ENVIRONMENTAL PRODUCT DECLARATION

FIBERGLAS™ PIPE INSULATION

NO WRAP, VAPORWICK® , ASJ MAX, ASJ, EVOLUTION™,

Owens Corning® FIBERGLAS™ Pipe Insulation.

Owens Corning, and its family of companies, is a leading global producer of residential and commercial building materials, glass fiber reinforcements, and engineered materials for composite systems. Founded in 1938, Owens Corning has earned its reputation as a market leading innovator of glass-fiber technology by consistently providing new solutions that deliver a strong combination of quality and value to its customers across the world.

Building Materials products – primarily roofing and insulation – are focused on making new and existing homes and buildings energy efficient, comfortable, and attractive. Owens Corning is committed to balancing economic growth with social progress and sustainable solutions to its building materials and composites customers around the world.

This Environmental Product Declaration is a component of our stated goal to provide life cycle information on all core products.

www.owenscorning.com

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

FIBERGLAS™ Pipe Insulation **According to ISO 14025**

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Owens Corning
DECLARATION NUMBER	4786077032.108.1
DECLARED PRODUCT	Owens Corning® FIBERGLAS™ Pipe Insulation
REFERENCE PCR	PCR Building Envelope Thermal Insulation v1.3 (June 1, 2014)
DATE OF ISSUE	August 21, 2015
PERIOD OF VALIDITY	5 years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications

The PCR review was conducted by:	UL Environment
	Approved by Expert Review Panel
	333 Pfingsten Road Northbrook, IL 60611
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	
	Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	
	Thomas Gloria, Industrial Ecology Consultants

ENVIRONMENTAL PRODUCT DECLARATION

FIBERGLAS™ Pipe Insulation

According to ISO 14025

Product Definition and Information

Product Description

FIBERGLAS™ Pipe Insulation is molded of heavy-density, resin-bonded inorganic glass fiber. The 36” long hinged sections are designed to insulate pipe with an operating temperature range from 0°F to 1,000°F (with heat-up schedule) in commercial and industrial buildings. The low thermal conductivity contributes to lower operating costs of mechanical equipment.

Manufacturing Locations

This Environmental Product Declaration (EPD) represents the production of FIBERGLAS™ Pipe Insulations manufactured at the Owens Corning Newark Insulation Plant located at 400 Case Ave, Newark, OH 43055.

Application and Uses

No Wrap FIBERGLAS™ Pipe Insulation – is available without a pre-applied jacket and is designed for field jacketing appropriate to the vapor control, damage or corrosion resistance requirements of the application.

VaporWick® Pipe Insulation – is designed specifically for chilled water lines and below-ambient-temperature applications in hot/humid environments with operating temperatures from 32°F to 220°F. It has a special material that wicks moisture away from the FIBERGLAS™ insulation so it stays dry and effective. It can be installed directly on wet pipes, saving the time and hassle of a system shutdown.

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FIBERGLAS™ Pipe Insulation

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ASJ (All Service Jacket) Max FIBERGLAS™ Pipe insulation – has a durable, cleanable, poly-encapsulated paper jacket that doesn't support mold or mildew growth. The new SSL® Max closure system was designed to work specifically with the jacket to provide a tight, reliable seal that doesn't need glue or staples. It can tolerate intermittent, short-duration precipitation during construction.

ASJ FIBERGLAS™ Pipe Insulation – has a factory-applied vapor retarder jacket with a double closure that provides a smooth, finished appearance. The double adhesive lap seal and two-part butt strip seal provide effective long term vapor sealing of the longitudinal and butt joints.

Evolution™ FIBERGLAS™ Pipe Insulation – features a jacket that does not support mold or mildew growth.

* Note: Evolution™ FIBERGLAS™ Pipe Insulation and ASJ FIBERGLAS™ Pipe Insulation will be retired in 2015.

Installation

No Wrap:
No Wrap FIBERGLAS™ Pipe Insulation is designed for field jacketing. The pipe section is open by the hinged sections, placed over the pipe, carefully aligned, and is secured by wires or bands, and vapor sealed where required. Outdoor applications must be protected from weather with weather proof jacketing.

VaporWick® Pipe Insulation:
VaporWick® Pipe Insulation sections are opened, placed over the pipe, closed and secured with a pressure-sensitive adhesive closure. Auxiliary items include rolls of wick material for wrapping elbows and valves; VaporWick® Pipe Insulation evaporation skirt (hula skirt) for verticals; and matching butt joint sealing tape for system closure. VaporWick® Pipe Insulation must be installed following Owens Corning VaporWick® detailed installation instructions at www.owenscorningcommercial.com

ASJ Max, ASJ, and Evolution Jacketed:

1. Ambient application temperatures are from 25°F (-4°C) to 110°F (43°C).
2. Open the hinged sections and place the insulation over the pipe, taking care not to get dirt, dust or moisture on the overlap area.
3. Pull the release strip from the lap. While preparing to close the insulation, do not allow the adhesive to contact anything until the insulation is properly lined up and closed over the pipe.
4. Seal the insulation. Start by pulling the lap down at the middle until the adhesive touches the jacket. Press together. Rub firmly with nylon sealing tool or squeegee from the middle of the section toward the end, until the lap is securely adhered to the jacket.
5. Apply the matching butt strip centered over the adjoining pipe sections and rub with firm pressure to complete the positive closure.
   Note: After adhesive tack and when the butt strip is applied, it is critical that the closures are not re-opened and repositioned on the facing. Doing so will diminish the bond strength.

Production

Material Content

FIBERGLAS™ Pipe Insulation consists of two major components, the fiberglass, and the binder system. The FIBERGLAS™ insulation is made from various inorganic minerals, which are referred to as batch chemicals. The binder system consists of non-renewable organic materials.

