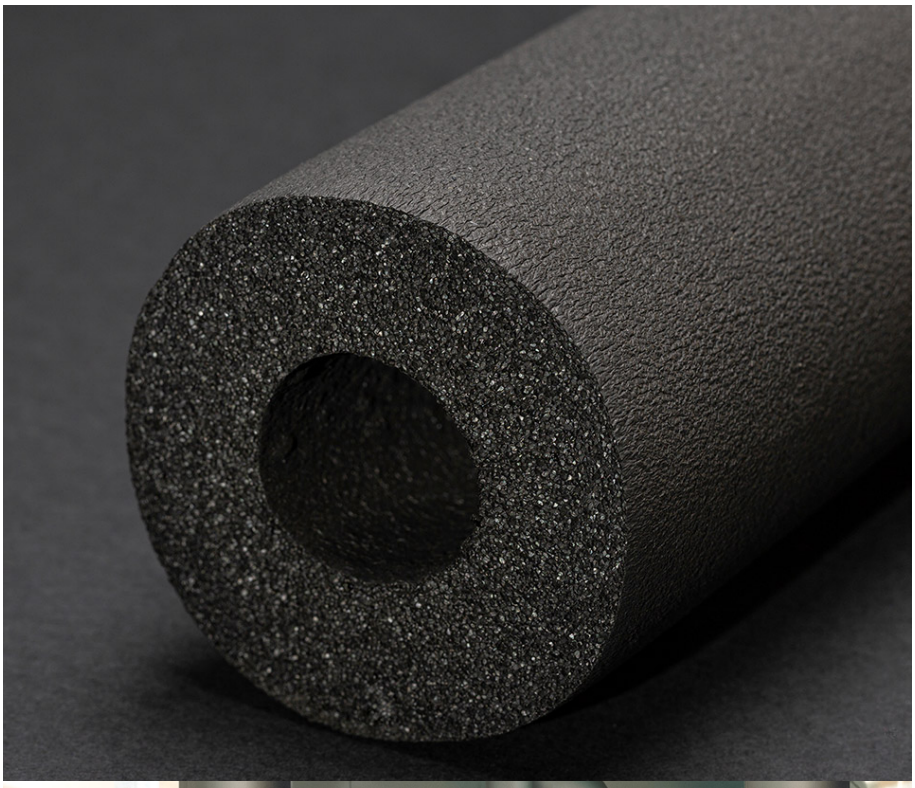
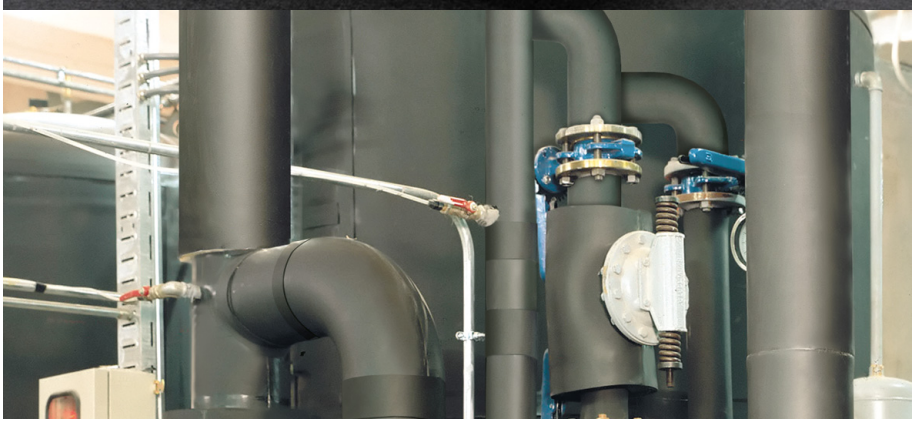
Environmental Product Declaration

K-FLEX ST, K-FLEX EC, K-FLEX SOLAR HT, K-FLEX TITAN, M-FLEX, K-FLEX K-PROTECT, INSULSHEET / INSULTUBE, K-FLEX CLASS 1, FRIGO, K-FLEX ECO

K-FLEX PIPE INSULATION FOR PRODUCTS INDUSTRIAL AND BUILDING INSTALLATION





K-FLEX
INNOVATION IN INSULATION

Environmental protection is one of the main pillars of corporate philosophy in K-FLEX. It is an integral part of the business strategy and ranks equally with other company objectives.

K-FLEX practices active environmental protection throughout the company. To efficiently utilize resources, we are constantly searching for ways to reduce raw material use, energy consumption and waste.

The environmental policy obliges all K-FLEX employees worldwide to aim to protect the environment and conserve natural resources.

For more information visit:
https://corporate.kflex.com
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ENVIRONMENTAL PRODUCT DECLARATION

K-FLEX
INNOVATION IN INSULATION

K-FLEX ST, K-FLEX EC, K-FLEX SOLAR HT, K-FLEX TITAN, M-FLEX, K-FLEX
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According to ISO 14025,
EN 15804 and ISO 21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL ENVIRONMENT 333 PFINGSTEN RD, NORTHBROOK, IL 60062 WWW.UL.COM WWW.SPOT.UL.COM
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	Program Operator Rules v 2.7 2022
EPD OWNER	K-FLEX (HONG KONG) INSULATION COMPANY LIMITED Address: 5/F, Manulife Place, 348 Kwun Tong Road, Kowloon, Hong Kong
MANUFACTURER NAME AND ADDRESS	**- K-FLEX MALAYSIA SDN BHD** Lot 2752, Jalan Raja Nong, Taman Klang Jaya, 41200 Klang, Selangor. **- L'ISOLANTE K-FLEX (SUZHOU) CO. LTD.** 2728 North Linhu Avenue, FOHO Hi-Tech Industrial Development Zone, Wujiang District, Suzhou City, Jiangsu Province, P.R. China 215211 **- K-FLEX (VIETNAM) CO. LTD.** Lot C8-3 & C8-4, Dai Dong- Hoan Son IP, Hoan Son Commune, Tien Du District, Bac Ninh Province
DECLARATION NUMBER	4790017808.102.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	1 m
REFERENCE PCR AND VERSION NUMBER	Product Category Rules for Building-Related Products and Services, Part A: Life Cycle Assessment Calculation Rules and Report Requirements; Part B: Mechanical, Specialty, Thermal, and Acoustic Insulation Product EPD Requirements.
DESCRIPTION OF PRODUCT APPLICATION/USE	Insulation
PRODUCT RSL DESCRIPTION (IF APPL.)	75 years
MARKETS OF APPLICABILITY	Global
DATE OF ISSUE	December 1, 2022
PERIOD OF VALIDITY	5 Years
EPD TYPE	Product-specific
RANGE OF DATASET VARIABILITY	Industry-average only
EPD SCOPE	Cradle to gate with options (A4, A5, C1, C2, C4)
YEAR(S) OF REPORTED PRIMARY DATA	2020
LCA SOFTWARE & VERSION NUMBER	SimaPro 9
LCI DATABASE(S) & VERSION NUMBER	Ecoinvent 3.6
LCIA METHODOLOGY & VERSION NUMBER	CML-IA (Baseline)

The PCR review was conducted by:	UL Environment PCR Review Panel epd@ul.com
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Environment
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Ecovane
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	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: Comparison of the environmental performance of construction works and construction products using EPD information shall be based on the product's use and impacts at the construction works level. In general, EPDs may not be used for comparability purposes when not considered in a construction works context. Given this PCR ensures products meet the same functional requirements, comparability is permissible provided the information given for such comparison is transparent and the limitations of comparability explained. When comparing EPDs created using this PCR, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

1. Product Definition and Information

1.1. Description of Company/Organization

K-FLEX is a multinational manufacturing company specialised in the production of thermal and acoustic flexible elastomeric insulation materials. Due to its focus on technological innovation and the quality of its products and services, K-FLEX is a worldwide market leader with more than thirty years' experience across a variety of business areas.

