ENVIRONMENTAL PRODUCT DECLARATION

THERMASMART PRO, ENEV & THERMAECO

Robust and light weight innovative pipe insulation materials for all HVAC and plumbing applications.

thermaflex®

taking care of energy and the environment

It is our nature to be smart, creative, flexible and convincingly different in everything we do! We see a future in which systems for heating and cooling are highly efficient and use renewable resources in every situation.

Thermaflex is an international company that, since 1976, has engaged in efficient thermal energy distribution. We are always looking for the most efficient and sustainable processes, materials and energy sources for all our activities.

We use (raw) materials in our products which meet the highest health and safety standards and are energy efficient and recyclable. The long life-cycles and recyclability of the materials we use make a significant difference and contribute greatly to sustainability.

We are on a special sustainable mission that drives us. At the same time we realize that we are modest servants to society and future generations.

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ENVIRONMENTAL PRODUCT DECLARATION

thermaflex

ThermaSmart PRO, ENEV and ThermaECO

According to ISO 14025
EN 15804, and ISO 21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Environment 333 Pfingsten Road Northbrook, IL 60611 https://www.ul.com/ https://spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	General Program Instructions v.2.4 July 2018
MANUFACTURER NAME AND ADDRESS	Thermaflex, Veerweg 1, 5145 NS Waalwijk, Phone: +31416567777. www.thermaflex.com
DECLARATION NUMBER	4789341811.101.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	ThermaSmart PRO, ENEV and ThermaECO , 1 kg
REFERENCE PCR AND VERSION NUMBER	PCR for Building-Related Products and Services - Part A: Calculation Rules for the LCA and Requirements, (UL Environment, v.3.2), Part B: Mechanical, Specialty, Thermal, and Acoustic Insulation EPD Req. UL 10010-3 v.1.0, ISO14025/40/44 ISO21930, EN 15804.
DESCRIPTION OF PRODUCT APPLICATION/USE	Mechanical Insulation
PRODUCT RSL DESCRIPTION (IF APPL.)	N/A
MARKETS OF APPLICABILITY	North America, Europe, Global
DATE OF ISSUE	July 1, 2020
PERIOD OF VALIDITY	5 Years
EPD TYPE	Product-Specific
RANGE OF DATASET VARIABILITY	N/A
EPD SCOPE	Cradle-to-grave
YEAR(S) OF REPORTED PRIMARY DATA	2019 & 2020
LCA SOFTWARE & VERSION NUMBER	SimaPro 9.1.0.8
LCI DATABASE(S) & VERSION NUMBER	Ecoinvent 3.6
LCIA METHODOLOGY & VERSION NUMBER	CML-IA baseline v3.06, TRACI 2.1 v1.05, Cumulative Energy Demand v1.11

This PCR review was conducted by:	UL Environment PCR Review Panel epd@ulenvironment.com
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Grant R. Martin Grant R. Martin, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria Thomas P. Gloria, Industrial Ecology Consultants

LIMITATIONS

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; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR 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.

1. Product Definition and Information

1.1. Company description

Thermaflex is an independent, family-based company established in Waalwijk, The Netherlands. We develop and produce solutions for efficient thermal energy distribution. Our solutions for heating, cooling, sanitary and ventilation are applied in residential areas, hotels, public buildings, hospitals and industries. With support and distribution offices in 15 countries, we work together with partners and clients in over 45 countries to create sustainable systems that are very efficient and can lower the barriers for the use of renewable energy.

In the four Thermaflex plants in Poland, Russia, Thailand and Turkey, products are exclusively made from modern plastics that are environmentally friendly in production, easy to recycle and upon combustion at end-of-life, are not toxic.

The heating and cooling of buildings accounts for a large fraction of global CO2 emissions. (1) That is exactly why professionally insulated pipes in heating and cooling are essential. At Thermaflex, with over 40 years of experience in this field, you always find the best, energy efficient and environmentally friendly solution.

1.2. Product Description

All Thermaflex insulation products are made of environmental friendly polyolefin granulate. Our products are robust and light weight which makes them easy to install and are recyclable. Our insulation materials are available in tube, sheet and “endless” coil versions.

- ThermaSmart PRO is a range of innovative ultra-flexible insulation foam for all HVAC and sanitary applications.
- ThermaSmart ENEV is similar product to ThermaSmart PRO, but has lower lambda value as it is designed to meet German energy saving legislation.[1]
- ThermaECO is a halogen-free (alternative) assortment for applications that do not require compliance with the highest fire resistance standards.

More information on products is available at https://thermaflex.com/en/products/insulation

Product specific physical characteristics are displayed in Table 1 - product properties

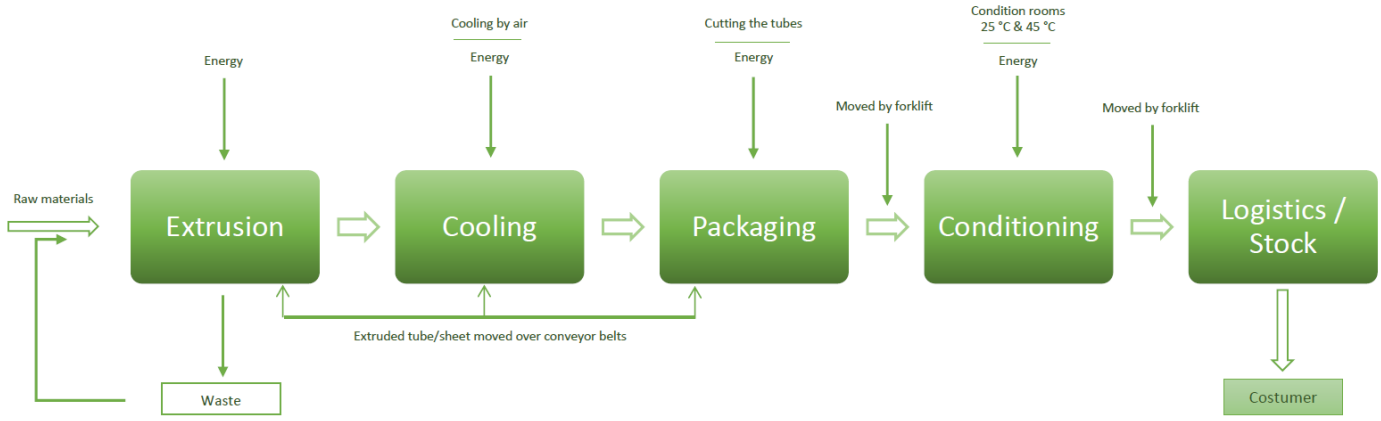
[1] Information on the energy performance regulations in the different EU-member states: http://www.enper.org and information on the present German regulations in detail: http://www.bbr.bund.de .

