



EcoBatt® batts and rolls

Unfaced, Kraft, FSK, Foil

Fiberglass insulation takes sustainability to a new level while delivering Knauf's exceptional quality, handling and durability. Leverages ECOSE® Technology— a revolutionary binder that transformed the glass wool insulation industry. It is based on rapidly renewable, bio- based material. EcoBatt® also contains sand— an abundant resource— for making glass and recycled glass.



Performance dashboard

Features & functionality

Faced products resist tears, are marked in one-foot increments, and feature extra wide stapling flange for faster and easier install

Highly resilient, recovers quickly to full thickness for snug fit and superior aesthetics

Consistent quality materials cut easily with low dust

Excellent acoustical properties reduce sound transmission

Visit Knauf for more product information

[EcoBatt® Insulation unfaced, kraft-faced, foil-faced, FSK-faced](#)

[EcoRoll® Insulation unfaced, kraft-faced, foil-faced, FSK-faced](#)

MasterFormat® 07 21 00

[EcoBatt® Insulation Technical Data Sheet](#)

[EcoRoll® Insulation Technical Data Sheet](#)

[EcoBatt® and EcoRoll® Insulation Guide Spec](#)
For spec help, [contact us](#) or call 317 421 8727

[See LCA, interpretation & rating systems](#)

[See materials, interpretation & rating systems](#)

Environment & materials

Improved by:

Utilization of recycled glass

Knauf's original plant-based ECOSE® Technology binder technology

Optimized compression packaging

Certification & rating systems:

Declare, Red List Free

HPD v2.2

Energy Star

UL GREENGUARD Gold certified

UL Validated recycled content

UL Validated formaldehyde-free

Audited, European Certification Board for Mineral Wool Products exoneration process

ASTM C 665; Type 1, Class A (unfaced); ASTM C 665; Type II, Class C (kraft faced); ASTM C 665; Type III, Class A (FSK-25 foil faced); ASTM C 665; Type III, Class B (foil faced)





SM Transparency Report (EPD)[™] + Material Health Overview[™]

EPD LCA

3rd-party verified ✓

Transparency Report (EPD)

3rd-party verified ✓

Validity: 12/12/23 – 12/12/28
KNA – 12122023 – 001

MATERIAL HEALTH Material evaluation

Self-declared ✓

This environmental product declaration (EPD) was externally verified by Harmony Environmental, LLC, according to ISO 21930:2017; UL Part A; UL Part B for Building Envelope Thermal Insulation Products; and ISO 14025:2006.

Harmony Environmental, LLC
16362 W. Briarwood Ct.
Olathe, KS 66062
www.harmonyenviro.com
(913) 780-3328



SUMMARY

Reference PCR

UL Part B: Building Envelope Thermal Insulation v2.0

Regions; system boundaries

North America; Cradle-to-grave

Functional unit / ESL:

1 m² installed insulation material, packaging included, with thickness that gives average thermal resistance of R_{si} = 1 m²·K/W over an estimated service life (ESL) of 75 years

LCIA methodology: TRACI 2.1

LCA software; LCI database

LCA for Experts v10.7; LCA for Experts 2023

In accordance with ISO 14044 and the reference PCR, this life cycle assessment was conducted by Sustainable Minds and verified by Harmony Environmental, LLC.

Public LCA:

Knauf Insulation North America and Manson Insulation Products

Knauf Insulation, Inc.
One Knauf Drive
Shelbyville, IN 46176
www.knaufinsulation.us
317 398 4434

Contact us

LCA results & interpretation

EcoBatt® and EcoRoll® Insulation

Albion, MI

Inwood, WV

Lanett, AL

Shasta Lake, CA

Shelbyville, IN

EPD add'l content

Material health

Scope and summary

☐ Cradle to gate ☐ Cradle to gate with options ☒ Cradle to grave

Application

Thermal and acoustical barriers for energy-efficient construction. They can be used in new and retrofit wood and metal frame applications in residential and commercial structures, as well as in manufactured housing. These applications include thermal and acoustical treatments to walls, ceilings, and floors.

Functional unit

One square meter of installed insulation material, packaging included, with a thickness that gives an average thermal resistance of $R_{Si} = 1 \text{ m}^2 \cdot \text{K/W}$ with a building service life of 75 years.

Reference service life: 75 years when installed per manufacturer's instructions

Reference flow:

Unfaced: 0.546 kg of product with no facer option.

Kraft-faced: 0.632 kg of product with kraft facer.

FSK-faced: 0.668 kg of product with foil skim kraft (FSK) facer.

Foil-faced: 0.644 kg of product with foil facer.

A thickness of 0.0398m achieves the functional unit. (ASTM C518)

Manufacturing data

Reporting period: January 2022 – December 2022

Location: Albion, MI

Default installation, packaging, and disposal scenarios

At the installation site, insulation products are unpackaged and installed. Staples may be used to install batts and rolls. The potential impact of the staples is assumed to be negligible since their use is spread out over hundreds of bags of product; therefore, they were not included in the model.

No material is assumed to be lost or wasted. Scraps are typically used to fill corners or crevices. Plastic packaging waste is disposed (9% to recycling, 68% to landfill, and 17% to incineration), and no maintenance or replacement is required over the life of the building. After removal, the insulation is assumed to be landfilled. Insulation and packaging waste are assumed to be transported 100 miles for disposal.

What's causing the greatest impacts

All life cycle stages

The manufacturing stage dominates all impact categories except ozone depletion, where the raw material acquisition stage takes precedence. The energy required to melt the glass and produce the glass fibers is the largest contributor to the manufacturing stage. The impact of the raw material acquisition stage is mostly due to the batch and binder materials. The contributions to outbound transportation are caused by the use of trucks and rail transport. The only impacts associated with installation and maintenance are due to the disposal of packaging waste, which is the smallest contributor of all the stages. At the end of life, insulation is manually removed from the building and landfilled. For all products, waste is dominated by the final disposal of the product. Non-hazardous waste accounts for waste generated during manufacturing and installation.

Raw materials acquisition and transportation

The raw material acquisition stage is the second highest contributor for most impact categories, but ozone depletion potential is almost entirely generated from this stage. The raw materials acquisition stage impact is largely due to the borax, manganese oxide, and soda ash in the batch and the sugars in the binder. Third-party verified ISO 14040/44 secondary LCI data sets contribute more than 80% of the total impacts to ozone depletion.

Manufacturing stage

The manufacturing stage has the most significant contribution to all impact categories, primarily due to the energy required to melt the glass and produce the glass fibers. Since some batch ingredients significantly contribute to the respiratory effects category, they can lead to higher impact results in the raw materials acquisition stage. However, since sand and borax are melted in the oven with the other batch materials, they are not released into the air as fine particulates. Therefore, the calculated potential impacts as shown in the results tables are likely much larger than the actual impacts in the raw material acquisition stage. This implies that the manufacturing stage may have a greater share of the impact than what is displayed in the total impacts by life cycle stage.

Distribution

Outbound transportation is the third highest contributor to smog impacts.

End of life

The end-of-life impacts are largely due to landfilling of the product after it has been removed from the building and transported to a landfill. Since materials are assumed to be landfilled at the end of life rather than incinerated or reused/recycled, no materials are available for energy recovery or reuse/recycling.

Embodied carbon

Embodied carbon can be defined as the cradle-to-gate (A1-A3) global warming potential impacts. The total embodied carbon per functional unit of EcoBatt® and EcoRoll® Insulation manufactured in Albion, MI is as follows: 9.97E-01 kg CO₂-eq for unfaced; 1.01E+00 kg CO₂-eq for kraft-faced; 1.45E+00 kg CO₂-eq for FSK-faced; and 1.24E+00 kg CO₂-eq for foil-faced.

Unfaced product composition and impacts

Material composition greater than 1% by weight

PART	MATERIAL	%WT.
Batch	Cullet	45-50%
Batch	Borates	8-10%
Batch	Soda ash	2-5%
Batch	Feldspar	2-5%
Batch	Limestone	<1%
Batch	Oxides	<1%
Binder	Water	10-15%
Binder	Sugars	2-5%
Binder	Additives	2-5%
Packaging	Plastic	8-10%

Material composition for other facers

The kraft facer accounts for 10-15%, and the foil and FSK facers account for 15-20% of the total mass per functional unit.

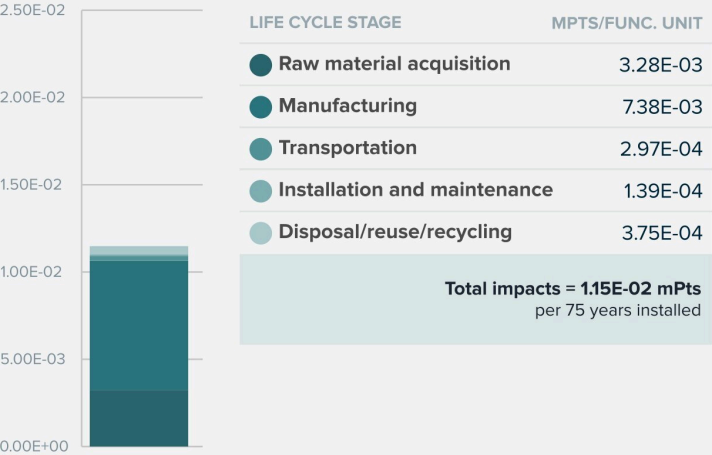
How we're making it greener

Knauf Insulation North America (KINA) is committed to providing products that conserve energy and preserve natural resources.

- Our products with ECOSE® Technology contain a bio-based binder adhesive instead of a fossil fuel-based binder.
- Our fiberglass contains on average over 60% recycled glass, which requires about 20% less energy required to form glass fibers, and results in about 25% reduction in embodied carbon.
- Our glass is audited by a 3rd party to ensure biosoluble chemistry from a health and safety standpoint.

[See how we make it greener](#)

Total impacts by life cycle stages [mPts/per func unit]



LCA results





LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
<div>Information modules: Included (X) Excluded (MND)*</div> <div>*Module D is also excluded from this system boundary (MND).</div>	(X) A1 Raw materials	(X) A3 Manufacturing	(X) A4 Distribution	(X) A5 Installation	(X) C1 Deconstruction
	(X) A2 Transportation			(X) B1 Use	(X) C2 Transportation
				(X) B2 Maintenance	(X) C3 Waste processing
				(X) B3 Repair	(X) C4 Disposal
				(X) B4 Replacement	
				(X) B5 Refurbishment	
				(X) B6 Operational energy use	
				(X) B7 Operational water use	
					

Impacts per 1 square meter of insulation material	Unfaced	3.28E-03 mPts	7.38E-03 mPts	2.97E-04 mPts	1.39E-04 mPts	3.75E-04 mPts
	Kraft-faced	3.11E-03 mPts	8.99E-03 mPts	3.44E-04 mPts	1.38E-04 mPts	4.40E-04 mPts
	FSK-faced	3.12E-03 mPts	1.72E-02 mPts	3.64E-04 mPts	1.34E-04 mPts	4.69E-04 mPts
	Foil-faced	3.29E-03 mPts	1.13E-02 mPts	3.50E-04 mPts	1.38E-04 mPts	4.50E-04 mPts
Materials or processes contributing >20% to total impacts in each life cycle stage		Batch material and binder material production.	Energy required to melt the glass and produce the glass fibers.	Truck and rail transportation used to transport product to building site.	Transportation to landfill and landfilling of packaging materials.	Transportation to landfill and landfilling of product at end of life.



TRACI v2.1 results per functional unit (unfaced EcoBatt® and EcoRoll® Insulation - Albion, MI)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq		1.23E-01	8.74E-01	1.60E-02	2.70E-02	1.82E-02
Ozone depletion	kg CFC-11 eq		2.75E-11	9.23E-14	3.58E-17	2.73E-16	5.23E-16
Acidification	kg SO ₂ eq		6.35E-04	1.33E-03	8.23E-05	1.61E-05	7.61E-05
Eutrophication	kg N eq		1.88E-04	3.37E-04	7.05E-06	7.45E-06	4.68E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq		7.06E-03	2.48E-02	2.82E-03	2.10E-04	1.49E-03
Respiratory effects	kg PM _{2.5} eq		4.93E-05	7.32E-05	4.02E-06	7.97E-07	5.13E-06





Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h		4.3%	92.1%	0.3%	0.4%	3.0%
Non-carcinogenics	CTU _h		8.5%	82.5%	0.5%	1.2%	7.3%
Ecotoxicity	CTU _e		13.5%	84.3%	1.0%	0.4%	0.9%
Fossil fuel depletion	MJ surplus		2.57E-01	1.66E+00	3.01E-02	6.56E-03	3.55E-02



TRACI v2.1 results per functional unit (kraft-faced EcoBatt® and EcoRoll® Insulation - Albion, MI)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq		1.17E-01	8.89E-01	1.86E-02	2.69E-02	2.13E-02
Ozone depletion	kg CFC-11 eq		2.61E-11	4.08E-09	4.14E-17	2.72E-16	6.15E-16
Acidification	kg SO ₂ eq		6.02E-04	1.72E-03	9.52E-05	1.60E-05	8.95E-05
Eutrophication	kg N eq		1.78E-04	4.14E-04	8.16E-06	7.43E-06	5.50E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq		6.69E-03	3.12E-02	3.27E-03	2.09E-04	1.75E-03
Respiratory effects	kg PM _{2.5} eq		4.68E-05	1.00E-04	4.65E-06	7.94E-07	6.03E-06

Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h	?	4.1%	91.6%	0.3%	0.4%	3.6%
Non-carcinogenics	CTU _h	?	7.8%	82.0%	0.6%	1.1%	8.4%
Ecotoxicity	CTU _e	?	12.6%	84.8%	1.1%	0.3%	1.1%
Fossil fuel depletion	MJ surplus	?	2.44E-01	1.93E+00	3.48E-02	6.54E-03	4.17E-02

TRACI v2.1 results per functional unit (FSK-faced EcoBatt® and EcoRoll® Insulation - Albion, MI)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq	?	1.17E-01	1.33E+00	1.96E-02	2.61E-02	2.27E-02
Ozone depletion	kg CFC-11 eq	?	2.62E-11	2.82E-09	4.38E-17	2.64E-16	6.55E-16
Acidification	kg SO ₂ eq	?	6.05E-04	3.31E-03	1.01E-04	1.55E-05	9.53E-05
Eutrophication	kg N eq	?	1.79E-04	4.49E-04	8.63E-06	7.20E-06	5.86E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq	?	6.72E-03	4.79E-02	3.45E-03	2.03E-04	1.86E-03
Respiratory effects	kg PM _{2.5} eq	?	4.70E-05	2.16E-04	4.92E-06	7.70E-07	6.43E-06

Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h	?	3.4%	92.8%	0.3%	0.3%	3.2%
Non-carcinogenics	CTU _h	?	5.8%	86.3%	0.5%	0.8%	6.6%
Ecotoxicity	CTU _e	?	11.6%	86.0%	1.1%	0.3%	1.1%
Fossil fuel depletion	MJ surplus	?	2.45E-01	2.39E+00	3.68E-02	6.34E-03	4.45E-02

TRACI v2.1 results per functional unit (foil-faced EcoBatt® and EcoRoll® Insulation - Albion, MI)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq	?	1.23E-01	1.12E+00	1.89E-02	2.69E-02	2.18E-02
Ozone depletion	kg CFC-11 eq	?	2.76E-11	2.19E-09	4.22E-17	2.72E-16	6.28E-16
Acidification	kg SO ₂ eq	?	6.36E-04	2.12E-03	9.70E-05	1.60E-05	9.13E-05
Eutrophication	kg N eq	?	1.89E-04	4.15E-04	8.32E-06	7.43E-06	5.61E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq	?	7.07E-03	3.74E-02	3.33E-03	2.09E-04	1.78E-03
Respiratory effects	kg PM _{2.5} eq	?	4.95E-05	1.25E-04	4.74E-06	7.94E-07	6.16E-06

Impact category	Unit						
Carcinogenics	CTU _h		3.8%	92.4%	0.3%	0.3%	3.2%
Non-carcinogenics	CTU _h		6.7%	84.9%	0.5%	0.9%	7.0%
Ecotoxicity	CTU _e		12.0%	85.7%	1.0%	0.3%	1.0%
Impact category	Unit						
Fossil fuel depletion	MJ surplus		2.58E-01	2.42E+00	3.55E-02	6.54E-03	4.26E-02

See the additional content on page 4 of the [Transparency Report PDF](#).

References

LCA Background Report

Knauf Insulation North America and Manson Insulation Products LCA Background Report (public version), Knauf Insulation North America (KINA) 2023; developed using the [TRACI v2.1](#) and [CML](#) impact assessment methodologies, and [LCA for Experts modeling software](#).

ISO 14025, “Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services”

ISO 21930:2017 serves as the core PCR along with UL Part A.

UL Part A: Life Cycle Assessment Calculation Rules and Report Requirements v4.0

March, 2022. PCR review conducted by Lindita Bushi, PhD, Chair (Athena Sustainable Materials Institute), lindita.bushi@athenasmi.org; Hugues Imbeault-Tétreault (Group AGECO); and Jack Geibig (Ecoform).

UL Part B: Building Envelope Thermal Insulation EPD Requirements, v2.0

April, 2018. PCR review conducted by Thomas Gloria, PhD, Chair (Industrial Ecology Consultants) t.gloria@industrial-ecology.com; Christoph Koffler, PhD (thinkstep); Andre Desjarlais (Oak Ridge National Laboratory).

UL Environment General Program Instructions v2.4, July 2018 (available upon request)

[Download PDF](#) SM Transparency Report / EPD

SM Transparency Reports (TR) are ISO 14025 Type III environmental declarations (EPD) that enable purchasers and users to compare the potential environmental performance of products on a life cycle basis. Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance with the PCR for Building Envelope Thermal Insulation allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

Rating systems

The intent is to reward project teams for selecting products from manufacturers who have verified improved life-cycle environmental performance.

LEED BD+C: New Construction | v4 - LEED v4

Building product disclosure and optimization

Environmental product declarations

- ☐ Industry-wide (generic) EPD
- ☒ Product-specific Type III EPD
- ½product
- 1 product

LEED BD+C: New Construction | v4.1 - LEED v4.1

Building product disclosure and optimization

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- ☐ Industry-wide (generic) EPD
- ☒ Product-specific Type III EPD
- 1 product
- 1.5 product

Collaborative for High Performance Schools National Criteria

MW C5.1 – Environmental Product Declarations

- ☒ Third-party certified type III EPD
- 2 point

Green Globes for New Construction and Sustainable Interiors

Materials and resources

- ☒ NC 3.5.1.2 Path B: Prescriptive Path for Building Core and Shell
- ☒ NC 3.5.2.2 and SI 4.1.2 Path B: Prescriptive Path for Interior Fit-outs

BREEAM New Construction 2018

Mat 02 - Environmental impacts from construction products

Environmental Product Declarations (EPD)

- ☐ Industry-average EPD
- ☐ Multi-product specific EPD
- ☒ Product-specific EPD
- .5 point
- .75 points
- 1 point



LCA results & interpretation

EcoBatt® and EcoRoll® Insulation

Albion, MI

Inwood, WV

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Material health

Scope and summary

☐ Cradle to gate ☐ Cradle to gate with options ☒ **Cradle to grave**

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One square meter of installed insulation material, packaging included, with a thickness that gives an average thermal resistance of $R_{Si} = 1\text{m}^2 \cdot \text{K/W}$ with a building service life of 75 years.

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Unfaced product composition and impacts

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All life cycle stages

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Distribution

Outbound transportation is the third highest contributor to smog impacts.

