**X**	SA
B4	Product replacement	No product replacements are required over the 50-year ESL of the assessment.	**X**	SA
B5	Product refurbishment	The products are not expected to require refurbishment over their lifetime	**X**	SA
B6	Operational energy use by technical building systems	There is no operational energy use associated with the use of the product	**X**	SA
B7	Operational water uses by technical building systems	There is no operational water use associated with the use of the product	**X**	SA
C1	Deconstruction, demolition	Demolition of the product is accomplished using hand tools with no associated emissions and negligible impacts	**X**	SA
C2	Transport (to waste processing)	Transport of the product to waste treatment at end-of-life	**X**	SA
C3	Waste processing for reuse, recovery and/or recycling	The products are disposed of by landfilling or incineration which require no waste processing	**X**	SA
C4	Disposal	Disposal of the product in a municipal landfill.	**X**	SA
D	Reuse-recovery-recycling potential	Module Not Declared	ND**	ND

**This includes unit processes involved in the generation of electricity, and production of material input (e.g., adhesives and pigments).*
*** Module Not Declared*

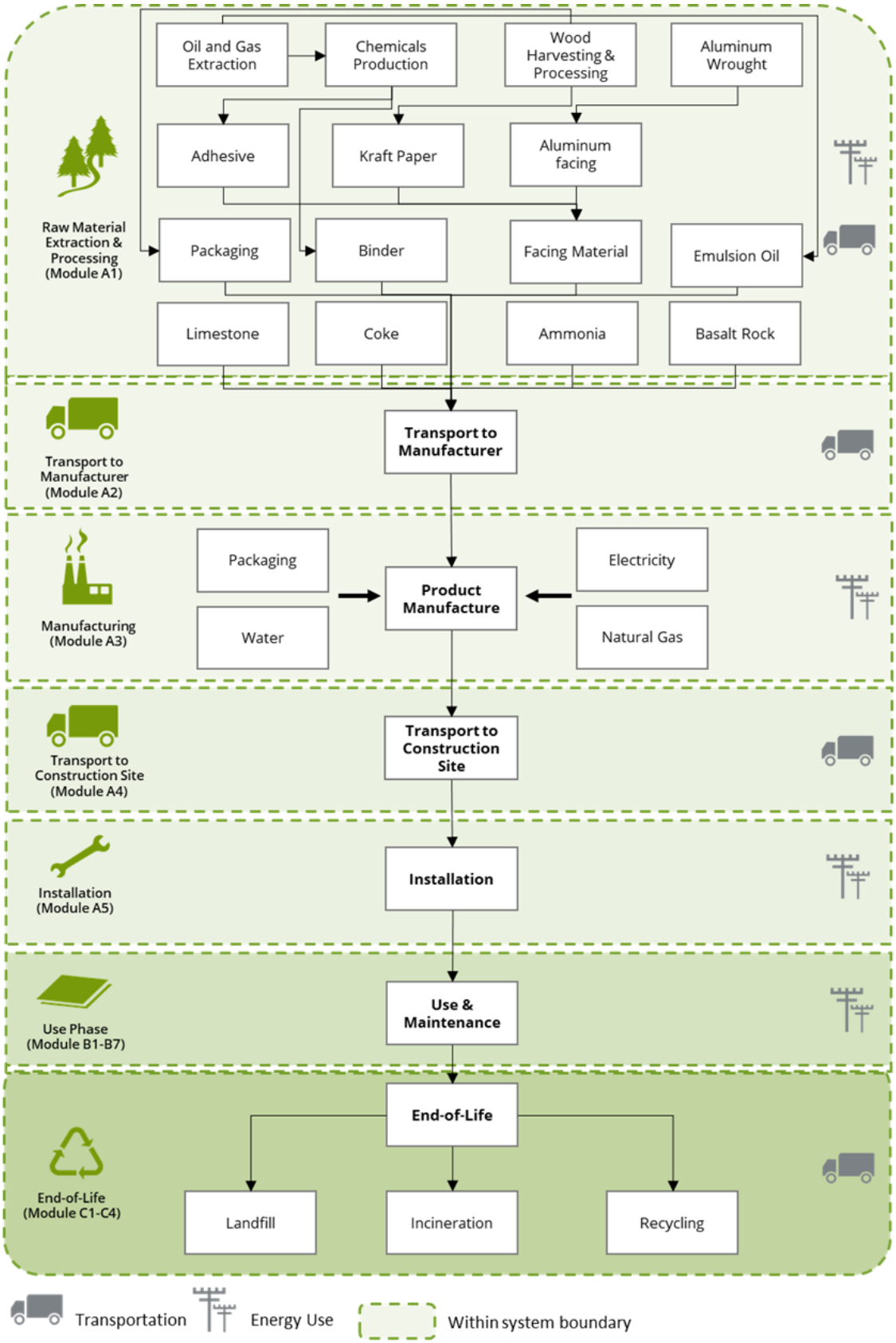


Figure 1. *Flow Diagram for the life cycle of Saudi Rock Wool rockwool insulation panels.*