Table 1 - product properties as delivered to the site

PROPERTIES	UNITS SI	THERMASMART PRO	THERMASMART ENEV	THERMAECO ZZ	THERMAECO FRZ	TESTING METHOD
Physical properties						
Dimensional tolerances	-	Coherent	Coherent	Coherent	Coherent	EN 14313
Density	kg/m^3	18 - 40	21 - 33	18-25	25 - 36	-
Thermal properties						
Service temperature range	°C	-80 to +95	-	-	-	-
Maximum service temperature	°C	+95	+95	+95	+95	EN 14707
Thermal conductivity (λ)	W/m·K	0.035 @ 10°C 0.038 @ 40°C	0.034 @ 10°C 0.036 @ 30°C	0.040 @ 20°C 0.042 @ 40°C	0.038 @ 20°C 0.040 @ 40°C	EN ISO 8497
Fire properties						
SBI classification	-	BL, s1, d0	C_L, s1, d0	E_L	E_L	EN 13501-1
British standard	-	Class 1	-	-	-	BS 476 Part 7
British standard	-	Class 0	-	-	-	BS 476 Part 6
Flammability standard	-	HF-1	-	-	-	UL94
Water resistance properties						
Water vapor diffusion	μ	≥ 10,000	-	-	-	EN 13469
Water absorption	kg/m^2	0.01	0.01	0.05	0.05	EN 13472

Following depicted a simplified flow diagram illustrating main production processes.

Figure 1 : ThermaSmart and ThermaECO manufacturing



(A1) Raw materials are supplied by various (A2) transportation modes to Thermaflex manufacturing sites. (A3) module general manufacturing flow diagram described in Figure 1 : ThermaSmart and ThermaECO manufacturing

Country average electricity mixes at grid used to model the production life cycle stage of product declared units.

1.3. Application

ThermaSmart and ThermaECO pipe and sheet insulation is used to insulate copper, iron and plastic piping and ducting in industrial applications and in commercial, residential and institutional buildings. The thermal insulation is suitable for hot, cold, concealed, cool and exposed piping systems operating at temperatures from -80°C up to 95°C. Additional weather protection is needed when the insulation material is used outdoors.

1.4. Declaration of Methodological Framework

EPD with respect to life cycle stages cover product life cycle from cradle-to-grave (A1-C4). Optional life cycle stages from B1 to B7 not declared as product use stages can vary, yet no maintenance, refurbishment, repair and replacement is expected during product life. Module D depicts positive environmental impact if at the end of life product is retrieved for recycling and fresh raw material input in production is substituted with recycled product. Insulation product ThermaSmart PRO is Cradle-to-Cradle certified.

Reference Service Life (RSL) for all declared products is 75years.

In cradle to grave stage, allocation is done by mass. Allocation associated with transportation from cradle-to-grave and based on weight, and estimated to be a realistic model representation.

No known flows are deliberately excluded from this EPD.

Cut off rule applied for adhesive life cycle modelling in product installation phase but it does not exceed 1% of total mass flow in the worst case scenario. It is estimated that environmental relevance over impact categories also does not exceed 1% in the worst case scenario and it is estimated that it does cover fully Global Warming Potential of environmental attribute.

1.5. Material Composition

Pipe insulation is made from Polyolefin-foam with a closed cellular structure. Around 90% of main components of products are crude oil derived and are non-renewable like polyethylene. All raw materials are produced in Europe. ThermaECO and ThermaSmart are based on polyolefin polymers and physically foamed with an organic foaming agent. Products can contain small amounts of flame retardant additives. The foaming and the propellant agent used in extrusion process does not deplete the ozone layer. Products are 100% recyclable and recycled content is used in production.

Table 2 - Raw material inputs per declared unit

Component	Wt. %	Recycled Resource	Mineral Resource	Renewable	Origin	Avg. Inbound Distance (mi)
ThermaSmart PRO						
Fire retardant masterbatch*	22.8 – 32.5		x		Europe	319
Cell stabilizer masterbatch*	2.8 - 4.0		x	x**	Europe	122
Nucleating agent masterbatch*	1.4 - 2.0		x		Europe	146
Color masterbatch*	4.3 – 6.2		x		Europe	319
Polyolefin	30.7 – 36.9		x		Europe	117
Polyolefin	0 - 6.2		x		Europe	166
Recycled ThermaSmart PRO	0 - 30.0	x	x	x**	Europe	0
ThermaSmart ENEV						

Fire retardant masterbatch*	22.8 – 32.5		x		Europe	319
Cell stabilizer masterbatch*	4.2 – 6.0		x	x**	Europe	122
Nucleating agent masterbatch*	0 - 2		x		Europe	146
Color masterbatch*	2.7 – 3.9		x		Europe	146
Polyolefin	38.3 - 40.3		x		Europe	227
Recycled ThermaSmart ENEV	0 - 30.0	x	x	x**	Europe	0
ThermaECO ZZ						
Color masterbatch*	0.3 – 0.4		x		Europe	332
Nucleating agent masterbatch*	0 – 3.0		x		Europe	146
Polyolefin	65.3 - 68.3		x		Europe	267
Cell stabilizer masterbatch*	1.4 – 2.0		x	x**	Europe	122
Recycled ThermaECO ZZ	0 - 30.0	x	x	x**	Europe	0
ThermaECO FRZ						
Color masterbatch*	2.2 – 3.1		x		Europe	235
Nucleating agent masterbatch*	0 – 3.0		x		Europe	146
Polyolefin	63.4 - 66.4		x		Europe	267
Cell stabilizer masterbatch*	1.4 – 2.0		x	x**	Europe	122
Recycled ThermaECO FRZ	0 - 30.0	x	x	x**	Europe	0

*Mixed with polyolefin

**Part of constituents is renewable

Raw material weight percentage input per declared unit depends on amount of recycled product used in production.

1.6. Manufacturing locations and product average

This Environmental Product Declaration (EPD) represents the production of ThermaSmart PRO, ThermaSmart ENEV and ThermaECO pipe and sheet insulation at Thermaflex production facilities in Żarów (PL), Schelkovo Moscow Region (RU), Merkez (TR) and Chonburi (TH).

Primary data was collected from Thermaflex production sites in the Poland, Russia, Turkey, and Thailand for the LCA study. Site specific results are obtained for (A2) transportation distances to all sites, (A3) for production steps of 1kg specific insulation product based on specific site data.

SimaPro 9 with Ecoinvent 3.6 database is used for secondary data to obtain average data to model life cycle stages A1 - A3, A4 – A5, C1 – C4 and packaging.

1.7. Packaging

Product is placed in corrugated cardboard box. Box dimensions are 210cm length by 40cm height and 60cm width. Specific weight of box was determined to be 2.6 kg on average. Secondary data from Ecoinvent v3 is selected to represent impact due to packaging use. At the end of its life, packaging is assumed to have municipal solid waste for packaging scenario (recycled: 83.5%; combusted with energy recovery: 5.7%; and landfilled: 10.8%) with 50km transportation distance.

Table 3 - Average amount (kg) of packaging per declared unit

THERMAECO FRZ, ZZ	THERMASMART PRO	THERMSMART ENEV
0.394	0.641	0.459

1.8. Transportation

Primary data included for transportation distances via truck and ship for the transport of the raw materials to the production facilities. Transport from production cailities to the construction site is also accounted for 50km, along with the transportation of product construction wastes for 50km and the deconstructed product at end-of-life to disposal for 50km.

Table 4 – Transport to building site (A4)

NAME	VALUE	UNIT
Fuel type	Diesel (Low-sulfur)	-
Liters of fuel	EURO6	various -
Vehicle type	7.5 – 16	ton
Transport distance	50	km
Capacity utilization (including empty runs, specify whether mass or volume based)	~58	%
Gross density of products transported	18 to 40	kg/m^3

1.9. Installation

Installation of foam insulation tubes is a rather simple task. Only a few tools are necessary for installation and only one consumable product might be needed — a water-based adhesive specific for foam insulation. The water-based adhesive is suggested by Thermaflex and used to bind insulation tubes together. Figure 2 with green area is highlighted where water based adhesive must be applied on insulation in order to install it on pipes properly. Tools like cutting instruments (knife, box-cutter), measuring devices, painting brushs and angle tools are necessary for specific installation of insulation.

