



## SANCTUARY® by Greenfiber® Blow-In or Spray-Applied Insulation

SANCTUARY cellulose insulation can be easily installed in attics, walls, floors, and ceilings to significantly improve the comfort, safety and well-being of any home. The first all-in-one fiber insulation that can be blown-in, spray-applied or dense-packed, and it's suitable for all climates and conditions. Capable of reducing sound power by 60% and heating and cooling costs by up to 25%, it's made from recycled plant fibers which locks in carbon for the life of the home.



### Performance dashboard

#### Features & functionality

Fills tiny joints, crevices or gaps, creating a dense barrier capable of muffling sound and reducing air infiltration.

Extremely versatile and easy to use.

Exceptional acoustical properties can abate the power of sound by **up to 60%** when installed in walls.

Capable of reducing heating and cooling costs by **up to 25%**.

Carries a **Class 1/A** fire rating and qualifies as a fire-blocking material for advanced fire resistance.

Locks in carbon for the life of the home to reduce global warming.

#### Environment & materials

##### Improved by:

Made with 85% post-consumer recycled paper

Uses low-energy manufacturing and short-haul transportation, resulting in insulation with lower embodied carbon

Free from unhealthy substances such as asbestos and formaldehyde

Lower carbon insulation material with high amount of carbon storage reduces global warming potential

##### Certifications & rating systems:

ASTM C739

Declare label, Red List Free

Canadian Construction Materials Centre

Energy Star

UL Classified

Health Product Declaration (HPD)

#### Visit Greenfiber for more product information

[Sanctuary® Blow-In or Spray-Applied Insulation](#)

MasterFormat® 07 20 00

[SANCTUARY Fact Sheet, Guide Specs](#)

For spec help, [contact us](#) or call 800.228.0024

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



## SM Transparency Report (EPD)™

#### VERIFICATION

3rd-party reviewed



Transparency Report (EPD)

3rd-party verified



Validity: 2022/12/09 – 2027/12/08

Decl #: AGG – 20221209 – 001

#### LCA

This environmental product declaration (EPD) was externally verified, according to ISO 21930:2017, UL Part A, and ISO 14025:2006, by Jack Geibig, President, Ecoform.

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#### SUMMARY

##### Reference PCR

ULE PCR Part B: Building Envelope Thermal Insulation EPD Requirements v2.0, 2018

##### Regions; system boundaries

North America; Cradle-to-grave

##### Functional unit / reference service life:

1 m<sup>2</sup> of installed insulation material, packaging included, with a thickness that gives an average thermal resistance of RSI=1m<sup>2</sup>·K/W; 75 years

##### LCIA methodology: TRACI 2.1

##### LCA software; LCI database

SimaPro Developer 9.4  
Ecolnvent 3.8, US-EI 2.2

##### LCA conducted by: Sustainable Minds

##### Public LCA:

Life Cycle Assessment of SANCTUARY Insulation for Applegate-Greenfiber

#### Greenfiber

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Contact us

## LCA results & interpretation

### SANCTUARY® Loose-Fill or Spray-Applied Insulation by Greenfiber®

#### Life cycle assessment

#### Scope and summary

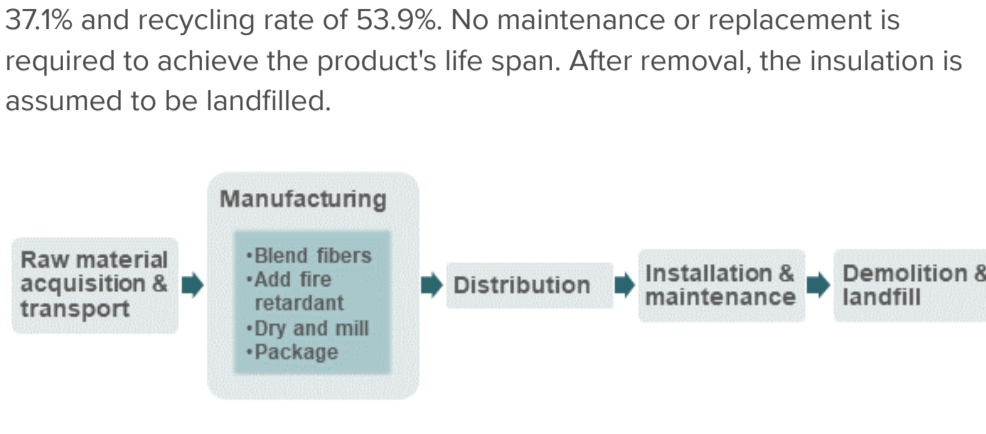
Cradle to gate  Cradle to gate with options  Cradle to grave

**Application**  
SANCTUARY is insulation primarily made of postconsumer paper and can be either blown-in or spray-applied in attics, walls, floors, and ceilings. This fiber insulation is suitable for all climates and conditions. SANCTUARY is engineered to fill tiny crevices and gaps, creating a dense, advanced barrier capable of reducing the power of sound and also heating and cooling costs. It can be easily filled over existing insulation and is designed to fill every gap, void, and hard-to-reach place without time consuming cutting and fitting.