3. Technical Information and Scenarios

3.1 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 in the rockwool panels to the manufacturing facility in Al Kharj Industrial City, Riyadh. Transport of the raw materials to Saudi Rock Wool Facility is done by freight truck. Transportation for the LCA model is based on primary data for transport from the component manufacturer (1st tier supplier) to the Saudi Rock Wool manufacturing facility. Transport distance and mode of transport were provided by Saudi Rock Wool. All transport was modeled in OpenLCA v1.10.3 using the Ecoinvent v3.8, EN 15804 add-on database prepared by GreenDelta. Transportation data for 2nd tier suppliers (material supplier to component manufacturer) are based on data embedded in the representative LCI datasets. Based on distances and transport modes from multiple suppliers, weighted transport distances, in kg-km (or ton-km), for upstream raw materials are estimated for modeling the product system.

Electricity use at the manufacturing facility is modeled based on the regional electricity grid supply mix applicable for Saudi Arabia [4]. Electricity and resources (e.g., natural gas, propane) used at the manufacturing facility are allocated to the products based on a mass basis using annual production data for calendar year 2021. As noted in the background report, the study chose to follow the ISO 21930 standard for the reporting of the generation of electricity, steam and heat from primary energy resources used in manufacturing, including their extraction, refining and transport to be reported in Module A3. The rockwool panels are wrapped in plastic shrink films for packaging.

Transport to Installation Site (A4)

This module includes all transport from the manufacturing facility to the construction site, distribution of the product to point of sale is included in the model, based on primary data received from the manufacturer. The average transportation distance to the installation/construction site was based on a weighted average of shipments over calendar year 2021 for the products (70% domestic, 30% exported) and is assumed as 20 km for domestic and estimated as 802 km for exports via diesel truck, using primary data from manufacturer. The export distribution center locations and the product distribution modeling parameters (e.g., the capacity and fuel utilization of the truck transport) used in all modules can be found in **Table 5** below.

Table 5. *The type, distance, fuel utilization, and capacity utilization of truck transport used in all modules.*

Distribution Center Location	Transportation Distance (km, via road)
United Arab Emirates, Dubai	939
Oman	1172
Bahrain	567
Dammam	508
United Arab Emirates, Abu Dhabi	843
Kuwait	780
Qatar	600
Transport Parameter	**Value**
Diesel truck – Fuel utilization (L/100 km)	18.7
Diesel truck – Capacity utilization (%)	76%
Diesel truck – One Way Distance (km)	20 (domestic), 802 (export)

Installation (A5)

The products are installed using hand tools with negligible associated impacts. Only impacts from the disposal of packaging materials are included in the product installation phase. **Table 6** summarizes the relevant parameters for the product installation phase.

Table 6. *Installation modeling parameters by product per functional unit.*

Parameter		Value
Ancillary materials		-
Net freshwater consumption (m^3)		-
Electricity consumption (kWh)		-
Product loss per functional unit (kg)		negligible
Waste materials generated by product installation (kg)		negligible
Output materials resulting from on-site waste processing (kg)		na
Mass of packaging waste (kg)	Plastic-shrink films	$1.19x10^{-3}$
Biogenic carbon contained in packaging (kg CO_2)		-

Use Phase (B1) and Maintenance (B2)

Once installed, the product requires no maintenance. No impacts are associated with the use of the product.

Demolition (C1)

Demolition of the product is accomplished using hand tools with no associated emissions and negligible impacts.

Waste Transport (C2)

This module includes the assumed 40 km transport of product waste to a waste landfill facility. The truck transport fuel and capacity utilization can be found in **Table 5**.