K-FLEX is continuing to strengthen penetration in the high growth emerging markets. The company's focus is to pursue new business opportunities in Asia Pacific, the Middle East, Eastern Europe and North America in order to expand its market in key countries all around the world. In addition, K-FLEX is committed to discover new synergy, combining different solutions and designing new systems to offer to the customers the most possible effective and accurate service.

The K-FLEX company has been awarded certificates for compliance with the following standards:

- ISO 50001:2011- Energy Management Systems

- ISO 14001:2015 - Environmental Management System

1.2. Product Description

1.2.1 Product Identification

K-FLEX insulation products have shown the advantages of continuous energy saving and condensation control. The combination of low thermal conductivity and high resistance to water vapour transmission prevents long-term energy losses and water vapour ingress and reduces the risk of corrosion under insulation.

K-FLEX insulation materials made of elastomer and cross-linked polyethylene are supplied in sheets, tubes and shaped pieces. K-FLEX pipe insulation products will properly protect the pipework and contribute to better thermal and acoustic performance.

There are ten types of K-FLEX insulation products in this EPD report, namely K-FLEX ST, K-FLEX EC, K-FLEX SOLAR HT, K-FLEX TITAN, M-FLEX, K-FLEX K-PROTECT, INSULSHEET / INSULTUBE, K-FLEX CLASS 1, FRIGO, K-FLEX ECO. These insulation materials are based on synthetic rubber, consisting of 5 groups of raw materials. Illustrating in Figure 1, K-FLEX ST shows an example of K-FLEX pipe insulation products.

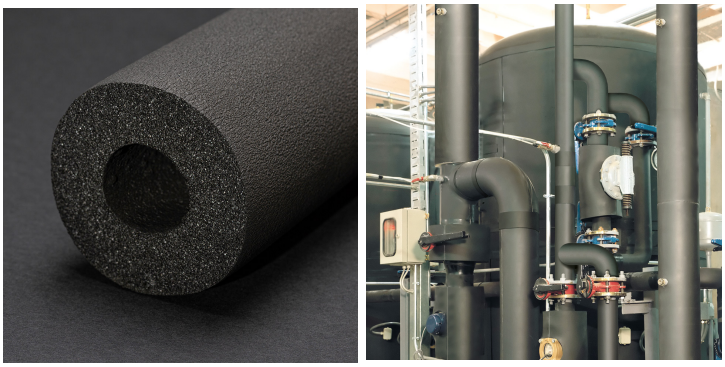

Figure 1: K-FLEX pipe insulation products

1.2.2 Product Specification

Table 1 presents technical data of pipe insulation products from gross density to fire resistance rate while the Figure 2 illustrates involving stages of products life cycle through a flow diagram.

Table 1: Technical data of K-FLEX pipe insulation products

PARAMETER	UNIT	K-FLEX ST	K-FLEX EC	K-FLEX SOLAR HT	K-FLEX TITAN	M-FLEX	K-FLEX K-PROTECT	INSULSHEET / INSULTUBE	K-FLEX CLASS 1	FRIGO	K-FLEX ECO
Gross density	kg/m^3	45~90	45~90	45~90	45~90	45~90	30 (Foam only)	45~90	45~90	45~90	45~90
Water vapor diffusion resistance factor	-	m>10,000	m>7,000	Water absorption: <0.1%	m>10,000	m>7,000	m>20,000	m>10,000	m>10,000	m>7,500	m>3,000
Thermal conductivity @ 0 ℃	W/(m.k)	0.032	0.034	0.04	0.032	0.036	0.032 (20C)	0.032	0.035	0.034	0.038
Minimum service temperature	℃	-200	-45	-40	-57	-45	-40	-200	-50	-40	-200
Maximum service temperature	℃	116	116	150	104	105	115	116	105	105	150
Fire resistance rating		1) BS476 CLASS 0 2) FM Approved 3) ASTM E84: 25/30 4) GB8624 Class B1 5) DNV IMO Certified	1) BS476 CLASS 1 2) UL94: V0, 5VA 3) BOMBA CLASS 0	1) Euro Class E 2) BS476 CLASS 0	1) BS476 CLASS 0 2) ASTM E84: 25/50 3) UL 94: HF-1, V-0, 5VA	1) BS476 CLASS 0 2) UL 94 HF-1, V-0, 5VA	1) FM Approved 2) BS476 CLASS 0 3) ASTM E84: 25/50	1) FM Approved 2) BS476 CLASS 0	1) GB8624 Class 1	1) CB8624 Not lower than Class C	1) BS476 CLASS 1 2) Euro Class E

1.2.3 Flow Diagram

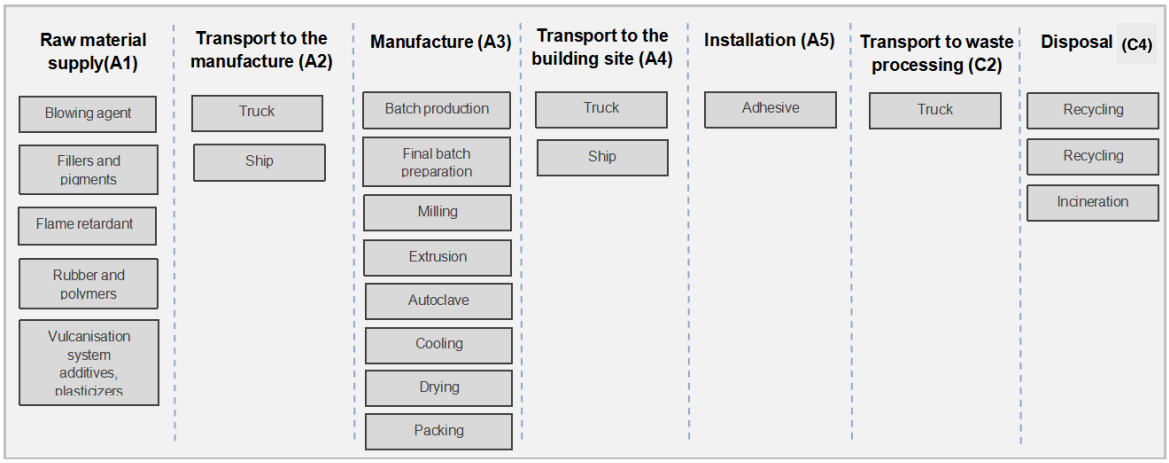

Figure 2: The flow diagram of K-FLEX pipe insulation products

1.2.4 Product-Specific EPD

This declaration covers ten types of K-FLEX pipe insulation products: K-FLEX ST, K-FLEX EC, K-FLEX SOLAR HT, K-FLEX TITAN, M-FLEX, K-FLEX K-PROTECT, INSULSHEET / INSULTUBE, K-FLEX CLASS 1, FRIGO, and K-FLEX ECO. The allocating energy and material usage within the production site, allocations were carried out based on the average annual mass ratio.