**Functional unit**  
Reference service life: 75 years. One square meter of installed insulation material, packaging included, with a thickness that gives an average thermal resistance of RSI=1m<sup>2</sup>/K/W and a period of 75 years.  
Reference flow: 0.653 kg  
HOW: 0.0378 m  
Density: 17.1 kg/m<sup>3</sup>

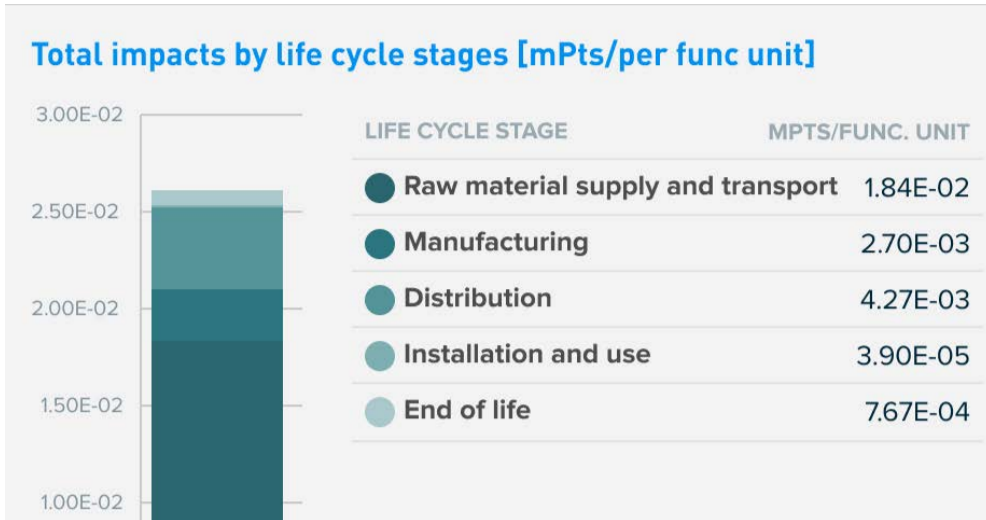
**Manufacturing data**  
Reporting period: January–December, 2021  
Representing six locations across the US, Mesa, AZ; Norfolk, NE; Salt Lake City, UT; Tampa, FL; Waco, TX; and Wilkes-Barre, PA. After raw materials are transported to the facilities, incoming waste paper is shredded and placed into a fiber handling system, which is then moved to the finish mills, where the final grind is conducted and the dry fire-retardant chemicals and then a liquid fire retardant are added. That product is moved to the packaging subsystem, which hydraulically compresses the insulation into its final packaging. Each facility has a dust collection system which traps the dust from the wastepaper processing and is later sent for recycling along with production scrap.

**Default installation, packaging, and disposal scenarios**  
At the installation site, insulation products are delivered in 25lb bags, unpackaged, and installed with a blowing machine, assumed to consume 0.003 kWh of electricity during the installation of one square meter. The disposal of packaging waste is modeled using US EPA's landfilling rate of 37.1% and recycling rate of 53.9%. No maintenance or replacement is required to achieve the product's life span. After removal, the insulation is assumed to be landfilled.



**Data quality**  
Primary data was collected for a time period of one year, which represents typical operations of Applegate-Greenfiber facilities. Inventory data is considered to have a good precision and provide a representative depiction of the facilities. Data is also considered to be complete, as no know flows are deliberately excluded from this analysis other than those defined to be outside of the system boundary.

FLOW	MASS PERCENTAGE
Wastepaper	83-85%
Boric acid	9%
Calcium sulfate	2-3%
Oil	2%
Starch	1%
Plastic bag (packaging)	1%



#### LCA results

LIFE CYCLE STAGE	RAW MATERIAL SUPPLY AND TRANSPORT	MANUFACTURING	DISTRIBUTION	INSTALLATION	USE	END OF LIFE
Information modules: Included (X) Excluded* (MND)	A1 Raw material extraction A2 Transport to facilities	A3 Manufacturing operations	A4 Transport to building sites	A5 Installation	B1 Use B2 Maintenance B3 Repair B4 Replacements B5 Refurbishment B6 Operational energy use B7 Operational water use	C1 Deconstruction C2 Waste transport C3 Waste processing C4 Disposal

Impacts per functional unit: weighted average of all plants	1.84E-02 mPts	2.70E-03 mPts	4.27E-03 mPts	3.90E-05 mPts	0 mPts	7.67E-04 mPts
Materials or processes contributing >20% to total impacts in each life cycle stage	Extraction of raw materials, especially boric acid and oil.	Electricity required to operate the manufacturing process.	Truck transportation for distribution of the product.	Electricity consumed by the blower during insulation.	No activities contributing to impacts in the use stage.	Truck transportation to the disposal site, and final waste landfill.