Waste Disposal (C4)

No specific data are available regarding the recycling rate of materials in the product or packaging at end-of-life. It is assumed the products are disposed of in a landfill. This assumption is based on 2022 International Trade Administration's Country Commercial Guide for Saudi Arabia, which states the majority of municipal waste is disposed of in landfills [5]. Ecoinvent datasets are used to model the impacts associated with landfilling, which does not include energy recovery from landfill gas. The end-of-life disposal scenario parameters are summarized in **Table 7**.

Table 7. *End-of-life disposal scenario parameters for the Saudi Rock Wool products per functional unit.*

Parameter		Value
Assumptions for scenario development		Landfill
Collection process		
Collected with mixed construction waste (kg)		2.69
Recovery		n/a
Disposal	Recycled (kg)	-
	Landfill (kg)	2.69
	Incineration (kg)	-
Removals of biogenic carbon (kg CO_2 eq)		n/a*

* As the products do not contain significant amounts of bio-based materials (less than 5% of the mass of the product), biogenic carbon content in the product at the factory gate are not declared.

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3.2 DATA SOURCES

Table 8. *LCI datasets and associated databases used to model material production and processing of Saudi Rock Wool rockwool panel.*

Component		Dataset	Data Source	Publication Date
MATERIALS				
Basalt Rock		market for basalt | basalt | Cutoff, U - GLO	EI v3.8, EN 15804 add-on	2021
Lime Stone		market for calcium carbonate, precipitated | calcium carbonate, precipitated | Cutoff, U – RoW	EI v3.8, EN 15804 add-on	2021
Binder	- Phenol - Phenolic resin - Triethyl amine	market for phenol | phenol | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
		market for phenolic resin | phenolic resin | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
		market for triethyl amine | triethyl amine | Cutoff, U - GLO	EI v3.8, EN 15804 add-on	2021
Facing Materials	- Adhesive - Kraft paper - Sheet rolling	market for adhesive, for metal | adhesive, for metal | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
		market for kraft paper | kraft paper | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
		market for sheet rolling, aluminium | sheet rolling, aluminium | Cutoff, U - GLO	EI v3.8, EN 15804 add-on	2021
Ammonia		market for ammonia, anhydrous, liquid | ammonia, anhydrous, liquid | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
Emulsion Oil		lubricating oil production | lubricating oil | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
PACKAGING				
Plastic-Shrink Film		market for packaging film, low density polyethylene | packaging film, low density polyethylene | Cutoff, U - GLO	EI v3.8, EN 15804 add-on	2021
RESOURCES				
Grid electricity		market for electricity, medium voltage | electricity, medium voltage | Cutoff, U - SA	EI v3.8, EN 15804 add-on	2021
Light Fuel oil, Petrol		market for light fuel oil | light fuel oil | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
Heavy Fuel Oil, Diesel		market for heavy fuel oil | heavy fuel oil | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
Propane		market for propane | propane | Cutoff, U - GLO	EI v3.8, EN 15804 add-on	2021
Oxygen		market for oxygen, liquid | oxygen, liquid | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
Foundry Coke		market for petroleum coke | petroleum coke | Cutoff, U - GLO	EI v3.8, EN 15804 add-on	2021
TRANSPORTATION				
Road transport		transport, freight, lorry >32 metric ton, EURO4 | transport, freight, lorry >32 metric ton, EURO4 | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
END OF LIFE				
PE bags		market for waste polyethylene | waste polyethylene | Cutoff, U – RoW	EI v3.8, EN 15804 add-on	2021
Carton / Paper		market for waste packaging paper | waste packaging paper | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
Plastic-shrink film		market for waste sealing sheet, polyethylene | waste sealing sheet, polyethylene | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021
Rockwool Product		market for process-specific burdens, inert material landfill | process-specific burdens, inert material landfill | Cutoff, U - RoW	EI v3.8, EN 15804 add-on	2021

3.3 DATA QUALITY

According to the PCR [7], The quality of the data used to calculate an EPD shall be addressed in the LCA project report. The data quality assessment is discussed in **Table 9** 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 9. *Data quality assessment of the Saudi Rock Wool rockwool panel 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 5 years old (typically 2016). All the data used represented an average of at least one year's worth of data collection, and up to three years in some cases. 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. Electricity use for product manufacture is modeled using representative data for Saudi Arabia. Surrogate data used in the assessment are representative of global operations. Data representative of global/ rest of world operations are considered sufficiently similar to actual processes. Data representing product disposal are based on the updated country commercial guide (last updated date: 2022-02-24).
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.
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 the insulation products. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator 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 considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent v3.8 data where available. Different portions of the product life cycle are equally considered.
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 use at Saudi Rock Wool's manufacturing facility represent an annual average and are considered of high quality due to the length of time over which these data are collected (1 year), as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI data, Ecoinvent v3.8 LCI data are used.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the products and packaging is low. Actual supplier data for upstream operations were not available and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) but lacked geographical representativeness. 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.