Figure 2

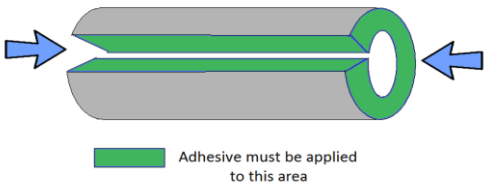


Table 5 – Installation into building (A5)

NAME	VALUE	UNIT
Ancillary materials	0 to 35	gram
Electricity consumption	0	kWh
Other energy carriers	-	MJ
Product loss per declared unit	0.05	kg
Waste materials at the construction site before waste processing, generated by product installation	0.05	kg
Output materials resulting from on-site waste processing (specified by route; e.g. for recycling, energy recovery and/or disposal)	-	kg
Mass of packaging waste specified by type	0.394 to 0.641 packaging waste scenario	kg
Biogenic carbon contained in packaging	49	%
Direct emissions to ambient air, soil and water	-	Kg
VOC emissions	-	µg/m3

1.10. Use

In the use stage, foam insulation tubes do not require maintenance or replacement and they do not require energy or material inputs (B2-B5). Analysed products do not create emissions to air or discharges to water or soil.

1.11. Disposal

In end of life (C1-C4) products can be easily dismantled from pipes by cutting them off with cutting tool (knife or box-cutter) and there are no other procedures required (module C1). Dismantled product can be gathered and transported 50km to final disposition (C2). Treatment of municipal waste by incineration assumed. Benefits of recycling are not to included in modules C1-C4 and are displayed in module D. The cut-off method is used.

Table 6 - End of life (C1-C4)

NAME		VALUE	UNIT
Collection process (specified by type)	Collected separately Collected with mixed construction waste	0.95 0	kg kg
Recovery (specified by type)	Reuse	0 (but possible up to 100%)	kg
	Recycling	0 or (0.95 module D)	kg
	Landfill	0	kg
	Incineration	-	kg
	Incineration with energy recovery	0.95	kg
	Energy conversion (specify efficiency rate)	13 electrical 25.6 thermal	%
Disposal (specified by type)	Product or material for final deposition	0	kg
Removals of biogenic carbon (excluding packaging)		-	kg CO_2

1.12. Reuse, Recycling, and Energy Recovery

Product reuse is possible. Insulation products have 100% recycling potential (module D) and ThermaSmart is Cradle-to-Cradle certified.

Environmental impacts created by internal closed loop recycling (module A1 - A3) is allocated to recycled product(co-product) which occur in production of declared unit. Impact of co-product is added to impact of declared unit as it is used in manufacturing of declared unit. Co-product of foam insulation tubes is not used to generate revenue for Thermaflex.

Feedstock energy of foam insulation tubes can be estimated based on values for polyethylene. Majority constituents of product analysed in this study consists of low-density polyethylene (LDPE). For foam insulation tubes feedstock energy is estimated to be 45MJ/kg (LHV) of product. Process energy for production of virgin polyethylene is estimated to be 46MJ/kg. In application during use phase over lifecycle foam insulation tubes will save more energy that it can be gained by its use as a fuel. At the end of life (module C1 – C4) products in disposal can be treated by waste-to-energy incineration to recover energy value product contains.

Table 7 - Scenarios and additional technical information

NAME	VALUE	UNIT
Net energy benefit from energy recovery from waste treatment declared as exported energy in C3 (R>0.6)	Not known	MJ
Net energy benefit from thermal energy due to treatment of waste declared as exported energy in C4 (R<0.6)	26	MJ

Net energy benefit from material flow declared in C3 for energy recovery	37.1	MJ
Process and conversion efficiencies	<=40	%
Further assumptions for scenario development (e.g. further processing technologies, assumptions on correction factors);	NA	NA

1.13. Reference Service Life and Estimated Building Service Life

The use phase is considered to be burden-free for insulation products as they require no maintenance and have a **75** year reference service life equal to that of the entire building.

2. Life Cycle Assessment Background Information

A 'cradle-to-grave' life cycle assessment (LCA) was conducted for ThermaSmart and ThermaECO products. The reviewer confirms the LCA Report for Thermaflex products – pipe insulation foam for sanitary, heating and cooling applications, May 2020, by New Land Company on behalf of Thermaflex International Holding, conforms to the PCR for Building-Related Products and Services - Part A: Calculation Rules for the LCA and Requirements, (UL Environment, v.3.2), Part B: Mechanical, Specialty, Thermal, and Acoustic Insulation EPD Req. UL 10010-3 v.1.0, ISO14025/40/44 ISO21930, EN 15804.

PCR are helping to increase comparability of products but one must take into consideration that EPDs, even when they comply with same PCR, can still differ due to differences in system boundaries, background data used and other variables.

2.1. Declared Unit

The Product Category Rule defines the declared unit for this analysis with a building service life (RSL) of 75 years with packaging included.

Table 8 - Declared unit parameters

NAME	VALUE	UNIT
Mass	1	kg
Density	Varies (see Table 1 - product properties as delivered to the site)	kg/m^3
Thickness (and outside diameter of piping applications)	Varies thickness from 6 to 30 (from 7 to 120 mm outside diameter)	mm
Scaling factors (piping applications)	See Table 14 - Scaling factor to one meter and Table 15 - Scaling factor to one linear foot	

In this analysis, none of the products has facing material. A declared unit is used instead of functional unit as the physical configuration of the pipe insulation influence thermal resistivity. It is virtually impossible to define a single, generic functional unit that would represent all possible configurations of pipe insulation materials.

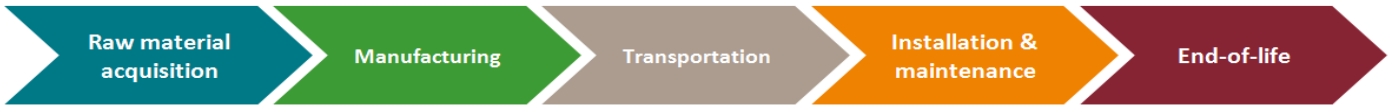
2.2. System Boundary

This study of Thermaflex foam insulation products (ThermaSmart, ThermaECO) includes life cycle information from cradle-to-grave. The analysis includes the consideration of the product stage for foam insulation tubes (extraction and

processing of raw materials, transportation to the factory and manufacturing processes with packaging). The construction process stage covers insulation product transportation to the building site from the factory gate and the installation phase (cutting, fitting and sealing thermal insulation on pipes). Lastly, the end of life stage includes the de-construction of insulation, transportation to final disposition site and disposal. The manufacturing facility heating and use of water is included. Resources of energy and materials used together with emissions to soil, water and air created over all life cycle stages of products are accounted for in the calculations of the Impact Assessment. Building operational energy and water use are considered outside of this study's scope: any impact that the use of insulation may have on a building's energy consumption is not calculated or incorporated into the analysis.