End of life

The end-of-life impacts are largely due to landfilling of the product after it has been removed from the building and transported to a landfill. Since materials are assumed to be landfilled at the end of life rather than incinerated or reused/recycled, no materials are available for energy recovery or reuse/recycling.

Embodied carbon

Embodied carbon can be defined as the cradle-to-gate (A1-A3) global warming potential impacts. The total embodied carbon per functional unit of EcoBatt® and EcoRoll® Insulation manufactured in Inwood, WV is as follows: 1.16E+00 kg CO₂-eq for unfaced; 1.21E+00 kg CO₂-eq for kraft-faced; 1.61E+00 kg CO₂-eq for FSK-faced; and 1.41E+00 kg CO₂-eq for foil-faced.

Material composition greater than 1% by weight

PART	MATERIAL	%WT.
Batch	Cullet	35-40%
Batch	Sand	10-15%
Batch	Borates	5-8%
Batch	Soda ash	5-8%
Batch	Feldspar	2-5%
Batch	Limestone	2-5%
Batch	Oxides	<1%
Binder	Water	10-15%
Binder	Sugars	2-5%
Binder	Additives	2-5%
Packaging	Plastic	8-10%

Material composition for other facers

The kraft facer accounts for 10-15%, and the foil and FSK facers account for 15-20% of the total mass per functional unit.

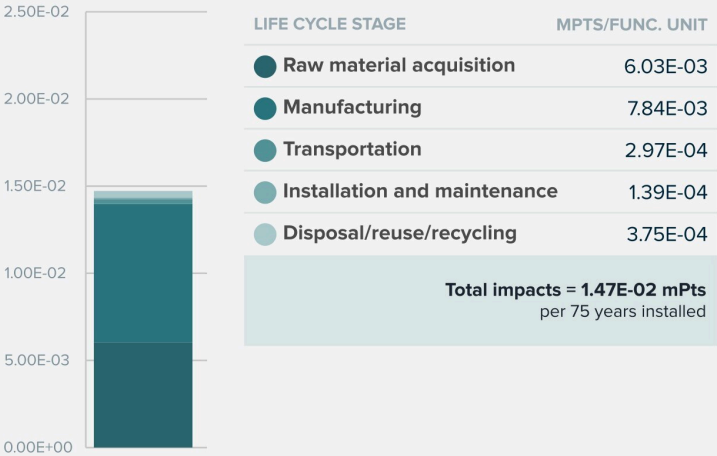
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[See how we make it greener](#)

Total impacts by life cycle stages [mPts/per func unit]



LCA results





LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
<p>Information modules: Included (X) Excluded (MND)*</p> <p>*Module D is also excluded from this system boundary (MND).</p>	(X) A1 Raw materials	(X) A3 Manufacturing	(X) A4 Distribution	(X) A5 Installation	(X) C1 Deconstruction
	(X) A2 Transportation			(X) B1 Use	(X) C2 Transportation
				(X) B2 Maintenance	(X) C3 Waste processing
				(X) B3 Repair	(X) C4 Disposal
				(X) B4 Replacement	
				(X) B5 Refurbishment	
				(X) B6 Operational energy use	
				(X) B7 Operational water use	
					

Impacts per 1 square meter of insulation material	Unfaced	6.03E-03 mPts	7.84E-03 mPts	2.97E-04 mPts	1.39E-04 mPts	3.75E-04 mPts
	Kraft-faced	6.03E-03 mPts	9.86E-03 mPts	3.44E-04 mPts	1.38E-04 mPts	4.40E-04 mPts
	FSK-faced	5.81E-03 mPts	1.77E-02 mPts	3.64E-04 mPts	1.34E-04 mPts	4.69E-04 mPts
	Foil-faced	6.11E-03 mPts	1.18E-02 mPts	3.50E-04 mPts	1.38E-04 mPts	4.50E-04 mPts
Materials or processes contributing >20% to total impacts in each life cycle stage		Batch material and binder material production.	Energy required to melt the glass and produce the glass fibers.	Truck and rail transportation used to transport product to building site.	Transportation to landfill and landfilling of packaging materials.	Transportation to landfill and landfilling of product at end of life.



TRACI v2.1 results per functional unit (unfaced EcoBatt® and EcoRoll® Insulation - Inwood-WV)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq		2.27E-01	9.28E-01	1.60E-02	2.70E-02	1.82E-02
Ozone depletion	kg CFC-11 eq		5.57E-14	8.60E-14	3.58E-17	2.73E-16	5.23E-16
Acidification	kg SO ₂ eq		1.24E-03	1.73E-03	8.23E-05	1.61E-05	7.61E-05
Eutrophication	kg N eq		2.69E-04	3.44E-04	7.05E-06	7.45E-06	4.68E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq		1.29E-02	3.99E-02	2.82E-03	2.10E-04	1.49E-03
Respiratory effects	kg PM _{2.5} eq		9.08E-05	7.70E-05	4.02E-06	7.97E-07	5.13E-06


Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h		5.8%	90.4%	0.3%	0.4%	3.1%
Non-carcinogenics	CTU _h		11.9%	79.3%	0.5%	1.1%	7.1%
Ecotoxicity	CTU _e		16.8%	81.0%	1.0%	0.3%	0.9%
Fossil fuel depletion	MJ surplus		3.48E-01	1.76E+00	3.01E-02	6.56E-03	3.55E-02



TRACI v2.1 results per functional unit (kraft-faced EcoBatt® and EcoRoll® Insulation - Inwood-WV)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq		2.27E-01	9.81E-01	1.86E-02	2.69E-02	2.13E-02
Ozone depletion	kg CFC-11 eq		5.57E-14	4.26E-09	4.14E-17	2.72E-16	6.15E-16
Acidification	kg SO ₂ eq		1.24E-03	2.19E-03	9.52E-05	1.60E-05	8.95E-05
Eutrophication	kg N eq		2.69E-04	4.42E-04	8.16E-06	7.43E-06	5.50E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq		1.29E-02	4.76E-02	3.27E-03	2.09E-04	1.75E-03
Respiratory effects	kg PM _{2.5} eq		9.08E-05	1.08E-04	4.65E-06	7.94E-07	6.03E-06

Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h	?	5.6%	90.2%	0.3%	0.4%	3.5%
Non-carcinogenics	CTU _h	?	11.1%	79.4%	0.6%	1.1%	7.8%
Ecotoxicity	CTU _e	?	15.8%	81.7%	1.1%	0.3%	1.0%
Fossil fuel depletion	MJ surplus	?	3.48E-01	2.10E+00	3.48E-02	6.54E-03	4.17E-02

TRACI v2.1 results per functional unit (FSK-faced EcoBatt® and EcoRoll® Insulation - Inwood-WV)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq	?	2.19E-01	1.39E+00	1.96E-02	2.61E-02	2.27E-02
Ozone depletion	kg CFC-11 eq	?	5.37E-14	2.82E-09	4.38E-17	2.64E-16	6.55E-16
Acidification	kg SO ₂ eq	?	1.20E-03	3.71E-03	1.01E-04	1.55E-05	9.53E-05
Eutrophication	kg N eq	?	2.59E-04	4.60E-04	8.63E-06	7.20E-06	5.86E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq	?	1.24E-02	6.26E-02	3.45E-03	2.03E-04	1.86E-03
Respiratory effects	kg PM _{2.5} eq	?	8.75E-05	2.20E-04	4.92E-06	7.70E-07	6.43E-06

Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h	?	4.7%	91.5%	0.3%	0.3%	3.2%
Non-carcinogenics	CTU _h	?	8.3%	84.0%	0.5%	0.8%	6.4%
Ecotoxicity	CTU _e	?	14.5%	83.1%	1.1%	0.3%	1.0%
Fossil fuel depletion	MJ surplus	?	3.35E-01	2.50E+00	3.68E-02	6.34E-03	4.45E-02

TRACI v2.1 results per functional unit (foil-faced EcoBatt® and EcoRoll® Insulation - Inwood-WV)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq	?	2.30E-01	1.18E+00	1.89E-02	2.69E-02	2.18E-02
Ozone depletion	kg CFC-11 eq	?	5.65E-14	2.19E-09	4.22E-17	2.72E-16	6.28E-16
Acidification	kg SO ₂ eq	?	1.26E-03	2.54E-03	9.70E-05	1.60E-05	9.13E-05
Eutrophication	kg N eq	?	2.72E-04	4.27E-04	8.32E-06	7.43E-06	5.61E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq	?	1.30E-02	5.29E-02	3.33E-03	2.09E-04	1.78E-03
Respiratory effects	kg PM _{2.5} eq	?	9.21E-05	1.30E-04	4.74E-06	7.94E-07	6.16E-06

Impact category	Unit						
Carcinogenics	CTU _h		5.1%	91.0%	0.3%	0.3%	3.2%
Non-carcinogenics	CTU _h		9.6%	82.3%	0.5%	0.9%	6.7%
Ecotoxicity	CTU _e		15.0%	82.7%	1.0%	0.3%	1.0%
Impact category	Unit						
Fossil fuel depletion	MJ surplus		3.53E-01	2.53E+00	3.55E-02	6.54E-03	4.26E-02

See the additional content on page 4 of the [Transparency Report PDF](#).

References

LCA Background Report

Knauf Insulation North America and Manson Insulation Products LCA Background Report (public version), Knauf Insulation North America (KINA) 2023; developed using the [TRACI v2.1](#) and [CML](#) impact assessment methodologies, and [LCA for Experts modeling software](#).

ISO 14025, “Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services”

ISO 21930:2017 serves as the core PCR along with UL Part A.

UL Part A: Life Cycle Assessment Calculation Rules and Report Requirements v4.0

March, 2022. PCR review conducted by Lindita Bushi, PhD, Chair (Athena Sustainable Materials Institute), lindita.bushi@athenasmi.org; Hugues Imbeault-Tétreault (Group AGECO); and Jack Geibig (Ecoform).

UL Part B: Building Envelope Thermal Insulation EPD Requirements, v2.0

April, 2018. PCR review conducted by Thomas Gloria, PhD, Chair (Industrial Ecology Consultants) t.gloria@industrial-ecology.com; Christoph Koffler, PhD (thinkstep); Andre Desjarlais (Oak Ridge National Laboratory).

UL Environment General Program Instructions v2.4, July 2018 (available upon request)

[Download PDF](#) SM Transparency Report / EPD

SM Transparency Reports (TR) are ISO 14025 Type III environmental declarations (EPD) that enable purchasers and users to compare the potential environmental performance of products on a life cycle basis. Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance with the PCR for Building Envelope Thermal Insulation allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

Rating systems

The intent is to reward project teams for selecting products from manufacturers who have verified improved life-cycle environmental performance.

LEED BD+C: New Construction | v4 - LEED v4

Building product disclosure and optimization

Environmental product declarations

- ☐ Industry-wide (generic) EPD ½product
- ☒ Product-specific Type III EPD 1 product

LEED BD+C: New Construction | v4.1 - LEED v4.1

Building product disclosure and optimization

Environmental product declarations

- ☐ Industry-wide (generic) EPD 1 product
- ☒ Product-specific Type III EPD 1.5 product

Collaborative for High Performance Schools National Criteria

MW C5.1 – Environmental Product Declarations

- ☒ Third-party certified type III EPD 2 point

Green Globes for New Construction and Sustainable Interiors

Materials and resources

- ☒ NC 3.5.1.2 Path B: Prescriptive Path for Building Core and Shell
- ☒ NC 3.5.2.2 and SI 4.1.2 Path B: Prescriptive Path for Interior Fit-outs

BREEAM New Construction 2018

Mat 02 - Environmental impacts from construction products

Environmental Product Declarations (EPD)

- ☐ Industry-average EPD .5 point
- ☐ Multi-product specific EPD .75 points
- ☒ Product-specific EPD 1 point



LCA results & interpretation

EcoBatt® and EcoRoll® Insulation

Albion, MI

Inwood, WV

Lanett, AL

Shasta Lake, CA

Shelbyville, IN

EPD add'l content

Material health

Scope and summary

☐ Cradle to gate ☐ Cradle to gate with options ☒ **Cradle to grave**

Application

Thermal and acoustical barriers for energy-efficient construction. They can be used in new and retrofit wood and metal frame applications in residential and commercial structures, as well as in manufactured housing. These applications include thermal and acoustical treatments to walls, ceilings, and floors.

Functional unit

One square meter of installed insulation material, packaging included, with a thickness that gives an average thermal resistance of $R_{Si} = 1\text{m}^2 \cdot \text{K/W}$ with a building service life of 75 years.

Reference service life: 75 years when installed per manufacturer's instructions

Reference flow:

Unfaced: 0.546 kg of product with no facer option.

Kraft-faced: 0.632 kg of product with kraft facer.

FSK-faced: 0.668 kg of product with foil skim kraft (FSK) facer.

Foil-faced: 0.644 kg of product with foil facer.

A thickness of 0.0398m achieves the functional unit. (ASTM C518)

Manufacturing data

Reporting period: January 2022 – December 2022

Location: Lanett, AL

Default installation, packaging, and disposal scenarios

At the installation site, insulation products are unpackaged and installed. Staples may be used to install batts and rolls. The potential impact of the staples is assumed to be negligible since their use is spread out over hundreds of bags of product; therefore, they were not included in the model.

No material is assumed to be lost or wasted. Scraps are typically used to fill corners or crevices. Plastic packaging waste is disposed (9% to recycling, 68% to landfill, and 17% to incineration), and no maintenance or replacement is required over the life of the building. After removal, the insulation is assumed to be landfilled. Insulation and packaging waste are assumed to be transported 100 miles for disposal.

What's causing the greatest impacts

All life cycle stages

The manufacturing stage dominates all impact categories except ozone depletion, where the raw material acquisition stage takes precedence. The energy required to melt the glass and produce the glass fibers is the largest contributor to the manufacturing stage. The impact of the raw material acquisition stage is mostly due to the batch and binder materials. The contributions to outbound transportation are caused by the use of trucks and rail transport. The only impacts associated with installation and maintenance are due to the disposal of packaging waste, which is the smallest contributor of all the stages. At the end of life, insulation is manually removed from the building and landfilled. For all products, waste is dominated by the final disposal of the product. Non-hazardous waste accounts for waste generated during manufacturing and installation.

Raw materials acquisition and transportation

The raw material acquisition stage is the second highest contributor for most impact categories, but ozone depletion potential is almost entirely generated from this stage. The raw materials acquisition stage impact is largely due to the borax, manganese oxide, and soda ash in the batch and the sugars in the binder. Third-party verified ISO 14040/44 secondary LCI data sets contribute more than 80% of the total impacts to ozone depletion.

Manufacturing stage

The manufacturing stage has the most significant contribution to all impact categories, primarily due to the energy required to melt the glass and produce the glass fibers. Since some batch ingredients significantly contribute to the respiratory effects category, they can lead to higher impact results in the raw materials acquisition stage. However, since sand and borax are melted in the oven with the other batch materials, they are not released into the air as fine particulates. Therefore, the calculated potential impacts as shown in the results tables are likely much larger than the actual impacts in the raw material acquisition stage. This implies that the manufacturing stage may have a greater share of the impact than what is displayed in the total impacts by life cycle stage.

Distribution

Outbound transportation is the third highest contributor to smog impacts.

End of life

The end-of-life impacts are largely due to landfilling of the product after it has been removed from the building and transported to a landfill. Since materials are assumed to be landfilled at the end of life rather than incinerated or reused/recycled, no materials are available for energy recovery or reuse/recycling.

Embodied carbon

Embodied carbon can be defined as the cradle-to-gate (A1-A3) global warming potential impacts. The total embodied carbon per functional unit of EcoBatt® and EcoRoll® Insulation manufactured in Lanett, AL is as follows: 1.12E+00 kg CO₂-eq for unfaced; 1.17E+00 kg CO₂-eq for kraft-faced; 1.59E+00 kg CO₂-eq for FSK-faced; and 1.40E+00 kg CO₂-eq for foil-faced.

Unfaced product composition and impacts

Material composition greater than 1% by weight

PART	MATERIAL	%WT.
Batch	Cullet	25-30%
Batch	Sand	10-15%
Batch	Borates	5-8%
Batch	Soda ash	8-10%
Batch	Feldspar	5-8%
Batch	Limestone	5-8%
Binder	Water	10-15%
Binder	Sugars	2-5%
Binder	Additives	2-5%
Packaging	Plastic	8-10%

Material composition for other facers

The kraft, foil, and FSK facers account for 15-20% of the total mass per functional unit.

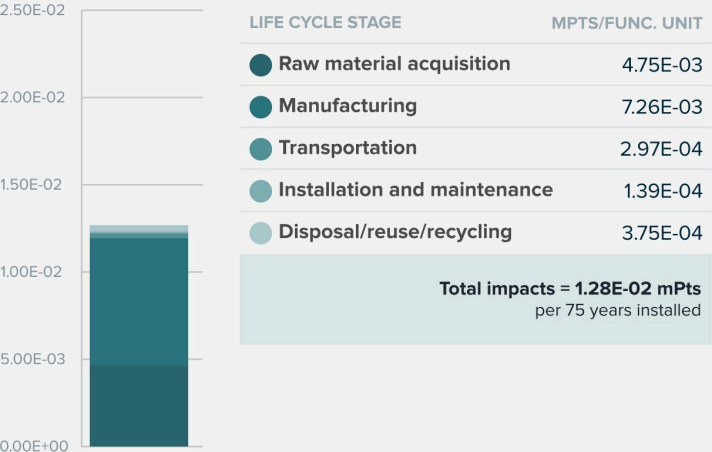
How we're making it greener

Knauf Insulation North America (KINA) is committed to providing products that conserve energy and preserve natural resources.

- Our products with ECOSE® Technology contain a bio-based binder adhesive instead of a fossil fuel-based binder.
- Our fiberglass contains on average over 60% recycled glass, which requires about 20% less energy required to form glass fibers, and results in about 25% reduction in embodied carbon.
- Our glass is audited by a 3rd party to ensure biosoluble chemistry from a health and safety standpoint.

[See how we make it greener](#)

Total impacts by life cycle stages [mPts/per func unit]



LCA results




LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
<div>Information modules: Included (X) Excluded (MND)*</div> <div>*Module D is also excluded from this system boundary (MND).</div>	(X) A1 Raw materials	(X) A3 Manufacturing	(X) A4 Distribution	(X) A5 Installation	(X) C1 Deconstruction
	(X) A2 Transportation			(X) B1 Use	(X) C2 Transportation
				(X) B2 Maintenance	(X) C3 Waste processing
				(X) B3 Repair	(X) C4 Disposal
				(X) B4 Replacement	
				(X) B5 Refurbishment	
				(X) B6 Operational energy use	
				(X) B7 Operational water use	
					

Impacts per 1 square meter of insulation material	Unfaced	4.75E-03 mPts	7.26E-03 mPts	2.97E-04 mPts	1.39E-04 mPts	3.75E-04 mPts
	Kraft-faced	4.73E-03 mPts	9.21E-03 mPts	3.44E-04 mPts	1.38E-04 mPts	4.40E-04 mPts
	FSK-faced	4.68E-03 mPts	1.73E-02 mPts	3.64E-04 mPts	1.34E-04 mPts	4.69E-04 mPts
	Foil-faced	4.93E-03 mPts	1.14E-02 mPts	3.50E-04 mPts	1.38E-04 mPts	4.50E-04 mPts
Materials or processes contributing >20% to total impacts in each life cycle stage		Batch material and binder material production.	Energy required to melt the glass and produce the glass fibers.	Truck and rail transportation used to transport product to building site.	Transportation to landfill and landfilling of packaging materials.	Transportation to landfill and landfilling of product at end of life.