Table 1: Material Content of FIBERGLAS™ Pipe Insulation

Materials	Function	Quantity (mass%)	Non-Renewable	Renewable	Recycle Material	Origin	Transportation Mode	Transportation (Miles)
Cullet	Glass Batch	48-51%	■		■	North America	Truck	120-150
Sand	Glass Batch	14-17%		■		North America	Truck	20-50
Silicates	Glass Batch	1-4%	■			North America	Truck	525-600
Soda Ash	Glass Batch	3-6%	■			North America	Rail	1600
Borates	Glass Batch	11-14%	■			Global	Rail	525-600
Oxides	Glass Batch	<1%	■			North America	Truck	525-600
Phenol Urea Formaldehyde Resin	Binder	5-7%	■			North America	Truck	95-140
Ammonia Hydroxide	Binder	1-3%	■			North America	Truck	95-140
Dust Suppressant	Binder	<1%	■			North America	Truck	95-140
Coupling Agent	Binder	<1%	■			North America	Truck	95-140

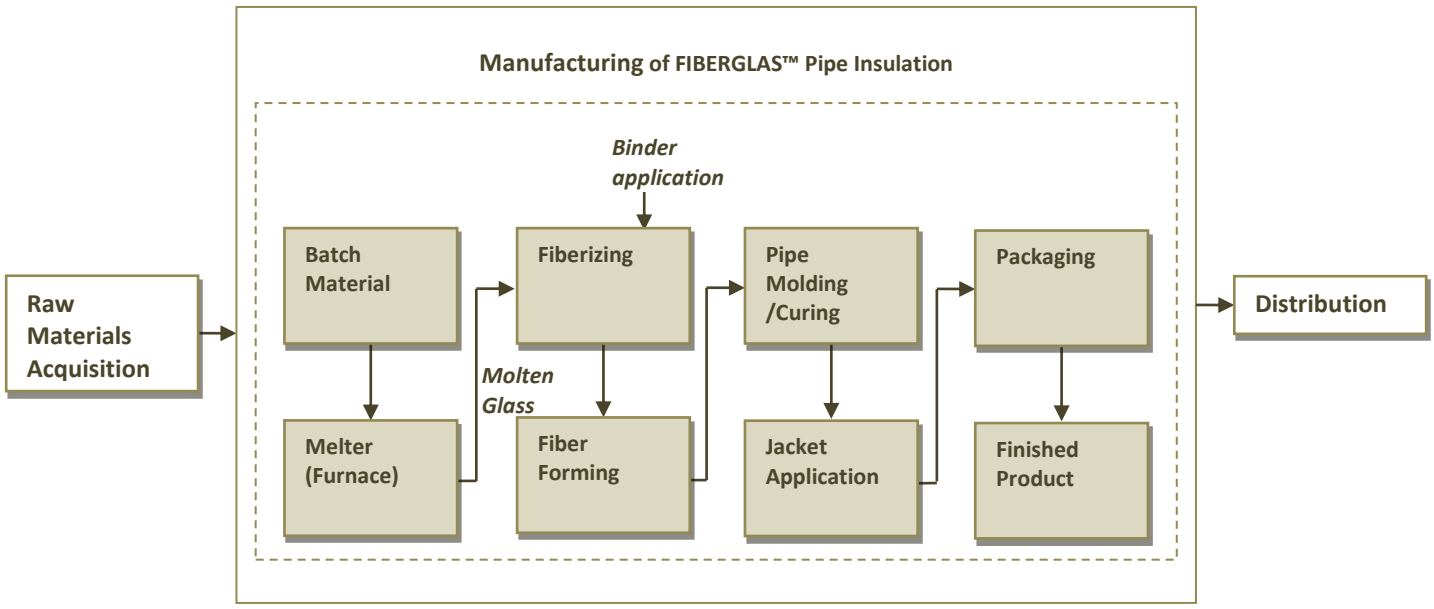
Table 2: Material Content of Jackets by Product Type

Material	Function	Quantity (Mass%/ m^2)	Non-Renewable	Renewable	Recycle Material	Origin	Transportation Mode	Transportation (miles)
VaporWick® Jacket								
Polymer	Film	100%	■			North America	Truck	400-600
Fabric	Wicking	ŧ						
ASJ Max Jacket								
Polymer Film	Exterior layer	25-28%	■			North America	Truck	400-600
Proprietary	Core	37-40%	■			North America	Truck	400-600
Fiberglass Mat	Reinforcement	22-25%	■			North America	Truck	400-600
Aluminum Foil	Interior layer	10-13%		■	■	North America	Truck	400-600
ASJ Jacket								
High Intensity White Kraft	Exterior layer	51-54%	■			North America	Truck	400-600
Flame Resister	Adhesive	1-4%	■			North America	Truck	400-600
Fiberglass Mat	Reinforcement	27-30%	■			North America	Truck	400-600
Elastomeric Polymer	Barrier coating	3-6%	■			North America	Truck	400-600
Aluminum Foil	Interior layer	11-14%		■	■	North America	Truck	400-600
Evolution™ Jacket								
Polymer Film	Exterior layer	47-50%	■			North America	Truck	400-600
Polymeric	Adhesive	1-4%	■			North America	Truck	400-600
Fiber	Reinforcement	36-39%	■			North America	Truck	400-600
Aluminum Foil	Interior layer	10-13%	■			North America	Truck	400-600

ŧ Material percentage for the Functional Unit R_{SI}=1 is not applicable and would distort the data. For jacketed products, the percent of jacket material varies as a function of product R-value and square foot weight.

Manufacturing Process

Figure 1: Owens Corning General Process Flow for FIBERGLAS™ Products



Life Cycle Assessment – Product System and Modeling

Functional Unit

For the pipe insulation a declared unit must be used in place of a functional unit because the physical configuration of pipe insulation affects thermal resistivity; thus, it is virtually impossible to define a single, generic functional unit that is representative of the all possible configurations. The following declared unit is therefore used for pipe insulation:

1 kilogram (kg) of insulation material plus 1 m^2 jacket with a building service life of 60 years.