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3.4 ALLOCATION

This study follows the allocation guidelines of ISO 14044 [1] and allocation rules specified in EN 15804+A2 [6] and the PCR [7] and minimized the use of allocation wherever possible. The PCR requires primary data for allocation based on physical relationships (e.g., volume, energy content, or mass-based relationships). Alternatively, economic allocation may be applied. The secondary databases used for the product system (discussed below) apply allocation based primarily on physical relationships.

Resource use at the Saudi Rock Wool facility (e.g., water and energy) in Al Kharj Industrial City were allocated to the product based on the product mass as a fraction of the total annual facility production (i.e., mass-based allocation). Electricity use at the manufacturing facilities was modeled using ecoinvent inventory datasets for the appropriate regional electricity grid resource mix [4].

Impacts from transportation, including product distribution to point of sale, were allocated based on the mass of material, mode of transportation, and distance transported.

3.5 CUT-OFF RULES

According to the PCR, life cycle inventory data shall according to EN 15804 include a minimum of 95% of total inflows (mass and energy) per module. In addition, if less than 100% of the inflows are accounted for, proxy data or extrapolation should be used to achieve 100% completeness. Inflows not included in the LCA shall be documented in the EPD. No data gaps were allowed which were expected to significantly affect the outcome of the indicator results. No known flows are deliberately excluded from this EPD.

3.6 SUMMARY OF ASSUMPTIONS

- Representative inventory data for raw materials and regional electricity grid was modeled with unit process data taken from Ecoinvent v3.8.
- Energy, resource use, emissions and waste at the production facility were allocated to the insulation products based on the mass of the product and annual production data for 2021 provided by the manufacturer.
- The product is assumed to be disposed in a landfill at end-of-life. For final disposal of the product at end-of-life, all materials are assumed to be transported 40 km by diesel truck to either a landfill, incineration facility, or material reclamation facility (for recycling).
- Inventory data for Binder and Emulsion oil were created using ingredient data on Safety Data Sheet (SDS).
- Inventory data for Facing Materials were modeled using ingredient data on Safety Data Sheet (SDS). Facing materials compose of aluminum facing (115g/m^2), Kraft paper (50g/m^2), and PE adhesive (30g/m^2).
- For the calculation of total mass of CO2 emission from facility chimney (sourced from on-site fuel combustion), ideal gas law is used at the atmospheric pressure and temperature of 280 °C.

3.7 PERIOD UNDER REVIEW

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

3.8 COMPARABILITY

The results of the study are not intended for use in 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 included flows and processes within the system boundary, the source of the data used in the study, the underlying databases used, and the specifications of the product modeled.

EPDs within the same product category but from different programs may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.

In addition, comparisons cannot be made between product-specific or industry average EPDs at the design stage of a project, before a building has been specified. Comparisons may be made between product-specific or industry average EPDs at the time of product purchase when product performance and specifications have been established and serve as a functional unit for comparison. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted.

Any comparison of EPDs shall be subject to the requirements of ISO 21930 [8], EN 15804 [6], and the PCR 2019:14 [7]. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparison can be inaccurate and could lead to erroneous selection of materials or products which are higher impact, at least in some impact categories.

4. LCA Results

Life Cycle Impact Assessment (LCIA) results are reported using core and additional environmental indicators, units and models prescribed by the PCR and EN 15804+A2, Annex C [6,7], which are shown in **Table 11** below.

The environmental impacts are reported by module in **Table 12**. Each module's contribution to the total of each impact category are displayed visually and graphically in **Table 13**. It should be noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. Table 10 presents disclaimers with regard to the declaration of relevant core and additional environmental impact indicators according to the following classification.

As the products and their packaging do not contain significant amounts of bio-based materials (less than 5% of the mass of the product), biogenic carbon content in the product at the factory gate are not declared.