TRACI v2.1 results per functional unit (unfaced EcoBatt® and EcoRoll® Insulation - Lanett, AL)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq		1.73E-01	9.46E-01	1.60E-02	2.70E-02	1.82E-02
Ozone depletion	kg CFC-11 eq		2.66E-15	1.11E-13	3.58E-17	2.73E-16	5.23E-16
Acidification	kg SO ₂ eq		9.20E-04	1.40E-03	8.23E-05	1.61E-05	7.61E-05
Eutrophication	kg N eq		2.31E-04	3.65E-04	7.05E-06	7.45E-06	4.68E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq		9.74E-03	3.04E-02	2.82E-03	2.10E-04	1.49E-03
Respiratory effects	kg PM _{2.5} eq		7.18E-05	6.60E-05	4.02E-06	7.97E-07	5.13E-06





Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h		4.5%	92.2%	0.3%	0.3%	2.7%
Non-carcinogenics	CTU _h		9.1%	83.1%	0.5%	1.0%	6.4%
Ecotoxicity	CTU _e		13.8%	84.1%	0.9%	0.3%	0.8%
Fossil fuel depletion	MJ surplus		3.08E-01	1.96E+00	3.01E-02	6.56E-03	3.55E-02

TRACI v2.1 results per functional unit (kraft-faced EcoBatt® and EcoRoll® Insulation - Lanett, AL)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq		1.73E-01	9.96E-01	1.86E-02	2.69E-02	2.13E-02
Ozone depletion	kg CFC-11 eq		2.65E-15	4.14E-09	4.14E-17	2.72E-16	6.15E-16
Acidification	kg SO ₂ eq		9.17E-04	1.84E-03	9.52E-05	1.60E-05	8.95E-05
Eutrophication	kg N eq		2.30E-04	4.59E-04	8.16E-06	7.43E-06	5.50E-06

Human health damage

Smog	kg O ₃ eq	?	9.70E-03	3.79E-02	3.27E-03	2.09E-04	1.75E-03
Respiratory effects	kg PM _{2.5} eq	?	7.15E-05	9.63E-05	4.65E-06	7.94E-07	6.03E-06

Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h	?	4.4%	92.0%	0.3%	0.3%	3.1%
Non-carcinogenics	CTU _h	?	8.6%	82.9%	0.5%	1.0%	7.1%
Ecotoxicity	CTU _e	?	13.2%	84.6%	1.0%	0.3%	0.9%
Fossil fuel depletion	MJ surplus	?	3.07E-01	2.29E+00	3.48E-02	6.54E-03	4.17E-02

TRACI v2.1 results per functional unit (FSK-faced EcoBatt® and EcoRoll® Insulation - Lanett, AL)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq	?	1.71E-01	1.42E+00	1.96E-02	2.61E-02	2.27E-02
Ozone depletion	kg CFC-11 eq	?	2.63E-15	2.82E-09	4.38E-17	2.64E-16	6.55E-16
Acidification	kg SO ₂ eq	?	9.08E-04	3.41E-03	1.01E-04	1.55E-05	9.53E-05
Eutrophication	kg N eq	?	2.28E-04	4.88E-04	8.63E-06	7.20E-06	5.86E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq	?	9.61E-03	5.41E-02	3.45E-03	2.03E-04	1.86E-03
Respiratory effects	kg PM _{2.5} eq	?	7.08E-05	2.11E-04	4.92E-06	7.70E-07	6.43E-06

Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h	?	3.8%	92.9%	0.3%	0.3%	2.8%
Non-carcinogenics	CTU _h	?	6.6%	86.4%	0.4%	0.7%	5.8%
Ecotoxicity	CTU _e	?	12.2%	85.7%	0.9%	0.3%	0.9%
Fossil fuel depletion	MJ surplus	?	3.04E-01	2.73E+00	3.68E-02	6.34E-03	4.45E-02

TRACI v2.1 results per functional unit (foil-faced EcoBatt® and EcoRoll® Insulation - Lanett, AL)





LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq	?	1.80E-01	1.22E+00	1.89E-02	2.69E-02	2.18E-02
Ozone depletion	kg CFC-11 eq	?	2.76E-15	2.19E-09	4.22E-17	2.72E-16	6.28E-16
Acidification	kg SO ₂ eq	?	9.55E-04	2.23E-03	9.70E-05	1.60E-05	9.13E-05
Eutrophication	kg N eq	?	2.39E-04	4.56E-04	8.32E-06	7.43E-06	5.61E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq	?	1.01E-02	4.39E-02	3.33E-03	2.09E-04	1.78E-03
Respiratory effects	kg PM _{2.5} eq	?	7.45E-05	1.20E-04	4.74E-06	7.94E-07	6.16E-06

Impact category	Unit						
Carcinogenics	CTU _h		4.1%	92.6%	0.3%	0.3%	2.8%
Non-carcinogenics	CTU _h		7.5%	85.2%	0.4%	0.8%	6.1%
Ecotoxicity	CTU _e		12.6%	85.4%	0.9%	0.3%	0.9%
Impact category	Unit						
Fossil fuel depletion	MJ surplus		3.20E-01	2.77E+00	3.55E-02	6.54E-03	4.26E-02

See the additional content required by the SM Part B for interior and exterior stone flooring on page 4 of the [Transparency Report PDF](#).

References

LCA Background Report

Knauf Insulation North America and Manson Insulation Products LCA Background Report (public version), Knauf Insulation North America (KINA) 2023; developed using the [TRACI v2.1](#) and [CML](#) impact assessment methodologies, and [LCA for Experts modeling software](#).

ISO 14025, “Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services”

ISO 21930:2017 serves as the core PCR along with UL Part A.

UL Part A: Life Cycle Assessment Calculation Rules and Report Requirements v4.0

March, 2022. PCR review conducted by Lindita Bushi, PhD, Chair (Athena Sustainable Materials Institute), lindita.bushi@athenasmi.org; Hugues Imbeault-Tétreault (Group AGECO); and Jack Geibig (Ecoform).

UL Part B: Building Envelope Thermal Insulation EPD Requirements, v2.0

April, 2018. PCR review conducted by Thomas Gloria, PhD, Chair (Industrial Ecology Consultants) t.gloria@industrial-ecology.com; Christoph Koffler, PhD (thinkstep); Andre Desjarlais (Oak Ridge National Laboratory).

UL Environment General Program Instructions v2.4, July 2018 (available upon request)

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Rating systems

The intent is to reward project teams for selecting products from manufacturers who have verified improved life-cycle environmental performance.

LEED BD+C: New Construction | v4 - LEED v4

Building product disclosure and optimization

Environmental product declarations

- ☐ Industry-wide (generic) EPD ½product
- ☒ Product-specific Type III EPD 1 product

LEED BD+C: New Construction | v4.1 - LEED v4.1

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Collaborative for High Performance Schools National Criteria

MW C5.1 – Environmental Product Declarations

- ☒ Third-party certified type III EPD 2 point

Green Globes for New Construction and Sustainable Interiors

Materials and resources

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- ☒ NC 3.5.2.2 and SI 4.1.2 Path B: Prescriptive Path for Interior Fit-outs

BREEAM New Construction 2018

Mat 02 - Environmental impacts from construction products

Environmental Product Declarations (EPD)

- ☐ Industry-average EPD .5 point
- ☐ Multi-product specific EPD .75 points
- ☒ Product-specific EPD 1 point

LCA results & interpretation

EcoBatt® and EcoRoll® Insulation

Albion, MI

Inwood, WV

Lanett, AL

Shasta Lake, CA

Shelbyville, IN

EPD add'l content

Material health

Scope and summary

☐ Cradle to gate ☐ Cradle to gate with options ☒ Cradle to grave

Application

Thermal and acoustical barriers for energy-efficient construction. They can be used in new and retrofit wood and metal frame applications in residential and commercial structures, as well as in manufactured housing. These applications include thermal and acoustical treatments to walls, ceilings, and floors.

Functional unit

One square meter of installed insulation material, packaging included, with a thickness that gives an average thermal resistance of $R_{Si} = 1\text{m}^2 \cdot \text{K/W}$ with a building service life of 75 years.

Reference service life: 75 years when installed per manufacturer's instructions

Reference flow:

Unfaced: 0.546 kg of product with no facer option.

Kraft-faced: 0.632 kg of product with kraft facer.

FSK-faced: 0.668 kg of product with foil skim kraft (FSK) facer.

Foil-faced: 0.644 kg of product with foil facer.

A thickness of 0.0398m achieves the functional unit. (ASTM C518)

Manufacturing data

Reporting period: January 2022 – December 2022

Location: Shasta Lake, CA

Default installation, packaging, and disposal scenarios

At the installation site, insulation products are unpackaged and installed. Staples may be used to install batts and rolls. The potential impact of the staples is assumed to be negligible since their use is spread out over hundreds of bags of product; therefore, they were not included in the model.

No material is assumed to be lost or wasted. Scraps are typically used to fill corners or crevices. Plastic packaging waste is disposed (9% to recycling, 68% to landfill, and 17% to incineration), and no maintenance or replacement is required over the life of the building. After removal, the insulation is assumed to be landfilled. Insulation and packaging waste are assumed to be transported 100 miles for disposal.

Unfaced product composition and impacts

What's causing the greatest impacts

All life cycle stages

The manufacturing stage dominates all impact categories except ozone depletion, where the raw material acquisition stage takes precedence. The energy required to melt the glass and produce the glass fibers is the largest contributor to the manufacturing stage. The impact of the raw material acquisition stage is mostly due to the batch and binder materials. The contributions to outbound transportation are caused by the use of trucks and rail transport. The only impacts associated with installation and maintenance are due to the disposal of packaging waste, which is the smallest contributor of all the stages. At the end of life, insulation is manually removed from the building and landfilled. For all products, waste is dominated by the final disposal of the product. Non-hazardous waste accounts for waste generated during manufacturing and installation.

Raw materials acquisition and transportation

The raw material acquisition stage is the second highest contributor for most impact categories, but ozone depletion potential is almost entirely generated from this stage. The raw materials acquisition stage impact is largely due to the borax, manganese oxide, and soda ash in the batch and the sugars in the binder. Third-party verified ISO 14040/44 secondary LCI data sets contribute more than 80% of the total impacts to ozone depletion.

Manufacturing stage

The manufacturing stage has the most significant contribution to all impact categories, primarily due to the energy required to melt the glass and produce the glass fibers. Since some batch ingredients significantly contribute to the respiratory effects category, they can lead to higher impact results in the raw materials acquisition stage. However, since sand and borax are melted in the oven with the other batch materials, they are not released into the air as fine particulates. Therefore, the calculated potential impacts as shown in the results tables are likely much larger than the actual impacts in the raw material acquisition stage. This implies that the manufacturing stage may have a greater share of the impact than what is displayed in the total impacts by life cycle stage.

Distribution

Outbound transportation is the third highest contributor to smog impacts.

End of life

The end-of-life impacts are largely due to landfilling of the product after it has been removed from the building and transported to a landfill. Since materials are assumed to be landfilled at the end of life rather than incinerated or reused/recycled, no materials are available for energy recovery or reuse/recycling.

Embodied carbon

Embodied carbon can be defined as the cradle-to-gate (A1-A3) global warming potential impacts. The total embodied carbon per functional unit of EcoBatt® and EcoRoll® Insulation manufactured in Shasta Lake, CA is as follows: 8.22E-01 kg CO₂-eq for unfaced; 8.77E-01 kg CO₂-eq for kraft-faced; 1.31E+00 kg CO₂-eq for FSK-faced; and 1.11E+00 kg CO₂-eq for foil-faced.

Unfaced product composition and impacts

Material composition greater than 1% by weight		
PART	MATERIAL	%WT.
Batch	Cullet	40-45%
Batch	Sand	8-10%
Batch	Borates	5-8%
Batch	Soda ash	2-5%
Batch	Limestone	2-5%
Batch	Oxides	<1%
Binder	Water	10-15%
Binder	Sugars	2-5%
Binder	Additives	2-5%
Packaging	Plastic	8-10%

Material composition for other facers

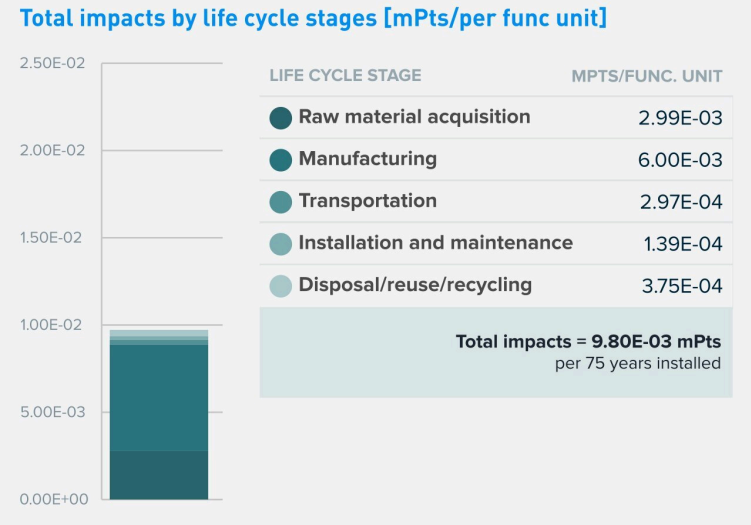
The kraft facer accounts for 10-15%, and the foil and FSK facers account for 15-20% of the total mass per functional unit.

How we're making it greener

Knauf Insulation North America (KINA) is committed to providing products that conserve energy and preserve natural resources.

- Our products with ECOSE® Technology contain a bio-based binder adhesive instead of a fossil fuel-based binder.
- Our fiberglass contains on average over 60% recycled glass, which requires about 20% less energy required to form glass fibers, and results in about 25% reduction in embodied carbon.
- Our glass is audited by a 3rd party to ensure biosoluble chemistry from a health and safety standpoint.

[See how we make it greener](#)



LCA results




LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
<div>Information modules: Included (X) Excluded (MND)*</div> <div>*Module D is also excluded from this system boundary (MND).</div>	(X) A1 Raw materials	(X) A3 Manufacturing	(X) A4 Distribution	(X) A5 Installation	(X) C1 Deconstruction
	(X) A2 Transportation			(X) B1 Use	(X) C2 Transportation
				(X) B2 Maintenance	(X) C3 Waste processing
				(X) B3 Repair	(X) C4 Disposal
				(X) B4 Replacement	
				(X) B5 Refurbishment	
				(X) B6 Operational energy use	
				(X) B7 Operational water use	
					

Impacts per 1 square meter of insulation material	Unfaced	2.99E-03 mPts	6.00E-03 mPts	2.97E-04 mPts	1.39E-04 mPts	3.75E-04 mPts
	Kraft-faced	3.01E-03 mPts	7.96E-03 mPts	3.44E-04 mPts	1.38E-04 mPts	4.40E-04 mPts
	FSK-faced	3.02E-03 mPts	1.62E-02 mPts	3.64E-04 mPts	1.34E-04 mPts	4.69E-04 mPts
	Foil-faced	3.18E-03 mPts	1.02E-02 mPts	3.50E-04 mPts	1.38E-04 mPts	4.50E-04 mPts
Materials or processes contributing >20% to total impacts in each life cycle stage		Batch material and binder material production.	Energy required to melt the glass and produce the glass fibers.	Truck and rail transportation used to transport product to building site.	Transportation to landfill and landfilling of packaging materials.	Transportation to landfill and landfilling of product at end of life.

TRACI v2.1 results per functional unit (unfaced EcoBatt® and EcoRoll® Insulation - Shasta Lake, CA)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq		1.10E-01	7.12E-01	1.60E-02	2.70E-02	1.82E-02
Ozone depletion	kg CFC-11 eq		6.32E-13	2.32E-13	3.58E-17	2.73E-16	5.23E-16
Acidification	kg SO ₂ eq		5.68E-04	1.55E-03	8.23E-05	1.61E-05	7.61E-05
Eutrophication	kg N eq		1.75E-04	3.39E-04	7.05E-06	7.45E-06	4.68E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq	?	6.40E-03	2.41E-02	2.82E-03	2.10E-04	1.49E-03
Respiratory effects	kg PM _{2.5} eq	?	4.51E-05	5.85E-05	4.02E-06	7.97E-07	5.13E-06



Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h		3.9%	92.6%	0.3%	0.3%	2.9%
Non-carcinogenics	CTU _h		7.7%	83.4%	0.5%	1.1%	7.2%
Ecotoxicity	CTU _e		12.6%	85.2%	1.0%	0.3%	0.9%
Fossil fuel depletion	MJ surplus		2.38E-01	1.54E+00	3.01E-02	6.56E-03	3.55E-02



TRACI v2.1 results per functional unit (kraft-faced EcoBatt® and EcoRoll® Insulation - Shasta Lake, CA)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq		1.10E-01	7.67E-01	1.86E-02	2.69E-02	2.13E-02
Ozone depletion	kg CFC-11 eq		6.36E-13	4.09E-09	4.14E-17	2.72E-16	6.15E-16
Acidification	kg SO ₂ eq		5.72E-04	2.00E-03	9.52E-05	1.60E-05	8.95E-05
Eutrophication	kg N eq		1.77E-04	4.36E-04	8.16E-06	7.43E-06	5.50E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq		6.44E-03	3.16E-02	3.27E-03	2.09E-04	1.75E-03
Respiratory effects	kg PM _{2.5} eq		4.55E-05	8.88E-05	4.65E-06	7.94E-07	6.03E-06

Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h	?	3.8%	92.3%	0.3%	0.3%	3.3%
Non-carcinogenics	CTU _h	?	7.3%	83.2%	0.6%	1.1%	7.9%
Ecotoxicity	CTU _e	?	11.9%	85.7%	1.0%	0.3%	1.0%
Fossil fuel depletion	MJ surplus	?	2.40E-01	1.88E+00	3.48E-02	6.54E-03	4.17E-02

TRACI v2.1 results per functional unit (FSK-faced EcoBatt® and EcoRoll® Insulation - Shasta Lake, CA)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq	?	1.11E-01	1.20E+00	1.96E-02	2.61E-02	2.27E-02
Ozone depletion	kg CFC-11 eq	?	6.38E-13	2.82E-09	4.38E-17	2.64E-16	6.55E-16
Acidification	kg SO ₂ eq	?	5.74E-04	3.59E-03	1.01E-04	1.55E-05	9.53E-05
Eutrophication	kg N eq	?	1.77E-04	4.69E-04	8.63E-06	7.20E-06	5.86E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq	?	6.46E-03	4.82E-02	3.45E-03	2.03E-04	1.86E-03
Respiratory effects	kg PM _{2.5} eq	?	4.56E-05	2.04E-04	4.92E-06	7.70E-07	6.43E-06

Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h	?	3.2%	93.3%	0.3%	0.3%	3.0%
Non-carcinogenics	CTU _h	?	5.5%	87.0%	0.5%	0.8%	6.3%
Ecotoxicity	CTU _e	?	11.0%	86.7%	1.0%	0.3%	1.0%
Fossil fuel depletion	MJ surplus	?	2.40E-01	2.33E+00	3.68E-02	6.34E-03	4.45E-02

TRACI v2.1 results per functional unit (foil-faced EcoBatt® and EcoRoll® Insulation - Shasta Lake, CA)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq	?	1.16E-01	9.90E-01	1.89E-02	2.69E-02	2.18E-02
Ozone depletion	kg CFC-11 eq	?	6.71E-13	2.19E-09	4.22E-17	2.72E-16	6.28E-16
Acidification	kg SO ₂ eq	?	6.04E-04	2.41E-03	9.70E-05	1.60E-05	9.13E-05
Eutrophication	kg N eq	?	1.87E-04	4.37E-04	8.32E-06	7.43E-06	5.61E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq	?	6.80E-03	3.77E-02	3.33E-03	2.09E-04	1.78E-03
Respiratory effects	kg PM _{2.5} eq	?	4.80E-05	1.13E-04	4.74E-06	7.94E-07	6.16E-06

Impact category	Unit						
Carcinogenics	CTU_h		3.5%	93.0%	0.3%	0.3%	2.9%
Non-carcinogenics	CTU_h		6.3%	85.8%	0.5%	0.9%	6.6%
Ecotoxicity	CTU_e		11.4%	86.4%	1.0%	0.3%	0.9%
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Fossil fuel depletion	MJ surplus		2.53E-01	2.35E+00	3.55E-02	6.54E-03	4.26E-02

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Scope and summary

☐ Cradle to gate ☐ Cradle to gate with options ☒ **Cradle to grave**

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Thermal and acoustical barriers for energy-efficient construction. They can be used in new and retrofit wood and metal frame applications in residential and commercial structures, as well as in manufactured housing. These applications include thermal and acoustical treatments to walls, ceilings, and floors.