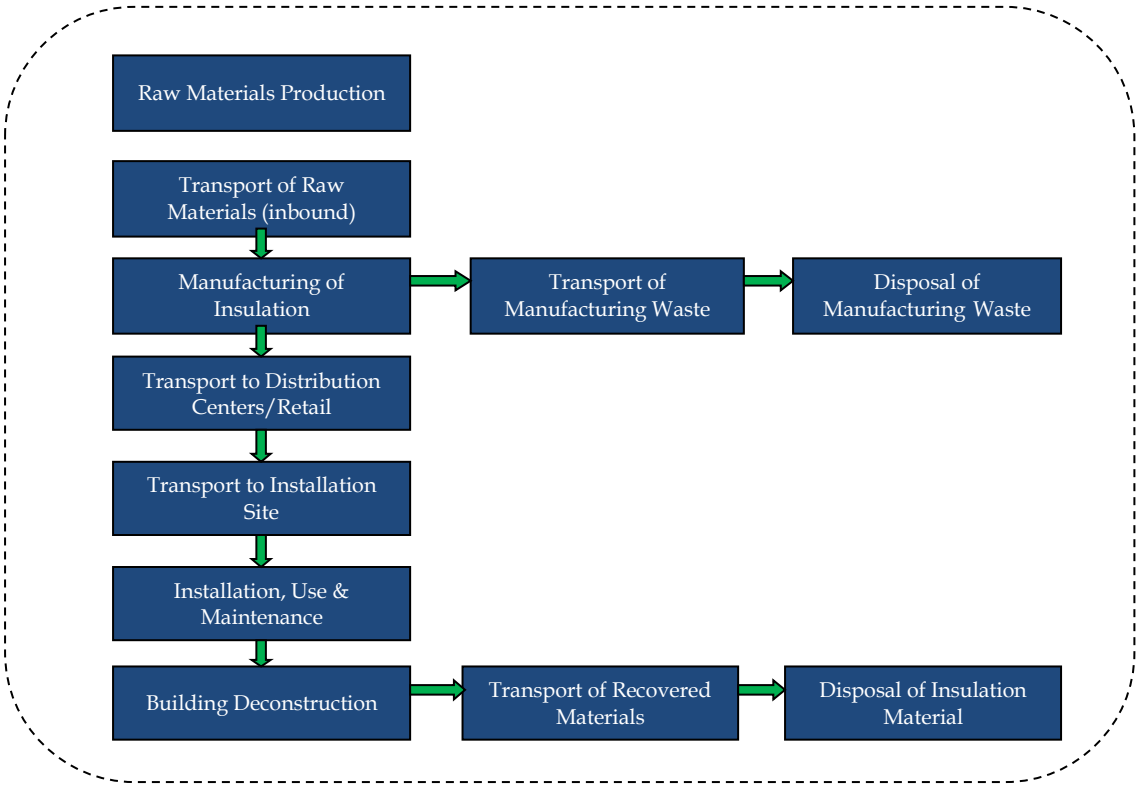
Life Cycle Stages Assessed

The underlying LCA, which provides the basis for this EPD, has been prepared following the requirements outlined in the applicable PCR. The LCA evaluates the fiberglass insulation by modeling the product life cycle considering the five stages mandated by the applicable PCR:

- Raw Materials Acquisition
- Manufacturing
- Distribution
- Installation and maintenance
- End-of-life (e.g., disposal, reuse, or recycle)

System Boundaries

Figure 2: System Boundaries



Assumptions

Assumptions are normal and necessary in conducting life cycle assessment. For the underlying cradle-to-grave LCA, assumptions have been made for both the installation and maintenance phase as well as the end-of-life phase. Assumptions regarding these phases can be found in the respective sections below.

Cut Off Criteria

The cut-off criteria for including or excluding materials, energy, and emissions data from the study are listed below, as per the applicable PCR.

- **Mass** – If a flow is less than 2% of the cumulative mass of the model it may be excluded, providing its environmental relevance is not a concern.
- **Energy** – If a flow is less than 1% of the cumulative energy of the model it may be excluded, providing its environmental relevance is not a concern.
- **Environmental relevance** – If a flow meets the above criteria for exclusion, yet is thought to potentially have a significant environmental impact, it will be included. Material flows which leave the system (emissions) and whose environmental impact is greater than 2% of the whole impact of an impact category that has been considered in the assessment must be covered. This judgment was made based on experience and documented as necessary.

The sum of the excluded material flows must not exceed 5% of mass, energy, or environmental relevance. The application of these criteria in the different life cycle steps is documented in the following sections.

- **Infrastructure and capital goods:** Inputs and outputs associated with infrastructure (construction, maintenance and demolition of buildings/plants, road surfaces, transport equipment etc.) are not included. This is based on experience from previous LCAs, where the contribution from these items is negligible due to the long life time of the equipment compared to that from the high production volume of the material during that lifetime;
- **Packaging:** Packaging is of a low mass compared to the quantity of product. As such, it has been excluded to reduce data collection efforts;
- **Workforce burdens:** Similarly, workforce impacts, such as travel to and from work, washing facilities, accommodation, canteen etc. when considered per processed ton of product, are considered likely to be insignificant and have been excluded; and
- **Installation and maintenance:** The mass and energy use at the manufacturing stage is limited to some electric tooling (such as screw drivers) and other small elements to fix the insulation boards. According to Owens Corning's manufacturing and product specialists, its mass and energy contribution is below the cut-off rules.

Transportation

The transportation stage has been modeled by splitting inbound transportation and outbound transportation (or distribution). Inbound transportation includes the transportation of all raw materials, including the batch, binder and packaging materials from suppliers to the Newark manufacturing facility. The outbound transportation or distribution includes the transportation of the final product to customers.

Period under Consideration

For the Newark, OH manufacturing facility considered in the LCA, Owens Corning primary data was collected for the 2014 calendar year.

Data Quality

To determine how representative the data used to model the life-cycle of FIBERGLAS™ Pipe Insulation manufactured in 2014 is, the temporal, geographical and technological aspects of the data were assessed. For Owens Corning's Newark, OH facility analyzed in the underlying LCA study, the data used adequately represents the technology used in 2014 in the United States. The secondary data used from SimaPro LCI databases was the most appropriate and current data available. When production data was not available for a specific material in use, available LCI data on similar materials were analyzed to determine the best surrogate.

Allocation

Owens Corning's Newark facility manufactures multiple products. Primary data of materials and utilities consumption was provided on the facility level instead of the product level, and therefore allocation was required. Machine operating hours (MOH) were used to allocate the utility consumption and other manufacturing impacts (such as air emissions) to each individual product. In transportation the product is volume limited and not mass limited. Since pipe products are volume limited for finished goods-transportation, a sensitivity analysis was performed for this study.

Installation and Maintenance

FIBERGLAS™ Pipe Insulation products are installed by hand and sometimes requires electric tools such as screwdrivers, some hand tools, and screws specifically designed to install certain Owens Corning® products. For the use phase, FIBERGLAS™ pipe insulation when properly installed is a passive device that requires no external resource but does save energy usage for a mechanical system. With proper installation FIBERGLAS™ pipe insulation doesn't require maintenance during its service life.

End-of-Life

It is assumed that no recycling occurs at end-of-life and that all construction waste is sent to landfill. The average distance from the demolition site to the construction material landfill is assumed to be 100 miles by use of an industrial garbage truck.