#### Mesa, AZ - TRACI v2.1 results per functional unit

LIFE CYCLE STAGE	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Ecological damage						

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Acidification	kg SO <sub>2</sub> eq	1.27E-03	3.24E-04	9.28E-05	1.93E-06	0	3.55E-05
Eutrophication	kg N eq	1.44E-04	2.72E-05	1.93E-05	4.48E-07	0	5.70E-06
Global warming (embodied carbon)	kg CO <sub>2</sub> eq	2.04E-01	8.33E-02	5.34E-02	7.53E-04	0	1.33E-02
Ozone depletion	kg CFC-11 eq	3.34E-08	2.29E-09	1.27E-08	8.70E-11	0	3.03E-09

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Carcinogenics	CTU <sub>h</sub>	2.76E-09	1.62E-10	4.90E-11	2.66E-12	0	1.03E-11
Non-carcinogenics	CTU <sub>h</sub>	4.93E-08	2.73E-09	7.49E-09	5.15E-11	0	1.37E-09
Respiratory effects	kg PM <sub>2.5</sub> eq	1.99E-04	1.96E-05	1.87E-05	1.20E-06	0	5.54E-06
Smog	kg O <sub>3</sub> eq	1.25E-02	2.80E-03	1.19E-03	2.40E-05	0	7.20E-04

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Fossil fuel depletion	MJ, LHV	4.97E-01	1.12E-01	1.13E-01	1.03E-03	0	2.79E-02
Ecotoxicity	CTU <sub>e</sub>	73.7 %	1.0 %	21.4 %	0.1 %	0 %	3.8 %

See the additional content required by the ULE PCR Part B for building envelope thermal insulation on page 4 of the [Transparency Report PDF](#).

#### Norfolk, NE - TRACI v2.1 results per functional unit

LIFE CYCLE STAGE	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Ecological damage						

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Acidification	kg SO <sub>2</sub> eq	1.28E-03	5.13E-04	1.18E-04	1.91E-06	0	3.52E-05
Eutrophication	kg N eq	1.41E-04	4.85E-05	2.46E-05	4.43E-07	0	5.65E-06
Global warming (embodied carbon)	kg CO <sub>2</sub> eq	1.90E-01	1.06E-01	6.80E-02	7.46E-04	0	1.31E-02
Ozone depletion	kg CFC-11 eq	2.96E-08	3.16E-09	1.62E-08	8.62E-11	0	3.00E-09

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Carcinogenics	CTU <sub>h</sub>	2.75E-09	2.61E-10	6.24E-11	2.64E-12	0	1.02E-11
Non-carcinogenics	CTU <sub>h</sub>	4.76E-08	4.29E-09	9.55E-09	5.10E-11	0	1.36E-09
Respiratory effects	kg PM <sub>2.5</sub> eq	1.98E-04	2.94E-05	2.38E-05	1.19E-06	0	5.48E-06
Smog	kg O <sub>3</sub> eq	1.35E-02	4.35E-03	1.52E-03	2.38E-05	0	7.13E-04

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Fossil fuel depletion	MJ, LHV	4.65E-01	8.96E-02	1.44E-01	1.02E-03	0	2.77E-02
Ecotoxicity	CTU <sub>e</sub>	67.8 %	1.5 %	26.9 %	0.1 %	0 %	3.7 %

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#### Salt Lake City, UT - TRACI v2.1 results per functional unit

LIFE CYCLE STAGE	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Ecological damage						

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Acidification	kg SO <sub>2</sub> eq	1.15E-03	2.05E-04	1.77E-04	1.91E-06	0	3.52E-05
Eutrophication	kg N eq	1.16E-04	1.72E-05	3.70E-05	4.43E-07	0	5.65E-06
Global warming (embodied carbon)	kg CO <sub>2</sub> eq	1.23E-01	5.28E-02	1.02E-01	7.46E-04	0	1.31E-02
Ozone depletion	kg CFC-11 eq	1.41E-08	1.46E-09	2.43E-08	8.62E-11	0	3.00E-09

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Carcinogenics	CTU <sub>h</sub>	2.70E-09	1.05E-10	9.37E-11	2.64E-12	0	1.02E-11
Non-carcinogenics	CTU <sub>h</sub>	4.28E-08	1.74E-09	1.43E-08	5.10E-11	0	1.36E-09
Respiratory effects	kg PM <sub>2.5</sub> eq	1.82E-04	1.26E-05	3.58E-05	1.19E-06	0	5.48E-06
Smog	kg O <sub>3</sub> eq	1.14E-02	1.79E-03	2.28E-03	2.38E-05	0	7.13E-04