Functional unit

One square meter of installed insulation material, packaging included, with a thickness that gives an average thermal resistance of $R_{Si} = 1\text{m}^2 \cdot \text{K/W}$ with a building service life of 75 years.

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A thickness of 0.0398m achieves the functional unit. (ASTM C518)

Manufacturing data

Reporting period: January 2022 – December 2022

Location: Shelbyville, IN

Default installation, packaging, and disposal scenarios

At the installation site, insulation products are unpackaged and installed. Staples may be used to install batts and rolls. The potential impact of the staples is assumed to be negligible since their use is spread out over hundreds of bags of product; therefore, they were not included in the model.

No material is assumed to be lost or wasted. Scraps are typically used to fill corners or crevices. Plastic packaging waste is disposed (9% to recycling, 68% to landfill, and 17% to incineration), and no maintenance or replacement is required over the life of the building. After removal, the insulation is assumed to be landfilled. Insulation and packaging waste are assumed to be transported 100 miles for disposal.

Unfaced product composition and impacts

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All life cycle stages

The manufacturing stage dominates all impact categories except ozone depletion, where the raw material acquisition stage takes precedence. The energy required to melt the glass and produce the glass fibers is the largest contributor to the manufacturing stage. The impact of the raw material acquisition stage is mostly due to the batch and binder materials. The contributions to outbound transportation are caused by the use of trucks and rail transport. The only impacts associated with installation and maintenance are due to the disposal of packaging waste, which is the smallest contributor of all the stages. At the end of life, insulation is manually removed from the building and landfilled. For all products, waste is dominated by the final disposal of the product. Non-hazardous waste accounts for waste generated during manufacturing and installation.

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Distribution

Outbound transportation is the third highest contributor to smog impacts.

End of life

The end-of-life impacts are largely due to landfilling of the product after it has been removed from the building and transported to a landfill. Since materials are assumed to be landfilled at the end of life rather than incinerated or reused/recycled, no materials are available for energy recovery or reuse/recycling.

Embodied carbon

Embodied carbon can be defined as the cradle-to-gate (A1-A3) global warming potential impacts. The total embodied carbon per functional unit of EcoBatt® and EcoRoll® Insulation manufactured in Shelbyville, IN is as follows: 1.20E+00 kg CO₂-eq for unfaced; 1.25E+00 kg CO₂-eq for kraft-faced; 1.63E+00 kg CO₂-eq for FSK-faced; and 1.45E+00 kg CO₂-eq for foil-faced.

Unfaced product composition and impacts

Material composition greater than 1% by weight

PART	MATERIAL	%WT.
Batch	Cullet	45-50%
Batch	Sand	8-10%
Batch	Borates	5-8%
Batch	Soda ash	2-5%
Batch	Feldspar	1-2%
Batch	Limestone	2-5%
Batch	Oxides	<1%
Binder	Water	10-15%
Binder	Sugars	2-5%
Binder	Additives	2-5%
Packaging	Plastic	8-10%

Material composition for other facers

The kraft facer accounts for 10-15%, and the foil and FSK facers account for 15-20% of the total mass per functional unit.

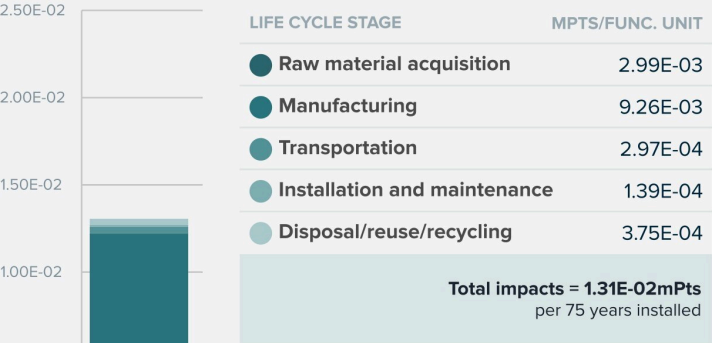
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[See how we make it greener](#)

Total impacts by life cycle stages [mPts/per func unit]



LCA results




LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
<div>Information modules: Included (X) Excluded (MND)* *Module D is also excluded from this system boundary (MND).</div>	(X) A1 Raw materials	(X) A3 Manufacturing	(X) A4 Distribution	(X) A5 Installation	(X) C1 Deconstruction
	(X) A2 Transportation			(X) B1 Use	(X) C2 Transportation
				(X) B2 Maintenance	(X) C3 Waste processing
				(X) B3 Repair	(X) C4 Disposal
				(X) B4 Replacement	
				(X) B5 Refurbishment	
				(X) B6 Operational energy use	
				(X) B7 Operational water use	
					

Impacts per 1 square meter of insulation material	Unfaced	2.99E-03 mPts	9.26E-03 mPts	2.97E-04 mPts	1.39E-04 mPts	3.75E-04 mPts
	Kraft-faced	2.99E-03 mPts	1.13E-02 mPts	3.44E-04 mPts	1.38E-04 mPts	4.40E-04 mPts
	FSK-faced	2.89E-03 mPts	1.91E-02 mPts	3.64E-04 mPts	1.34E-04 mPts	4.69E-04 mPts
	Foil-faced	3.05E-03 mPts	1.32E-02 mPts	3.50E-04 mPts	1.38E-04 mPts	4.50E-04 mPts
Materials or processes contributing >20% to total impacts in each life cycle stage		Batch material and binder material production.	Energy required to melt the glass and produce the glass fibers.	Truck and rail transportation used to transport product to building site.	Transportation to landfill and landfilling of packaging materials.	Transportation to landfill and landfilling of product at end of life.

TRACI v2.1 results per functional unit (unfaced EcoBatt® and EcoRoll® Insulation - Shelbyville, IN)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq		1.07E-01	1.09E+00	1.60E-02	2.70E-02	1.82E-02
Ozone depletion	kg CFC-11 eq		8.10E-13	1.15E-13	3.58E-17	2.73E-16	5.23E-16
Acidification	kg SO ₂ eq		5.79E-04	1.72E-03	8.23E-05	1.61E-05	7.61E-05
Eutrophication	kg N eq		1.95E-04	4.26E-04	7.05E-06	7.45E-06	4.68E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq	?	6.66E-03	3.34E-02	2.82E-03	2.10E-04	1.49E-03
Respiratory effects	kg PM _{2.5} eq	?	4.51E-05	9.22E-05	4.02E-06	7.97E-07	5.13E-06





Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h		3.6%	93.5%	0.2%	0.3%	2.4%
Non-carcinogenics	CTU _h		6.9%	85.8%	0.4%	0.9%	5.9%
Ecotoxicity	CTU _e		11.8%	86.4%	0.8%	0.3%	0.8%
Fossil fuel depletion	MJ surplus		2.52E-01	1.92E+00	3.01E-02	6.56E-03	3.55E-02



TRACI v2.1 results per functional unit (kraft-faced EcoBatt® and EcoRoll® Insulation - Shelbyville, IN)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit						
Global warming	kg CO ₂ eq		1.08E-01	1.14E+00	1.86E-02	2.69E-02	2.13E-02
Ozone depletion	kg CFC-11 eq		8.12E-13	4.24E-09	4.14E-17	2.72E-16	6.15E-16
Acidification	kg SO ₂ eq		5.80E-04	2.19E-03	9.52E-05	1.60E-05	8.95E-05
Eutrophication	kg N eq		1.95E-04	5.25E-04	8.16E-06	7.43E-06	5.50E-06

Human health damage

Impact category	Unit						
Smog	kg O ₃ eq		6.67E-03	4.12E-02	3.27E-03	2.09E-04	1.75E-03
Respiratory effects	kg PM _{2.5} eq		4.52E-05	1.24E-04	4.65E-06	7.94E-07	6.03E-06

Additional environmental information

Impact category	Unit						
Carcinogenics	CTU _h	?	3.5%	93.2%	0.3%	0.3%	2.7%
Non-carcinogenics	CTU _h	?	6.6%	85.6%	0.5%	0.9%	6.5%
Ecotoxicity	CTU _e	?	11.2%	86.8%	0.9%	0.3%	0.8%
Fossil fuel depletion	MJ surplus	?	2.52E-01	2.27E+00	3.48E-02	6.54E-03	4.17E-02

TRACI v2.1 results per functional unit (FSK-faced EcoBatt® and EcoRoll® Insulation - Shelbyville, IN)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit					
Global warming	kg CO ₂ eq	?	1.04E-01	1.53E+00	1.96E-02	2.27E-02
Ozone depletion	kg CFC-11 eq	?	7.85E-13	2.82E-09	4.38E-17	2.64E-16
Acidification	kg SO ₂ eq	?	5.61E-04	3.70E-03	1.01E-04	1.55E-05
Eutrophication	kg N eq	?	1.89E-04	5.40E-04	8.63E-06	7.20E-06

Human health damage

Impact category	Unit					
Smog	kg O ₃ eq	?	6.45E-03	5.64E-02	3.45E-03	2.03E-04
Respiratory effects	kg PM _{2.5} eq	?	4.37E-05	2.34E-04	4.92E-06	7.70E-07

Additional environmental information

Impact category	Unit					
Carcinogenics	CTU _h	?	3.0%	93.8%	0.2%	0.2%
Non-carcinogenics	CTU _h	?	5.1%	88.2%	0.4%	0.7%
Ecotoxicity	CTU _e	?	10.4%	87.6%	0.9%	0.3%
Fossil fuel depletion	MJ surplus	?	2.44E-01	2.65E+00	3.68E-02	6.34E-03

TRACI v2.1 results per functional unit (foil-faced EcoBatt® and EcoRoll® Insulation - Shelbyville, IN)

LIFE CYCLE STAGE	RAW MATERIAL ACQUISITION	MANUFACTURING	TRANSPORTATION	INSTALLATION AND MAINTENANCE	DISPOSAL/ REUSE/ RECYCLING
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Ecological damage

Impact category	Unit					
Global warming	kg CO ₂ eq	?	1.10E-01	1.34E+00	1.89E-02	2.69E-02
Ozone depletion	kg CFC-11 eq	?	8.26E-13	2.19E-09	4.22E-17	2.72E-16
Acidification	kg SO ₂ eq	?	5.90E-04	2.53E-03	9.70E-05	1.60E-05
Eutrophication	kg N eq	?	1.99E-04	5.11E-04	8.32E-06	7.43E-06

Human health damage

Impact category	Unit					
Smog	kg O ₃ eq	?	6.79E-03	4.63E-02	3.33E-03	2.09E-04
Respiratory effects	kg PM _{2.5} eq	?	4.60E-05	1.45E-04	4.74E-06	7.94E-07

Impact category	Unit						
Carcinogenics	CTU _h		3.3%	93.6%	0.2%	0.3%	2.6%
Non-carcinogenics	CTU _h		5.8%	87.3%	0.4%	0.8%	5.7%
Ecotoxicity	CTU _e		10.8%	87.3%	0.8%	0.3%	0.8%
Impact category	Unit						
Fossil fuel depletion	MJ surplus		2.57E-01	2.69E+00	3.55E-02	6.54E-03	4.26E-02

References

LCA Background Report

Knauf Insulation North America and Manson Insulation Products LCA Background Report (public version), Knauf Insulation North America (KINA) 2023; developed using the [TRACI v2.1](#) and [CML](#) impact assessment methodologies, and [LCA for Experts modeling software](#).

ISO 14025, “Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services”

ISO 21930:2017 serves as the core PCR along with UL Part A.

UL Part A: Life Cycle Assessment Calculation Rules and Report Requirements v4.0

March, 2022. PCR review conducted by Lindita Bushi, PhD, Chair (Athena Sustainable Materials Institute), lindita.bushi@athenasmi.org; Hugues Imbeault-Tétreault (Group AGECO); and Jack Geibig (Ecoform).

UL Part B: Building Envelope Thermal Insulation EPD Requirements, v2.0

April, 2018. PCR review conducted by Thomas Gloria, PhD, Chair (Industrial Ecology Consultants) t.gloria@industrial-ecology.com; Christoph Koffler, PhD (thinkstep); Andre Desjarlais (Oak Ridge National Laboratory).

UL Environment General Program Instructions v2.4, July 2018 (available upon request)

[Download PDF](#) SM Transparency Report / EPD

SM Transparency Reports (TR) are ISO 14025 Type III environmental declarations (EPD) that enable purchasers and users to compare the potential environmental performance of products on a life cycle basis. Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance with the PCR for Building Envelope Thermal Insulation allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

Rating systems

The intent is to reward project teams for selecting products from manufacturers who have verified improved life-cycle environmental performance.

LEED BD+C: New Construction | v4 - LEED v4

Building product disclosure and optimization

Environmental product declarations

- ☐ Industry-wide (generic) EPD ½product
- ☒ Product-specific Type III EPD 1 product

LEED BD+C: New Construction | v4.1 - LEED v4.1

Building product disclosure and optimization

Environmental product declarations

- ☐ Industry-wide (generic) EPD 1 product
- ☒ Product-specific Type III EPD 1.5 product

Collaborative for High Performance Schools National Criteria

MW C5.1 – Environmental Product Declarations

- ☒ Third-party certified type III EPD 2 point

Green Globes for New Construction and Sustainable Interiors

Materials and resources

- ☒ NC 3.5.1.2 Path B: Prescriptive Path for Building Core and Shell
- ☒ NC 3.5.2.2 and SI 4.1.2 Path B: Prescriptive Path for Interior Fit-outs

BREEAM New Construction 2018

Mat 02 - Environmental impacts from construction products

Environmental Product Declarations (EPD)

- ☐ Industry-average EPD .5 point
- ☐ Multi-product specific EPD .75 points
- ☒ Product-specific EPD 1 point



EPD add'l content

EcoBatt® and EcoRoll® Insulation

Albion, MI

Inwood, WV

Lanett, AL

Shasta Lake, CA

Shelbyville, IN

EPD add'l content

Material health

Data

Background This product-specific plant-specific declaration was created by collecting production data from the Albion, MI; Inwood, WV; Lanett, AL; Shasta Lake, CA; and Shelbyville, IN production locations. Secondary data sources include those available in LCA for Experts 2023 databases.

Allocation The PCR prescribes where and how allocation occurs. Since only facility-level data were available, allocation among the facilities' other co-products was necessary to determine the input and output flows associated with the product. Allocation of batch materials and energy was done on a product output mass basis, binder materials were allocated based on the mass calculated from the bill of materials and binder formulations, facers were allocated based on product area, and packaging was allocated based on mass per package of product. Allocation of transportation was based on either weight or volume, depending on which was found to restrict the amount of cargo; the limiting factor was used in allocating transportation.

Cut-off criteria for the inclusion of mass and energy flows are 1% of renewable primary resource (energy) usage, 1% nonrenewable primary resource (energy) usage, 1% of the total mass input of that unit process, and 1% of environmental impacts. The total of neglected input flows per module does not exceed 5% of energy usage, mass, and environmental impacts. The only exceptions to these criteria are substances with hazardous and toxic properties, which must be listed even when the given process unit is under the cut-off criterion of 1% of the total mass. No known flows are deliberately excluded from this declaration; therefore, these criteria have been met. Biogenic carbon is included in reported results.

Quality Temporal and technological representativeness are considered to be high. Geographical representativeness is considered to be high. All relevant process steps for the product system were considered and modeled. The process chain is considered sufficiently complete with regards to the goal and scope of this study. The product system was checked for mass balance and completeness of the inventory. Capital goods were excluded since they are assumed not to significantly affect the conclusions of the LCA. Otherwise, no data were knowingly omitted. For more information on data quality, see the LCA background report.

LCIA impact factors required by the PCR are global warming, ozone depletion, acidification, eutrophication, smog, and fossil fuel depletion; "These six impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes."

Scenarios and additional technical information

PARAMETER	VALUE	UNIT
Transport to the building site [A4]		
Vehicle type	Truck and trailer	-
Fuel type	Diesel	-
Average distance from manufacturing to installation site	161	km
Capacity utilization	27	%
Gross density	96.1	kg/m ³
Capacity utilization volume factor	1	-

Installation into the building [A5]

Mass of plastic packaging waste	0.0544	kg
Biogenic carbon content of packaging	0	kg CO ₂

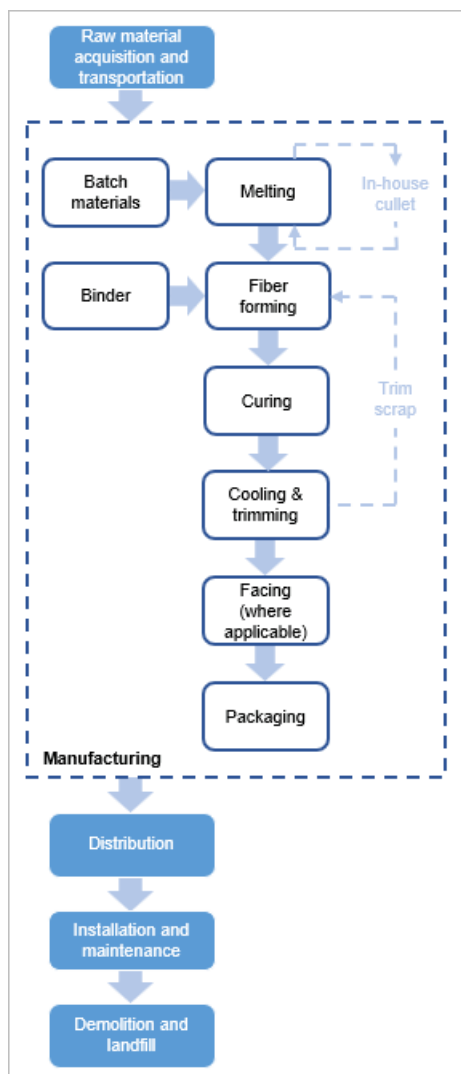
End of life [C1-C4]

Assumptions for scenario development	Following manual removal of the insulation, it was assumed to be transported 100 miles to disposal. The PCR prescribes that 100% of the insulation is sent to landfill, where no prior waste processing is required.	
Collection process	Collected with mixed construction waste	Unfaced: 0.492 kg Kraft: 0.578 kg FSK: 0.614 kg Foil: 0.590 kg
Disposal	Product for final deposition in landfill	Unfaced: 0.492 kg Kraft: 0.578 kg FSK: 0.614 kg Foil: 0.590 kg

Technical properties

Dimensions/quantities delivered to installation site	<ul style="list-style-type: none"> EcoBatt® is sold in batts. One master bag contains 5 plastic bags, and each bag contains 10 to 12 pieces of EcoBatt® batts. The dimensions of each EcoBatt® batt are 3½" thick, 15" – 16" in width, and 93' – 96' in length. EcoRoll® is sold in rolls. One master bag contains 6 plastic bags, and each bag contains 1 roll of EcoRoll. The dimensions of each EcoRoll® are 3½" thick, 15" in width, and 32' – 62.67' in length.
ASTM or ANSI product specification	<ul style="list-style-type: none"> ASTM C 665; Type 1, Class A (unfaced) ASTM C 665; Type II, Class C (kraft faced)

Flow diagram



Technical properties

	<ul style="list-style-type: none"> ASTM C 665; Type III, Class A (FSK-25 foil faced) ASTM C 665; Type III, Class B (foil faced)
Corrosion	ASTM C1617
Combustibility	ASTM E136; Non-combustible
Water Vapor Permeance	ASTM E96 <ul style="list-style-type: none"> Kraft Faced: 1.0 perms or less FSK-25 and Foil Faced: 0.05 perms
Water vapor sorption (by weight)	ASTM E96 <ul style="list-style-type: none"> Kraft Faced: 1.0 perms or less FSK-25 and Foil Faced: 0.05 perms
Mold growth	ASTM C1338; Pass
Surface burning characteristics (flame spread/smoke developed)	ASTM E84 <ul style="list-style-type: none"> Unfaced and flamed-rated FSK facings: 25/50 Kraft facing will burn and should not be left exposed.