1.3. Application

K-FLEX insulation materials are used to insulate pipes, air ducts and vessels including fittings and flanges of industrial installations and building equipment. The application of K-FLEX pipe insulation materials are as follow:

- Condensation control, energy saving and noise control in refrigeration and air conditioning equipment and process plants.
- Energy saving according to local energy saving laws, prevention of heat loss and noise reduction of heating and plumbing systems.
- Condensation control and noise reduction in service-water and waste-water systems.
- Condensation control, energy saving and noise control in refrigeration and air conditioning equipment in the ship-building sector.

1.4. Declaration of Methodological Framework

A full LCA approach was considered in this project while applying generic data model for most background systems. The EPD analysis used a cradle-to-grave system boundary and no known flows were deliberately excluded from this EPD.

A 75-year reference service life (RSL) was assumed for the declared products to calculate the LCA results for the product maintenance stage.

Additional details on assumptions, cut-offs and allocation procedures can be found in the *section 2: Methodological Framework*.

1.5. Properties of Declared Product as Delivered

According to K-FLEX, the target market of products including China, south East Asia, South Asia, and other regions. It should be noted that road and oceanic transportation distance for product delivery is estimated by K-FLEX and details can be found in Table 2. The sales proportion for each production site is calculated separately.

Table 2: Transportation of pipe insulation products

Production Site	Market area	Distance km	Truck/ ship	Percentage	K-FLEX ST	K-FLEX EC	K-FLEX SOLAR HT	K-FLEX TITAN	M-FLEX	K-FLEX K-PROTECT	INSULSHEET / INSULTUBE	K-FLEX CLASS 1	FRIGO	K-FLEX ECO
Malaysia	Malaysia	150	Truck	%	11	69		20		45				
	Singapore	400	Truck	%	22			80		5				
	Thailand	1470	Truck	%	28	13			58	20				
	Vietnam	1182	Ship	%	8				37	10				
	Philippine	2377	Ship	%	10				5					
	Australia	4743	Ship	%	16		100			15				
	New	8891	Ship	%	3									
	Cambodia	2000	Ship	%		17								
	Indonesia	3470	Ship	%	1					5	100			
Vietnam	Philippines	2167	Ship	%					16					
	Thailand	2726	Ship	%					35					
	Australia	8470	Ship	%	12									
	Korea	3727	Ship	%	88									
	Hanoi	50	Truck	%					48					
	TP. Ho Chi Minh	1605	Truck	%					2					
China	North China	1146	Truck	%	19							13	5	81
	South China	1410	Truck	%	10							30	29	19
	East China	80	Truck	%	44							41	37	
	West China	1990	Truck	%	27							16	29	

1.6. Material Composition

This EPD report includes K-FLEX ST, K-FLEX EC, K-FLEX SOLAR HT, K-FLEX TITAN, M-FLEX, K-FLEX K-PROTECT, INSULSHEET / INSULTUBE, K-FLEX CLASS 1, FRIGO, and K-FLEX ECO. These pipe insulation materials are based on synthetic rubber, consisting of approximately 20 basic components.

The materials of pipe insulation materials are based on synthetic rubber, consisting of approximately 20 basic components. Table 3 displays the composition split into functional substance groups. The quantities are based on declared unit.

Table 3: Composition/formulation of K-FLEX pipe insulation products

COMPOSITION	K-FLEX ST	K-FLEX EC K-FLEX SOLAR HT K-FLEX TITAN M-FLEX K-FLEX K-PROTECT INSULSHEET / INSULTUBE	K-FLEX CLASS 1 FRIGO K-FLEX ECO
Blowing agent	12.26%-23.1%	23.10%	12.26%
Fillers and pigments	3.44%-19.98%	19.98%	3.44%
Flame retardant	1.09%-29.01%	1.09%	29.01%
Rubber and polymers	9.71%-10.39%	10.39%	9.71%
	16.85%-17.69%	17.69%	16.85%
Vulcanisation system additives, plasticizers	3.88%-4.06%	3.88%	4.06%
	23.86%-24.68%	23.86%	24.68%

2. Methodological Framework

2.1. Declared Unit

In this study, the declared units for the piping insulation materials is defined as 1m of insulation product for Piping applications with service time of 75 years with packaging included. Parameters per declaration unit that support the calculation of the LCA results are depicted in tables below.

Table 4-1: Declared units for pipe applications

NAME	PIPE APPLICATIONS	
	Value	unit
K-FLEX ST	1	m
K-FLEX EC	1	m
K-FLEX SOLAR HT	1	m
K-FLEX TITAN	1	m
M-FLEX	1	m
K-FLEX K-PROTECT	1	m
INSULSHEET / INSULTUBE	1	m
K-FLEX CLASS 1	1	m
FRIGO	1	m
K-FLEX ECO	1	m

Table 4-2: Additional declared unit parameters

Name		Value (Pipe applications)		Unit
Mass	K-FLEX ST	0.684		kg
	K-FLEX EC	0.684		kg
	K-FLEX SOLAR HT	0.684		kg
	K-FLEX TITAN	0.143		kg
	M-FLEX	0.684		kg
	K-FLEX K-PROTECT	0.413		kg
	INSULSHEET / INSULTUBE	0.684		kg
	K-FLEX CLASS 1	0.684		kg
	FRIGO	0.684		kg
	K-FLEX ECO	0.684		kg
Density	K-FLEX ST	45~90		kg/m^3
	K-FLEX K-FONIK OPEN CELL	/		kg/m^3
	K-FLEX SOLAR HT	45~90		kg/m^3
	K-FLEX TITAN	45~90		kg/m^3
	M-FLEX	45~90		kg/m^3
	K-FLEX K-PROTECT	30		kg/m^3
	INSULSHEET / INSULTUBE	45~90		kg/m^3
	K-FLEX CLASS 1	45~90		kg/m^3
	FRIGO	45~90		kg/m^3
	K-FLEX ECO	45~90		kg/m^3
Thickness (and outside diameter for piping applications)		0.6-5 (average: 2.8)	Thickness: 0.6-5 (average: 2.81) Diameter: K-FLEX TITAN:1.8-10 (average: 5.9) K-FLEX K-PROTECT:1.8-35 (average: 18.4) Others:1.8-26 .8 (average: 14.3)	cm

2.2. System Boundary

This study of K-FLEX foam insulation products includes life cycle information from cradle to installation with end of life. The product stage for foam insulation tubes and sheets products includes extraction and processing of raw materials, transportation to the factory and manufacturing processes with packaging and all the rest. The construction process stage includes transportation of insulation product to the building site from the factory and the installation phase. And the end of life stage includes transportation of waste products to final disposition site and disposal. Over the life cycle stages of products, resources of energy and materials used together with emissions to soil, water and air are accounted for in the calculations of the Impact Assessment. Building's additional operational energy and water use are considered outside of this study's scope: any impact may have on a building's energy consumption by the use of insulation is not calculated or incorporated into the analysis. The system boundaries for the K-FLEX insulation product is illustrated in Figure 3.