Life Cycle Assessment - Results

Use of Material and Energy Resources

Table 3: Primary Energy Demand per Functional Unit

Environmental Indicator	Unit	No Wrap Fiberglas™ Pipe Insulation
Non renewable, fossil oil, coal, natural gas	MJ	8.69E+01
Non-renewable, nuclear	MJ	1.89E+01
Non-renewable, biomass	MJ	9.83E-05
Renewable, biomass	MJ	7.71E-01
Renewable, water	MJ	4.30E-01
Renewable, wind, solar, geothermal	MJ	1.99E-01
TOTAL Primary Energy Demand	**MJ**	**1.07E+02**

Table 4: Primary Energy Demand per Functional Unit (by Jacket Type)

Environmental Indicator	Unit	VaporWick® Jacket	ASJ Max Jacket	ASJ Jacket	Evolution™ Jacket
Non renewable, fossil oil, coal, natural gas	MJ	2.43E+00	9.78E+00	7.92E+00	1.24E+01
Non-renewable, nuclear	MJ	1.21E-01	5.62E-01	4.34E-01	6.49E-01
Non-renewable, biomass	MJ	2.31E-05	2.99E-03	3.31E-04	2.30E-03
Renewable, biomass	MJ	5.14E-02	2.57E+00	3.39E+00	2.75E-01
Renewable, water	MJ	3.04E-02	4.96E-01	4.88E-01	4.88E-01
Renewable, wind, solar, geothermal	MJ	5.69E-03	2.42E-02	2.56E-02	2.52E-02
TOTAL Primary Energy Demand	**MJ**	**2.64E+00**	**1.34E+01**	**1.23E+01**	**1.39E+01**

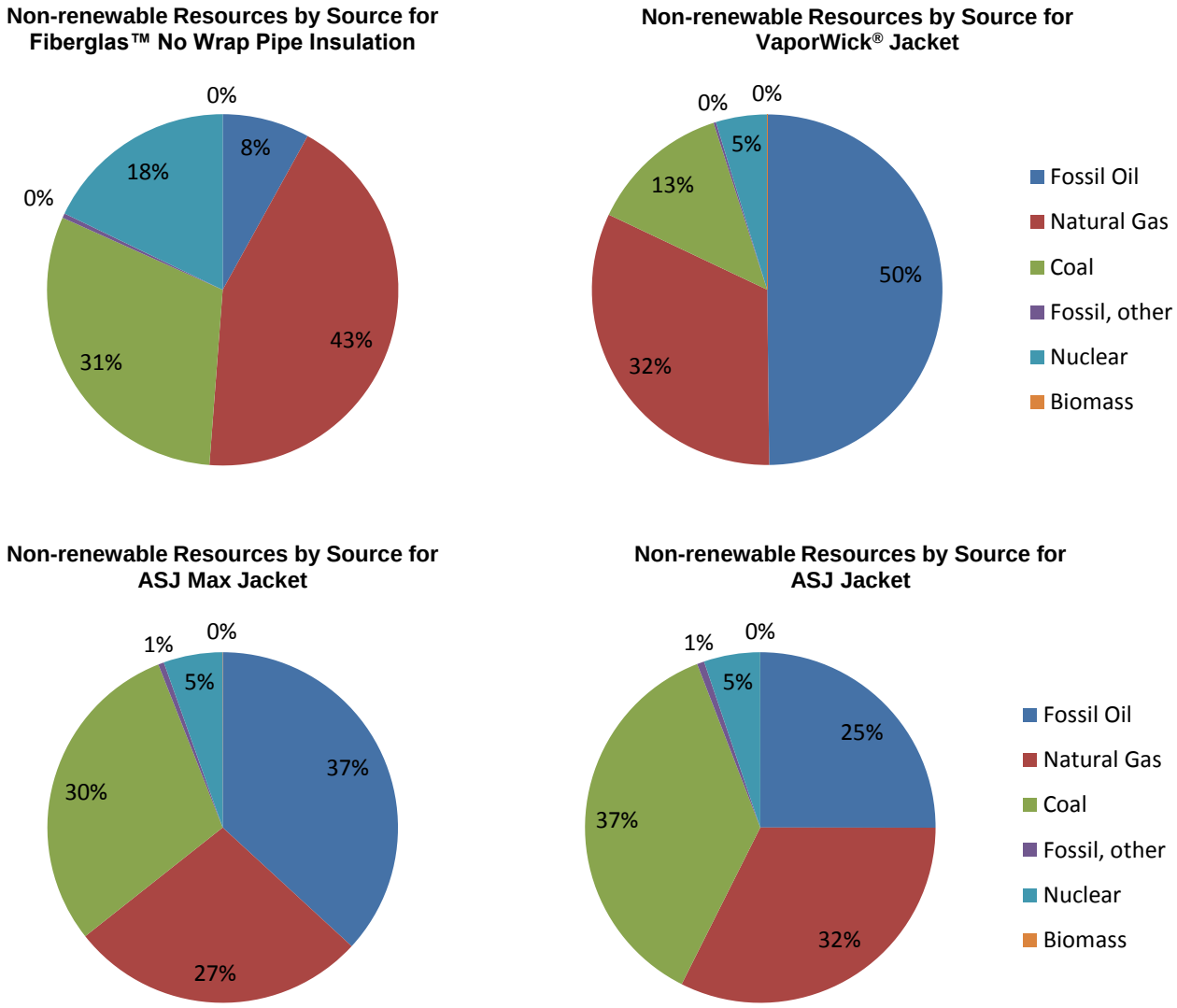
Table 5: Primary Energy Demand per Functional Unit (by Resource)

Environmental Indicator	Unit	No Wrap Fiberglas™ Pipe Insulation
Non renewable Resources		
Fossil Oil	MJ	8.50E+00
Natural Gas	MJ	4.57E+01
Coal	MJ	3.23E+01
Fossil, other	MJ	4.47E-01
Nuclear	MJ	1.89E+01
Biomass	MJ	9.83E-05
Non-renewable total	**MJ**	**1.06E+02**
Renewable Resources		
Biomass	MJ	7.71E-01
Water	MJ	4.30E-01
Wind	MJ	1.58E-01
Solar	MJ	8.18E-05
Geothermal	MJ	4.10E-02
Renewable Total	**MJ**	**1.40E+00**
TOTAL Primary Energy Demand	**MJ**	**1.07E+02**

Table 6: Primary Energy Demand per Functional Unit (by Jacket Type)