Major system boundary exclusions

- Capital goods and infrastructure; maintenance of operation and support equipment;
- Manufacture & transport of packaging materials not associated with final product;
- Human labor and employee transport;
- Building operational energy and water use not associated with final product.

Major assumptions and limitations

- Due to the nature of fiberglass insulation, it is anticipated that it will last for the lifetime of the building, so the reference service life (RSL) is considered to be the same as the building estimated service life (ESL) of 75 years.
- Generic data sets used for material inputs, transport, and waste processing are considered good quality, but actual impacts from material suppliers, transport carriers, and local waste processing may vary.
- The impact assessment methodology categories do not represent all possible environmental impact categories.
- Characterization factors used within the impact assessment methodology may contain varying levels of uncertainty.
- LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Unfaced EcoBatt® and EcoRoll Insulation produced in Albion, MI: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	9.97E-01	1.60E-02	2.70E-02	0	0	7.89E-03	0	1.03E-02	1.06E+00
Ozone depletion	kg CFC-11 eq	2.76E-11	3.58E-17	2.73E-16	0	0	1.76E-17	0	5.06E-16	2.76E-11
Acidification	kg SO ₂ eq	1.97E-03	8.23E-05	1.61E-05	0	0	2.16E-05	0	5.46E-05	2.14E-03
Eutrophication	kg N eq	5.25E-04	7.05E-06	7.45E-06	0	0	2.29E-06	0	2.39E-06	5.44E-04
Smog	kg O ₃ eq	3.18E-02	2.82E-03	2.10E-04	0	0	4.93E-04	0	9.95E-04	3.64E-02
Respiratory effects	kg PM _{2.5} eq	1.23E-04	4.02E-06	7.97E-07	0	0	9.26E-07	0	4.21E-06	1.32E-04
Additional environmental information										
Carcinogenics	CTUh	96.4%	0.3%	0.4%	0.0%	0.0%	0.1%	0.0%	2.9%	100%
Non-carcinogenics	CTUh	91.0%	0.5%	1.2%	0.0%	0.0%	0.3%	0.0%	7.1%	100%
Ecotoxicity	CTUe	97.7%	1.0%	0.4%	0.0%	0.0%	0.5%	0.0%	0.5%	100%
Fossil fuel depletion	MJ surplus	1.91E+00	3.01E-02	6.56E-03	0	0	1.48E-02	0	2.07E-02	1.99E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	3.72E+00	8.84E-03	1.10E-02	0	0	4.35E-03	0	1.93E-02	3.76E+00

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Renewable primary resources with energy content used as material	MJ, LHV	2.01E-08	-7.31E-13	2.57E-12	0	0	-3.60E-13	0	3.84E-12	2.01E-08
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	1.87E+01	2.27E-01	7.14E-02	0	0	1.12E-01	0	1.65E-01	1.93E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	7.43E-08	9.05E-10	1.75E-10	0	0	4.45E-10	0	4.10E-10	7.63E-08
Secondary materials	kg	2.38E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.38E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m³	2.88E-01	3.07E-05	5.99E-05	0	0	1.51E-05	0	2.04E-05	2.89E-01
Abiotic depletion potential, fossil	MJ, LHV	1.66E+01	2.26E-01	6.07E-02	0	0	1.11E-01	0	1.59E-01	1.72E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	4.33E-03	0.00E+00	3.70E-02	0	0	0.00E+00	0	4.92E-01	5.33E-01
High-level radioactive waste	kg	7.33E-07	6.61E-10	4.56E-09	0	0	3.25E-10	0	2.04E-09	7.40E-07
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	7.46E-04	5.57E-07	3.83E-06	0	0	2.74E-07	0	1.82E-06	7.53E-04
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	1.21E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	1.21E-01
Biogenic carbon emission from product	kg CO ₂	8.56E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	8.45E-04	8.65E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Kraft-faced EcoBatt® and EcoRoll Insulation produced in Albion, MI: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.01E+00	1.86E-02	2.69E-02	0	0	9.27E-03	0	1.21E-02	1.07E+00
Ozone depletion	kg CFC-11 eq	4.11E-09	4.14E-17	2.72E-16	0	0	2.07E-17	0	5.94E-16	4.11E-09
Acidification	kg SO ₂ eq	2.32E-03	9.52E-05	1.60E-05	0	0	2.54E-05	0	6.41E-05	2.52E-03
Eutrophication	kg N eq	5.92E-04	8.16E-06	7.43E-06	0	0	2.69E-06	0	2.81E-06	6.14E-04
Smog	kg O ₃ eq	3.79E-02	3.27E-03	2.09E-04	0	0	5.79E-04	0	1.17E-03	4.31E-02
Respiratory effects	kg PM _{2.5} eq	1.47E-04	4.65E-06	7.94E-07	0	0	1.09E-06	0	4.94E-06	1.58E-04

Additional environmental information

FSK-faced EcoBatt® and EcoRoll Insulation produced in Albion, MI: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										

Global warming	kg CO ₂ eq	1.44E+00	1.96E-02	2.61E-02	0	0	9.88E-03	0	1.29E-02	1.51E+00
Ozone depletion	kg CFC-11 eq	2.85E-09	4.38E-17	2.64E-16	0	0	2.21E-17	0	6.33E-16	2.85E-09
Acidification	kg SO ₂ eq	3.92E-03	1.01E-04	1.55E-05	0	0	2.70E-05	0	6.83E-05	4.13E-03
Eutrophication	kg N eq	6.28E-04	8.63E-06	7.20E-06	0	0	2.86E-06	0	2.99E-06	6.49E-04
Smog	kg O ₃ eq	5.46E-02	3.45E-03	2.03E-04	0	0	6.17E-04	0	1.25E-03	6.01E-02
Respiratory effects	kg PM _{2.5} eq	2.63E-04	4.92E-06	7.70E-07	0	0	1.16E-06	0	5.27E-06	2.75E-04
Additional environmental information										
Carcinogenics	CTUh	96.2%	0.3%	0.3%	0.0%	0.0%	0.2%	0.0%	3.0%	100%
Non-carcinogenics	CTUh	92.1%	0.5%	0.8%	0.0%	0.0%	0.2%	0.0%	6.4%	100%
Ecotoxicity	CTUe	97.6%	1.1%	0.3%	0.0%	0.0%	0.5%	0.0%	0.5%	100%
Fossil fuel depletion	MJ surplus	2.64E+00	3.68E-02	6.34E-03	0	0	1.85E-02	0	2.59E-02	2.73E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	7.12E+00	1.08E-02	1.06E-02	0	0	5.45E-03	0	2.41E-02	7.17E+00
Renewable primary resources with energy content used as material	MJ, LHV	2.12E-05	-8.95E-13	2.48E-12	0	0	-4.51E-13	0	4.80E-12	2.12E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.63E+01	2.78E-01	6.90E-02	0	0	1.40E-01	0	2.06E-01	2.70E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	8.16E-08	1.11E-09	1.69E-10	0	0	5.57E-10	0	5.14E-10	8.39E-08
Secondary materials	kg	2.97E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.97E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	2.81E-01	3.76E-05	5.79E-05	0	0	1.89E-05	0	2.55E-05	2.81E-01
Abiotic depletion potential, fossil	MJ, LHV	2.31E+01	2.76E-01	5.86E-02	0	0	1.39E-01	0	2.00E-01	2.38E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	5.40E-03	0.00E+00	3.70E-02	0	0	0.00E+00	0	6.14E-01	6.56E-01
High-level radioactive waste	kg	1.06E-06	8.09E-10	4.41E-09	0	0	4.07E-10	0	2.55E-09	1.07E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.14E-03	6.82E-07	3.69E-06	0	0	3.43E-07	0	2.28E-06	1.15E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.61E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.61E-01
Biogenic carbon emission from product	kg CO ₂	1.00E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	1.06E-03	1.01E-01
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from non renewable sources used in production processes										

Foil-faced EcoBatt® and EcoRoll Insulation produced in Albion, MI: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.24E+00	1.89E-02	2.69E-02	0	0	9.46E-03	0	1.23E-02	1.31E+00
Ozone depletion	kg CFC-11 eq	2.22E-09	4.22E-17	2.72E-16	0	0	2.11E-17	0	6.06E-16	2.22E-09
Acidification	kg SO ₂ eq	2.76E-03	9.70E-05	1.60E-05	0	0	2.59E-05	0	6.54E-05	2.96E-03
Eutrophication	kg N eq	6.04E-04	8.32E-06	7.43E-06	0	0	2.74E-06	0	2.87E-06	6.25E-04
Smog	kg O ₃ eq	4.44E-02	3.33E-03	2.09E-04	0	0	5.91E-04	0	1.19E-03	4.98E-02
Respiratory effects	kg PM _{2.5} eq	1.75E-04	4.74E-06	7.94E-07	0	0	1.11E-06	0	5.05E-06	1.86E-04
Additional environmental information										
Carcinogenics	CTUh	96.2%	0.3%	0.3%	0.0%	0.0%	0.1%	0.0%	3.0%	100%
Non-carcinogenics	CTUh	91.6%	0.5%	0.9%	0.0%	0.0%	0.3%	0.0%	6.7%	100%
Ecotoxicity	CTUe	97.7%	1.0%	0.3%	0.0%	0.0%	0.5%	0.0%	0.5%	100%
Fossil fuel depletion	MJ surplus	2.67E+00	3.55E-02	6.54E-03	0	0	1.78E-02	0	2.48E-02	2.76E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	5.26E+00	1.04E-02	1.09E-02	0	0	5.22E-03	0	2.31E-02	5.31E+00
Renewable primary resources with energy content used as material	MJ, LHV	1.64E-05	-8.63E-13	2.56E-12	0	0	-4.32E-13	0	4.60E-12	1.64E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.49E+01	2.68E-01	7.12E-02	0	0	1.34E-01	0	1.97E-01	2.55E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	8.68E-08	1.07E-09	1.75E-10	0	0	5.34E-10	0	4.92E-10	8.91E-08
Secondary materials	kg	2.86E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.86E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	2.92E-01	3.62E-05	5.97E-05	0	0	1.81E-05	0	2.45E-05	2.93E-01
Abiotic depletion potential, fossil	MJ, LHV	2.24E+01	2.66E-01	6.05E-02	0	0	1.33E-01	0	1.91E-01	2.30E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	5.19E-03	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.90E-01	6.32E-01
High-level radioactive waste	kg	8.63E-07	7.80E-10	4.55E-09	0	0	3.90E-10	0	2.44E-09	8.72E-07
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	8.84E-04	6.57E-07	3.81E-06	0	0	3.29E-07	0	2.18E-06	8.91E-04
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.25E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.25E-01
Biogenic carbon emission from product	kg CO ₂	9.14E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	1.01E-03	9.24E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Unfaced EcoBatt® and EcoRoll Insulation produced in Inwood, WV: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.15E+00	1.60E-02	2.70E-02	0	0	7.89E-03	0	1.03E-02	1.22E+00
Ozone depletion	kg CFC-11 eq	1.42E-13	3.58E-17	2.73E-16	0	0	1.76E-17	0	5.06E-16	1.43E-13
Acidification	kg SO ₂ eq	2.97E-03	8.23E-05	1.61E-05	0	0	2.16E-05	0	5.46E-05	3.15E-03
Eutrophication	kg N eq	6.13E-04	7.05E-06	7.45E-06	0	0	2.29E-06	0	2.39E-06	6.32E-04
Smog	kg O ₃ eq	5.28E-02	2.82E-03	2.10E-04	0	0	4.93E-04	0	9.95E-04	5.73E-02
Respiratory effects	kg PM _{2.5} eq	1.68E-04	4.02E-06	7.97E-07	0	0	9.26E-07	0	4.21E-06	1.78E-04
Additional environmental information										
Carcinogenics	CTUh	96.2%	0.3%	0.4%	0.0%	0.0%	0.1%	0.0%	2.9%	100%
Non-carcinogenics	CTUh	91.3%	0.5%	1.1%	0.0%	0.0%	0.3%	0.0%	6.8%	100%
Ecotoxicity	CTUe	97.8%	1.0%	0.3%	0.0%	0.0%	0.5%	0.0%	0.4%	100%
Fossil fuel depletion	MJ surplus	2.10E+00	3.01E-02	6.56E-03	0	0	1.48E-02	0	2.07E-02	2.18E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	3.42E+00	8.84E-03	1.10E-02	0	0	4.35E-03	0	1.93E-02	3.46E+00
Renewable primary resources with energy content used as material	MJ, LHV	3.35E-09	-7.31E-13	2.57E-12	0	0	-3.60E-13	0	3.84E-12	3.35E-09
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.18E+01	2.27E-01	7.14E-02	0	0	1.12E-01	0	1.65E-01	2.24E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	7.98E-08	9.05E-10	1.75E-10	0	0	4.45E-10	0	4.10E-10	8.18E-08
Secondary materials	kg	1.80E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	1.80E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	2.72E-01	3.07E-05	5.99E-05	0	0	1.51E-05	0	2.04E-05	2.72E-01
Abiotic depletion potential, fossil	MJ, LHV	1.86E+01	2.26E-01	6.07E-02	0	0	1.11E-01	0	1.59E-01	1.92E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	7.17E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	4.92E-01	6.00E-01
High-level radioactive waste	kg	1.20E-06	6.61E-10	4.56E-09	0	0	3.25E-10	0	2.04E-09	1.20E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.13E-03	5.57E-07	3.83E-06	0	0	2.74E-07	0	1.82E-06	1.13E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	1.13E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	1.13E-01

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Biogenic carbon emission from product	kg CO ₂	7.32E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	8.45E-04	7.40E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Kraft-faced EcoBatt® and EcoRoll Insulation produced in Inwood, WV: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.21E+00	1.86E-02	2.69E-02	0	0	9.27E-03	0	1.21E-02	1.28E+00
Ozone depletion	kg CFC-11 eq	4.26E-09	4.14E-17	2.72E-16	0	0	2.07E-17	0	5.94E-16	4.26E-09
Acidification	kg SO ₂ eq	3.43E-03	9.52E-05	1.60E-05	0	0	2.54E-05	0	6.41E-05	3.63E-03
Eutrophication	kg N eq	7.11E-04	8.16E-06	7.43E-06	0	0	2.69E-06	0	2.81E-06	7.32E-04
Smog	kg O ₃ eq	6.05E-02	3.27E-03	2.09E-04	0	0	5.79E-04	0	1.17E-03	6.57E-02
Respiratory effects	kg PM _{2.5} eq	1.99E-04	4.65E-06	7.94E-07	0	0	1.09E-06	0	4.94E-06	2.11E-04
Additional environmental information										
Carcinogenics	CTUh	95.8%	0.3%	0.4%	0.0%	0.0%	0.2%	0.0%	3.3%	100%
Non-carcinogenics	CTUh	90.6%	0.6%	1.1%	0.0%	0.0%	0.3%	0.0%	7.5%	100%
Ecotoxicity	CTUe	97.6%	1.1%	0.3%	0.0%	0.0%	0.5%	0.0%	0.5%	100%
Fossil fuel depletion	MJ surplus	2.45E+00	3.48E-02	6.54E-03	0	0	1.74E-02	0	2.43E-02	2.53E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	5.12E+00	1.02E-02	1.09E-02	0	0	5.11E-03	0	2.26E-02	5.17E+00
Renewable primary resources with energy content used as material	MJ, LHV	3.19E-05	-8.47E-13	2.56E-12	0	0	-4.23E-13	0	4.51E-12	3.19E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.47E+01	2.63E-01	7.12E-02	0	0	1.31E-01	0	1.93E-01	2.54E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	8.60E-08	1.05E-09	1.74E-10	0	0	5.23E-10	0	4.82E-10	8.83E-08
Secondary materials	kg	2.11E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.11E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	2.73E-01	3.56E-05	5.97E-05	0	0	1.78E-05	0	2.40E-05	2.73E-01
Abiotic depletion potential, fossil	MJ, LHV	2.14E+01	2.61E-01	6.05E-02	0	0	1.30E-01	0	1.87E-01	2.20E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	8.43E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.78E-01	6.99E-01
High-level radioactive waste	kg	1.30E-06	7.65E-10	4.55E-09	0	0	3.82E-10	0	2.39E-09	1.30E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.19E-03	6.45E-07	3.81E-06	0	0	3.22E-07	0	2.14E-06	1.20E-03

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	3.05E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	3.05E-01
Biogenic carbon emission from product	kg CO ₂	7.38E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	9.93E-04	7.48E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

FSK-faced EcoBatt® and EcoRoll Insulation produced in Inwood, WV: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.61E+00	1.96E-02	2.61E-02	0	0	9.88E-03	0	1.29E-02	1.67E+00
Ozone depletion	kg CFC-11 eq	2.82E-09	4.38E-17	2.64E-16	0	0	2.21E-17	0	6.33E-16	2.82E-09
Acidification	kg SO ₂ eq	4.90E-03	1.01E-04	1.55E-05	0	0	2.70E-05	0	6.83E-05	5.12E-03
Eutrophication	kg N eq	7.18E-04	8.63E-06	7.20E-06	0	0	2.86E-06	0	2.99E-06	7.40E-04
Smog	kg O ₃ eq	7.50E-02	3.45E-03	2.03E-04	0	0	6.17E-04	0	1.25E-03	8.06E-02
Respiratory effects	kg PM _{2.5} eq	3.07E-04	4.92E-06	7.70E-07	0	0	1.16E-06	0	5.27E-06	3.19E-04
Additional environmental information										
Carcinogenics	CTUh	96.2%	0.3%	0.3%	0.0%	0.0%	0.2%	0.0%	3.1%	100%
Non-carcinogenics	CTUh	92.3%	0.5%	0.8%	0.0%	0.0%	0.2%	0.0%	6.2%	100%
Ecotoxicity	CTUe	97.6%	1.1%	0.3%	0.0%	0.0%	0.5%	0.0%	0.5%	100%
Fossil fuel depletion	MJ surplus	2.83E+00	3.68E-02	6.34E-03	0	0	1.85E-02	0	2.59E-02	2.92E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	6.87E+00	1.08E-02	1.06E-02	0	0	5.45E-03	0	2.41E-02	6.92E+00
Renewable primary resources with energy content used as material	MJ, LHV	2.11E-05	-8.95E-13	2.48E-12	0	0	-4.51E-13	0	4.80E-12	2.11E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.94E+01	2.78E-01	6.90E-02	0	0	1.40E-01	0	2.06E-01	3.01E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	8.75E-08	1.11E-09	1.69E-10	0	0	5.57E-10	0	5.14E-10	8.99E-08
Secondary materials	kg	2.24E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.24E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	2.68E-01	3.76E-05	5.79E-05	0	0	1.89E-05	0	2.55E-05	2.68E-01
Abiotic depletion potential, fossil	MJ, LHV	2.52E+01	2.76E-01	5.86E-02	0	0	1.39E-01	0	2.00E-01	2.58E+01