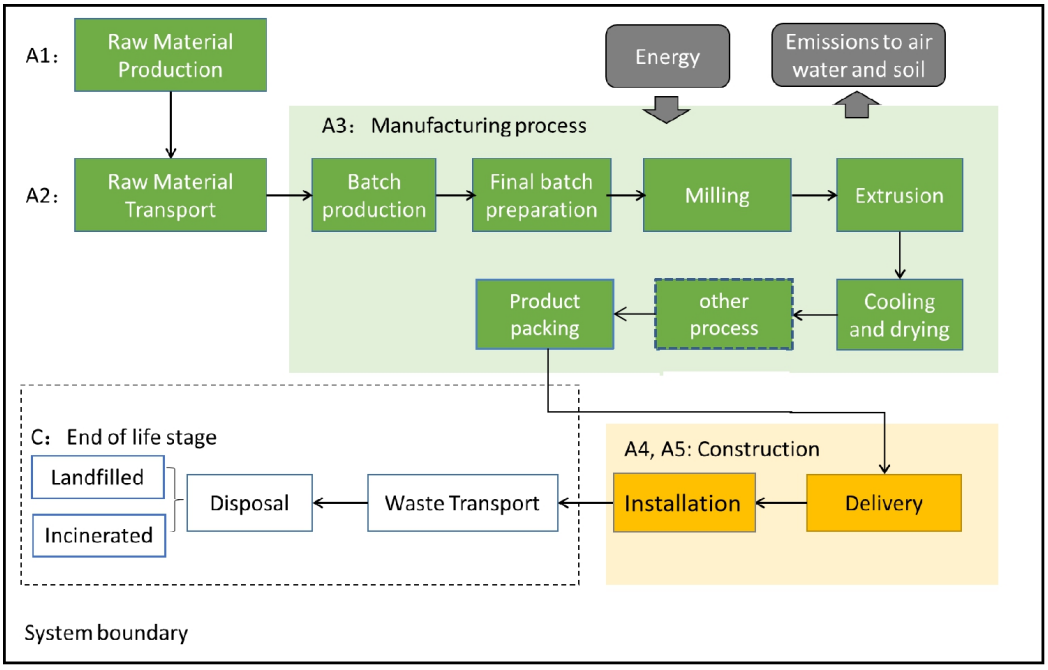

Figure 3: System boundary of insulation products

2.3. Allocation

Allocation refers to partitioning of input or output flows of a process or a product system between the product systems under study and one or more other product systems.

Multi-input processes

For data sets in this study, the allocation of the inputs from coupled processes is generally carried out via the mass and volume. The consumption of raw materials is allocated by mass ratio. The transportation of raw materials is allocated by mass. And for foam production, the total consumption of energy and water during manufacturing is equally allocated to per unit volume of foam product. The allocation of total energy consumption among various productions stages is divided by calculation of power consumption rate times operation time of each product stage for each product type during production, as no other approach of allocation of energy consumption for each type of product is taken.

Multi-output processes

In this study, there is no other by products produced from the production line, hence, there is quite little occasion that required allocation for multi-output processes. One allocation occurs on the environmental emissions allocation, especially in the area of waste treatment. The environmental emissions of product are allocated by mass and volume to each unit product respectively. In the end of life stage, the allocation within the disposal scenario follows mass allocation, which applies to waste treatment process inventory adopted from Ecoinvent data.

2.4. Cut-off Rules

The following procedure was followed for the exclusion of inputs and outputs:

All inputs and outputs to a (unit) process will be included in the calculation for which data is available. Data gaps may

be filled by conservative assumptions with average or generic data. Any assumptions for such choices will be documented;

In case of insufficient input data or data gaps for a unit process, according to the PCR requirement, the cut-off criteria chosen is 1% of renewable and non-renewable primary energy usage and 1% of the total mass of that unit process. The total neglected input flows of the cradle to installation with end of life stage, e.g. per module A1-A3, A4-A5, C1, C2 and C4 shall be a maximum of 5% of energy usage and mass.

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.

Material and energy flows known to have the potential to cause significant emissions into air and water or soil related to the environmental indicators of this study will be included in the assessment. According to review of the Material Safety Data Sheet (MSDS) and relevant physical, chemical and other information of the flows listed in table above, no significant negative emission to the environment from above listed flows is identified.

2.5. Data Sources

Steps were taken to ensure that the life cycle inventory data were reliable and representative. The type of data that was used is clearly stated in the Inventory Analysis, be it measured or calculated from primary sources or whether data are from the life cycle inventory databases. In this study, generic data for certain processes were sourced from the databases in SimaPro.

SimaPro is the world's most widely used LCA software and the data in it comes predominantly from Ecoinvent, the world's most complete and widely used set of data on industrial processes, material production, packaging production, transport and so on.

In case of gap of data from Ecoinvent database, to avoid using dummy (empty) processes in the study, and also to use as much regional data as possible in some cases, alternative database is also referred to, including ChinaLCI, ELCD, IVAM (Dutch) and etc. For more of the data information, please refer to section 9 of transparency documentation.

2.6. Data Quality

The data quality requirements for this study were as follows:

- Existing LCI data were, at most, 10 years old. Newly collected LCI data were current or up to 3 years old.
- The LCI data related to the geographical locations in which the processes occurred, e.g. electricity and transportation data from China.
- The technology represented the average technologies at the time of data collection.

In the study the key parameters for producer-specific foreground data are based on yearly production amounts and extrapolations of measurements on specific machines and plants. The production data refer to an average of the year 2020, and the input data of raw material transportation refer to an average of production scenario. Most of the necessary life cycle inventories for the basic materials are available in the Simapro database. The last update of the

database was 2018. Further LCIs for materials of the supply chain of the basic materials are approximated with LCIs of similar materials or estimated by the combination of available LCIs.

2.7. Period under Review

The study used primary data collected from January 2020 to December 2020.

2.8. Comparability and Bench-marking

No comparisons or bench-marking are included in this EPD. LCA results across EPDs can be calculated with different background databases, modeling assumptions, geographic scope and time periods, all of which are valid and acceptable according to the Product Category Rules (PCR) and ISO standards. The user of the EPD should take care when comparing EPDs from different companies. Assumptions, data sources, and assessment tools may all impact the uncertainty of the final results and make comparisons misleading.

2.9. Estimates and Assumptions

The main assumptions of this LCA study are as follows：

- Material flow of trace scrap which is evaporated during product is included in the system boundary.
- Distance of raw material and product transportation including land transportation and oversea transportation uses estimated figure and a sensitivity analysis is conducted.
- Consumption of adhesive used for product installation is based on assumption of types and quantity, and a sensitivity analysis is conducted.
- The transportation distance of packaging and auxiliary materials, like lubricating oil and engine oil is assumed to be 30 km as more accurate data is unavailable, a sensitivity analysis was conducted.
- Deconstruction of product during the disposal stage was considered through manual operation, and the removal of product was omitted from modelling. It was also considered that no waste processing is needed before disposal.
- Waste to energy was not considered in this modeling and the distance from construction site to incineration site was assumed 100 km.
- Installation will generate 1% scrap and scrap applies the same end-of-life disposal scenario as the dismantled product at end-of-life.