Environmental Indicator	Unit	VaporWick® Jacket	ASJ Max Jacket	ASJ Jacket	Evolution™ Jacket
Non renewable Resources					
Fossil Oil	MJ	1.27E+00	3.81E+00	2.09E+00	5.28E+00
Natural Gas	MJ	8.23E-01	2.85E+00	2.71E+00	3.86E+00
Coal	MJ	3.32E-01	3.07E+00	3.07E+00	3.24E+00
Fossil, other	MJ	5.69E-03	5.52E-02	5.56E-02	5.86E-02
Nuclear	MJ	1.21E-01	5.62E-01	4.34E-01	6.49E-01
Biomass	MJ	2.31E-05	2.99E-03	3.31E-04	2.30E-03
Non-renewable total	**MJ**	**2.55E+00**	**1.03E+01**	**8.36E+00**	**1.31E+01**
Renewable Resources					
Biomass	MJ	5.14E-02	2.57E+00	3.39E+00	2.75E-01
Water	MJ	3.04E-02	4.96E-01	4.88E-01	4.88E-01
Wind	MJ	2.00E-03	6.88E-03	8.02E-03	9.28E-03
Solar	MJ	2.04E-06	5.39E-06	5.16E-06	1.95E-05
Geothermal	MJ	3.69E-03	1.73E-02	1.75E-02	1.59E-02
Renewable Total	**MJ**	**8.75E-02**	**3.09E+00**	**3.90E+00**	**7.88E-01**
TOTAL Primary Energy Demand	**MJ**	**2.64E+00**	**1.34E+01**	**1.23E+01**	**1.39E+01**

Figure 3: Non-renewable Resources by Source for Pipe Insulation Products and Jacket Options



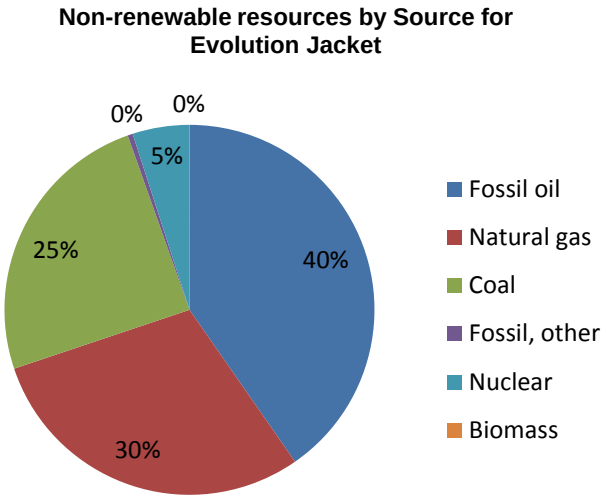
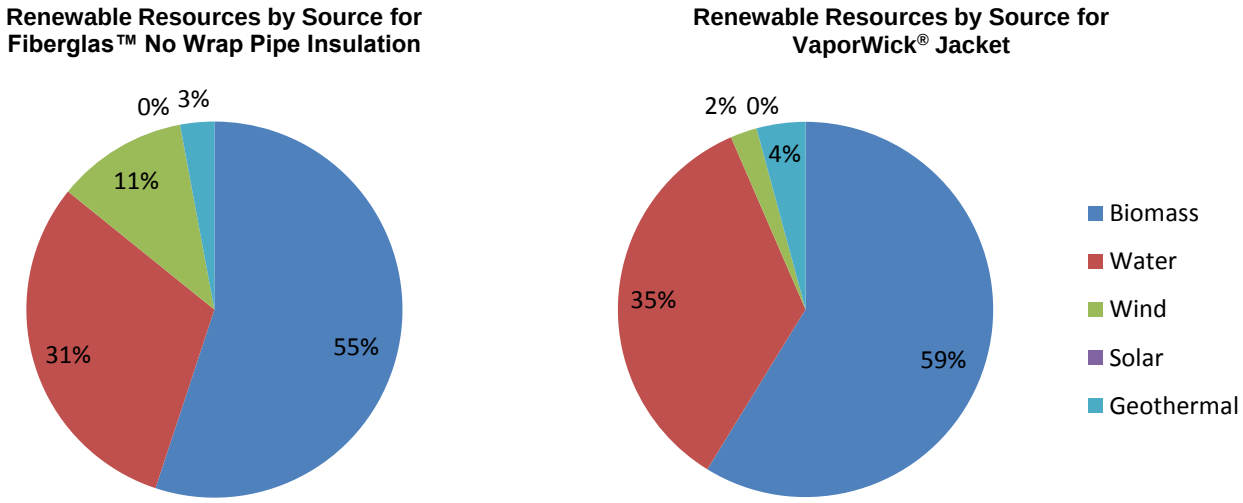
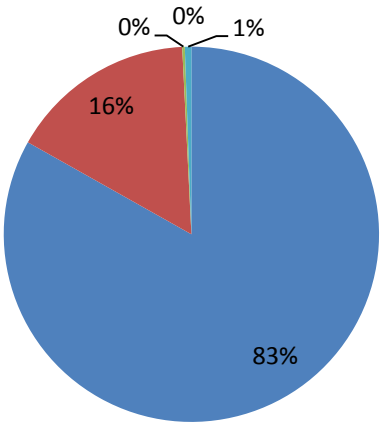


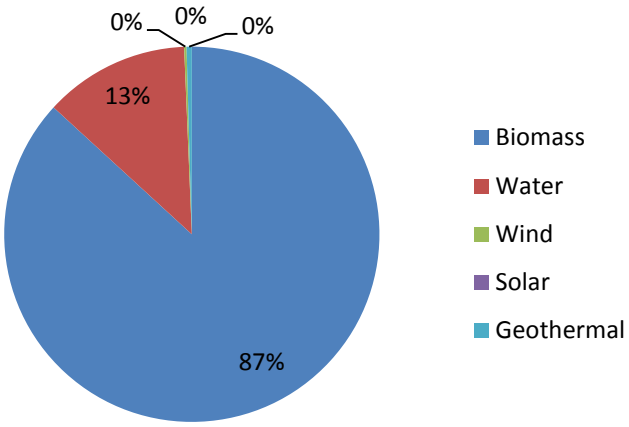
Figure 4: Renewable Resources by Source for Pipe Insulation Products and Jacket Options