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	8.96E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	6.14E-01	7.40E-01
High-level radioactive waste	kg	1.52E-06	8.09E-10	4.41E-09	0	0	4.07E-10	0	2.55E-09	1.52E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.52E-03	6.82E-07	3.69E-06	0	0	3.43E-07	0	2.28E-06	1.52E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.55E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.55E-01
Biogenic carbon emission from product	kg CO ₂	8.92E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	1.06E-03	9.03E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Foil-faced EcoBatt® and EcoRoll Insulation produced in Inwood, WV: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.41E+00	1.89E-02	2.69E-02	0	0	9.46E-03	0	1.23E-02	1.48E+00
Ozone depletion	kg CFC-11 eq	2.19E-09	4.22E-17	2.72E-16	0	0	2.11E-17	0	6.06E-16	2.19E-09
Acidification	kg SO ₂ eq	3.79E-03	9.70E-05	1.60E-05	0	0	2.59E-05	0	6.54E-05	4.00E-03
Eutrophication	kg N eq	6.99E-04	8.32E-06	7.43E-06	0	0	2.74E-06	0	2.87E-06	7.21E-04
Smog	kg O ₃ eq	6.60E-02	3.33E-03	2.09E-04	0	0	5.91E-04	0	1.19E-03	7.13E-02
Respiratory effects	kg PM _{2.5} eq	2.22E-04	4.74E-06	7.94E-07	0	0	1.11E-06	0	5.05E-06	2.33E-04
Additional environmental information										
Carcinogenics	CTUh	96.1%	0.3%	0.3%	0.0%	0.0%	0.2%	0.0%	3.1%	100%
Non-carcinogenics	CTUh	91.9%	0.5%	0.9%	0.0%	0.0%	0.2%	0.0%	6.5%	100%
Ecotoxicity	CTUe	97.7%	1.0%	0.3%	0.0%	0.0%	0.5%	0.0%	0.5%	100%
Fossil fuel depletion	MJ surplus	2.88E+00	3.55E-02	6.54E-03	0	0	1.78E-02	0	2.48E-02	2.96E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	5.00E+00	1.04E-02	1.09E-02	0	0	5.22E-03	0	2.31E-02	5.05E+00
Renewable primary resources with energy content used as material	MJ, LHV	1.64E-05	-8.63E-13	2.56E-12	0	0	-4.32E-13	0	4.60E-12	1.64E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.82E+01	2.68E-01	7.12E-02	0	0	1.34E-01	0	1.97E-01	2.88E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	9.31E-08	1.07E-09	1.75E-10	0	0	5.34E-10	0	4.92E-10	9.54E-08

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Secondary materials	kg	2.15E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.15E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m³	2.79E-01	3.62E-05	5.97E-05	0	0	1.81E-05	0	2.45E-05	2.79E-01
Abiotic depletion potential, fossil	MJ, LHV	2.46E+01	2.66E-01	6.05E-02	0	0	1.33E-01	0	1.91E-01	2.52E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	8.61E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.90E-01	7.13E-01
High-level radioactive waste	kg	1.34E-06	7.80E-10	4.55E-09	0	0	3.90E-10	0	2.44E-09	1.35E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.28E-03	6.57E-07	3.81E-06	0	0	3.29E-07	0	2.18E-06	1.29E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.19E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.19E-01
Biogenic carbon emission from product	kg CO ₂	7.97E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	1.01E-03	8.07E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.12E+00	1.60E-02	2.70E-02	0	0	7.89E-03	0	1.03E-02	1.18E+00
Ozone depletion	kg CFC-11 eq	1.14E-13	3.58E-17	2.73E-16	0	0	1.76E-17	0	5.06E-16	1.15E-13
Acidification	kg SO ₂ eq	2.32E-03	8.23E-05	1.61E-05	0	0	2.16E-05	0	5.46E-05	2.49E-03
Eutrophication	kg N eq	5.96E-04	7.05E-06	7.45E-06	0	0	2.29E-06	0	2.39E-06	6.15E-04
Smog	kg O ₃ eq	4.02E-02	2.82E-03	2.10E-04	0	0	4.93E-04	0	9.95E-04	4.47E-02
Respiratory effects	kg PM _{2.5} eq	1.38E-04	4.02E-06	7.97E-07	0	0	9.26E-07	0	4.21E-06	1.48E-04
Additional environmental information										
Carcinogenics	CTUh	96.7%	0.3%	0.3%	0.0%	0.0%	0.1%	0.0%	2.6%	100%
Non-carcinogenics	CTUh	92.2%	0.5%	1.0%	0.0%	0.0%	0.2%	0.0%	6.1%	100%
Ecotoxicity	CTUe	98.0%	0.9%	0.3%	0.0%	0.0%	0.4%	0.0%	0.4%	100%
Fossil fuel depletion	MJ surplus	2.27E+00	3.01E-02	6.56E-03	0	0	1.48E-02	0	2.07E-02	2.34E+00
Resource use indicators										

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	3.80E+00	8.84E-03	1.10E-02	0	0	4.35E-03	0	1.93E-02	3.84E+00
Renewable primary resources with energy content used as material	MJ, LHV	8.68E-10	-7.31E-13	2.57E-12	0	0	-3.60E-13	0	3.84E-12	8.74E-10
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.09E+01	2.27E-01	7.14E-02	0	0	1.12E-01	0	1.65E-01	2.15E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	8.48E-08	9.05E-10	1.75E-10	0	0	4.45E-10	0	4.10E-10	8.68E-08
Secondary materials	kg	1.27E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	1.27E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m³	3.23E-01	3.07E-05	5.99E-05	0	0	1.51E-05	0	2.04E-05	3.24E-01
Abiotic depletion potential, fossil	MJ, LHV	1.84E+01	2.26E-01	6.07E-02	0	0	1.11E-01	0	1.59E-01	1.90E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	7.65E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	4.92E-01	6.05E-01
High-level radioactive waste	kg	8.59E-07	6.61E-10	4.56E-09	0	0	3.25E-10	0	2.04E-09	8.67E-07
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	8.69E-04	5.57E-07	3.83E-06	0	0	2.74E-07	0	1.82E-06	8.75E-04
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	1.33E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	1.33E-01
Biogenic carbon emission from product	kg CO ₂	9.46E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	8.45E-04	9.55E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Kraft-faced EcoBatt® and EcoRoll Insulation produced in Lanett, AL: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.17E+00	1.86E-02	2.69E-02	0	0	9.27E-03	0	1.21E-02	1.24E+00
Ozone depletion	kg CFC-11 eq	4.14E-09	4.14E-17	2.72E-16	0	0	2.07E-17	0	5.94E-16	4.14E-09
Acidification	kg SO ₂ eq	2.76E-03	9.52E-05	1.60E-05	0	0	2.54E-05	0	6.41E-05	2.96E-03
Eutrophication	kg N eq	6.89E-04	8.16E-06	7.43E-06	0	0	2.69E-06	0	2.81E-06	7.10E-04
Smog	kg O ₃ eq	4.76E-02	3.27E-03	2.09E-04	0	0	5.79E-04	0	1.17E-03	5.28E-02

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Respiratory effects	kg PM _{2.5} eq	1.68E-04	4.65E-06	7.94E-07	0	0	1.09E-06	0	4.94E-06	1.79E-04
Additional environmental information										
Carcinogenics	CTUh	96.3%	0.3%	0.3%	0.0%	0.0%	0.1%	0.0%	2.9%	100%
Non-carcinogenics	CTUh	91.5%	0.5%	1.0%	0.0%	0.0%	0.3%	0.0%	6.8%	100%
Ecotoxicity	CTUe	97.8%	1.0%	0.3%	0.0%	0.0%	0.5%	0.0%	0.5%	100%
Fossil fuel depletion	MJ surplus	2.60E+00	3.48E-02	6.54E-03	0	0	1.74E-02	0	2.43E-02	2.68E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	5.44E+00	1.02E-02	1.09E-02	0	0	5.11E-03	0	2.26E-02	5.49E+00
Renewable primary resources with energy content used as material	MJ, LHV	3.10E-05	-8.47E-13	2.56E-12	0	0	-4.23E-13	0	4.51E-12	3.10E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.37E+01	2.63E-01	7.12E-02	0	0	1.31E-01	0	1.93E-01	2.43E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	9.06E-08	1.05E-09	1.74E-10	0	0	5.23E-10	0	4.82E-10	9.29E-08
Secondary materials	kg	1.49E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	1.49E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	3.24E-01	3.56E-05	5.97E-05	0	0	1.78E-05	0	2.40E-05	3.24E-01
Abiotic depletion potential, fossil	MJ, LHV	2.10E+01	2.61E-01	6.05E-02	0	0	1.30E-01	0	1.87E-01	2.17E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	8.99E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.78E-01	7.04E-01
High-level radioactive waste	kg	9.55E-07	7.65E-10	4.55E-09	0	0	3.82E-10	0	2.39E-09	9.63E-07
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	9.28E-04	6.45E-07	3.81E-06	0	0	3.22E-07	0	2.14E-06	9.35E-04
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.11E-06	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.11E-06
Biogenic carbon emission from product	kg CO ₂	3.35E-04	0.00E+00	0.00E+00	0	0	0.00E+00	0	9.93E-04	1.33E-03
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

FSK-faced EcoBatt® and EcoRoll Insulation produced in Lanett, AL: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.60E+00	1.96E-02	2.61E-02	0	0	9.88E-03	0	1.29E-02	1.66E+00
Ozone depletion	kg CFC-11 eq	2.82E-09	4.38E-17	2.64E-16	0	0	2.21E-17	0	6.33E-16	2.82E-09
Acidification	kg SO ₂ eq	4.32E-03	1.01E-04	1.55E-05	0	0	2.70E-05	0	6.83E-05	4.53E-03
Eutrophication	kg N eq	7.15E-04	8.63E-06	7.20E-06	0	0	2.86E-06	0	2.99E-06	7.37E-04
Smog	kg O ₃ eq	6.37E-02	3.45E-03	2.03E-04	0	0	6.17E-04	0	1.25E-03	6.92E-02
Respiratory effects	kg PM _{2.5} eq	2.81E-04	4.92E-06	7.70E-07	0	0	1.16E-06	0	5.27E-06	2.93E-04
Additional environmental information										
Carcinogenics	CTUh	96.6%	0.3%	0.3%	0.0%	0.0%	0.1%	0.0%	2.7%	100%
Non-carcinogenics	CTUh	93.0%	0.4%	0.7%	0.0%	0.0%	0.2%	0.0%	5.6%	100%
Ecotoxicity	CTUe	97.9%	0.9%	0.3%	0.0%	0.0%	0.5%	0.0%	0.4%	100%
Fossil fuel depletion	MJ surplus	3.03E+00	3.68E-02	6.34E-03	0	0	1.85E-02	0	2.59E-02	3.12E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	7.32E+00	1.08E-02	1.06E-02	0	0	5.45E-03	0	2.41E-02	7.38E+00
Renewable primary resources with energy content used as material	MJ, LHV	2.11E-05	-8.95E-13	2.48E-12	0	0	-4.51E-13	0	4.80E-12	2.11E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.89E+01	2.78E-01	6.90E-02	0	0	1.40E-01	0	2.06E-01	2.96E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	9.40E-08	1.11E-09	1.69E-10	0	0	5.57E-10	0	5.14E-10	9.64E-08
Secondary materials	kg	1.59E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	1.59E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	3.25E-01	3.76E-05	5.79E-05	0	0	1.89E-05	0	2.55E-05	3.25E-01
Abiotic depletion potential, fossil	MJ, LHV	2.53E+01	2.76E-01	5.86E-02	0	0	1.39E-01	0	2.00E-01	2.60E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	9.55E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	6.14E-01	7.46E-01
High-level radioactive waste	kg	1.21E-06	8.09E-10	4.41E-09	0	0	4.07E-10	0	2.55E-09	1.22E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.29E-03	6.82E-07	3.69E-06	0	0	3.43E-07	0	2.28E-06	1.29E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.77E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.77E-01
Biogenic carbon emission from product	kg CO ₂	1.12E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	1.06E-03	1.13E-01
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Carbon emissions from combustion of waste from renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from non renewable sources used in production processes										

Foil-faced EcoBatt® and EcoRoll Insulation produced in Lanett, AL: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.40E+00	1.89E-02	2.69E-02	0	0	9.46E-03	0	1.23E-02	1.47E+00
Ozone depletion	kg CFC-11 eq	2.19E-09	4.22E-17	2.72E-16	0	0	2.11E-17	0	6.06E-16	2.19E-09
Acidification	kg SO ₂ eq	3.18E-03	9.70E-05	1.60E-05	0	0	2.59E-05	0	6.54E-05	3.39E-03
Eutrophication	kg N eq	6.96E-04	8.32E-06	7.43E-06	0	0	2.74E-06	0	2.87E-06	7.17E-04
Smog	kg O ₃ eq	5.40E-02	3.33E-03	2.09E-04	0	0	5.91E-04	0	1.19E-03	5.94E-02
Respiratory effects	kg PM _{2.5} eq	1.94E-04	4.74E-06	7.94E-07	0	0	1.11E-06	0	5.05E-06	2.06E-04
Additional environmental information										
Carcinogenics	CTUh	96.7%	0.3%	0.3%	0.0%	0.0%	0.1%	0.0%	2.7%	100%
Non-carcinogenics	CTUh	92.7%	0.4%	0.8%	0.0%	0.0%	0.2%	0.0%	5.8%	100%
Ecotoxicity	CTUe	98.0%	0.9%	0.3%	0.0%	0.0%	0.4%	0.0%	0.4%	100%
Fossil fuel depletion	MJ surplus	3.09E+00	3.55E-02	6.54E-03	0	0	1.78E-02	0	2.48E-02	3.17E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	5.47E+00	1.04E-02	1.09E-02	0	0	5.22E-03	0	2.31E-02	5.52E+00
Renewable primary resources with energy content used as material	MJ, LHV	1.64E-05	-8.63E-13	2.56E-12	0	0	-4.32E-13	0	4.60E-12	1.64E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.76E+01	2.68E-01	7.12E-02	0	0	1.34E-01	0	1.97E-01	2.83E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	9.99E-08	1.07E-09	1.75E-10	0	0	5.34E-10	0	4.92E-10	1.02E-07
Secondary materials	kg	1.52E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	1.52E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	3.39E-01	3.62E-05	5.97E-05	0	0	1.81E-05	0	2.45E-05	3.39E-01
Abiotic depletion potential, fossil	MJ, LHV	2.47E+01	2.66E-01	6.05E-02	0	0	1.33E-01	0	1.91E-01	2.54E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	9.18E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.90E-01	7.18E-01
High-level radioactive waste	kg	1.02E-06	7.80E-10	4.55E-09	0	0	3.90E-10	0	2.44E-09	1.03E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.04E-03	6.57E-07	3.81E-06	0	0	3.29E-07	0	2.18E-06	1.04E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.41E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.41E-01
Biogenic carbon emission from product	kg CO ₂	1.04E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	1.01E-03	1.05E-01
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

[illegible]

Unfaced EcoBatt® and EcoRoll Insulation produced in Shasta Lake, CA: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	8.22E-01	1.60E-02	2.70E-02	0	0	7.89E-03	0	1.03E-02	8.83E-01
Ozone depletion	kg CFC-11 eq	8.64E-13	3.58E-17	2.73E-16	0	0	1.76E-17	0	5.06E-16	8.65E-13
Acidification	kg SO ₂ eq	2.11E-03	8.23E-05	1.61E-05	0	0	2.16E-05	0	5.46E-05	2.29E-03
Eutrophication	kg N eq	5.15E-04	7.05E-06	7.45E-06	0	0	2.29E-06	0	2.39E-06	5.34E-04
Smog	kg O ₃ eq	3.05E-02	2.82E-03	2.10E-04	0	0	4.93E-04	0	9.95E-04	3.50E-02
Respiratory effects	kg PM _{2.5} eq	1.04E-04	4.02E-06	7.97E-07	0	0	9.26E-07	0	4.21E-06	1.14E-04
Additional environmental information										
Carcinogenics	CTUh	96.5%	0.3%	0.3%	0.0%	0.0%	0.1%	0.0%	2.8%	100%
Non-carcinogenics	CTUh	91.2%	0.5%	1.1%	0.0%	0.0%	0.3%	0.0%	6.9%	100%
Ecotoxicity	CTUe	97.8%	1.0%	0.3%	0.0%	0.0%	0.5%	0.0%	0.4%	100%
Fossil fuel depletion	MJ surplus	1.78E+00	3.01E-02	6.56E-03	0	0	1.48E-02	0	2.07E-02	1.85E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	6.02E+00	8.84E-03	1.10E-02	0	0	4.35E-03	0	1.93E-02	6.06E+00
Renewable primary resources with energy content used as material	MJ, LHV	3.02E-08	-7.31E-13	2.57E-12	0	0	-3.60E-13	0	3.84E-12	3.02E-08
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	1.66E+01	2.27E-01	7.14E-02	0	0	1.12E-01	0	1.65E-01	1.71E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	8.41E-08	9.05E-10	1.75E-10	0	0	4.45E-10	0	4.10E-10	8.60E-08
Secondary materials	kg	2.14E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.14E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	3.06E-01	3.07E-05	5.99E-05	0	0	1.51E-05	0	2.04E-05	3.06E-01
Abiotic depletion potential, fossil	MJ, LHV	1.45E+01	2.26E-01	6.07E-02	0	0	1.11E-01	0	1.59E-01	1.51E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	1.36E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	4.92E-01	5.42E-01
High-level radioactive waste	kg	7.04E-07	6.61E-10	4.56E-09	0	0	3.25E-10	0	2.04E-09	7.12E-07
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	7.31E-04	5.57E-07	3.83E-06	0	0	2.74E-07	0	1.82E-06	7.37E-04
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Biogenic carbon removal from product	kg CO ₂	1.25E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	1.25E-01
Biogenic carbon emission from product	kg CO ₂	9.23E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	8.45E-04	9.32E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Kraft-faced EcoBatt® and EcoRoll Insulation produced in Shasta Lake, CA: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	8.77E-01	1.86E-02	2.69E-02	0	0	9.27E-03	0	1.21E-02	9.44E-01
Ozone depletion	kg CFC-11 eq	4.09E-09	4.14E-17	2.72E-16	0	0	2.07E-17	0	5.94E-16	4.09E-09
Acidification	kg SO ₂ eq	2.57E-03	9.52E-05	1.60E-05	0	0	2.54E-05	0	6.41E-05	2.77E-03
Eutrophication	kg N eq	6.12E-04	8.16E-06	7.43E-06	0	0	2.69E-06	0	2.81E-06	6.34E-04
Smog	kg O ₃ eq	3.81E-02	3.27E-03	2.09E-04	0	0	5.79E-04	0	1.17E-03	4.33E-02
Respiratory effects	kg PM _{2.5} eq	1.34E-04	4.65E-06	7.94E-07	0	0	1.09E-06	0	4.94E-06	1.46E-04
Additional environmental information										
Carcinogenics	CTUh	96.1%	0.3%	0.3%	0.0%	0.0%	0.2%	0.0%	3.1%	100%
Non-carcinogenics	CTUh	90.5%	0.6%	1.1%	0.0%	0.0%	0.3%	0.0%	7.6%	100%
Ecotoxicity	CTUe	97.6%	1.0%	0.3%	0.0%	0.0%	0.5%	0.0%	0.5%	100%
Fossil fuel depletion	MJ surplus	2.11E+00	3.48E-02	6.54E-03	0	0	1.74E-02	0	2.43E-02	2.20E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	7.71E+00	1.02E-02	1.09E-02	0	0	5.11E-03	0	2.26E-02	7.75E+00
Renewable primary resources with energy content used as material	MJ, LHV	3.07E-05	-8.47E-13	2.56E-12	0	0	-4.23E-13	0	4.51E-12	3.07E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	1.94E+01	2.63E-01	7.12E-02	0	0	1.31E-01	0	1.93E-01	2.01E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	9.05E-08	1.05E-09	1.74E-10	0	0	5.23E-10	0	4.82E-10	9.28E-08
Secondary materials	kg	2.52E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.52E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	3.10E-01	3.56E-05	5.97E-05	0	0	1.78E-05	0	2.40E-05	3.10E-01
Abiotic depletion potential, fossil	MJ, LHV	1.72E+01	2.61E-01	6.05E-02	0	0	1.30E-01	0	1.87E-01	1.78E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	1.60E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.78E-01	6.31E-01
High-level radioactive waste	kg	8.02E-07	7.65E-10	4.55E-09	0	0	3.82E-10	0	2.39E-09	8.10E-07