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Fossil fuel depletion	MJ, LHV	3.26E-01	7.32E-02	2.16E-01	1.02E-03	0	2.77E-02
Ecotoxicity	CTU <sub>e</sub>	55.4 %	0.6 %	40.2 %	0.1 %	0 %	3.7 %

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#### Tampa, FL - TRACI v2.1 results per functional unit

LIFE CYCLE STAGE	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Ecological damage						

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Acidification	kg SO <sub>2</sub> eq	1.16E-03	2.32E-04	1.21E-04	1.93E-06	0	3.55E-05
Eutrophication	kg N eq	1.20E-04	2.75E-05	2.52E-05	4.48E-07	0	5.70E-06
Global warming (embodied carbon)	kg CO <sub>2</sub> eq	1.37E-01	1.16E-01	6.97E-02	7.53E-04	0	1.33E-02
Ozone depletion	kg CFC-11 eq	1.77E-08	2.36E-09	1.66E-08	8.70E-11	0	3.03E-09

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Carcinogenics	CTU <sub>h</sub>	2.72E-09	1.07E-10	6.39E-11	2.66E-12	0	1.03E-11
Non-carcinogenics	CTU <sub>h</sub>	4.51E-08	2.07E-09	9.78E-09	5.15E-11	0	1.37E-09
Respiratory effects	kg PM <sub>2.5</sub> eq	1.86E-04	1.52E-05	2.44E-05	1.20E-06	0	5.54E-06
Smog	kg O <sub>3</sub> eq	1.13E-02	2.43E-03	1.55E-03	2.40E-05	0	7.20E-04

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Fossil fuel depletion	MJ, LHV	3.58E-01	2.45E-01	1.48E-01	1.03E-03	0	2.79E-02
Ecotoxicity	CTU <sub>e</sub>	65.9 %	0.9 %	29.2 %	0.1 %	0 %	4.0 %

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#### Waco, TX - TRACI v2.1 results per functional unit

LIFE CYCLE STAGE	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Ecological damage						

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Acidification	kg SO <sub>2</sub> eq	1.16E-03	2.94E-04	7.81E-05	1.91E-06	0	3.52E-05
Eutrophication	kg N eq	1.16E-04	2.47E-05	1.63E-05	4.43E-07	0	5.65E-06
Global warming (embodied carbon)	kg CO <sub>2</sub> eq	1.23E-01	8.43E-02	4.49E-02	7.46E-04	0	1.31E-02
Ozone depletion	kg CFC-11 eq	1.40E-08	3.59E-09	1.07E-08	8.62E-11	0	3.00E-09

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Carcinogenics	CTU <sub>h</sub>	2.76E-09	1.52E-10	4.12E-11	2.64E-12	0	1.02E-11
Non-carcinogenics	CTU <sub>h</sub>	4.45E-08	2.63E-09	6.31E-09	5.10E-11	0	1.36E-09
Respiratory effects	kg PM <sub>2.5</sub> eq	1.86E-04	1.83E-05	1.57E-05	1.19E-06	0	5.48E-06
Smog	kg O <sub>3</sub> eq	1.12E-02	2.65E-03	1.00E-03	2.38E-05	0	7.13E-04

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Fossil fuel depletion	MJ, LHV	3.26E-01	1.27E-01	9.52E-02	1.02E-03	0	2.77E-02
Ecotoxicity	CTU <sub>e</sub>	71.3 %	1.3 %	22.5 %	0.1 %	0 %	4.7 %

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#### Wilkes-Barre, PA - TRACI v2.1 results per functional unit

LIFE CYCLE STAGE	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Ecological damage						

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Acidification	kg SO <sub>2</sub> eq	1.21E-03	2.24E-04	1.07E-04	1.91E-06	0	3.52E-05
Eutrophication	kg N eq	1.27E-04	1.88E-05	2.23E-05	4.43E-07	0	5.65E-06
Global warming (embodied carbon)	kg CO <sub>2</sub> eq	1.53E-01	5.13E-02	6.17E-02	7.46E-04	0	1.31E-02
Ozone depletion	kg CFC-11 eq	2.20E-08	2.78E-09	1.47E-08	8.62E-11	0	3.00E-09

Impact category	Unit	A1-A2 RM SUPPLY & TRANSPORT	A3 MANUFACTURING	A4 DISTRIBUTION	A5 INSTALLATION	B1-B7 USE	C1-C4 END OF LIFE
Carcinogenics	CTU <sub>h</sub>	2.65E-09	1.19E-10	5.66E-11	2.64E-		

## How we make it greener

## SANCTUARY® Loose-Fill or Spray-Applied Insulation by Greenfiber®

[Collapse all](#)

[See LCA results by life cycle stage](#)

### RAW MATERIAL ACQUISITION

#### 85% Recycled Content

SANCTUARY® Cellulose Insulation is made from up to 85% recycled paper, and cardboard—higher recycled content than almost any other commonly used building material. This plant-based, or biogenic, material locks more carbon into the paper (and out of the air) than what was emitted in harvesting and manufacturing. This opens up a new category of building materials with carbon removal and storage potential. When added to homes, cellulose insulation traps that carbon for the life of the home, effectively lowering the carbon footprint of homes.