Renewable Resources by Source for ASJ Max Jacket



Renewable Resources by Source for ASJ Jacket



Renewable resources by Source for Evolution™ Jacket

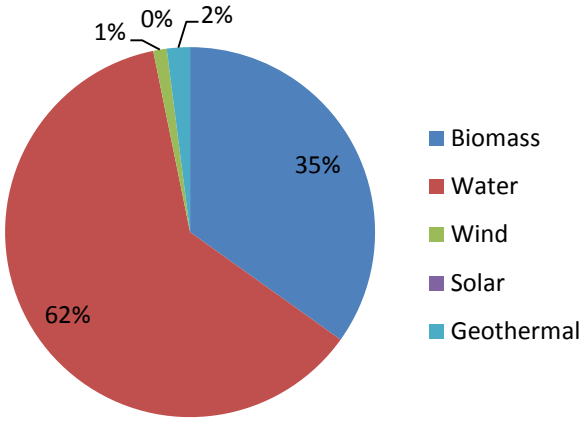
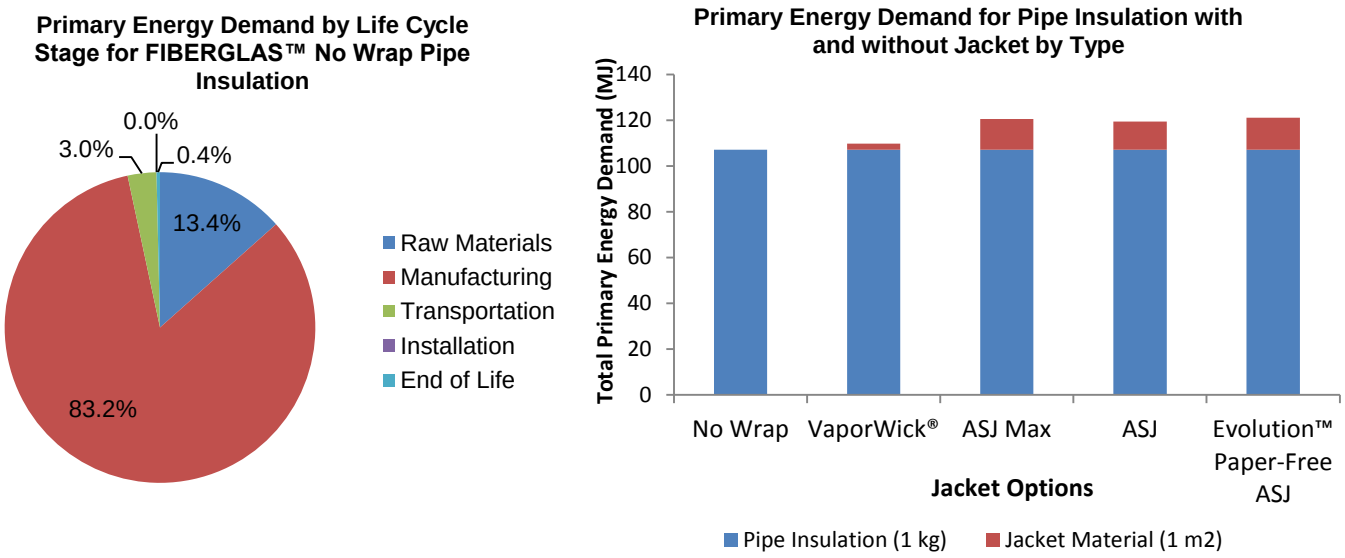


Figure 5: Primary Energy Demand by Life Cycle Stage for Pipe Insulation Products and Jacket Options



For the jackets analyzed, the primary impact contributors are the raw materials. Inbound and outbound transportation and final disposal in landfill account in average for less than 10% of the jacket impact. The products that present the highest impact are those that have jackets with a layer of aluminum foil (ASJ Max, ASJ and Evolution™) in the bill of materials. The energy intensity required to produce aluminum causes these jackets to have a higher impact.

Life Cycle Impact Assessment Results

Table 7: Life Cycle Impact Assessment Results for 1kg of Fiberglas™ No Wrap Pipe Insulation Material

Impact category	Unit	Total	Raw Materials - Batch	Raw Materials - Binder	Transportation	Manufacturing	Installation and Maintenance	End-of-life
Global warming	kg CO2 eq	6.52E+00	4.12E-01	2.28E-01	2.07E-01	5.65E+00	0.00E+00	2.51E-02
Acidification	kg SO2 eq	5.45E-02	2.59E-03	1.85E-03	1.37E-03	4.85E-02	0.00E+00	1.64E-04
Eutrophication	kg N eq	1.61E-02	8.80E-04	2.58E-04	1.51E-04	1.48E-02	0.00E+00	1.85E-05
Smog	kg O3 eq	3.29E-01	2.91E-02	8.38E-03	4.01E-02	2.47E-01	0.00E+00	4.77E-03
Ozone depletion	kg CFC-11 eq	9.81E-07	3.95E-08	5.68E-08	5.13E-08	8.27E-07	0.00E+00	6.18E-09

Table 8: Life Cycle Impact Assessment Results for Jacket Materials

Impact category	Unit	VaporWick® Jacket	ASJ Max Jacket	ASJ Jacket	Evolution™ Jacket
Global warming	kg CO2 eq	1.04E-01	6.45E-01	6.26E-01	8.23E-01
Acidification	kg SO2 eq	5.42E-04	4.96E-03	5.02E-03	5.03E-03
Eutrophication	kg N eq	2.19E-04	1.56E-03	1.98E-03	1.83E-03
Smog	kg O3 eq	5.00E-03	4.63E-02	4.61E-02	5.00E-02
Ozone depletion	kg CFC-11 eq	9.85E-09	3.71E-08	4.10E-08	5.90E-08

Water Consumption and Non-Hazardous Waste

The water consumed and waste generated over the cradle-to-gate life cycle of pipe insulation is shown in the table below. The values, which are applicable for the functional unit amount of insulation, have been calculated for each of the Pipe insulation products.

Table 9: Water usage (m^3) for 1 kg of Pipe Insulation

Water usage	Unit	Pipe insulation 1 kg
Water	m^3	2.57E-04

Table 10: Water usage (m^3) for 1m^2 Jacket Material

Water usage	Unit	VaporWick® Jacket	ASJ Max Jacket	ASJ Jacket	Evolution™ Jacket
Water	m^3	2.43E-05	2.98E-04	2.96E-04	3.18E-04

Table 11: Waste-to-landfill (kg) for 1 kg of Pipe insulation material

Waste	Unit	Pipe insulation 1 kg
Waste to landfill	kg	1.77E+00
Hazardous waste	kg	3.61E-06

Table 12: Waste-to-landfill (kg) for 1m^2 Jacket Material

Waste	Unit	VaporWick® Jacket	ASJ Max Jacket	ASJ Jacket	Evolution™ Jacket
Waste to landfill	kg	1.8E-02	1.61E-01	1.41E-01	1.39E-01
Hazardous waste	kg	-	-	-	-

All disposed jacket waste is considered non-hazardous. There is no waste-to-energy reported or tracked within the system boundaries.