Table 10. *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 nuclear 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 11. *The name, unit, and abbreviation of all impact categories required by the PCR.*

EN 15804:2012 + A2:2019 Indicator Category	Abbreviation	Unit
Climate change – total	GWP-total	kg CO_2 eq
Climate change - fossil	GWP-fossil	kg CO_2 eq
Climate change - biogenic	GWP-biogenic	kg CO_2 eq
Climate change - land use and land use change	GWP-luluc	kg CO_2 eq
Global Warming Potential – greenhouse gas	GWP-GHG	kg CO_2 eq
Ozone Depletion	ODP	kg CFC 11 eq
Acidification	AP	mol H+ eq
Eutrophication aquatic freshwater	EP-freshwater	kg PO4 eq and kg P eq
Eutrophication aquatic marine	EP-marine	kg N eq
Eutrophication terrestrial	EP-terrestrial	mol N eq
Photochemical ozone formation	POCP	kg NMVOC eq
Depletion of abiotic resources - minerals and metals	ADP-minerals & metals	kg Sb eq
Depletion of abiotic resources - fossil fuels	ADP-fossil	MJ, net calorific value
Water use	WDP	m^3 world eq. deprived
Particulate matter emissions	PM	Disease incidence
Ionizing radiation, human health	IRP	kBq U235 eq.
Ecotoxicity (freshwater)	ETP-fw	CTUe
Human toxicity, cancer effects	HTP-c	CTUh
Human toxicity, noncancer effects	HTP-nc	CTUh
Land use	LU	Pt

Table 12. *Life Cycle Impact Assessment (LCIA) results per functional unit for the Saudi Rock Wool Panels over a 50-yr service life time horizon. All values are rounded to two significant digits.*

Abbreviation	Unit	A1	A2	A3	A4	A5	C2	C4	Total
GWP-total	kg CO_2 eq	0.829	0.443	1.57	$6.37x10^{-2}$	$3.07x10^{-3}$	$1.00x10^{-2}$	$7.24x10^{-3}$	2.93
GWP-fossil	kg CO_2 eq	0.833	0.442	1.57	$6.36x10^{-2}$	$3.07x10^{-3}$	$1.00x10^{-2}$	$7.24x10^{-3}$	2.93
GWP-biogenic	kg CO_2 eq	$-5.25x10^{-3}$	$6.19x10^{-4}$	$7.26x10^{-4}$	$8.93x10^{-5}$	$1.24x10^{-7}$	$1.40x10^{-5}$	$2.17x10^{-5}$	$-3.78x10^{-3}$
GWP-luluc	kg CO_2 eq	$8.61x10^{-4}$	$1.70x10^{-4}$	$2.41x10^{-4}$	$2.44x10^{-5}$	$2.06x10^{-8}$	$3.84x10^{-6}$	$7.90x10^{-7}$	$1.30x10^{-3}$
GWP-GHG	kg CO_2 eq	0.813	0.439	1.55	$6.32x10^{-2}$	$3.10x10^{-3}$	$9.9x10^{-3}$	$7.1x10^{-3}$	2.89
ODP	kg CFC 11 eq	$4.49x10^{-7}$	$1.00x10^{-7}$	$2.30x10^{-7}$	$1.45x10^{-8}$	$3.31x10^{-12}$	$2.27x10^{-9}$	$1.44x10^{-9}$	$7.97x10^{-7}$
AP	mol H+ eq	$6.27x10^{-3}$	$2.26x10^{-3}$	$9.12x10^{-3}$	$3.23x10^{-4}$	$4.24x10^{-7}$	$5.09x10^{-5}$	$7.20x10^{-5}$	$1.81x10^{-2}$
EP-freshwater	kg PO4 eq kg P eq	$1.87x10^{-4}$ $1.64x10^{-4}$	$3.70x10^{-5}$ $3.24x10^{-5}$	$6.75x10^{-5}$ $5.92x10^{-5}$	$5.32x10^{-6}$ $4.66x10^{-6}$	$5.38x10^{-9}$ $4.71x10^{-9}$	$8.37x10^{-7}$ $7.33x10^{-7}$	$4.30x10^{-7}$ $3.76x10^{-7}$	$7.98x10^{-4}$ $2.61x10^{-4}$
EP-marine	kg N eq	$1.08x10^{-3}$	$7.53x10^{-4}$	$1.43x10^{-3}$	$1.10x10^{-4}$	$2.08x10^{-7}$	$1.73x10^{-5}$	$3.10x10^{-5}$	$3.41x10^{-3}$
EP-terrestrial	mol N eq	$1.16x10^{-2}$	$8.34x10^{-3}$	$1.47x10^{-2}$	$1.21x10^{-3}$	$2.13x10^{-6}$	$1.89x10^{-4}$	$3.50x10^{-4}$	$3.64x10^{-2}$
POCP	kg NMVOC eq	$4.14x10^{-3}$	$2.45x10^{-3}$	$4.38x10^{-3}$	$3.50x10^{-4}$	$5.14x10^{-7}$	$5.54x10^{-5}$	$9.24x10^{-5}$	$1.15x10^{-2}$
ADP-minerals & metals	kg Sb eq	$1.10x10^{-5}$	$9.81x10^{-7}$	$1.64x10^{-6}$	$1.41x10^{-7}$	$1.19x10^{-10}$	$2.22x10^{-8}$	$3.37x10^{-9}$	$1.38x10^{-5}$
ADP-fossil	MJ, net calorific value	3.22	0.723	1.34	0.104	$9.51x10^{-5}$	$1.64x10^{-2}$	$9.50x10^{-3}$	5.41
WDP	m_3 world eq. deprived	0.314	$3.67x10^{-2}$	0.159	$5.27x10^{-3}$	$1.19x10^{-5}$	$8.34x10^{-4}$	$2.47x10^{-4}$	0.516
PM	Disease incidence	$4.55x10^{-8}$	$4.03x10^{-8}$	$6.37x10^{-8}$	$5.80x10^{-9}$	$2.30x10^{-12}$	$9.12x10^{-10}$	$1.88x10^{-9}$	$1.58x10^{-7}$
IRP	kBq U235 eq.	0.137	$3.20x10^{-2}$	$5.85x10^{-2}$	$4.60x10^{-3}$	$8.58x10^{-7}$	$7.26x10^{-4}$	$4.30x10^{-4}$	0.233
ETP-fw	CTUe	1.98	0.285	0.234	$4.10x10^{-2}$	$5.30x10^{-5}$	$6.46x10^{-3}$	$5.11x10^{-4}$	2.55
HTP-c	CTUh	$1.22x10^{-9}$	$1.26x10^{-10}$	$3.55x10^{-10}$	$1.82x10^{-11}$	$7.39x10^{-14}$	$2.86x10^{-12}$	$1.93x10^{-12}$	$1.72x10^{-9}$
HTP-nc	CTUh	$2.89x10^{-8}$	$8.80x10^{-9}$	$1.28x10^{-8}$	$1.27x10^{-9}$	$3.76x10^{-11}$	$1.99x10^{-10}$	$3.53x10^{-11}$	$5.20x10^{-8}$
LU	Pt	5.72	10.2	0.361	1.46	$2.22x10^{-4}$	0.230	0.272	18.2