Raw material acquisition (A1-A2): Raw material extraction from nature, raw material production, raw material transportation from supplier to Thermaflex production site;
Manufacturing (A3): Manufacturing of insulation, finished product packaging, production waste recycling, releases to the environment;
Transportation (A4): Distribution of product from Thermaflex production site to building site;
Installation and maintenance (A5): Installation of product, installation wastes and releases to the environment and maintenance;
End-of-Life (C1-C4): Dismantling/demolition, transportation to final disposition site, product disposal;
Module D: Reuse, recovery and/or recycling potential expressed as net impacts and benefits.

Figure 3 - System boundaries



2.3. Estimates and Assumptions

The analysis uses the following assumptions:

- If insulation foam tubes are used in correct applications according to Thermaflex guidelines, then the product service life is 75 years;
- Thermaflex products do not require replacements over the duration of building RSL;
- Installation is done using water based adhesive that is suggested by Thermaflex;
- Installation and dismantling is done by hand and assumed not to contribute to environmental impact;
- Installation has 5% scrap rate and scrap has end-of-life municipal waste disposal scenario with 50km transportation distance;

- End-of-life for product corrugated packaging after installation(83.5% recycled, 5.7% incinerated, 10.8% landfilled).

2.4. Cut-off Criteria

Processes or activities that contribute no more than 2% of the total mass and 1% of the total energy may be omitted under PCR cut-off criteria. If omitted material flows have relevant contributions to the selected impact categories, their

exclusion must be justified by a sensitivity analysis. The sum of the excluded material flows must not exceed 5% of mass, energy or environmental relevance.

It is estimated that the largest omitted mass flow in the product life cycle is associated with installation, but it does not exceed 2% of total mass flow in the worst-case scenario. It is estimated that environmental relevance over impact categories during whole product life cycle does not exceed 2% in the worst-case scenario.

Cut-off criteria were applied to capital equipment production and maintenance. It was assumed that the impacts associated with these aspects were sufficiently small enough to fall below cut-off when it is scaled down to the declared unit.

2.5. Period under Review

Primary data was collected from production sites for insulation production from 2019 and 2020.

2.6. Data Sources

Primary data was collected from production sites. SimaPro 9.1.0.8 software is used to create LCA model. Ecoinvent3.6 was used to obtain LCI secondary data and average data for upstream (raw material production) and downstream (installation and end of life) processes.

2.7. Data Quality

Data quality of the LCA study is considered to be good to high quality. The datasets and data cover all important process steps and technologies over the supply chain of Thermaflex foam tube insulation (ThermaSmart, ThermaECO) products. The large majority of secondary data is from Ecoinvent 3.6 databases and thus represent reproducible, critically viewed data. Consistency is applied wherever possible. The data used is complete and reproducible to limited uncertainty. The geographical region represented is Europe. The technological region represented is Europe with coverage of data less than ten years old.

If data was found missing, it was critically analysed and if it had a significant impact on model results, the analysis was revised in SimaPro. Datasets for missing data were gathered and prepared based on a literature study.

2.8. Allocation

In the cradle to gate stage allocation is done by mass. Environmental impacts created by internal closed-loop recycling are allocated to recycled product (co-product) which occurs in production. The impact of the co-product is added to impact of declared unit as the co-product is used in the manufacturing of the declared unit together with raw materials. The co-product of foam insulation tubes is not sold to generate revenue for Thermaflex.

Allocation associated with transportation from cradle-to-grave is based on weight and it is estimated to be a realistic model representation.

2.9. Health, Safety and Environmental Aspects during Production

Thermaflex management is committed to provide a work environment that is safe for all employees. Thermaflex International Holding has environmental management and production certifications for its production sites in Europe for ISO 9001:2015 and ISO 14001:2015 standards.

2.10. End of life

At the end-of-life, the product is dismantled from the building (C1) and brought to disposition site 50 km away (C2). No specific waste processing for products is necessary and is excluded from the modelling (C3). Benefits of recycling are not to included in modules C1-C4. The cut-off method is used. Typical municipal waste disposal by incineration used (C4) when product dismantled for disposal. Benefits of recycling and reuse expressed in modules D.

3. Life Cycle Assessment Results and Analysis

Table 9 - Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCT-ION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Life	Building Operational Water Use During Product Life	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type	X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

X = included in LCA; MND = module not declared(optional)

3.1. Life Cycle Impact Assessment

Table 10 - LCA results

THERMAECO FRZ - CML-IA BASELINE V3.06 / EU25									
Impact category	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D - recycle**
Global warming (GWP100a)	kg CO2 eq	3.814	0.015	0.190	0.00E+00	1.01E-02	0.00E+00	2.050	-3.335
Ozone layer depletion (ODP)	kg CFC-11 eq	2.06E-07	2.70E-09	4.97E-09	0.00E+00	1.81E-09	0.00E+00	2.26E-09	-1.83E-07
Acidification	kg SO2 eq	1.61E-02	3.59E-05	1.52E-04	0.00E+00	2.41E-05	0.00E+00	1.91E-04	-1.39E-02
Eutrophication	kg PO4--- eq	7.48E-03	8.28E-06	1.04E-04	0.00E+00	5.56E-06	0.00E+00	3.92E-04	-6.02E-03
Photochemical oxidation	kg C2H4 eq	1.45E-03	1.82E-06	7.83E-06	0.00E+00	1.24E-06	0.00E+00	7.48E-06	-1.36E-03
Abiotic depletion	kg Sb eq	7.41E-05	4.92E-07	2.66E-07	0.00E+00	3.31E-07	0.00E+00	7.18E-07	-7.22E-05
Abiotic depletion (fossil fuels)	MJ	79.163	0.220	0.392	0.00E+00	1.01E-02	0.00E+00	1.24E-01	-73.4949
THERMAECO ZZ - CML-IA BASELINE V3.06 / EU25									
Impact category	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D - recycle**
Global warming (GWP100a)	kg CO2 eq	0.015	0.191	2.081	0.000	0.010	0.000	2.071	-3.236
Ozone layer depletion (ODP)	kg CFC-11 eq	2.70E-09	4.96E-09	3.82E-09	0.00E+00	1.81E-09	0.00E+00	2.01E-09	-1.78E-07
Acidification	kg SO2 eq	3.59E-05	1.52E-04	2.13E-04	0.00E+00	2.41E-05	0.00E+00	1.89E-04	-1.33E-02
Eutrophication	kg PO4--- eq	8.28E-06	1.04E-04	4.00E-04	0.00E+00	5.56E-06	0.00E+00	3.94E-04	-5.86E-03
Photochemical oxidation	kg C2H4 eq	1.9E-06	7.8E-06	8.6E-06	0.0E+00	1.2E-06	0.0E+00	7.3E-06	-1.3E-03
Abiotic depletion	kg Sb eq	4.9E-07	2.6E-07	1.0E-06	0.0E+00	3.3E-07	0.0E+00	7.0E-07	-5.0E-05