2.10. Units

SI units are used for all LCA results of K-FLEX pipe insulation products.

3. Technical Information and Scenarios

3.1. Raw material acquisition

The raw materials of the piping insulation products include blowing agent, fillers and pigments, flame retardant, rubber and polymers, vulcanization system additives, and plasticizers.

According to the production sites, most of the raw materials are sourced from China, Malaysia and Korea delivered by truck and container through ocean. The distances are estimated by mentioned three production sites. A sensitivity analysis was conducted to simulate the impact of different distances on the result and the information related to raw materials transportation including, distance, vehicle is shown in the tables below.

Table 5-1: Raw materials transportation-Malaysia

Raw materials	Vendor Location	Distance (km)	Transport vehicle (Truck, Sea, Rail, Air)
Blowing agent	China	3490	SEA
	Korea	4355	SEA
Fillers and pigments	China	3490	SEA
	Malaysia	200	TRUCK
Flame retardant	China	3490	SEA
	Malaysia	200	TRUCK
	India	2200	SEA
Rubber and polymers	Korea	4355	SEA
	Thailand	950	SEA
	Malaysia	200	TRUCK
	Italy	10834	SEA
Vulcanisation system additives, plasticizers	China	3490	SEA
	Malaysia	200	TRUCK

Table 5-2 Raw materials transportation- Vietnam

Raw materials	Vendor Location	Distance (km)	Transport vehicle (Truck, Sea, Rail, Air)
Blowing agent	China	1,411	Sea
Fillers and pigments	China	1,411	Sea
Flame retardant	Leping City, Jiangxi,	1,411	Sea
Rubber and polymers	Seoul, South Korea	2,704	Sea
	Wujiang City, Jiangsu,	1,824	Sea
Vulcanisation system additives, plasticizers	Puyang, Henan,	1,840	Sea
	Ha Noi, Viet Nam	40	Truck
	Shanghai, China	1,896	Sea

Table 5-3 Raw materials transportation-China

Raw materials	Vendor Location	Distance (km)	Transport vehicle (Truck, Sea, Rail, Air)
Blowing agent	Leping City	700	Truck
Fillers and pigments	Chizhou City	600	Truck
	Teng xian	1600	Truck
	Anshan city	1800	Truck
	Suzhou city	60	Truck
	Weifang city	840	Truck
Flame retardant	Foshan city	2200	Truck
	Yiyang city	1100	Truck
Rubber and polymers	Lanzhou city	2040	Truck
	Tianjin city	1080	sea
	Binhai city	760	Truck
	Wuxi city	110	Truck
Vulcanisation system additives, plasticizers	Qingyuan city	1330	Truck
	Danyang city	184	Truck
	Changzhou city	100	Truck

3.2. Manufacturing

The manufacturing process of pipe insulation products mainly includes batch production, final batch preparation, milling, extrusion, autoclave, cooling, drying and packaging, which involves raw materials, energy, water, emissions (Figure 4). Since the raw materials are already considered in “raw material acquisition” step above, the model will mainly deal with energy and water consumption and emissions, along with the supply chain for packaging material and other auxiliaries in this stage.

The pipe insulation products are produced in three plants which are located in China, Vietnam and Malaysia respectively. The data of the manufacturing process performed at the sites with regard to energy, water, natural gas and other material and emission are all acquired in this study. The life cycle inventory data of the product was calculated using weighted average method, an additional detailed transparency documentation listing the assumption and calculations for the distribution of the results among product series and product stages are provided for further reference in the end of this report. And the transportation distance of packaging and auxiliary materials is assumed to be 30 km as more accurate data is unavailable, a sensitivity analysis is conducted.

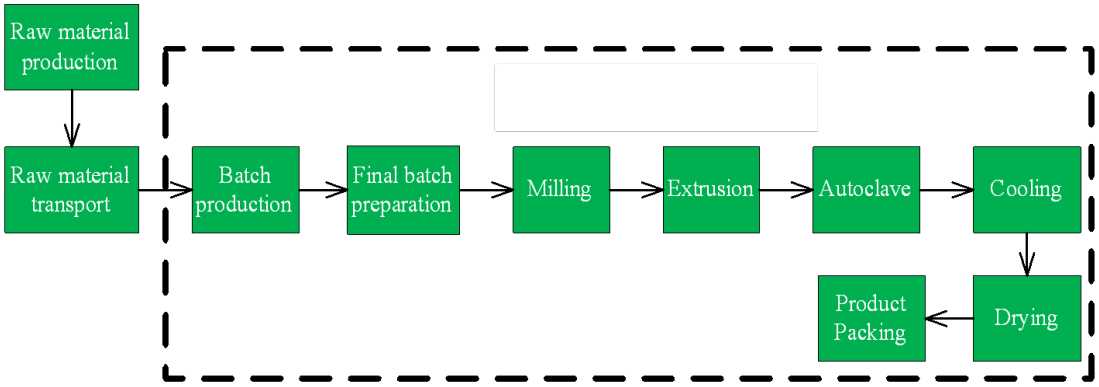

Figure 4: Production Process Flowchart of K-FLEX insulation products

3.3. Transportation

The transportation mainly takes place on the upstream of raw material supply and downstream of product delivery. The transportation of raw material and auxiliary supplies are considered in the stage of “raw material acquisition” and “manufacturing”.

According to K-FLEX, the target market of products including China, south East Asia, South Asia, and other regions. Road and oceanic transportation distance for product delivery is estimated by K-FLEX. A sensitivity analysis was also conducted by changes of assumption of various transportation distances. In this study a default value for the distance is given in the Table 6.

Table 6: Scenario and additional technical information of transport to the building site

Name	Value		Unit
	Road	Ocean	
Fuel type	Diesel	Heavy Oil	
Liters of fuel	31.11 l/100km	12.483 t/100km	L /100km or T/100km
Vehicle type	Lorry (32t)	Transoceanic Ship (50000 dwt)	
Transport distance	574.5	1256.9	km
Capacity utilization (including empty runs, mass based	50%	100	%
Gross density of products transported	45-90	45-90	kg/m^3
Capacity utilization volume factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaging products)	0.4	0.4	-

Note: Transport distance uses weighted value, namely, Transport distance=∑market ratio*market distance. Since there are eleven series of K-FLEX product, Gross density of products transported is calculated according to the information of the representative as default, i.e. K-FLEX ST

3.4. Product Installation

Installation of insulation products is a task requiring only a few tools, including one consumable product—adhesive specific for foam insulation. The adhesive is used to bind insulation together. Tools like cutting instruments (knife, box-cutter), measuring devices, painting brushes and angle tools are necessary for installation of insulation. As tools are reusable, the consumption of tools is omitted in this study. The amount of adhesive used is 10gram per kilogram product, estimated by K-FLEX.

Approximately 1% of the total material is cut off as waste, according to estimation by K-FLEX. For the simplicity of the study, we assume that the scrap from the installation is treated following the normal end of life disposal scenarios in the target market.