In addition, the PCR requires the GWP-GHG to be reported for the electricity mix in kg CO_2 eq/kWh if the electricity accounts for more than 30% of the total energy use in stage A1-A3. The GWP-GHG for the electricity mix of the Rockwool Panels is **1.01 kg CO_2 eq/kWh.**

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Table 13. *Contribution analysis for the Saudi Rock Wool Insulation Panels.*

Impact Categories	A1	A2	A3	A4	A5	C2	C4
GWP-total	28%	15%	54%	2%	0%	0%	0%
GWP-fossil	28%	15%	54%	2%	0%	0%	0%
GWP-biogenic	139%	-16%	-19%	-2%	0%	0%	-1%
GWP-LULUC	66%	13%	19%	2%	0%	0%	0%
GWP-GHG	28%	15%	54%	2%	0%	0%	0%
ODP	56%	13%	29%	2%	0%	0%	0%
AP	35%	12%	50%	2%	0%	0%	0%
EP-freshwater	63%	12%	23%	2%	0%	0%	0%
EP-marine	32%	22%	42%	3%	0%	1%	1%
EP-terrestrial	32%	23%	40%	3%	0%	1%	1%
POCP	36%	21%	38%	3%	0%	0%	1%
ADP-minerals & metals	80%	7%	12%	1%	0%	0%	0%
ADP-fossil	59%	13%	25%	2%	0%	0%	0%
WDP	61%	7%	31%	1%	0%	0%	0%
PM	29%	26%	40%	4%	0%	1%	1%
IRP	59%	14%	25%	2%	0%	0%	0%
ETP-fw	78%	11%	9%	2%	0%	0%	0%
HTP-c	71%	7%	21%	1%	0%	0%	0%
HTP-nc	56%	17%	25%	2%	0%	0%	0%
LU	31%	56%	2%	8%	0%	1%	1%

5. LCI Results

The following inventory parameters, specified by the PCR, are also reported based on the total cradle to grave analysis results.