Abiotic depletion (fossil fuels)	MJ	0.220	0.392	0.276	0.000	0.148	0.000	0.128	-72.948
THERMASMART ENEV - CML-IA BASELINE V3.06 / EU25									
Impact category	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D - recycle**
Global warming (GWP100a)	kg CO2 eq	4.041	0.016	0.187	0.00E+00	1.01E-02	0.00E+00	1.779	-3.561
Ozone layer depletion (ODP)	kg CFC-11 eq	2.43E-07	2.83E-09	5.75E-09	0.00E+00	1.81E-09	0.00E+00	2.34E-09	-2.20E-07
Acidification	kg SO2 eq	2.04E-02	3.76E-05	1.74E-04	0.00E+00	2.41E-05	0.00E+00	1.97E-04	-1.81E-02
Eutrophication	kg PO4--- eq	0.017	0.000	0.000	0.00E+00	5.56E-06	0.00E+00	3.67E-04	-0.0151
Photochemical oxidation	kg C2H4 eq	1.45E-03	1.94E-06	8.91E-06	0.00E+00	1.24E-06	0.00E+00	7.62E-06	-0.0014
Abiotic depletion	kg Sb eq	3.049E-02	5.16E-07	7.76E-07	0.00E+00	3.31E-07	0.00E+00	9.83E-06	-0.0305
Abiotic depletion (fossil fuels)	MJ	77.192	0.231	0.455	0.00E+00	1.48E-01	0.00E+00	1.63E-01	-71.5133
THERMASMART PRO - CML-IA BASELINE V3.06 / EU25									
Impact category	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D - recycle**
Global warming (GWP100a)	kg CO2 eq	4.449	0.018	0.237	0.00E+00	0.010	0.00E+00	1.903	-3.967
Ozone layer depletion (ODP)	kg CFC-11 eq	2.72E-07	3.19E-09	8.01E-09	0.00E+00	1.81E-09	0.00E+00	2.75E-09	-2.49E-07
Acidification	kg SO2 eq	2.23E-02	4.25E-05	2.43E-04	0.00E+00	2.41E-05	0.00E+00	2.25E-04	-2.00E-02
Eutrophication	kg PO4--- eq	1.74E-02	9.81E-06	1.61E-04	0.00E+00	5.56E-06	0.00E+00	3.98E-04	-0.016
Photochemical oxidation	kg C2H4 eq	1.61E-03	2.19E-06	1.27E-05	0.00E+00	1.24E-06	0.00E+00	8.87E-06	-1.52E-03
Abiotic depletion	kg Sb eq	3.05E-02	5.84E-07	1.35E-06	0.00E+00	3.31E-07	0.00E+00	1.87E-05	-3.05E-02
Abiotic depletion (fossil fuels)	MJ	83.638	0.261	0.635	0.00E+00	0.148	0.00E+00	0.196	-0.031
THERMAECO FRZ - TRACI 2.1 (VERSION 1.05)									
Impact category	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D - recycle**
Global warming	kg CO2 eq	3.383	0.0151	0.188	0.00E+00	1.01E-02	0.00E+00	2.050	-2.906
Ozone depletion	kg CFC-11 eq	2.56E-07	3.57E-09	6.58E-09	0.00E+00	2.40E-09	0.00E+00	2.68E-09	-2.27E-07
Acidification	kg SO2 eq	1.45E-02	3.63E-05	1.84E-04	0.00E+00	2.44E-05	0.00E+00	2.51E-04	-1.23E-02
Eutrophication	kg N eq	1.34E-02	1.56E-05	2.23E-04	0.00E+00	1.05E-05	0.00E+00	1.04E-03	-1.02E-02
Smog	kg O3 eq	0.174	5.21E-04	4.84E-03	0.00E+00	3.50E-04	0.00E+00	7.56E-03	-0.1533
THERMAECO ZZ - TRACI 2.1 (VERSION 1.05)									
Impact category	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D - recycle**
Global warming	kg CO2 eq	3.285	0.0151	0.189	0.00E+00	1.01E-02	0.00E+00	2.072	-2.808
Ozone depletion	kg CFC-11 eq	2.51E-07	3.57E-09	6.56E-09	0.00E+00	2.40E-09	0.00E+00	2.28E-09	-2.22E-07
Acidification	kg SO2 eq	1.39E-02	3.63E-05	1.84E-04	0.00E+00	2.44E-05	0.00E+00	2.49E-04	-1.17E-02
Eutrophication	kg N eq	1.31E-02	1.56E-05	2.23E-04	0.00E+00	1.05E-05	0.00E+00	1.05E-03	-9.84E-03
Smog	kg O3 eq	0.168	5.21E-04	4.84E-03	0.00E+00	3.50E-04	0.00E+00	7.53E-03	-0.1465
THERMASMART ENEV - TRACI 2.1 (VERSION 1.05)									
Impact category	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D - recycle**
Global warming	kg CO2 eq	3.549	1.58E-02	1.85E-01	0.00E+00	1.01E-02	0.00E+00	1.78E+00	-3.071
Ozone depletion	kg CFC-11 eq	2.93E-07	3.74E-09	7.60E-09	0.00E+00	2.40E-09	0.00E+00	2.75E-09	-2.64E-07
Acidification	kg SO2 eq	1.89E-02	3.81E-05	2.11E-04	0.00E+00	2.44E-05	0.00E+00	2.53E-04	-1.67E-02

Eutrophication	kg N eq	3.35E-02	1.64E-05	2.41E-04	0.00E+00	1.05E-05	0.00E+00	9.61E-04	-3.03E-02
Smog	kg O3 eq	0.244	5.46E-04	5.54E-03	0.00E+00	3.50E-04	0.00E+00	7.21E-03	-0.223
THERMASMART PRO - TRACI 2.1 (VERSION 1.05)									
Impact category	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D - recycle**
Global warming	kg CO2 eq	3.773	1.79E-02	2.33E-01	0.00E+00	1.01E-02	0.00E+00	1.90E+00	-3.293
Ozone depletion	kg CFC-11 eq	3.38E-07	4.23E-09	1.06E-08	0.00E+00	2.40E-09	0.00E+00	3.29E-09	-3.09E-07
Acidification	kg SO2 eq	2.00E-02	4.31E-05	2.94E-04	0.00E+00	2.44E-05	0.00E+00	2.84E-04	-1.78E-02
Eutrophication	kg N eq	3.41E-02	1.85E-05	3.37E-04	0.00E+00	1.05E-05	0.00E+00	1.04E-03	-3.09E-02
Smog	kg O3 eq	0.257	6.17E-04	7.65E-03	0.00E+00	3.50E-04	0.00E+00	7.81E-03	-0.236

3.2. Use of Material and Energy Resources

Table 11 - Cumulative energy demand (by type) display energy demand for the declared unit of products over their life cycle from cradle to grave. Cumlative Energy Demand 1.11 methodology was used.

Table 11 - Cumulative energy demand (by type)

IMPACT CATEGORY	UNIT	THERMAECO FRZ	THERMAECO ZZ	THERMASMART ENEV	THERMASMART PRO
Non renewable, fossil	MJ	85.055	84.479	82.818	89.308
Non-renewable, nuclear*	MJ	7.551	7.544	7.840	8.551
Non-renewable, biomass	MJ	0.042	0.042	0.062	0.061
Renewable, biomass	MJ	1.587	1.563	1.867	1.756
Renewable, wind, solar, geothe	MJ	0.547	0.546	0.588	0.623
Renewable, water	MJ	1.739	1.608	1.948	2.137
Water resource depletion[2]	m^3 water eq	0.0159	0.0155	0.0206	0.0217

Table 12 - Installation phase (A5)

NAME	THERMASMART PRO	THERMASMART ENEV	THERMAECO	UNIT
Ancillary materials*	0.0349	0.0233	0.020	kg
Electricity consumption	0	0	0	kWh
Product loss per functional unit**	5%	5%	5%	kg
Biogenic carbon contained in packaging	0.314	0.226	0..193	kg CO_2
Direct emissions to ambient air, soil and water	0	0	0	kg

*If glueing is required (expressed per average 1kg tube product)
**Insulation product cuntings while fitting

[2] Boulay et al 2011 (Water Scarcity)
This method is based on the following publication: Boulay, A.-M.; Bulle, C.; Bayart, J.-B.; Deschenes, L.; Margni, M. Regional Characterization of Freshwater Use in LCA: Modeling Direct Impacts on Human Health Environmental Science & Technology 2011, 45, 8948-8957.