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	7.94E-04	6.45E-07	3.81E-06	0	0	3.22E-07	0	2.14E-06	8.01E-04
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	3.10E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	3.10E-01
Biogenic carbon emission from product	kg CO ₂	9.37E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	9.93E-04	9.47E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

FSK-faced EcoBatt® and EcoRoll Insulation produced in Shasta Lake, CA: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.31E+00	1.96E-02	2.61E-02	0	0	9.88E-03	0	1.29E-02	1.38E+00
Ozone depletion	kg CFC-11 eq	2.82E-09	4.38E-17	2.64E-16	0	0	2.21E-17	0	6.33E-16	2.82E-09
Acidification	kg SO ₂ eq	4.16E-03	1.01E-04	1.55E-05	0	0	2.70E-05	0	6.83E-05	4.38E-03
Eutrophication	kg N eq	6.47E-04	8.63E-06	7.20E-06	0	0	2.86E-06	0	2.99E-06	6.68E-04
Smog	kg O ₃ eq	5.47E-02	3.45E-03	2.03E-04	0	0	6.17E-04	0	1.25E-03	6.02E-02
Respiratory effects	kg PM _{2.5} eq	2.50E-04	4.92E-06	7.70E-07	0	0	1.16E-06	0	5.27E-06	2.62E-04
Additional environmental information										
Carcinogenics	CTUh	96.5%	0.3%	0.3%	0.0%	0.0%	0.1%	0.0%	2.8%	100%
Non-carcinogenics	CTUh	92.5%	0.5%	0.8%	0.0%	0.0%	0.2%	0.0%	6.1%	100%
Ecotoxicity	CTUe	97.7%	1.0%	0.3%	0.0%	0.0%	0.5%	0.0%	0.5%	100%
Fossil fuel depletion	MJ surplus	2.57E+00	3.68E-02	6.34E-03	0	0	1.85E-02	0	2.59E-02	2.66E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	9.66E+00	1.08E-02	1.06E-02	0	0	5.45E-03	0	2.41E-02	9.71E+00
Renewable primary resources with energy content used as material	MJ, LHV	2.12E-05	-8.95E-13	2.48E-12	0	0	-4.51E-13	0	4.80E-12	2.12E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.49E+01	2.78E-01	6.90E-02	0	0	1.40E-01	0	2.06E-01	2.56E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	9.48E-08	1.11E-09	1.69E-10	0	0	5.57E-10	0	5.14E-10	9.72E-08
Secondary materials	kg	2.52E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.52E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m³	3.15E-01	3.76E-05	5.79E-05	0	0	1.89E-05	0	2.55E-05	3.15E-01
Abiotic depletion potential, fossil	MJ, LHV	2.16E+01	2.76E-01	5.86E-02	0	0	1.39E-01	0	2.00E-01	2.23E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	1.60E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.78E-01	6.31E-01
High-level radioactive waste	kg	1.07E-06	8.09E-10	4.41E-09	0	0	4.07E-10	0	2.55E-09	1.07E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.16E-03	6.82E-07	3.69E-06	0	0	3.43E-07	0	2.28E-06	1.17E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.72E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.72E-01
Biogenic carbon emission from product	kg CO ₂	1.12E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	1.06E-03	1.13E-01
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kgCO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Foil-faced EcoBatt® and EcoRoll Insulation produced in Shasta Lake, CA: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.11E+00	1.89E-02	2.69E-02	0	0	9.46E-03	0	1.23E-02	1.17E+00
Ozone depletion	kg CFC-11 eq	2.19E-09	4.22E-17	2.72E-16	0	0	2.11E-17	0	6.06E-16	2.19E-09
Acidification	kg SO ₂ eq	3.02E-03	9.70E-05	1.60E-05	0	0	2.59E-05	0	6.54E-05	3.22E-03
Eutrophication	kg N eq	6.24E-04	8.32E-06	7.43E-06	0	0	2.74E-06	0	2.87E-06	6.45E-04
Smog	kg O ₃ eq	4.45E-02	3.33E-03	2.09E-04	0	0	5.91E-04	0	1.19E-03	4.99E-02
Respiratory effects	kg PM _{2.5} eq	1.61E-04	4.74E-06	7.94E-07	0	0	1.11E-06	0	5.05E-06	1.73E-04
Additional environmental information										
Carcinogenics	CTUh	96.5%	0.3%	0.3%	0.0%	0.0%	0.1%	0.0%	2.8%	100%
Non-carcinogenics	CTUh	92.1%	0.5%	0.9%	0.0%	0.0%	0.2%	0.0%	6.3%	100%
Ecotoxicity	CTUe	97.8%	1.0%	0.3%	0.0%	0.0%	0.5%	0.0%	0.5%	100%
Fossil fuel depletion	MJ surplus	2.60E+00	3.55E-02	6.54E-03	0	0	1.78E-02	0	2.48E-02	2.69E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	7.93E+00	1.04E-02	1.09E-02	0	0	5.22E-03	0	2.31E-02	7.98E+00
Renewable primary resources with energy content used as material	MJ, LHV	1.64E-05	-8.63E-13	2.56E-12	0	0	-4.32E-13	0	4.60E-12	1.64E-05

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.34E+01	2.68E-01	7.12E-02	0	0	1.34E-01	0	1.97E-01	2.41E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	1.01E-07	1.07E-09	1.75E-10	0	0	5.34E-10	0	4.92E-10	1.03E-07
Secondary materials	kg	2.57E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.57E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m³	3.29E-01	3.62E-05	5.97E-05	0	0	1.81E-05	0	2.45E-05	3.29E-01
Abiotic depletion potential, fossil	MJ, LHV	2.08E+01	2.66E-01	6.05E-02	0	0	1.33E-01	0	1.91E-01	2.15E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	1.63E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.90E-01	6.43E-01
High-level radioactive waste	kg	8.72E-07	7.80E-10	4.55E-09	0	0	3.90E-10	0	2.44E-09	8.80E-07
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	9.08E-04	6.57E-07	3.81E-06	0	0	3.29E-07	0	2.18E-06	9.15E-04
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.37E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.37E-01
Biogenic carbon emission from product	kg CO ₂	1.04E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	1.01E-03	1.05E-01
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Unfaced EcoBatt® and EcoRoll Insulation produced in Shelbyville, IN: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.19E+00	1.60E-02	2.70E-02	0	0	7.89E-03	0	1.03E-02	1.25E+00
Ozone depletion	kg CFC-11 eq	9.25E-13	3.58E-17	2.73E-16	0	0	1.76E-17	0	5.06E-16	9.26E-13
Acidification	kg SO ₂ eq	2.30E-03	8.23E-05	1.61E-05	0	0	2.16E-05	0	5.46E-05	2.48E-03
Eutrophication	kg N eq	6.21E-04	7.05E-06	7.45E-06	0	0	2.29E-06	0	2.39E-06	6.40E-04
Smog	kg O ₃ eq	4.01E-02	2.82E-03	2.10E-04	0	0	4.93E-04	0	9.95E-04	4.46E-02
Respiratory effects	kg PM _{2.5} eq	1.37E-04	4.02E-06	7.97E-07	0	0	9.26E-07	0	4.21E-06	1.47E-04
Additional environmental information										
Carcinogenics	CTUh	97.1%	0.2%	0.3%	0.0%	0.0%	0.1%	0.0%	2.3%	100%
Non-carcinogenics	CTUh	92.8%	0.4%	0.9%	0.0%	0.0%	0.2%	0.0%	5.6%	100%

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Ecotoxicity	CTUe	98.2%	0.8%	0.3%	0.0%	0.0%	0.4%	0.0%	0.4%	100%
Fossil fuel depletion	MJ surplus	2.17E+00	3.01E-02	6.56E-03	0	0	1.48E-02	0	2.07E-02	2.24E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	4.27E+00	8.84E-03	1.10E-02	0	0	4.35E-03	0	1.93E-02	4.31E+00
Renewable primary resources with energy content used as material	MJ, LHV	3.86E-08	-7.31E-13	2.57E-12	0	0	-3.60E-13	0	3.84E-12	3.86E-08
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.33E+01	2.27E-01	7.14E-02	0	0	1.12E-01	0	1.65E-01	2.39E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	8.30E-08	9.05E-10	1.75E-10	0	0	4.45E-10	0	4.10E-10	8.50E-08
Secondary materials	kg	2.24E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.24E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	3.66E-01	3.07E-05	5.99E-05	0	0	1.51E-05	0	2.04E-05	3.66E-01
Abiotic depletion potential, fossil	MJ, LHV	1.92E+01	2.26E-01	6.07E-02	0	0	1.11E-01	0	1.59E-01	1.98E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	7.73E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	4.92E-01	6.06E-01
High-level radioactive waste	kg	1.53E-06	6.61E-10	4.56E-09	0	0	3.25E-10	0	2.04E-09	1.54E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.45E-03	5.57E-07	3.83E-06	0	0	2.74E-07	0	1.82E-06	1.45E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	1.33E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	1.33E-01
Biogenic carbon emission from product	kg CO ₂	9.54E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	8.45E-04	9.62E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Kraft-faced EcoBatt® and EcoRoll Insulation produced in Shelbyville, IN: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.25E+00	1.86E-02	2.69E-02	0	0	9.27E-03	0	1.21E-02	1.32E+00
Ozone depletion	kg CFC-11 eq	4.24E-09	4.14E-17	2.72E-16	0	0	2.07E-17	0	5.94E-16	4.24E-09

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Acidification	kg SO ₂ eq	2.77E-03	9.52E-05	1.60E-05	0	0	2.54E-05	0	6.41E-05	2.97E-03
Eutrophication	kg N eq	7.20E-04	8.16E-06	7.43E-06	0	0	2.69E-06	0	2.81E-06	7.41E-04
Smog	kg O ₃ eq	4.79E-02	3.27E-03	2.09E-04	0	0	5.79E-04	0	1.17E-03	5.31E-02
Respiratory effects	kg PM _{2.5} eq	1.69E-04	4.65E-06	7.94E-07	0	0	1.09E-06	0	4.94E-06	1.80E-04
Additional environmental information										
Carcinogenics	CTUh	96.7%	0.3%	0.3%	0.0%	0.0%	0.1%	0.0%	2.6%	100%
Non-carcinogenics	CTUh	92.1%	0.5%	0.9%	0.0%	0.0%	0.2%	0.0%	6.3%	100%
Ecotoxicity	CTUe	98.0%	0.9%	0.3%	0.0%	0.0%	0.4%	0.0%	0.4%	100%
Fossil fuel depletion	MJ surplus	2.52E+00	3.48E-02	6.54E-03	0	0	1.74E-02	0	2.43E-02	2.60E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	5.98E+00	1.02E-02	1.09E-02	0	0	5.11E-03	0	2.26E-02	6.03E+00
Renewable primary resources with energy content used as material	MJ, LHV	3.18E-05	-8.47E-13	2.56E-12	0	0	-4.23E-13	0	4.51E-12	3.18E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.62E+01	2.63E-01	7.12E-02	0	0	1.31E-01	0	1.93E-01	2.69E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	8.93E-08	1.05E-09	1.74E-10	0	0	5.23E-10	0	4.82E-10	9.16E-08
Secondary materials	kg	2.63E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.63E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	3.68E-01	3.56E-05	5.97E-05	0	0	1.78E-05	0	2.40E-05	3.68E-01
Abiotic depletion potential, fossil	MJ, LHV	2.20E+01	2.61E-01	6.05E-02	0	0	1.30E-01	0	1.87E-01	2.26E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	9.08E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.78E-01	7.05E-01
High-level radioactive waste	kg	1.63E-06	7.65E-10	4.55E-09	0	0	3.82E-10	0	2.39E-09	1.64E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.52E-03	6.45E-07	3.81E-06	0	0	3.22E-07	0	2.14E-06	1.52E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	3.25E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	3.25E-01
Biogenic carbon emission from product	kg CO ₂	9.62E-02	0.00E+00	0.00E+00	0	0	0.00E+00	0	9.93E-04	9.72E-02
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

FSK-faced EcoBatt® and EcoRoll Insulation produced in Shelbyville, IN: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.64E+00	1.96E-02	2.61E-02	0	0	9.88E-03	0	1.29E-02	1.71E+00
Ozone depletion	kg CFC-11 eq	2.82E-09	4.38E-17	2.64E-16	0	0	2.21E-17	0	6.33E-16	2.82E-09
Acidification	kg SO ₂ eq	4.26E-03	1.01E-04	1.55E-05	0	0	2.70E-05	0	6.83E-05	4.47E-03
Eutrophication	kg N eq	7.28E-04	8.63E-06	7.20E-06	0	0	2.86E-06	0	2.99E-06	7.50E-04
Smog	kg O ₃ eq	6.28E-02	3.45E-03	2.03E-04	0	0	6.17E-04	0	1.25E-03	6.83E-02
Respiratory effects	kg PM _{2.5} eq	2.78E-04	4.92E-06	7.70E-07	0	0	1.16E-06	0	5.27E-06	2.90E-04
Additional environmental information										
Carcinogenics	CTUh	96.9%	0.2%	0.2%	0.0%	0.0%	0.1%	0.0%	2.5%	100%
Non-carcinogenics	CTUh	93.3%	0.4%	0.7%	0.0%	0.0%	0.2%	0.0%	5.4%	100%
Ecotoxicity	CTUe	98.0%	0.9%	0.3%	0.0%	0.0%	0.4%	0.0%	0.4%	100%
Fossil fuel depletion	MJ surplus	2.89E+00	3.68E-02	6.34E-03	0	0	1.85E-02	0	2.59E-02	2.98E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	7.70E+00	1.08E-02	1.06E-02	0	0	5.45E-03	0	2.41E-02	7.75E+00
Renewable primary resources with energy content used as material	MJ, LHV	2.12E-05	-8.95E-13	2.48E-12	0	0	-4.51E-13	0	4.80E-12	2.12E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	3.08E+01	2.78E-01	6.90E-02	0	0	1.40E-01	0	2.06E-01	3.15E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	9.06E-08	1.11E-09	1.69E-10	0	0	5.57E-10	0	5.14E-10	9.30E-08
Secondary materials	kg	2.63E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.63E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	3.60E-01	3.76E-05	5.79E-05	0	0	1.89E-05	0	2.55E-05	3.60E-01
Abiotic depletion potential, fossil	MJ, LHV	2.57E+01	2.76E-01	5.86E-02	0	0	1.39E-01	0	2.00E-01	2.63E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	9.08E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.78E-01	7.05E-01
High-level radioactive waste	kg	1.83E-06	8.09E-10	4.41E-09	0	0	4.07E-10	0	2.55E-09	1.84E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.82E-03	6.82E-07	3.69E-06	0	0	3.43E-07	0	2.28E-06	1.83E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.75E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.75E-01
Biogenic carbon emission from product	kg CO ₂	1.11E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	1.06E-03	1.12E-01
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00

Foil-faced EcoBatt® and EcoRoll Insulation produced in Shelbyville, IN: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
LCIA results										
Global warming	kg CO ₂ eq	1.45E+00	1.89E-02	2.69E-02	0	0	9.46E-03	0	1.23E-02	1.51E+00
Ozone depletion	kg CFC-11 eq	2.19E-09	4.22E-17	2.72E-16	0	0	2.11E-17	0	6.06E-16	2.19E-09
Acidification	kg SO ₂ eq	3.12E-03	9.70E-05	1.60E-05	0	0	2.59E-05	0	6.54E-05	3.32E-03
Eutrophication	kg N eq	7.10E-04	8.32E-06	7.43E-06	0	0	2.74E-06	0	2.87E-06	7.31E-04
Smog	kg O ₃ eq	5.31E-02	3.33E-03	2.09E-04	0	0	5.91E-04	0	1.19E-03	5.85E-02
Respiratory effects	kg PM _{2.5} eq	1.91E-04	4.74E-06	7.94E-07	0	0	1.11E-06	0	5.05E-06	2.03E-04
Additional environmental information										
Carcinogenics	CTUh	96.9%	0.2%	0.3%	0.0%	0.0%	0.1%	0.0%	2.5%	100%
Non-carcinogenics	CTUh	93.1%	0.4%	0.8%	0.0%	0.0%	0.2%	0.0%	5.5%	100%
Ecotoxicity	CTUe	98.1%	0.8%	0.3%	0.0%	0.0%	0.4%	0.0%	0.4%	100%
Fossil fuel depletion	MJ surplus	2.94E+00	3.55E-02	6.54E-03	0	0	1.78E-02	0	2.48E-02	3.03E+00
Resource use indicators										
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	5.88E+00	1.04E-02	1.09E-02	0	0	5.22E-03	0	2.31E-02	5.93E+00
Renewable primary resources with energy content used as material	MJ, LHV	1.64E-05	-8.63E-13	2.56E-12	0	0	-4.32E-13	0	4.60E-12	1.64E-05
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	2.96E+01	2.68E-01	7.12E-02	0	0	1.34E-01	0	1.97E-01	3.03E+01
Non-renewable primary resources with energy content used as material	MJ, LHV	9.64E-08	1.07E-09	1.75E-10	0	0	5.34E-10	0	4.92E-10	9.87E-08
Secondary materials	kg	2.69E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.69E-01
Renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Use of net fresh water resources	m ³	3.76E-01	3.62E-05	5.97E-05	0	0	1.81E-05	0	2.45E-05	3.76E-01
Abiotic depletion potential, fossil	MJ, LHV	2.51E+01	2.66E-01	6.05E-02	0	0	1.33E-01	0	1.91E-01	2.58E+01
Output flows and waste category indicators										
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	9.27E-02	0.00E+00	3.70E-02	0	0	0.00E+00	0	5.90E-01	7.19E-01
High-level radioactive waste	kg	1.67E-06	7.80E-10	4.55E-09	0	0	3.90E-10	0	2.44E-09	1.68E-06
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	1.60E-03	6.57E-07	3.81E-06	0	0	3.29E-07	0	2.18E-06	1.61E-03
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	8.16E-03	0	0	0.00E+00	0	0.00E+00	8.16E-03
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Exported energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions and removals										
Biogenic carbon removal from product	kg CO ₂	2.39E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	2.39E-01
Biogenic carbon emission from product	kg CO ₂	1.03E-01	0.00E+00	0.00E+00	0	0	0.00E+00	0	1.01E-03	1.04E-01

Parameter	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
Biogenic carbon removal from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from packaging	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Biogenic carbon emission from combustion of waste	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Calcination carbon emissions	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbonation carbon removals	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from renewable sources used in production processes + Carbon emissions from combustion of waste from non renewable sources used in production processes	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0	0.00E+00	0.00E+00



LCA & material health results & interpretation

EcoBatt® and EcoRoll® Insulation

Albion, MI

Inwood, WV

Lanett, AL

Shasta Lake, CA

Shelbyville, IN

EPD add'l content

Material health

Evaluation programs

Declare

Declare labels are issued to products disclosing ingredient inventory, **sourcing and end of life options**. Declare labels are based on the Manufacturers Guide to Declare, administered by the International Living Future Institute.