Table 14. The full name, abbreviation, and unit of additional LCI indicators required by the PCR.

Parameter	Abbreviation	Unit
Resources		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ-eq
Use of renewable primary energy resources used as raw materials	PERM	MJ-eq
Total use of renewable primary energy resources	PERT	MJ-eq
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ-eq
Use of non-renewable primary energy resources used as raw materials	PENRM	MJ-eq
Total use of non-renewable primary energy resources	PENRT	MJ-eq
Use of secondary material	SM	kg
Use of renewable secondary fuels	RSF	MJ
Use of non-renewable secondary fuels	NRSF	MJ
Use of net fresh water	FW	m3
Wastes		
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed	RWD	kg
Output Flows		
Components for re-use	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported energy	EE	MJ per energy carrier

Table 15. *Saudi Rock Wool rockwool panels resource use, wastes, and output flows results per functional unit of installed insulation product. All values are rounded to three significant digits.*

Parameter	Unit	A1	A2	A3	A4	A5	C2	C4	Total
PERE	MJ-eq	0.394	$5.67x10^{-2}$	0.139	$8.15x10^{-3}$	$5.26x10^{-6}$	$1.29x10^{-3}$	$4.57x10^{-4}$	0.599
PERM	MJ-eq	0.415	$1.87x10^{-2}$	$3.02x10^{-2}$	$2.69x10^{-3}$	$2.77x10^{-6}$	$4.30x10^{-4}$	$3.23x10^{-4}$	0.467
PERT	MJ-eq	0.809	$7.53x10^{-2}$	0.169	$1.08x10^{-2}$	$8.03x10^{-6}$	$1.69x10^{-3}$	$7.80x10^{-4}$	1.07
PENRE	MJ-eq	3.75	0.813	1.53	0.117	$1.02x10^{-4}$	$1.84x10^{-2}$	$1.01x10^{-2}$	6.23
PENRM	MJ-eq	31.3	6.12	20.7	0.880	$2.96x10^{-4}$	0.138	$8.68x10^{-2}$	59.2
PENRT	MJ-eq	35.0	6.93	22.3	0.997	$4.04x10^{-4}$	0.157	$9.69x10^{-2}$	65.5
SM	kg	$2.40x10^{-2}$	$4.73x10^{-3}$	$5.22x10^{-3}$	$6.73x10^{-4}$	$1.85x10^{-6}$	$1.07x10^{-4}$	$7.44x10^{-5}$	$3.48x10^{-2}$
RSF	MJ	$3.71x10^{-3}$	$8.34x10^{-4}$	$1.08x10^{-3}$	$1.18x10^{-4}$	$6.40x10^{-8}$	$1.86x10^{-5}$	$9.51x10^{-6}$	$5.77x10^{-3}$
NRSF	MJ	$7.61x10^{-3}$	$1.21x10^{-3}$	$2.69x10^{-3}$	$1.73x10^{-4}$	$1.59x10^{-7}$	$2.72x10^{-5}$	$1.19x10^{-5}$	$1.17x10^{-2}$
FW	m^3	$7.42x10^{-3}$	$8.88x10^{-4}$	$2.80x10^{-3}$	$1.27x10^{-4}$	$2.85x10^{-7}$	$2.00x10^{-5}$	$5.92x10^{-6}$	$1.13x10^{-2}$
HWD	kg	0.859	0.164	0.305	$2.36x10^{-2}$	$3.82x10^{-5}$	$3.71x10^{-3}$	$1.83x10^{-3}$	1.36
NHWD	kg	$9.33x10^{-2}$	0.627	$1.79x10^{-2}$	$9.02x10^{-2}$	$1.21x10^{-3}$	$1.42x10^{-2}$	$7.94x10^{-5}$	0.844
RWD	kg	$4.57x10^{-4}$	$1.03x10^{-4}$	$2.01x10^{-4}$	$1.49x10^{-5}$	$4.98x10^{-9}$	$2.34x10^{-6}$	$1.10x10^{-6}$	$7.80x10^{-4}$
CRU	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MFR	kg	$1.02x10^{-2}$	$3.31x10^{-3}$	$3.15x10^{-3}$	$4.84x10^{-4}$	$4.96x10^{-7}$	$7.47x10^{-5}$	$4.77x10^{-5}$	$1.73x10^{-2}$
MER	kg	$2.61x10^{-3}$	$1.64x10^{-3}$	$9.95x10^{-4}$	$2.36x10^{-4}$	$3.60x10^{-7}$	$3.71x10^{-5}$	$3.37x10^{-5}$	$5.55x10^{-3}$
EE	MJ per energy carrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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6. Additional Environmental Information

6.1 Indoor Air Emissions

Saudi Rockwool Panels are chemically and biologically inert during the use phase, as such, there are no emission to indoor air, soil, or water during the use stage.