### TRANSPORTATION

#### Regional Transportation

The Applegate-Greenfiber® supply chain is sustainably focused, as we have a plant in each region of the country to keep the delivery of raw materials and shipping of finished product to within a 500 mile radius of each plant, lowering resulting fuel emissions.

Our SANCTUARY® Insulation is also compressively packaged to 6x, or more, nominal settled density for maximum transportation efficiency. This compressive packaging allows for fewer deliveries and more cellulose insulation on the transportation vehicle.



### MANUFACTURING

#### Low-Energy Manufacturing

Our electric powered plants use low-energy manufacturing processes that generate zero waste, other than dust, which is confined within the production system and filtered out of the air that gets discharged into the atmosphere. We even recycle that dust, and the paper scrap from production, back into the product. Fire retardants used in our insulation are considered to be of low or no toxicity. Improvements in fire retardant processing and infusion technology have resulted in historically low fire retardant content with no loss of fire safety.

Applegate-Greenfiber's process diverts about 277,000 TONS of paper from landfills each year, equivalent to 157,000 ACRES of forest.



### USE AND END OF LIFE

#### Protecting People and the Environment

With SANCTUARY® Insulation, the same attributes that contribute to the low global warming potential make it a great choice for homeowners who desire more sustainable, healthy homes. If you're torn between cellulose and other insulation alternatives, consider this breakdown of greenhouse gas impact, recycled content and toxic emissions. Non-irritating cellulose insulation requires no special protective clothing during installation. Our insulation products has been tested for VOC emission and have been found to be low VOC sources.

Most construction projects have large dumpsters on site full of construction waste and debris from building products that end up in the waste stream and require shipping to landfills, further impacting the environment. Our insulation is fully recovered and reused on-site when installed, leaving virtually no excess material to return to the waste stream. Special machines used in the blown-in process allow excess or over sprayed material to be vacuumed up and be blown back in on site or salvaged for a future installation.

#### Low Carbon Footprint Homes

Research on the use of wood-intensive construction and cellulose insulation products in homes shows it is possible to lower the carbon footprint of houses, so they become "carbon sinks" capable of locking in carbon for the life of the dwelling. The carbon rich wood and cellulose wood fiber stays in the home for years effectively trapping the carbon from escaping into the environment.



## SM Transparency Report (EPD)™

#### VERIFICATION

LCA

3rd-party reviewed



Transparency Report (EPD)

3rd-party verified



Validity: 2022/12/09 – 2027/12/08  
Decl #: AGG – 20221209 – 001

This environmental product declaration (EPD) was externally verified, according to ISO 21930:2017, UL Part A, and ISO 14025:2006, by Jack Geibig, President, Ecoform.

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#### SUMMARY

**Reference PCR**  
ULE PCR Part B: Building Envelope Thermal Insulation EPD Requirements v2.0, 2018

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North America; Cradle-to-grave

**Functional unit / reference service life:**  
1 m<sup>2</sup> of installed insulation material, packaging included, with a thickness that gives an average thermal resistance of RSI=1m<sup>2</sup>:K/W; 75 years

**LCIA methodology:** TRACI 2.1

**LCA software; LCI database**  
SimaPro Developer 9.4  
EcoInvent 3.8, US-EI 2.2

**LCA conducted by:** Sustainable Minds

**Public LCA:**  
Life Cycle Assessment of SANCTUARY Insulation for Applegate-Greenfiber

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Contact us

**Additional EPD content required by: ULE PCR Part B: Building Envelope Thermal Insulation EPD Requirements** SANCTUARY Insulation

**Data** Scenarios and additional technical information

**Background** This product-specific declaration was created by collecting production data from six Applegate-Greenfiber facilities. Secondary data sources include the following:

**Allocation** The allocation methods used were examined according to the updated allocation rules in ISO 21930:2017. All facilities provided annual data for the studied product. Manufacturing inputs were allocated by mass using the amount of SANCTUARY produced compared to total production for CV2021. Based on the annual production mass, the inventory (material and resources inputs and outputs) was developed for each facility for the production of a 25lb bag of SANCTUARY Insulation, which was later scaled to meet the functional unit. No further allocation was performed.