Table 7: Scenario and additional technical information of installation

Name	Value	Unit
Ancillary materials	0.01	kg
Net freshwater consumption specified by water source and fate (e.g., X m3 river water evaporated, X m3 city water disposed to sewer)	-	m^3
Other resources	-	kg
Electricity consumption	-	kWh
Other energy carriers	-	MJ
Product loss per functional unit	0.01	kg/kg
Waste materials at the construction site before waste processing, generated by product installation	0.01	kg/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	Paper: 0.104	kg/kg
Biogenic carbon contained in packaging	0.343	kg CO_2/kg
Direct emissions to ambient air, soil and water	-	kg
VOC emissions	N/A	µg/m^3

Note: The VOC emissions shall be determined in accordance to “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers- version 1.2” CA Specification 01350.

3.6. Disposal

According to K-FLEX, the products are consumed mainly in China, south East Asia and other regions. The disposal of the used products will adopt a country and region average disposal mode following literature review. End of life disposal treatment process (C4) from ecoinvent will be used in this LCA study. For the waste scenario, 100km of road transportation (C2) from construction site to MSW treatment site was assumed. Deconstruction of product during the disposal stage was considered through manual operation, hence input and output is omitted in deconstruction (C1), and the impact is zero. It was also considered that no waste processing is needed before disposal and the module waste processing (C3) stage of the insulation life cycle was not declared in this LCA study.

Table 8: Product disposal scenarios

Nation/region		Material Type	Recycling Rate	Landfill Rate	Incineration Rate
China		all	5%	95%	0%
South Korea		all	84%	9%	6%
South Asia	India	all	0%	100%	0%
	South Asia (except India)	N/A	N/A	N/A	N/A
south East Asia	Singapore	all	94%	6%	0%
	Malaysia	all	0%	100%	0%
	South East Asia-others	all	5%	95%	0%
New Zealand		N/A	N/A	N/A	N/A
Australia		N/A	N/A	N/A	N/A

Source: UL PCR for Building-Related Products and Services (Part A).

For products disposal in New Zealand and Australia, an average waste disposal scenario of all the market is adopted as default, as the waste disposal scenarios is unavailable. A sensitivity analysis is conducted to see the various disposal scenarios’ impact on the final score.

Table 9: Scenario and additional technical information of end of life

Name		Value		Unit
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation)		See description and table above		
Collection process (specified by type)	Collected separately	-		kg
	Collected with mixed construction waste	sheet (1 m^2) Tube (1 m)	1.89 0.684	kg
Recovery (specified by type)	Reuse	-		kg
	Recycling	sheet (1 m2) Tube (1 m)	6.15E-01 2.23E-01	kg
	Landfill	sheet (1 m^2) Tube (1 m)	1.28E+00 4.61E-01	kg
	Incineration	sheet (1 m^2) Tube (1 m)	0 0	kg
	Incineration with energy recovery	-		kg
	Energy conversion efficiency rate	-		
Disposal (specified by type)	Product or material for final deposition	0		kg
Removals of biogenic carbon (excluding packaging)		0		kg CO_2

Note: Since there are eleven series of K-FLEX product, collection process and recovery is calculated according to the information of the representative product as default, i.e. K-FLEX ST.

4. Environmental Indicators Derived from LCA

Table 10: 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 Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type: Cradle to grave	x	x	x	x	x	MND	MND	MND	MND	MND	MND	MND	x	x	MND	x	MND

4.1. Life Cycle Impact Assessment Results

LCIA provides indicators and basis for analyzing the potential contributions of the resource extractions, usage of material and wastes disposal/emissions in an inventory to a number of potential impacts. According to ISO 14040, Life Cycle Impact Assessment (LCIA) is essentially meant to improve the understanding of the results of the inventory phase.

This LCA follows the UL PCR guideline and use the recommended impact method for the analysis. As almost all of the eleven series of insulation products are consumed in China, South East Asia and South Asia, the CML-IA (baseline) method was used in this report.

CML-IA (baseline) is a LCA methodology developed by the center of Environmental Science (CML) of Leiden University in the Netherlands. This method is an update of the CML 2 baseline 2000 and released by CML in April 2013 (version 4.2). The CML-IA (baseline) method elaborates on the problem – oriented (midpoint) approach. The impact categories presented in this CML baseline method are the recommended methods according to the Handbook on Life Cycle Assessment (table 4.2.2, page 534).

Table 11: Results by stage for K-FLEX ST (1 kg)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	3.53E+00	6.37E-02	1.15E-01	1.28E-01	5.18E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	2.62E-07	1.22E-08	1.79E-09	2.34E-08	3.35E-09
Photochemical oxidation	kg C_2H_4 eq	-3.40E-03	1.75E-05	2.90E-05	2.40E-05	8.49E-06
Acidification	kg SO_2 eq	1.91E-02	4.31E-04	7.76E-05	6.08E-04	2.27E-04
Eutrophication	kg PO_4^{-3}eq	6.09E-03	6.03E-05	2.40E-04	1.30E-04	3.19E-04

Table 12: Results by stage for K-FLEX ST (1 m)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	2.42E+00	4.36E-02	7.86E-02	8.77E-02	3.54E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	1.79E-07	8.33E-09	1.23E-09	1.60E-08	2.29E-09
Photochemical oxidation	kg C_2H_4 eq	-2.33E-03	1.20E-05	1.99E-05	1.64E-05	5.80E-06
Acidification	kg SO_2 eq	1.31E-02	2.94E-04	5.31E-05	4.16E-04	1.55E-04
Eutrophication	kg PO_4^{-3}eq	4.17E-03	4.13E-05	1.64E-04	8.91E-05	2.18E-04

Table 13: Results by stage for K-FLEX EC (1 kg)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	4.13E+00	2.93E-02	1.58E-01	1.28E-01	5.19E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	2.97E-07	5.70E-09	1.92E-09	2.34E-08	3.36E-09
Photochemical oxidation	kg C_2H_4 eq	-4.04E-03	6.63E-06	4.09E-05	2.40E-05	8.89E-06
Acidification	kg SO_2 eq	2.24E-02	1.49E-04	8.56E-05	6.08E-04	2.28E-04
Eutrophication	kg PO_4^{-3}eq	7.16E-03	2.33E-05	3.57E-04	1.30E-04	3.26E-04

Table 14: Results by stage for K-FLEX EC (1 m)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	2.82E+00	2.00E-02	1.08E-01	8.77E-02	3.55E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	2.03E-07	3.90E-09	1.31E-09	1.60E-08	2.30E-09
Photochemical oxidation	kg C_2H_4 eq	-2.76E-03	4.53E-06	2.80E-05	1.64E-05	6.08E-06
Acidification	kg SO_2 eq	1.53E-02	1.02E-04	5.85E-05	4.16E-04	1.56E-04
Eutrophication	kg PO_4^{-3}eq	4.89E-03	1.60E-05	2.44E-04	8.91E-05	2.23E-04

Table 15: Results by stage for K-FLEX SOLAR HT (1 kg)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	4.10E+00	5.33E-02	9.27E-02	1.28E-01	5.17E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	2.96E-07	8.54E-09	1.71E-09	2.34E-08	3.35E-09
Photochemical oxidation	kg C_2H_4 eq	-4.05E-03	3.63E-05	2.32E-05	2.40E-05	8.23E-06
Acidification	kg SO_2 eq	2.22E-02	1.12E-03	7.31E-05	6.08E-04	2.27E-04
Eutrophication	kg PO_4^{-3}eq	7.13E-03	1.18E-04	1.65E-04	1.30E-04	3.14E-04