3.3. Waste to Disposal

There is no hazardous waste associated with production of these products. Installation waste is assumed to be 5% of products due to fitting on pipe installation. LCA methodology EDIP2003[3] is used to estimate waste generated during the whole life cycle (from cradle-to-grave) for the product declared unit.

Table 13 - Waste estimation for product declared unit from cradle-to-grave

IMPACT CATEGORY	UNIT	THERMAECO FRZ	THERMAECO ZZ	THERMASMART ENEV	THERMASMART PRO
Hazardous waste	kg	3.42E-05	3.23E-05	2.66E-04	2.78E-04
Slags/ashes	kg	0.075	0.061	0.086	0.101
Bulk waste	kg	0.416	0.394	0.536	0.610
Radioactive waste	kg	7.45E-05	7.27E-05	9.95E-05	1.12E-04

4. LCA Interpretation

Specific data used in LCA modelling cover time period 2019 and 2020. Main assumption made in LCA model is related to system boundary module (A4) transport from gate to site and (C2) transport at the end of life. There estimate of 50km transportation distance assumed.

All product declared units have rather similar physical characteristic but the main difference is in chemical composition and product density. That could be the main reason why in most of impact categories products show similar LCA results. ThermaEco ZZ, FRZ products environmentally outperform ThermaSmart products over LCA TRACI and CML impact assessment methods. Yet ThermaSmart PRO is technically more superior product comparing to the rest.

ThermaSmart PRO insulation foam tubes shows the highest impact over multiple impact categories. One of the reasons can be technical parameter – density and raw materials composition. To produce one declared unit of this products more time and energy is required in production. Also impact from packaging and adhesive contributing more than for the other assessed products. For example, ratio of kg packaging per kg product and kg adhesive per kg product contribute additionally to LCA results.

5. Additional Environmental Information

5.1. Scaling to Various Pipe Sizes

In this report, a declared unit is used instead of functional unit due to difficulties in defining a single, generic functional unit that is representative for all pipe insulation ranges. Calculated impact results above can be multiplied by scaling factors to estimate environmental impact per one meter of insulation.

Scaling factors for ThermaSmart foam insulation tubes are displayed in following table.
Formula– $\text{Scaling factor} = (\pi r^2 - D - r_i^2) * \text{Density}$

r-tube radius, D-tube diameter, r_i-tube internal radius, Density-tube material density.

Table 14 - Scaling factor to one meter

THERMASMART PRO		
AVERAGE DENSITY (KG/M3)	27	INSULATION SCALING FACTOR TO ONE METER

[3] Contact information: www.lca-center.dk/cms/site.aspx?p=4441

Iron Pipe size (In)	Copper Pipe size (In)	ID insulation (mm)	Wall thickness (mm) 9	Wall thickness (mm) 13	Wall thickness (mm) 15	Wall thickness (mm) 20	Wall thickness (mm) 25	Wall thickness (mm) 30
	1/4	6	0.0114	0.0209	0.0267	0.0441	0.0657	0.0916
		8	0.0130	0.0232	0.0293	0.0475	0.0700	0.0967
1/8	3/8	10	0.0145	0.0254	0.0318	0.0509	0.0742	0.1018
	1/2	12	0.0160	0.0276	0.0343	0.0543	0.0784	0.1069
1/4	5/8	15	0.0183	0.0309	0.0382	0.0594	0.0848	0.1145
3/8	3/4	18	0.0206	0.0342	0.0420	0.0645	0.0912	0.1221
1/2	7/8	22	0.0237	0.0386	0.0471	0.0712	0.0996	0.1323
	1	25	0.0260	0.0419	0.0509	0.0763	0.1060	0.1399
3/4	1 1/8	28	0.0282	0.0452	0.0547	0.0814	0.1124	0.1476
1	1 3/8	35	0.0336	0.0529	0.0636	0.0933	0.1272	0.1654
1 1/4	1 5/8	42	0.0389	0.0606	0.0725	0.1052	0.1421	0.1832
1 1/2		48	0.0435	0.0673	0.0801	0.1153	0.1548	0.1984
		50	0.0450	0.0695	0.0827	0.1187	0.1590	0.2035
	2 1/8	54	0.0481	0.0739	0.0878	0.1255	0.1675	0.2137
		57	0.0504	0.0772	0.0916	0.1306	0.1739	0.2213
2		60	0.0527	0.0805	0.0954	0.1357	0.1802	0.2290
		64	0.0557	0.0849	0.1005	0.1425	0.1887	0.2392
		70	0.0603	0.0915	0.1081	0.1527	0.2014	0.2544
	3	76	0.0649	0.0981	0.1158	0.1628	0.2141	0.2697
	3 1/8	80	0.0679	0.1025	0.1208	0.1696	0.2226	0.2799
3	3 1/2	89	0.0748	0.1125	0.1323	0.1849	0.2417	0.3028
3 1/2		102	0.0847	0.1268	0.1488	0.2069	0.2693	0.3358
		108	0.0893	0.1334	0.1565	0.2171	0.2820	0.3511
		114	0.0939	0.1400	0.1641	0.2273	0.2947	0.3664

Table 15 displays scaling factors to one linear foot for ThermaSmart PRO insulation tube.

Table 15 - Scaling factor to one linear foot

Insulation scaling factor to one linear foot					
9	**13**	**15**	**20**	**25**	**30**
0.0035	0.0064	0.0081	0.0134	0.0200	0.0279
0.0040	0.0071	0.0089	0.0145	0.0213	0.0295
0.0044	0.0077	0.0097	0.0155	0.0226	0.0310
0.0049	0.0084	0.0105	0.0165	0.0239	0.0326
0.0056	0.0094	0.0116	0.0181	0.0258	0.0349
0.0063	0.0104	0.0128	0.0196	0.0278	0.0372

0.0072	0.0118	0.0143	0.0217	0.0304	0.0403
0.0079	0.0128	0.0155	0.0233	0.0323	0.0427
0.0086	0.0138	0.0167	0.0248	0.0343	0.0450
0.0102	0.0161	0.0194	0.0284	0.0388	0.0504
0.0119	0.0185	0.0221	0.0321	0.0433	0.0558
0.0133	0.0205	0.0244	0.0352	0.0472	0.0605
0.0137	0.0212	0.0252	0.0362	0.0485	0.0620
0.0147	0.0225	0.0268	0.0383	0.0511	0.0651
0.0154	0.0235	0.0279	0.0398	0.0530	0.0675
0.0161	0.0245	0.0291	0.0414	0.0549	0.0698
0.0170	0.0259	0.0306	0.0434	0.0575	0.0729
0.0184	0.0279	0.0330	0.0465	0.0614	0.0775
0.0198	0.0299	0.0353	0.0496	0.0653	0.0822
0.0207	0.0313	0.0368	0.0517	0.0679	0.0853
0.0228	0.0343	0.0403	0.0564	0.0737	0.0923
0.0258	0.0386	0.0454	0.0631	0.0821	0.1024
0.0272	0.0407	0.0477	0.0662	0.0859	0.1070
0.0286	0.0427	0.0500	0.0693	0.0898	0.1117

Health, Safety, and Environmental Aspects during Installation

ThermaSmart and ThermaECO are thermoplastic polyolefin foams that can contain flame retardant additives and are produced in a continuous extrusion process. When handling insulation materials, one should practice reasonable care as a normal safety precaution. When storing insulation materials, one should practice reasonable care and cleanliness, and provide adequate distance between stacks as a safety precaution. Materials should not be exposed to any source of flame or ignition. Inside storage is recommended due to potential of degradation from UV light.