Scaling to Various Pipe Sizes

This study uses a declared unit instead of a functional unit for pipe insulation due to the difficulty in defining a single functional unit that is representative of all possible pipe insulation configurations. Environmental impacts per linear foot of pipe insulation for various pipe diameters and insulation thicknesses can be calculated by multiplying the impacts, summarized in Table 5, by the scaling factors presented in Table 9 and adding those to jacket impacts summarized in Table 6, multiplied by the scaling factors presented in Table 10.

$$Impact = [(Pipe\ Insulation\ Impact)^a \cdot (Pipe\ Insulation\ Scaling\ Factor)^b] + [(Jacket\ Impact)^c \cdot (Jacket\ Scaling\ Factor)^d]$$

where a=Table 7, b = Table 13, c = Table 8, d =Table 14

Table 13: Scaling factors for 1 linear foot of pipe insulation material at various pipe sizes

	Thickness of Insulation Material (inch)									
Pipe Size (inch)	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
0.50	0.019	0.057	0.113	0.189	0.284	0.397	0.530	0.681	0.851	1.040
1.00	0.028	0.076	0.142	0.227	0.331	0.454	0.596	0.757	0.936	1.135
1.50	0.038	0.095	0.170	0.265	0.378	0.511	0.662	0.832	1.021	1.230
2.00	0.047	0.113	0.199	0.303	0.426	0.567	0.728	0.908	1.107	1.324
2.50	0.057	0.132	0.227	0.340	0.473	0.624	0.794	0.984	1.192	1.419
3.00	0.066	0.151	0.255	0.378	0.520	0.681	0.861	1.059	1.277	1.513
3.50	0.076	0.170	0.284	0.416	0.567	0.738	0.927	1.135	1.362	1.608
4.00	0.085	0.189	0.312	0.454	0.615	0.794	0.993	1.211	1.447	1.702
4.50	0.095	0.208	0.340	0.492	0.662	0.851	1.059	1.286	1.532	1.797
5.00	0.104	0.227	0.369	0.530	0.709	0.908	1.126	1.362	1.617	1.892
5.50	0.113	0.246	0.397	0.567	0.757	0.965	1.192	1.438	1.702	1.986
6.00	0.123	0.265	0.426	0.605	0.804	1.021	1.258	1.513	1.788	2.081
7.00	0.142	0.303	0.482	0.681	0.899	1.135	1.390	1.665	1.958	2.270
8.00	0.161	0.340	0.539	0.757	0.993	1.248	1.523	1.816	2.128	2.459
9.00	0.180	0.378	0.596	0.832	1.088	1.362	1.655	1.967	2.298	2.648
10.00	0.199	0.416	0.653	0.908	1.182	1.475	1.788	2.119	2.469	2.837
11.00	0.218	0.454	0.709	0.984	1.277	1.589	1.920	2.270	2.639	3.027
12.00	0.236	0.492	0.766	1.059	1.371	1.702	2.052	2.421	2.809	3.216
13.00	0.255	0.530	0.823	1.135	1.466	1.816	2.185	2.573	2.979	3.405
14.00	0.274	0.567	0.880	1.211	1.561	1.929	2.317	2.724	3.150	3.594
15.00	0.293	0.605	0.936	1.286	1.655	2.043	2.450	2.875	3.320	3.783
16.00	0.312	0.643	0.993	1.362	1.750	2.156	2.582	3.027	3.490	3.972
17.00	0.331	0.681	1.050	1.438	1.844	2.270	2.714	3.178	3.660	4.162
18.00	0.350	0.719	1.107	1.513	1.939	2.383	2.847	3.329	3.831	4.351
19.00	0.369	0.757	1.163	1.589	2.034	2.497	2.979	3.481	4.001	4.540
20.00	0.388	0.794	1.220	1.665	2.128	2.610	3.112	3.632	4.171	4.729
21.00	0.407	0.832	1.277	1.740	2.223	2.724	3.244	3.783	4.341	4.918
22.00	0.426	0.870	1.334	1.816	2.317	2.837	3.377	3.935	4.512	5.107
23.00	0.445	0.908	1.390	1.892	2.412	2.951	3.509	4.086	4.682	5.297
24.00	0.463	0.946	1.447	1.967	2.506	3.064	3.641	4.237	4.852	5.486
25.00	0.482	0.984	1.504	2.043	2.601	3.178	3.774	4.389	5.022	5.675
26.00	0.501	1.021	1.561	2.119	2.696	3.291	3.906	4.540	5.193	5.864
27.00	0.520	1.059	1.617	2.194	2.790	3.405	4.039	4.691	5.363	6.053
28.00	0.539	1.097	1.674	2.270	2.885	3.518	4.171	4.843	5.533	6.242
29.00	0.558	1.135	1.731	2.346	2.979	3.632	4.303	4.994	5.703	6.432
30.00	0.577	1.173	1.788	2.421	3.074	3.745	4.436	5.145	5.874	6.621
31.00	0.596	1.211	1.844	2.497	3.168	3.859	4.568	5.297	6.044	6.810
32.00	0.615	1.248	1.901	2.573	3.263	3.972	4.701	5.448	6.214	6.999
33.00	0.634	1.286	1.958	2.648	3.358	4.086	4.833	5.599	6.384	7.188

* This listing may not represent the full product offering.