How it works

Material ingredients are inventoried and screened against the [Living Building Challenge](#) (LBC) Red List which represents the 'worst in class' materials, chemicals, and elements known to pose serious risks to human health and the greater ecosystem.

The Health Product Declaration®

The HPD Open Standard provides a consistent, and transparent format to accurately disclose the material contents and associated hazard classifications for a building product.

How it works

Material ingredients are screened and categorized according to the hazards that international governmental bodies and toxicology experts have associated with them, based on two listings:

- Authoritative lists maintained or recognized by government bodies
- Screening lists, which include chemicals that government bodies determined need further scrutiny, as well as chemical lists not recognized by any government body.

Assessment scope and results

Declare™

Inventory threshold: 100ppm

Declare level:

The Declare product database and label are used to select products that meet the LBC's stringent materials requirements, streamlining the materials specification and certification process.

- LBC Red List Free [?]
- LBC Red List Approved [?]
- Declared [?]

What's in this product and why

Declare level

Unfaced and kraft faced products do not have Red List chemicals. The Red List is a list of chemicals that are not allowed in Living Building Challenge buildings. Being Red List free is our design benchmark at Knauf Insulation North America.

EcoBatt utilizes a bio-based binder chemistry derived from corn that is formaldehyde-free and more interior friendly than phenol-formaldehyde (P/F) systems. This product transformed the industry, moving away from P/F systems and toward bio-based binder adhesive systems for wall and ceiling batt products.

What's in the product and why

The ingredients of most EcoBatt® variants avoid the 800+ chemicals of the Living Building Challenge Red List. This is primarily because of its bio-based binder adhesive chemistry known as ECOSE® Technology. ECOSE is based on dextrose or high fructose corn syrup instead of phenol and formaldehyde. Dextrose and fructose can be used interchangeably. The ECOSE binder allows the product to be validated by the UL Environment as formaldehyde-free. Formaldehyde is a Red List chemical.

EcoBatt Products with foil scrim kraft (FSK) facers do not meet Red List free status because the facer contains a halogenated fire retardant (HFR).

Red List free is our development benchmark and we constantly challenge ourselves on elimination of Red List chemicals. An HFR is used on the FSK variant because the product is for exposed applications and must meet stringent fire performance requirements.

We are very aware of the concerns associated with HFRs and continually work with vendors on this issue. At the same time, fire performance is critical and current events relating to fire performance of building materials only support the importance of fire-safe products.

What's been done in the design and manufacture in consideration of the potential human health impacts in the use stage

The primary ingredient in this product is recycled glass. While recycled content may vary from year to year, the recycled content is currently greater than 60% by weight. The second largest content is silica sand which is sourced as locally as possible. The third largest ingredient is corn-based syrup (dextrose or fructose). As a result of using plant-based binders, the VOC profile of this product is very interior friendly.

The emission from our factories is also much better for our communities. We ensure our glass formulations have no serious health concerns by allowing our processes to be audited to meet European Certification Board for Mineral Wool Products (EUCEB) biosolubility requirements.

Where it goes at the end of its life

At this time, the product is landfilled at end of life. We take extended producer responsibility very seriously and have active programs to address end of life. There is no option other than landfills at this time.

Click the label to see the full declaration.

EcoBatt®
Unfaced

Declare.

EcoBatt Unfaced
Knauf Insulation

Final Assembly: Multiple Locations in USA

Life Expectancy: 30 Years

End of Life Options: Salvageable/Reusable in its Entirety, Landfill (100%)

EU GHS Screened: Contains

Ingredients:

Styrene, polyisocyanate, butadiene, hydrolyzed starch, Ammonium Sulfate, **Heavy Oil**, Asphalt Coating, Brown Kraft Paper, Stone

Task List present > 100gpm

Living Building Challenge Criteria: Compliant

115 Red List

■ LBC Red List Free

% Disclosed: 100% at 100gpm

LBC Red List Approved

VOC Content: Not Applicable

Disclosed

130 Interior Performance

CCPI Standard Method v1-2000

114 Responsible Sourcing

Not Applicable

ENF-0003

ENF-01 APR 2024

SCREENED: 09 MAR 2023

Original Issue Date: 2013

INTERNATIONAL LIVING FUTURE INSTITUTE™

livingfuture.org/declares

EcoBatt® Kraft
Faced

Declare.

EcoBatt Kraft Faced
Knauf Insulation

Final Assembly: Multiple Locations in USA

Life Expectancy: 30 Years

End of Life Options: Landfill (100%)

EU GHS Screened: Contains

Ingredients:

Styrene, polyisocyanate, butadiene, hydrolyzed starch, Ammonium Sulfate, **Heavy Oil**, Asphalt Coating, Brown Kraft Paper, Stone

Task List present > 100gpm

Living Building Challenge Criteria: Compliant

115 Red List

■ LBC Red List Free

% Disclosed: 100% at 100gpm

LBC Red List Approved

VOC Content: Not Applicable

Disclosed

130 Interior Performance

CCPI Standard Method v1-2000

114 Responsible Sourcing

Not Applicable

ENF-0003

ENF-01 APR 2024

SCREENED: 09 MAR 2023

Original Issue Date: 2013

INTERNATIONAL LIVING FUTURE INSTITUTE™

livingfuture.org/declares

EcoBatt® Foil
Faced

Declare.

Knauf EcoBatt(R) Foil Faced Batts & Rolls
Knauf Insulation

Final Assembly: Multiple Locations in USA

Life Expectancy: Life of Structure (N/A)

End of Life Options: Salvageable/Reusable in its Entirety, Landfill (100%)

EU GHS Screened: Contains

Ingredients:

Styrene, polyisocyanate, butadiene, hydrolyzed starch, Ammonium Sulfate, **Heavy Oil**, Asphalt Coating, Brown Kraft Paper, Stone, Polyethylene, Rubber Adhesive

Task List present > 100gpm

Living Building Challenge Criteria: Compliant

115 Red List

■ LBC Red List Free

% Disclosed: 100% at 100gpm

LBC Red List Approved

VOC Content: Not Applicable

Disclosed

130 Interior Performance

CCPI Standard Method v1-2000

114 Responsible Sourcing

Not Applicable

ENF-0003

ENF-01 APR 2024

SCREENED: 09 MAR 2023

Original Issue Date: 2017

INTERNATIONAL LIVING FUTURE INSTITUTE™

livingfuture.org/declares

Health Product Declaration®

EcoBatt® (FSK Faced)

Full disclosure known hazards: Yes

Based on the selected content inventory threshold:

☒ Characterized ☒ Screened ☐ Identified

MASS SHARE

Category	Mass Share
102.05%	102.05%
6.51%	6.51%
4%	4%
0.51%	0.51%
0.51%	0.51%

GreenScreen® List Translator Scores

- List Translator Likely Benchmark 1 / Benchmark 1 [?](#)
- List Translator Possible Benchmark 1 [?](#)
- List Translator Benchmark Unknown [?](#)
- Benchmark 2 [?](#)
- Benchmark 3 [?](#)
- Benchmark 4 [?](#)
- No GS data available [?](#)

[Learn about the GreenScreen® List Translator](#)

Total VOC Content²

VOC Content data is not applicable for this product category.

References

Declare

ECOBATT UNFACED

ECOBATT KRAFT FACED

KNAUF ECOBATT(R) FOIL FACED BATTS & ROLLS

Manufacturer's Guide to Declare

A comprehensive guide providing information about the program, the assessment methodology, how to submit material data to obtain a Declare label and how they are used to meet the Health & Happiness and Materials Petals of the Living Building Challenge.

Health Product Declaration®

EcoBatt (FSK Faced)

Health Product Declaration Open Standard v2.2

The standard provides guidance to accurately disclose the material contents of a building product using a standard, consistent, and transparent format.

How we're making it healthier

Knauf engages very closely with its vendors to eliminate and avoid chemicals of concern. No competitor has as many Red List free products as Knauf Insulation. We continually reduce our environmental impacts through recycled content and optimize our products by designing them to be transformative.

[See how we make it greener](#)

Rating systems

LEED BD+C: New Construction | v4 - LEED v4

Building product disclosure and optimization

Material Ingredients

Credit value options 1 product each

☒ 1. Reporting ☐ 2. Optimization ☐ 3. Supply Chain Optimization

LEED BD+C: New Construction | v4.1 - LEED v4.1

Materials and resources

Material Ingredients

Credit value options 1 product each

☒ 1. Reporting ☐ 2. Optimization ☐ 3. Supply Chain Optimization

Living Building Challenge

Materials petals imperatives

☒ 10. Red List Free ☐ 12. Responsible Industry ☐ 13. Living Economy Sourcing

WELL Building Standard®

Air and Mind Features

☒ X07 Materials Transparency

☐ X08 Materials Optimization

Collaborative for High Performance Schools National Criteria

EQ C7.1 Material Health Disclosures

☒ Performance Approach 2 points

☒ Prescriptive Approach 2 points

SM Transparency Report (EPD)™

How we make it greener

EcoBatt® and EcoRoll® Insulation

[Expand all](#)

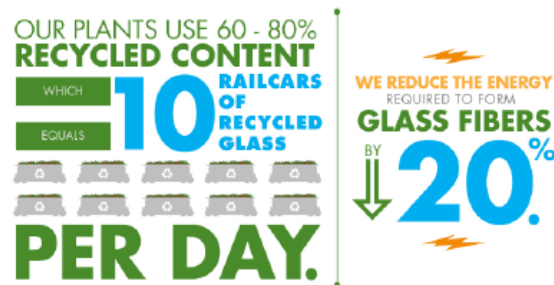
RAW MATERIALS ACQUISITION



Utilize recycled content

By leveraging recycled content, we reduce the energy required to form glass fibers.

- We use about 10 railcars of recycled glass per day.



MANUFACTURING

Lead green chemistry efforts

Following the launch of our ECOSE® Technology in 2008, we had transformed most of our products and processes to this new technology. Using our bio-based ECOSE® Technology has removed phenol and formaldehyde from our stack emissions. This initiative not only established Knauf Insulation North America in a leadership position, but it had a transformative impact on our industry in general.



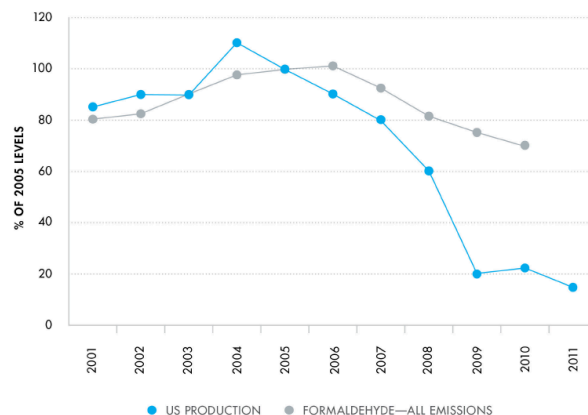
Reduce scrap generation and energy consumption

Continuous improvement is the methodology we utilize to engage the entire Knauf team in our manufacturing excellence and sustainability journey.

Knauf Insulation, comprised of Knauf Insulation North America (KINA) and Knauf Insulation Europe, Middle East, Asia, Asia Pacific (KI EMEA & APAC), share an overall global certification for ISO 45001 Health & Safety, ISO 14001 Environmental, ISO 50001 Energy, and ISO 9001 Quality through a third-party Certification Body.

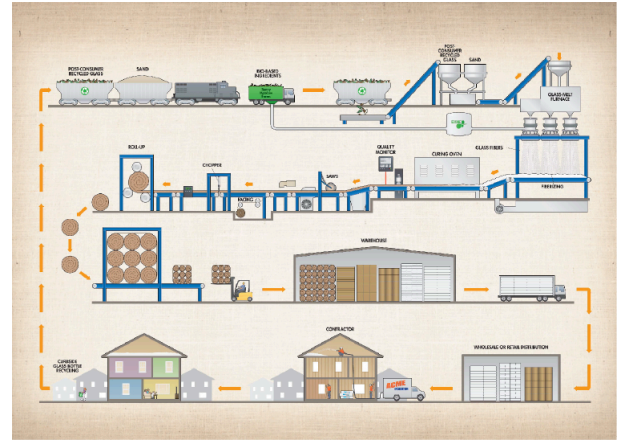
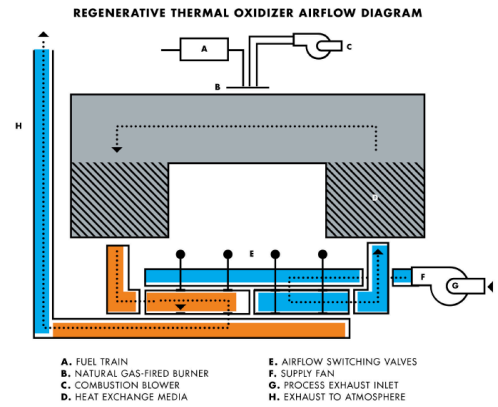
Our Continuous Improvement Program, with all its tools and systems associated with it, provide a formal process where we are constantly monitoring our manufacturing and sustainability Key Performance Indicators (KPIs) with an eye towards improvement. This Continuous Improvement centric management system has proven to be effective in improving our sustainability by reducing scrap generation and energy consumption.

GLASS-BASED INSULATION INDUSTRY FORMALDEHYDE REDUCTION



Green manufacturing Processes

Regenerative thermal oxidizers We use regenerative thermal oxidizers (RTO) to capture and recycle much of the energy we use to cure our products. RTO is equipment used for the treatment of exhaust air. Our ovens exhaust into a ceramic heat exchange media to capture and reuse the heat in the exhausted air. Therefore, the amount of energy required to cure our product is reduced substantially.



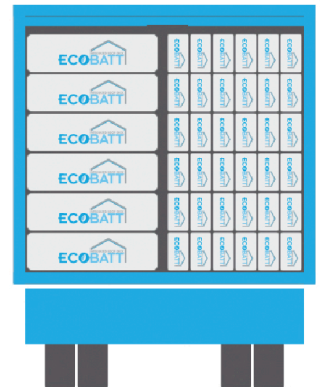
TRANSPORTATION



Leverage compression packaging

Glass is a high modulus material, which helps to facilitate compression packaging. We compress our insulation to fit up to five times more product on every truck, thereby reducing the amount of deliveries that need to be made, which saves time and emissions from transportation.

WE COMPRESS OUR
INSULATION
TO FIT UP TO
5X
MORE PRODUCT
ON EVERY TRUCK.



INSTALLATION AND MAINTENANCE



Be confident in glass fiber's safety

In the past, a label regarding the carcinogenic potential of insulation made from glass fibers was required on all packaging. Following forty years of research, fiberglass has been exonerated entirely. Our fiberglass is comprised of fibers that are biosoluble, meaning that the fibers dissolve in the body in a short period of time and exit the body with normal bodily functions. The scrutiny fiberglass has undergone is now seen as proof of its safety.

Meet and exceed green standards

GREENGUARD certified On the forefront of indoor air quality, Knauf Insulation North America had the first GREENGUARD certified product in 2002. This achievement led us to understand the impact our formaldehyde-free products could have on the indoor

environment. The formaldehyde-free claim is third party validated by UL Environment.

3rd Party UL Environmental Claim Validation states that Knauf Insulation products manufactured in North America contain an average of 61% recycled content, consisting of 20% post-consumer and 41% pre-consumer recycled glass.

EUCEB tested Glass fiber is a widely studied building material. All of our processes and formulations are voluntarily third-party audited for compliance with the health and safety exoneration criteria for glass and rock based fiber through the European Certification Board for Mineral Wool Products (EUCEB) exoneration process. This guarantees the formulations are

biosoluble and pose no health concerns. Having over 35 years of research behind its safety, fiberglass products have been thoroughly evaluated and therefore we believe it is one of the safest building materials available today.



Green building rating systems

Our products offer a vast array of potential credits for major green building rating systems, including: WELL, LEED v4, International Green Construction Code, Green Guide for Health Care, NAHB Green Building Standard, and more.

Visit the [green building rating systems page](#) to see all the credits you can earn using Manson and Knauf Insulation products

Green building rating system credits

Find out all the credits you can earn with Knauf products.

[Learn more](#)

DISPOSAL



Promote Recycling

By taking a comprehensive approach of the benefits of recycling, Knauf Insulation North America advocates and promotes local recycling initiatives as well as actively participates in state and local government policy development. In addition, as a member of the North American Insulation Manufacturers Association (NAIMA) and Glass Recycling Coalition (GRC), we encourage regulatory and legislative initiatives that focus on glass recycling infrastructure deployment to increase the availability of post-consumer recycled glass.





SM Transparency Report (EPD)[™] + Material Health Overview[™]

EPD LCA

3rd-party verified ✓

Transparency Report (EPD)

3rd-party verified ✓

Validity: 12/12/23 – 12/12/28
KNA – 12122023 – 001

MATERIAL HEALTH Material evaluation

Self-declared ✓

This environmental product declaration (EPD) was externally verified by Harmony Environmental, LLC, according to ISO 21930:2017; UL Part A; UL Part B for Building Envelope Thermal Insulation Products; and ISO 14025:2006.

Harmony Environmental, LLC
16362 W. Briarwood Ct.
Olathe, KS 66062
www.harmonyenviro.com

(913) 780-3328



SUMMARY

Reference PCR

UL Part B: Building Envelope Thermal Insulation v2.0

Regions; system boundaries

North America; Cradle-to-grave

Functional unit / ESL:

1 m² installed insulation material, packaging included, with thickness that gives average thermal resistance of R_{eq} = 1 m²·K/W over an estimated service life (ESL) of 75 years

LCIA methodology: TRACI 2.1

LCA software; LCI database

LCA for Experts v10.7; LCA for Experts 2023

In accordance with ISO 14044 and the reference PCR, this life cycle assessment was conducted by Sustainable Minds and verified by Harmony Environmental, LLC.

Public LCA:

Knauf Insulation North America and Manson Insulation Products

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