Table 16: Results by stage for K-FLEX SOLAR HT (1 m)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	2.80E+00	3.65E-02	6.34E-02	8.77E-02	3.53E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	2.03E-07	5.84E-09	1.17E-09	1.60E-08	2.29E-09
Photochemical oxidation	kg C_2H_4 eq	-2.77E-03	2.48E-05	1.58E-05	1.64E-05	5.63E-06
Acidification	kg SO_2 eq	1.52E-02	7.69E-04	5.00E-05	4.16E-04	1.55E-04
Eutrophication	kg PO_4^{-3}eq	4.88E-03	8.09E-05	1.13E-04	8.91E-05	2.15E-04

Table 17: Results by stage for K-FLEX TITAN (1 kg)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	4.10E+00	3.02E-02	5.92E-02	1.28E-01	5.15E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	2.96E-07	6.04E-09	1.62E-09	2.34E-08	3.34E-09
Photochemical oxidation	kg C_2H_4 eq	-4.05E-03	4.78E-06	1.40E-05	2.40E-05	7.89E-06
Acidification	kg SO_2 eq	2.22E-02	8.08E-05	6.71E-05	6.08E-04	2.27E-04
Eutrophication	kg PO_4^{-3}eq	7.13E-03	1.76E-05	9.21E-05	1.30E-04	3.07E-04

Table 18: Results by stage for K-FLEX TITAN (1 m)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	5.86E-01	4.32E-03	8.47E-03	1.83E-02	7.37E-02
Ozone layer depletion (ODP)	kg CFC-11 eq	4.24E-08	8.64E-10	2.32E-10	3.34E-09	4.77E-10
Photochemical oxidation	kg C_2H_4 eq	-5.79E-04	6.84E-07	2.01E-06	3.43E-06	1.13E-06
Acidification	kg SO_2 eq	3.18E-03	1.16E-05	9.60E-06	8.70E-05	3.24E-05
Eutrophication	kg PO_4^{-3}eq	1.02E-03	2.52E-06	1.32E-05	1.86E-05	4.40E-05

Table 19: Results by stage for M-FLEX (1 kg)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	3.78E+00	1.99E-02	5.15E-01	1.28E-01	5.19E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	1.94E-07	3.40E-09	2.88E-09	2.34E-08	3.36E-09
Photochemical oxidation	kg C_2H_4 eq	-4.05E-03	1.07E-05	1.38E-04	2.40E-05	8.84E-06
Acidification	kg SO_2 eq	2.13E-02	3.20E-04	1.50E-04	6.08E-04	2.28E-04
Eutrophication	kg PO_4^{-3}eq	7.23E-03	3.54E-05	1.12E-03	1.30E-04	3.25E-04

Table 20: Results by stage for M-FLEX (1 m)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	2.59E+00	1.36E-02	3.53E-01	8.77E-02	3.55E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	1.32E-07	2.32E-09	1.97E-09	1.60E-08	2.30E-09
Photochemical oxidation	kg C_2H_4 eq	-2.77E-03	7.34E-06	9.46E-05	1.64E-05	6.05E-06
Acidification	kg SO_2 eq	1.46E-02	2.19E-04	1.02E-04	4.16E-04	1.56E-04
Eutrophication	kg PO_4^{-3}eq	4.95E-03	2.42E-05	7.66E-04	8.91E-05	2.23E-04

Table 21: Results by stage for K-FLEX K-PROTECT (1 kg)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	4.16E+00	4.29E-02	2.79E-02	1.28E-01	5.18E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	3.44E-07	8.18E-09	1.59E-09	2.34E-08	3.36E-09
Photochemical oxidation	kg C_2H_4 eq	-4.00E-03	1.20E-05	5.40E-06	2.40E-05	8.72E-06
Acidification	kg SO_2 eq	2.28E-02	2.98E-04	6.26E-05	6.08E-04	2.27E-04
Eutrophication	kg PO_4^{-3}eq	7.08E-03	4.13E-05	1.08E-04	1.30E-04	3.23E-04

Table 22: Results by stage for K-FLEX K-PROTECT (1 m)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	1.72E+00	1.77E-02	1.15E-02	5.30E-02	2.14E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	1.42E-07	3.38E-09	6.56E-10	9.66E-09	1.39E-09
Photochemical oxidation	kg C_2H_4 eq	-1.65E-03	4.95E-06	2.23E-06	9.90E-06	3.60E-06
Acidification	kg SO_2 eq	9.42E-03	1.23E-04	2.59E-05	2.51E-04	9.39E-05
Eutrophication	kg PO_4^{-3}eq	2.92E-03	1.71E-05	4.48E-05	5.38E-05	1.33E-04

Table 23: Results by stage for INSULSHEET / INSULTUBE (1 kg)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	4.13E+00	3.90E-02	1.53E-01	1.28E-01	5.19E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	2.97E-07	6.25E-09	1.91E-09	2.34E-08	3.36E-09
Photochemical oxidation	kg C_2H_4 eq	-4.04E-03	2.66E-05	3.96E-05	2.40E-05	8.84E-06
Acidification	kg SO_2 eq	2.24E-02	8.22E-04	8.47E-05	6.08E-04	2.28E-04
Eutrophication	kg PO_4^{-3}eq	7.16E-03	8.65E-05	3.45E-04	1.30E-04	3.25E-04

Table 24: Results by stage for INSULSHEET / INSULTUBE (1 m)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	7.80E+00	7.37E-02	2.90E-01	2.42E-01	9.81E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	5.61E-07	1.18E-08	3.60E-09	4.42E-08	6.35E-09
Photochemical oxidation	kg C_2H_4 eq	-7.63E-03	5.02E-05	7.49E-05	4.53E-05	1.67E-05
Acidification	kg SO_2 eq	4.23E-02	1.55E-03	1.60E-04	1.15E-03	4.30E-04
Eutrophication	kg PO_4^{-3}eq	1.35E-02	1.64E-04	6.53E-04	2.46E-04	6.15E-04

Table 25: Results by stage for K-FLEX CLASS 1 (1 kg)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	2.37E+00	8.04E-02	7.67E-02	1.28E-01	5.19E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	1.64E-07	1.61E-08	1.67E-09	2.34E-08	3.36E-09
Photochemical oxidation	kg C_2H_4 eq	5.17E-04	1.27E-05	1.88E-05	2.40E-05	8.84E-06
Acidification	kg SO_2 eq	1.02E-02	2.15E-04	7.03E-05	6.08E-04	2.28E-04
Eutrophication	kg PO_4^{-3}eq	2.91E-03	4.69E-05	1.30E-04	1.30E-04	3.25E-04

Table 26: Results by stage for K-FLEX CLASS 1 (1m)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	1.62E+00	5.50E-02	5.25E-02	8.77E-02	3.55E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	1.12E-07	1.10E-08	1.14E-09	1.60E-08	2.30E-09
Photochemical oxidation	kg C_2H_4 eq	3.54E-04	8.71E-06	1.29E-05	1.64E-05	6.05E-06
Acidification	kg SO_2 eq	7.00E-03	1.47E-04	4.81E-05	4.16E-04	1.56E-04
Eutrophication	kg PO_4^{-3}eq	1.99E-03	3.21E-05	8.92E-05	8.91E-05	2.23E-04