Table 14: Scaling factors for jacket material for 1 linear foot of pipe insulation material at various pipe sizes

	Thickness of Insulation Material (inch)									
Pipe Size (inch)	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
0.50	0.036	0.061	0.085	0.109	0.134	0.158	0.182	0.207	0.231	0.255
1.00	0.049	0.073	0.097	0.122	0.146	0.170	0.195	0.219	0.243	0.268
1.50	0.061	0.085	0.109	0.134	0.158	0.182	0.207	0.231	0.255	0.280
2.00	0.073	0.097	0.122	0.146	0.170	0.195	0.219	0.243	0.268	0.292
2.50	0.085	0.109	0.134	0.158	0.182	0.207	0.231	0.255	0.280	0.304
3.00	0.097	0.122	0.146	0.170	0.195	0.219	0.243	0.268	0.292	0.316
3.50	0.109	0.134	0.158	0.182	0.207	0.231	0.255	0.280	0.304	0.328
4.00	0.122	0.146	0.170	0.195	0.219	0.243	0.268	0.292	0.316	0.341
4.50	0.134	0.158	0.182	0.207	0.231	0.255	0.280	0.304	0.328	0.353
5.00	0.146	0.170	0.195	0.219	0.243	0.268	0.292	0.316	0.341	0.365
5.50	0.158	0.182	0.207	0.231	0.255	0.280	0.304	0.328	0.353	0.377
6.00	0.170	0.195	0.219	0.243	0.268	0.292	0.316	0.341	0.365	0.389
7.00	0.195	0.219	0.243	0.268	0.292	0.316	0.341	0.365	0.389	0.413
8.00	0.219	0.243	0.268	0.292	0.316	0.341	0.365	0.389	0.413	0.438
9.00	0.243	0.268	0.292	0.316	0.341	0.365	0.389	0.413	0.438	0.462
10.00	0.268	0.292	0.316	0.341	0.365	0.389	0.413	0.438	0.462	0.486
11.00	0.292	0.316	0.341	0.365	0.389	0.413	0.438	0.462	0.486	0.511
12.00	0.316	0.341	0.365	0.389	0.413	0.438	0.462	0.486	0.511	0.535
13.00	0.341	0.365	0.389	0.413	0.438	0.462	0.486	0.511	0.535	0.559
14.00	0.365	0.389	0.413	0.438	0.462	0.486	0.511	0.535	0.559	0.584
15.00	0.389	0.413	0.438	0.462	0.486	0.511	0.535	0.559	0.584	0.608
16.00	0.413	0.438	0.462	0.486	0.511	0.535	0.559	0.584	0.608	0.632
17.00	0.438	0.462	0.486	0.511	0.535	0.559	0.584	0.608	0.632	0.657
18.00	0.462	0.486	0.511	0.535	0.559	0.584	0.608	0.632	0.657	0.681
19.00	0.486	0.511	0.535	0.559	0.584	0.608	0.632	0.657	0.681	0.705
20.00	0.511	0.535	0.559	0.584	0.608	0.632	0.657	0.681	0.705	0.730
21.00	0.535	0.559	0.584	0.608	0.632	0.657	0.681	0.705	0.730	0.754
22.00	0.559	0.584	0.608	0.632	0.657	0.681	0.705	0.730	0.754	0.778
23.00	0.584	0.608	0.632	0.657	0.681	0.705	0.730	0.754	0.778	0.803
24.00	0.608	0.632	0.657	0.681	0.705	0.730	0.754	0.778	0.803	0.827
25.00	0.632	0.657	0.681	0.705	0.730	0.754	0.778	0.803	0.827	0.851
26.00	0.657	0.681	0.705	0.730	0.754	0.778	0.803	0.827	0.851	0.876
27.00	0.681	0.705	0.730	0.754	0.778	0.803	0.827	0.851	0.876	0.900
28.00	0.705	0.730	0.754	0.778	0.803	0.827	0.851	0.876	0.900	0.924
29.00	0.730	0.754	0.778	0.803	0.827	0.851	0.876	0.900	0.924	0.949
30.00	0.754	0.778	0.803	0.827	0.851	0.876	0.900	0.924	0.949	0.973
31.00	0.778	0.803	0.827	0.851	0.876	0.900	0.924	0.949	0.973	0.997
32.00	0.803	0.827	0.851	0.876	0.900	0.924	0.949	0.973	0.997	1.022
33.00	0.827	0.851	0.876	0.900	0.924	0.949	0.973	0.997	1.022	1.046

* This listing may not represent the full product offering.

Additional Environmental Information

Use Stage Benefits

Insulation is a passive device that requires no extra utilities to operate over its useful life. Insulation of a mechanical system is responsible for reducing the energy burden associated with heating and cooling of the fluid or media handled by the system. In the following examples, the 3E Plus® Computer Program was used to model pipes both with and without an ASJ FIBERGLAS™ Pipe Insulation. Table 15 provides an example of net energy savings (energy saved minus life cycle energy of FIBERGLAS™ Pipe Insulation) from using the insulation on different pipe sizes, conveying a cold fluid. Table 16 provides an example of net energy savings from using the insulation on different pipe sizes, conveying a hot fluid. In addition, the two examples provide the time period the ASJ FIBERGLAS™ Pipe Insulation must be in service in order to recover the energy spent in manufacturing it.

Table 15: Days to recover primary energy demand based on electricity savings

Pipe Diameter (in)	Process Temperature (°F)	Insulation Thickness (in)	Pipe SF	Jacket SF	Energy Savings (MJ/hr·ft)	Avoided PED (MJ-eq/hr·ft)	Insulation PED (MJ-eq)	Payback Period (days)
2	50	1	0.113	0.097	0.021	0.066	13	8
4	50	1	0.189	0.146	0.039	0.122	22	8
6	50	1	0.265	0.195	0.056	0.174	31	7

Table 16: Days to recover primary energy demand based on natural gas savings

Pipe Diameter (in)	Process Temperature (°F)	Insulation Thickness (in)	Pipe SF	Jacket SF	Energy Savings (MJ/hr·ft)	Avoided PED (MJ-eq/hr·ft)	Insulation PED (MJ-eq)	Payback Period (days)
2	350	5	1.324	0.292	0.537	0.680	146	9
4	350	5	1.702	0.341	0.991	1.254	187	6
6	350	5	2.081	0.389	1.440	1.821	228	5

Other Relevant Information

Applies to jacketed products only.

References

- ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation
- ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
- Product Category Rules for Preparing an Environmental Product Declaration (EPD) for Product Group: Building Envelope Thermal Insulation, Version 1.3, June 1, 2014
- ISO 14025:2006(E), Environmental labels and declarations – Type III environmental declarations – Principles and procedures, 1 July 2006
- ISO 14040:2006(E), Environmental management – Life cycle assessment – Principles and framework, 1 July 2006
- ISO 14044:2006(E), Environmental management – Life cycle assessment – Requirements and guidelines, 1 July 2006
- National American Insulation Manufacturers Association (NAIMA), 3E Plus® Version 4.1