Toxicological information: After contact with skin or eyes, no special measures are required. Polyolefin foams are among the most inert polymer foams and constitute no hazards in terms of normal handling and skin contact.11

Ecological information: Environmentally harmless:

- insoluble in water: no contamination
- insoluble in most solvents
- degradable only by UV light

Material safety data and technical data sheets are available:

ThermaSmart - https://thermaflex.com/en/products/insulation/thermasmart-pro#!downloads;

ThermaECO - https://thermaflex.com/en/products/insulation/thermaeco-frz#!downloads.

For additional product information, contact Thermaflex - https://thermaflex.com/en/offices.

Indoor environment

ThermaSmart and ThermaECO pipe insulation products are safe to use in an indoor environment. Products are certified by the Polish National Institute of Hygiene. Products have been tested for VOC emissions at Eurofins Product Testing A/S based on published methods: ISO 16000-3, ISO 16000-6, ISO 16000-9, ISO 16000-10, ISO 16000-11.

Environmental Activities and Certifications

Thermaflex product TharmaSmart PRO and other products are Cradle-to-Cradle certified. https://www.c2ccertified.org/products/scorecard/thermasmart-pro-thermaflex-international-holding-b.v

Building use stage benefits

Table 16 - **Savings 1 meter in 1 hour in W/m. Medium 60 & Environment 24 degrees Celsius. Windspeed 0** Table 17 - **Savings 1 ft in 1 hour in BTU/hr·ft. Medium 140 & Environment 75 degrees Fahrenheit. Windspeed 0** and Table 18 - **Savings 1 meter in 1 hour in W/m. Medium 60 & Environment 24 degrees Celsius. Windspeed 0** display energy savings figures according to EN-ISO 12241 for foam insulation tubes. Savings are calculated with conditions of 24°C temperature surrounding environment, 60 °C of insulated medium in pipe and 0m/s of wind speed.

Table 16 - Savings 1 meter in 1 hour in W/m. Medium 60 & Environment 24 degrees Celsius. Windspeed 0

Horizontal Pipe			Energy loss uninsulated	Savings with wall thickness insulation (mm)					
Iron Pipe size (In)	Copper Pipe size (In)	ID insulation (mm)		Wall thickness (mm) 9	Wall thickness (mm) 13	Wall thickness (mm) 15	Wall thickness (mm) 20	Wall thickness (mm) 25	Wall thickness (mm) 30
	1/4	6	12.10	6.90	7.60	7.80	8.20	8.50	8.70
		8	15.40	9.40	10.20	10.50	11.00	11.30	11.60
1/8	3/8	10	18.70	11.90	12.90	13.20	13.80	14.20	14.50
	1/2	12	21.80	14.20	15.40	15.80	16.50	16.90	17.30
1/4	5/8	15	26.40	17.70	19.10	19.60	20.40	21.00	21.40
3/8	3/4	18	30.90	21.10	22.70	23.30	24.30	24.90	25.40
1/2	7/8	22	36.80	25.60	27.50	28.20	29.40	30.10	30.70
	1	25	41.10	28.80	31.00	31.80	33.10	33.90	34.60
3/4	1 1/8	28	45.40	32.10	34.50	35.30	36.80	37.70	38.40
1	1 3/8	35	55.10	39.30	42.30	43.30	45.10	46.30	47.10
1 1/4	1 5/8	42	64.60	46.40	50.00	51.20	53.30	54.70	55.70
1 1/2		48	72.60	52.40	56.40	57.80	60.20	61.60	62.90
	2 1/8	54	80.50	58.20	62.80	64.30	67.00	68.70	70.00
		57	84.50	61.20	66.00	67.60	70.40	72.30	73.60
2		60	88.40	64.10	69.10	70.80	73.80	75.70	77.10

		64	93.60	67.90	73.30	75.10	78.20	80.30	81.80
		70	101.30	73.60	79.40	81.40	84.80	87.10	88.70
	3	76	108.90	79.20	85.50	87.60	91.30	93.80	95.50
	3 1/8	80	114.00	83.00	89.60	91.80	95.70	98.30	100.10
3	3 1/2	89	125.10	91.00	98.40	100.90	105.20	108.00	110.00
3 1/2		102	141.40	103.00	111.40	114.20	119.10	122.40	124.60
		108	148.80	108.40	117.30	120.20	125.50	128.90	131.30
		114	156.10	113.70	123.10	126.20	131.70	135.30	137.80

Table 17 - Savings 1 ft in 1 hour in BTU/hr·ft. Medium 140 & Environment 75 degrees Fahrenheit. Windspeed 0

Iron Pipe size (In)	Copper Pipe size (In)	ID insulation (mm)	Energy loss uninsulated	Wall thickness (inch) 0.354	Wall thickness (inch) 0.51	Wall thickness (inch) 0.59	Wall thickness (inch) 0.787	Wall thickness (inch) 0.98	Wall thickness (inch) 1.18
	1/4	6	12.58	7.18	7.90	8.11	8.53	8.84	9.05
		8	16.02	9.78	10.61	10.92	11.44	11.75	12.06
1/8	3/8	10	19.45	12.38	13.42	13.73	14.35	14.77	15.08
	1/2	12	22.67	14.77	16.02	16.43	17.16	17.58	17.99
1/4	5/8	15	27.46	18.41	19.86	20.38	21.22	21.84	22.26
3/8	3/4	18	32.14	21.94	23.61	24.23	25.27	25.90	26.42
1/2	7/8	22	38.27	26.62	28.60	29.33	30.58	31.30	31.93
	1	25	42.74	29.95	32.24	33.07	34.42	35.26	35.98
3/4	1 1/8	28	47.22	33.38	35.88	36.71	38.27	39.21	39.94
1	1 3/8	35	57.31	40.87	43.99	45.03	46.90	48.15	48.98
1 1/4	1 5/8	42	67.19	48.26	52.00	53.25	55.43	56.89	57.93
1 1/2		48	75.51	54.50	58.66	60.11	62.61	64.07	65.42
		50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2 1/8	54	83.72	60.53	65.31	66.87	69.68	71.45	72.80
		57	87.88	63.65	68.64	70.31	73.22	75.19	76.55
2		60	91.94	66.67	71.87	73.63	76.75	78.73	80.19
		63	97.35	70.62	76.23	78.11	81.33	83.51	85.07
		70	105.35	76.55	82.58	84.66	88.19	90.59	92.25
	3	76	113.26	82.37	88.92	91.11	94.95	97.55	99.32
	3 1/8	80	118.56	86.32	93.19	95.47	99.53	102.23	104.11
3	3 1/2	89	130.11	94.64	102.34	104.94	109.41	112.32	114.40
3 1/2		102	147.06	107.12	115.86	118.77	123.87	127.30	129.59
		108	154.76	112.74	121.99	125.01	130.52	134.06	136.55
		114	162.35	118.25	128.03	131.25	136.97	140.71	143.31