**Cut-off criteria** for the inclusion of mass and energy flows are 1% of renewable primary resource (energy) usage. 1% non-renewable 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 will 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 good. All relevant process steps for the product system were considered and modeled. The process allocation 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 equipment was excluded as required by the PCR. Otherwise, no data were knowingly omitted. For more information on data quality, see the CA background report.

PARAMETER	VALUE UNIT
<b>Transport to the building site [A4]</b>	
Vehicle type	Lorry, 16-32 ton
Fuel type	Diesel
Liters of fuel	42 / 1700 km
Distance from manufacturer to installation site	558 km (Mass, AZ)
	71 km (Raleigh, NC)
	1069 km (Salt Lake City, UT)
	729 km (Tempe, FL)
	640 km (Waco, TX)
Capacity utilization (mass based)	76 %
Capacity utilization (volume based)	>1
Gross density of products transported	144 kg/m <sup>3</sup> (compressed in bag)
<b>Installation into the building [A5]</b>	
Installation scrap assumed	1 %
Electricity consumption	0.00649 kWh
Product loss per functional unit (scrap)	0.00649 kg
Waste materials at the construction site before waste processing (product scrap and packaging waste)	0.0109 kg
Output materials from on-site waste processing	
Landfill	0.004 kg
Recycling	0.006 kg
Biogenic carbon contained in packaging	0 kg CO <sub>2</sub>
VOC emissions	0 µg/m <sup>3</sup>
The final evaluation report addressing all standards required for the testing, evaluation, and approval of the declared product and its application in building assemblies for building code and other regulation compliance is available at: <a href="https://www.greenfiber.com/uploads/documents/UL-Evaluation-Report.pdf">https://www.greenfiber.com/uploads/documents/UL-Evaluation-Report.pdf</a>	
<b>Reference service life</b>	
Reference Service Life (RSL)	75 years
Declared product properties	Relevant to 'Relevant technical properties'
Design application parameters, indoor environment	Installation as recommended by the manufacturer, either blown-in or spray-applied in attics, walls, floors, and ceilings
Maintenance process information	Not expected to require maintenance, repair, replacement, or refurbishment. Expected to be undisturbed during use, unless associated operational energy or water use
<b>End of life [C1-C4]</b>	
Assumptions for scenario development	Manual deconstruction, sent to landfill by truck
Collection process	Collected separately
Waste materials at the construction site before waste processing (product scrap and packaging waste)	0 kg
Waste materials at the construction site before waste processing (waste with mixed construction)	0.648 kg
Recovery	
Reuse	0 kg
Recycling	0 kg
Landfill	100 kg
Waste transport	0 km
Final disposal (landfill)	0.648 kg
Removals of biogenic carbon (excluding packaging)	0 kg CO <sub>2</sub>

**Major system boundary exclusions:**

- Construction & infrastructure: maintenance and operation of support equipment.
- Manufacturer's 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:**

- Generic data sets used for material inputs, transport, and waste processing are considered good quality, but actual impacts from material suppliers, possible emissions, 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.

**Relevant technical properties**

License-III applications are in accordance with ASTM C739, and stabilized applications are for professionally certified specialized equipment in accordance with ASTM C1497. Installation must comply with ASTM C1015, as applicable, and Applegate-Greenfiber installation instructions for each application. Compliance with model building codes does not always ensure compliance with state or local building codes, which may be amended versions of these model codes. Always check with local building code officials to confirm compliance. The thermal resistance (R-value) is determined by ASTM C518.

**Scaling factors**

The scaling factors below are based on the mass and thickness of SANCTUARY and can be used to determine the impacts for each R-value. Multiply the results per functional unit by the corresponding scaling factor for the R-value of interest in order to get results for your specific application.

Application	Loose-filled and stabilized application										Dense pack application				Spray-applied application						
Scaling factor	11	13	16	19	22	26	30	32	38	40	44	48	49	50	60	13	21	28	13	21	
R-value	2.40	2.85	4.25	4.96	6.04	7.27	7.91	9.91	10.6	12.0	13.4	13.7	14.0	17.4	7.89	12.1	16.5	5.95	9.34		

**Mesa, AZ: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit**

Parameter	Unit	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
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**LCIA results (per m<sup>2</sup> installed including packaging, that gives an average thermal resistance of RSI=1m<sup>2</sup>/K/W)**