6.2 Hazardous Substances

The product materials were reviewed for the presence of any toxic or hazardous chemicals. Based on a review of the product components provided by the manufacturer, no regulated chemicals were identified in the product or product components.

6.3 Additional LCIA Results for North American and International Markets

The following impact indicators, specified by the ISO 21930 standard for use in North American and International markets, are reported below. The results for the North American market are reported using the TRACI characterization method. The results for the International market are reported using the CML characterization method, which uses the methods identified in the ISO 21930 standard for the default international methods.

Table 16. *The name, unit, and abbreviation of all impact categories required by the ISO 21930 Standard.*

North American Market - TRACI Indicator Category	Abbreviation	Unit
Global Warming Potential	GWP	kg CO_2 eq
Ozone Depletion Potential	ODP	kg CFC 11 eq
Acidification Potential	AP	kg SO2 eq
Eutrophication Potential	EP	kg N eq
Photochemical Ozone Creation Potential	POCP	kg O3 eq
International Market - CML Indicator Category	**Abbreviation**	**Unit**
Global Warming Potential	GWP	kg CO_2 eq
Ozone Depletion Potential	ODP	kg CFC 11 eq
Acidification Potential	AP	kg SO2 eq
Eutrophication Potential	EP	kg PO4 eq
Photochemical Ozone Creation Potential	POCP	kg C2H4 eq

Table 17. *Life Cycle Impact Assessment (LCIA) results per functional unit for the Saudi Rock Wool Panels over a 50-yr service life time horizon. All values are rounded to two significant digits.*

TRACI	Unit	A1	A2	A3	A4	A5	C2	C4	Total
GWP	kg CO_2 eq	0.799	0.437	1.55	0.063	0.003	0.010	0.007	2.87
ODP	kg CFC 11 eq	$4.74x10^{-7}$	$1.06x10^{-7}$	$2.42x10^{-7}$	$1.53x10^{-8}$	$4.26x10^{-12}$	$2.40x10^{-9}$	$1.52x10^{-9}$	$8.41x10^{-7}$
AP	kg SO2 eq	0.005	0.002	0.007	$2.80x10^{-4}$	$4.09x10^{-7}$	$4.47x10^{-5}$	$6.56x10^{-5}$	0.015
EP	kg N eq	$2.17x10^{-3}$	$4.70x10^{-4}$	$9.30x10^{-4}$	$6.79x10^{-5}$	$2.22x10^{-6}$	$1.07x10^{-5}$	$8.41z10^{-6}$	$3.66x10^{-3}$
POCP	kg O3 eq	0.065	0.048	0.085	0.007	$1.27x10^{-5}$	$1.08x10^{-3}$	$1.97x10^{-3}$	0.208
CML	Unit	A1	A2	A3	A4	A5	C2	C4	Total
GWP	kg CO2 eq	0.807	0.438	1.55	0.063	0.003	0.010	0.007	2.88
ODP	kg CFC 11 eq	$3.58x10^{-7}$	$7.96x10^{-8}$	$1.82x10^{-7}$	$1.14x10^{-8}$	$3.42x10^{-12}$	$1.80x10^{-9}$	$1.14x10^{-9}$	$6.34x10^{-7}$
AP	kg SO2 eq	0.005	0.002	0.008	$2.40x10^{-4}$	$3.12x10^{-7}$	$3.81x10^{-5}$	$5.15x10^{-5}$	0.015
EP	kg PO4 eq	$1.06x10^{-3}$	$3.90x10^{-4}$	$7.40x10^{-4}$	$5.63x10^{-5}$	$7.94x10^{-7}$	$8.86x10^{-6}$	$1.21x10^{-5}$	$2.27x10^{-3}$
POCP	kg C2H4 eq	$4.00x10^{-4}$	$5.62x10^{-5}$	$3.10x10^{-4}$	$8.09x10^{-6}$	$6.23x10^{-9}$	$1.27x10^{-6}$	$2.09x10^{-6}$	$7.80x10^{-4}$

7. References

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