Table 18 - Savings 1 meter in 1 hour in W/m. Medium 60 & Environment 24 degrees Celsius. Windspeed 0

Horizontal Pipe				Savings with wall thickness insulation (mm)					
Iron Pipe size (In)	Copper Pipe size (In)	ID insulation (mm)	Energy loss uninsulated	9	13	15	20	25	30
	1/4	6	12.10	6.90	7.60	7.80	8.20	8.50	8.70
		8	15.40	9.40	10.20	10.50	11.00	11.30	11.60
1/8	3/8	10	18.70	11.90	12.90	13.20	13.80	14.20	14.50
	1/2	12	21.80	14.20	15.40	15.80	16.50	16.90	17.30
1/4	5/8	15	26.40	17.70	19.10	19.60	20.40	21.00	21.40
3/8	3/4	18	30.90	21.10	22.70	23.30	24.30	24.90	25.40
1/2	7/8	22	36.80	25.60	27.50	28.20	29.40	30.10	30.70
	1	25	41.10	28.80	31.00	31.80	33.10	33.90	34.60
3/4	1 1/8	28	45.40	32.10	34.50	35.30	36.80	37.70	38.40
1	1 3/8	35	55.10	39.30	42.30	43.30	45.10	46.30	47.10
1 1/4	1 5/8	42	64.60	46.40	50.00	51.20	53.30	54.70	55.70
1 1/2		48	72.60	52.40	56.40	57.80	60.20	61.60	62.90
		50							
	2 1/8	54	80.50	58.20	62.80	64.30	67.00	68.70	70.00
		57	84.50	61.20	66.00	67.60	70.40	72.30	73.60
2		60	88.40	64.10	69.10	70.80	73.80	75.70	77.10
		64	93.60	67.90	73.30	75.10	78.20	80.30	81.80
		70	101.30	73.60	79.40	81.40	84.80	87.10	88.70
	3	76	108.90	79.20	85.50	87.60	91.30	93.80	95.50
	3 1/8	80	114.00	83.00	89.60	91.80	95.70	98.30	100.10
3	3 1/2	89	125.10	91.00	98.40	100.90	105.20	108.00	110.00
3 1/2		102	141.40	103.00	111.40	114.20	119.10	122.40	124.60
		108	148.80	108.40	117.30	120.20	125.50	128.90	131.30
		114	156.10	113.70	123.10	126.20	131.70	135.30	137.80

6. Supporting Documentation

For the normative references mentioned in standard NEN-EN 14313+A1 - Thermal insulation products for building equipment and industrial installations – Factory made polyethylene foam (PEF) products - Specification, the following equivalents exist in the Netherlands that's used at Thermaflex:

Mentioned standard * Dutch standard * Title

EN 822 * NEN-EN 822 * Materials for the thermal insulation of buildings - Determination of length and width

EN 823 * NEN-EN 823 * Materials for the thermal insulation of buildings - Determination of thickness

EN 824 * NEN-EN 824 * Materials for the thermal insulation of buildings - Determination of squareness

EN 1604 * NEN-EN 1604 * Materials for the thermal insulation of buildings - Determination of the dimensional stability at specified temperature and humidity conditions

EN 1609 * NEN-EN 1609 * Materials for the thermal insulation of buildings - Determination of the water absorption at short-term partial immersion

EN 12085 * NEN-EN 12085 * Materials for the thermal insulation of buildings - Determination of linear dimensions of test pieces

EN 12086 * NEN-EN 12086 * Materials for the thermal insulation of buildings - Determination of the water vapor permeability properties

EN 12667 * NEN-EN 12667 * Thermal properties of building materials and products - Determination of heat resistance according to the shielded hot plate method and the method with heat flow meter - Products with an average and a high heat resistance

EN 12939 * NEN-EN 12939 * Thermal properties of building materials and products - Determination of heat resistance according to the methods with the shielded "hot plate "and the heat flow meter - Thick products with a high and an average heat resistance

EN 13172 * NEN-EN 13172 * Products for thermal insulation - Conformity assessment

EN 13467 * NEN-EN 13467 * Materials for the thermal insulation of buildings industrial plants - Determination of dimensions, squareness and straightness of preformed pipe insulation

EN 13468 * NEN-EN 13468 * Materials for the thermal insulation of buildings industrial plants - Determination of trace quantities of water-soluble chloride, fluoride, silicate, and sodium ions and pH

EN 13469 * NEN-EN 13469 * Materials for the thermal insulation of buildings industrial plants - Determination of the water vapor permeability properties of preformed pipe insulation

EN 13472 * NEN-EN 13472 * Materials for the thermal insulation of buildings industrial plants - Determination of the water absorption with short-term partial immersion of preformed pipe insulation

EN 13501-1: 2007 * NEN-EN 13501-1: 2007 * Fire classification of construction products and building parts - Part 1: Classification based on results of fire behavior testing

EN 13823 * NEN-EN 13823 * Determination of the fire behavior of construction products - Construction products, with the exception of floor finishes, exposed to a thermal attack with a burning object

EN 14366: 2004 * NEN-EN 14366: 2004 * Laboratory measurements of noise from wastewater plants

EN 14706 * NEN-EN 14706 * Materials for the thermal insulation of buildings industrial plants - Determination of the maximum operating temperature

EN 14707 * NEN-EN 14707 * Materials for the thermal insulation of buildings industrial plants - Determination of the maximum operating temperature for preformed pipe insulation

EN 15715: 2009 * NEN-EN 15715: 2009 * Thermal insulation products - Instructions for fixings and connections for comments on fire tests - Factory manufactured Products

EN ISO 354 * NEN-EN-ISO 354 * Acoustics - Measurement of sound absorption in one reverberation room

EN ISO 3822-1 * NEN-EN-ISO 3822-1 / A1 * Acoustics - Laboratory testing of the noise emissions from installations and fittings appliances used in water supply installations – Part 1: Measurement method - Amendment 1: Measurement uncertainty

EN ISO 4589-1 * NEN-EN-ISO 4589-1 * Plastics - Determination of the fire behavior with the oxygen index - Part 1: Guidance

EN ISO 8497 * NEN-EN-ISO 8497 * Thermal insulation - Determination of stationary thermal conductivity properties of heat insulation of pipes

EN ISO 11654 * NEN-EN-ISO 11654 * Acoustics - Silencers for use in buildings - Single number designator for the sound absorption

EN ISO 11925-2 * NEN-EN-ISO 11925-2 * Fire behavior tests - Flammability of construction products with direct exposure to flames - Part 2: Test with flames of one source

EN ISO 13787 * NEN-EN-ISO 13787 * Thermal insulation materials for buildings industrial plants - Determination of the declared value for thermal conductivity

7. References

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14. UL Environment PCR Part A: Life Cycle Assessment Calculation Rules and Report Requirements (December 2018, version 3.2)
15. UL Environment PCR Part B: Mechanical, Specialty, Thermal, and Acoustic Insulation Product EPD Requirements, UL 10010–03 v.1.0, September 2019

8. EPD Development

The EPD and LCA study was prepared with support from New Land Company (Mail: info@newlandcorporation.com) and UL Environment.

9. Contact Information

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