Ozone depletion	kg CFC-11 eq	6.01E-09	2.73E-08	2.29E-09	1.27E-08	8.70E-11	0	0	2.75E-09	0	2.74E-10	5.15E-08
Global warming	kg CO <sub>2</sub> eq	8.82E-02	1.16E-01	8.20E-02	5.34E-02	7.45E-04	0	0	1.17E-02	0	1.61E-03	3.55E-01
Smog	kg SO <sub>2</sub> eq	1.02E-02	3.36E-03	4.35E-03	1.92E-03	2.40E-05	0	0	2.53E-04	0	4.68E-04	1.73E-02
Acidification	kg SO <sub>2</sub> eq	1.07E-03	1.94E-04	3.24E-04	9.28E-05	1.93E-06	0	0	2.00E-05	0	1.55E-05	1.72E-03
Eutrophication	kg N eq	1.02E-04	4.12E-05	2.72E-05	1.93E-05	4.48E-07	0	0	4.98E-06	0	1.52E-06	1.96E-04
Cardiogenics	CTUh	2.67E-09	9.13E-11	2.72E-10	4.90E-11	2.65E-12	0	0	9.85E-12	0	4.71E-13	2.99E-09
Non-cardiogenics	CTUh	3.82E-08	1.18E-08	1.62E-09	7.49E-09	5.15E-11	0	0	1.35E-09	0	1.86E-11	6.09E-08
Respiratory effects	kg PM <sub>2.5</sub> eq	1.69E-04	3.05E-05	1.96E-05	1.87E-05	1.20E-06	0	0	3.52E-06	0	2.01E-06	2.44E-04
Ecotoxicity	CTUe	43.4%	30.4%	1.0%	21.4%	-1%	0%	0%	3.8%	0%	-1%	100%
Fossil fuel depletion	MJ surplus	2.54E-01	2.43E-01	1.12E-01	1.13E-01	1.03E-03	0	0	2.45E-02	0	3.48E-03	7.51E-01

**Resource use indicators**

Renewable primary energy used as energy carrier (fuel)	MJ LHV	5.18E-02	1.55E-03	2.33E-01	7.20E-04	6.73E-04	0	0	1.55E-04	0	3.50E-05	2.88E-01
Renewable primary resources with energy content used as material	MJ LHV	2.00E-01	5.65E-04	2.56E-02	0	2.05E-04	0	0	0	0	0	2.27E-01
Total use of renewable primary resources with energy content	MJ LHV	2.52E-01	2.1E-03	2.58E-01	7.20E-04	8.78E-04	0	0	1.55E-04	0	3.50E-05	5.14E-01

Non-renewable primary resources with energy content used as material	MJ LHV	1.98E+00	1.62E+00	1.26E+00	7.55E-01	1.22E-02	0	0	1.62E-01	0	2.23E-02	1.81E+00
Non-renewable primary resources with energy content used as material	MJ LHV	1.75E-04	4.85E-06	2.37E-06	0	2.40E-08	0	0	0	0	0	1.82E-04
Total use of non-renewable primary resources with energy content	MJ LHV	1.98E+00	1.62E+00	1.26E+00	7.55E-01	1.22E-02	0	0	1.62E-01	0	2.23E-02	5.81E+00

Secondary materials	kg	0	0	0	0	0	0	0	0	0	0	5.67E-01
Renewable secondary fuels	MJ LHV	0	0	0	0	0	0	0	0	0	0	0
Non-renewable secondary fuels	MJ LHV	0	0	0	0	0	0	0	0	0	0	0
Recovered energy	MJ LHV	0	0	0	0	0	0	0	0	0	0	0
Use of net fresh water resources	m <sup>3</sup>	1.79E-01	8.05E-03	4.84E-03	3.74E-03	2.98E-03	0	0	8.04E-04	0	3.92E-06	1.99E-01

**Output flows and waste category indicators**

Hazardous waste disposed	kg	0	0	0	0	0	0	0	0	0	0	0
Non-hazardous waste disposed	kg	0	0	1.86E-03	0	8.50E-03	0	0	0	0	0	1.04E-02
High-level radioactive waste, conditioned, to final repository	kg	2.18E-05	5.59E-07	3.06E-06	2.60E-07	8.10E-07	0	0	5.58E-08	0	2.39E-09	2.65E-05
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	5.09E-08	2.40E-07	3.00E-08	1.12E-07	1.17E-09	0	0	2.40E-08	0	2.52E-11	4.58E-07
Components for re-use	kg	0	0	0	0	0	0	0	0	0	0	0
Materials for recycling	kg	0	0	1.78E-02	0	6.47E-03	0	0	0	0	0	2.43E-02
Materials for energy recovery	kg	0	0	0	0	0	0	0	0	0	0	0
Exported energy	MJ LHV	0	0	0	0	0	0	0	0	0	0	0

**Carbon emissions and removals**

Biogenic carbon removal from product	kg CO <sub>2</sub>	1.04E+00	0	5.76E-02	0	0	0	0	0	0	0	1.10E+00
Biogenic carbon emission from product	kg CO <sub>2</sub>	0	0	2.06E-02	0	3.69E-03	0	0	0	0	9.98E-01	1.02E+00
Biogenic carbon removal from packaging	kg CO <sub>2</sub>	2.54E-04	0	0	0	0	0	0	0	0	0	2.54E-04
Biogenic carbon emission from packaging	kg CO <sub>2</sub>	0	0	0	0	0	0	0	0	0	0	0
Biogenic carbon emission from combustion of waste from renewable sources used in production processes	kg CO <sub>2</sub>	0	0	0	0	0	0	0	0	0	0	0
Calcination carbon emissions	kg CO <sub>2</sub>	0	0	0	0	0	0	0	0	0	0	0
Carbonation carbon removals	kg CO <sub>2</sub>	0	0	0	0	0	0	0	0	0	0	0
Carbon emissions from combustion of waste from non-renewable sources used in production processes	kg CO <sub>2</sub>	0	0	0	0	0	0	0	0	0	0	0

**Norfolk, NE: LCIA results, resource use, output and waste flows, and carbon emissions & removals per functional unit**

Parameter	Unit	A1	A2	A3	A4	A5	B1-B7	C1	C2	C3	C4	Total
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**LCIA results (per m<sup>2</sup> installed including packaging, that gives an average thermal resistance of RSI=1m<sup>2</sup>/K/W)**

Ozone depletion	kg CFC-11 eq	6.01E-09	2.36E-08	3.16E-09	1.62E-08	8.62E-11	0	0	2.76E-09	0	2.74E-10	5.15E-08
Global warming	kg CO <sub>2</sub> eq	8.82E-02	1.01E-01	1.06E-01	6.80E-02	7.46E-04	0	0	1.17E-02	0	1.61E-03	3.55E-01
Smog	kg SO <sub>2</sub> eq	1.02E-02	3.36E-03	4.35E-03	1.52E-03	2.38E-05	0	0	2.53E-04	0	4.68E-04	1.73E-02
Acidification	kg SO <sub>2</sub> eq	1.07E-03	2.10E-04	5.93E-04	1.88E-04	1.91E-06	0	0	2.00E-05	0	1.55E-05	1.72E-03
Eutrophication	kg N eq	1.02E-04	3.82E-05	4.58E-05	2.46E-05	4.43E-07	0	0	4.98E-06	0	1.52E-06	1.96E-04
Cardiogenics	CTUh	2.67E-09	9.13E-11	2.72E-10	4.90E-11	2.65E-12	0	0	9.85E-12	0	4.71E-13	2.99E-09
Non-cardiogenics	CTUh	3.82E-08	1.18E-08	1.62E-09	7.49E-09	5.15E-11	0	0	1.35E-09	0	1.86E-11	6.09E-08
Respiratory effects	kg PM <sub>2.5</sub> eq	1.69E-04	3.05E-05	1.96E-05	1.87E-05	1.20E-06	0	0	3.52E-06	0	2.01E-06	2.44E-04
Ecotoxicity	CTUe	43.4%	30.4%	1.0%	21.4%	-1%	0%	0%	3.8%	0%	-1%	100%
Fossil fuel depletion	MJ surplus	2.54E-01	2.43E-01	1.12E-01	1.13E-01	1.03E-03	0	0	2.45E-02	0	3.48E-03	7.51E-01

**Resource use indicators**

Renewable primary energy used as energy carrier (fuel)	MJ LHV	5.18E-02	2.54E-03	2.23E-01	9.17E-04	6.80E-04	0	0	1.56E-04	0	3.54E-05	2.79E-01
Renewable primary resources with energy content used as material	MJ LHV	2.00E-01	6.16E-04	1.86E-02	0	2.05E-04	0	0	0	0	0	2.20E-01
Total use of renewable primary resources with energy content	MJ LHV	2.52E-01	3.16E-03	2.42E-01	9.17E-04	8.85E-04	0	0	1.56E-04	0	3.54E-05	4.99E-01

Non-renewable primary resources with energy content used as material	MJ LHV	1.98E+00	1.42E+00	1.46E+00	9.62E-01	1.23E-02	0	0	1.64E-01	0	2.26E-02	6.01E+00
Non-renewable primary resources with energy content used as material	MJ LHV	1.87E-04	1.75E-04	6.22E-06	0	2.87E-06	0	0	0	0	0	3.7E-04
Total use of non-renewable primary resources with energy content	MJ LHV	1.98E+00	1.42E+00	1.46E+00	9.62E-01	1.23E-02	0	0	1.64E-01	0	2.26E-02	6.01E+00

Secondary materials	kg	5.83E-01	0	0	0	0	0	0	0	0	0	5.83E-01
Renewable secondary fuels	MJ LHV	0	0	0	0	0	0	0	0	0	0	0
Non-renewable secondary fuels	MJ LHV	0	0	0	0	0	0	0	0	0	0	0
Recovered energy	MJ LHV	0	0	0	0	0	0	0	0	0	0	0
Use of net fresh water resources	m <sup>3</sup>	1.79E-01	1.27E-02	6.09E-03	4.77E-03	2.98E-03						