Table 27: Results by stage for FRIGO (1 kg)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	2.37E+00	7.94E-02	7.67E-02	1.28E-01	5.19E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	1.64E-07	1.59E-08	1.67E-09	2.34E-08	3.36E-09
Photochemical oxidation	kg C_2H_4 eq	5.17E-04	1.26E-05	1.88E-05	2.40E-05	8.84E-06
Acidification	kg SO_2 eq	1.02E-02	2.12E-04	7.03E-05	6.08E-04	2.28E-04
Eutrophication	kg PO_4^{-3}eq	2.91E-03	4.64E-05	1.30E-04	1.30E-04	3.25E-04

Table 28: Results by stage for FRIGO (1 m)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	1.62E+00	5.43E-02	5.25E-02	8.77E-02	3.55E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	1.12E-07	1.09E-08	1.14E-09	1.60E-08	2.30E-09
Photochemical oxidation	kg C_2H_4 eq	3.54E-04	8.60E-06	1.29E-05	1.64E-05	6.05E-06
Acidification	kg SO_2 eq	7.00E-03	1.45E-04	4.81E-05	4.16E-04	1.56E-04
Eutrophication	kg PO_4^{-3}eq	1.99E-03	3.17E-05	8.92E-05	8.91E-05	2.23E-04

Table 29: Results by stage for K-FLEX ECO (1 kg)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	2.37E+00	1.03E-01	7.67E-02	1.28E-01	5.19E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	1.64E-07	2.07E-08	1.67E-09	2.34E-08	3.36E-09
Photochemical oxidation	kg C_2H_4 eq	5.17E-04	1.63E-05	1.88E-05	2.40E-05	8.84E-06
Acidification	kg SO_2 eq	1.02E-02	2.76E-04	7.03E-05	6.08E-04	2.28E-04
Eutrophication	kg PO_4^{-3}eq	2.91E-03	6.03E-05	1.30E-04	1.30E-04	3.25E-04

Table 30: Results by stage for K-FLEX ECO (1 m)

Impact category	Unit	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
Global warming (GWP100a)	kg CO_2 eq	1.62E+00	7.06E-02	5.25E-02	8.77E-02	3.55E-01
Ozone layer depletion (ODP)	kg CFC-11 eq	1.12E-07	1.41E-08	1.14E-09	1.60E-08	2.30E-09
Photochemical oxidation	kg C_2H_4 eq	3.54E-04	1.12E-05	1.29E-05	1.64E-05	6.05E-06
Acidification	kg SO_2 eq	7.00E-03	1.89E-04	4.81E-05	4.16E-04	1.56E-04
Eutrophication	kg PO_4^{-3}eq	1.99E-03	4.12E-05	8.92E-05	8.91E-05	2.23E-04

4.2. Life Cycle Inventory Results

The life cycle inventory analysis results of the primary renewable / nonrenewable energy demand, and waste / hazardous waste as well as water consumption is depicted in tables below.

The results below are based on different declared units of the ten insulation product series and 1m of insulation product for piping applications. Analysis results of unit mass, i.e., 1kg of product are also depicted.

Table 31: Life cycle inventory results-K-FLEX ST (1 kg)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	7.49E+01	7.11E+01	1.03E+00	6.50E-01	1.79E+00	3.35E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	2.10E+00	2.06E+00	1.30E-02	1.05E-02	7.98E-03	9.33E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	5.69E-02	5.51E-02	2.04E-04	2.57E-04	2.26E-04	1.12E-03
HWD	kg	1.28E-02	1.28E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	8.61E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 32: Life cycle inventory results-K-FLEX ST (1 m)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	4.87E+01	7.04E-01	4.44E-01	1.22E+00	2.29E-01	0.00E+00
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	1.41E+00	8.88E-03	7.19E-03	5.46E-03	6.38E-03	0.00E+00
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	3.77E-02	1.40E-04	1.76E-04	1.55E-04	7.69E-04	0.00E+00
HWD	kg	8.74E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	5.89E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 33: Life cycle inventory results-K-FLEX EC (1 kg)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	8.31E+01	7.98E+01	4.77E-01	6.67E-01	1.79E+00	3.36E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	2.31E+00	2.27E+00	5.51E-03	1.12E-02	7.98E-03	9.37E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	6.11E-02	5.93E-02	9.46E-05	2.69E-04	2.26E-04	1.13E-03
HWD	kg	1.34E-02	1.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	6.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 34: Life cycle inventory results- K-FLEX EC (1 m)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	5.68E+01	5.46E+01	3.26E-01	4.56E-01	1.22E+00	2.30E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	1.58E+00	1.55E+00	3.77E-03	7.64E-03	5.46E-03	6.41E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	4.18E-02	4.06E-02	6.47E-05	1.84E-04	1.55E-04	7.70E-04
HWD	kg	9.18E-03	9.18E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	4.23E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 35: Life cycle inventory results- K-FLEX SOLAR HT (1 kg)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	8.24E+01	7.89E+01	7.91E-01	6.40E-01	1.79E+00	3.34E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	2.28E+00	2.24E+00	1.77E-02	1.02E-02	7.98E-03	9.30E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	6.07E-02	5.89E-02	1.58E-04	2.48E-04	2.26E-04	1.12E-03
HWD	kg	1.34E-02	1.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	6.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 36: Life cycle inventory results- K-FLEX SOLAR HT (1 m)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	5.64E+01	5.39E+01	5.41E-01	4.38E-01	1.22E+00	2.29E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	1.56E+00	1.53E+00	1.21E-02	6.94E-03	5.46E-03	6.36E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	4.15E-02	4.03E-02	1.08E-04	1.69E-04	1.55E-04	7.69E-04
HWD	kg	9.18E-03	9.18E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	4.23E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 37: Life cycle inventory results- K-FLEX TITAN (1 kg)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	8.21E+01	7.89E+01	5.00E-01	6.28E-01	1.79E+00	3.33E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	2.27E+00	2.24E+00	5.04E-03	9.65E-03	7.98E-03	9.27E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	6.06E-02	5.89E-02	9.89E-05	2.38E-04	2.26E-04	1.12E-03
HWD	kg	1.34E-02	1.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	6.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 38: Life cycle inventory results- K-FLEX TITAN (1 m)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	1.17E+01	1.13E+01	7.14E-02	8.98E-02	2.56E-01	4.77E-02
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	3.24E-01	3.20E-01	7.21E-04	1.38E-03	1.14E-03	1.32E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	8.67E-03	8.42E-03	1.41E-05	3.41E-05	3.23E-05	1.61E-04
HWD	kg	1.92E-03	1.92E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	8.83E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 39: Life cycle inventory results- M-FLEX (1 kg)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	7.22E+01	6.89E+01	3.04E-01	7.96E-01	1.79E+00	3.36E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	6.54E+00	6.50E+00	5.73E-03	1.65E-02	7.98E-03	9.36E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	6.09E-02	5.91E-02	6.06E-05	3.69E-04	2.26E-04	1.13E-03
HWD	kg	3.59E-02	3.59E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	5.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 40: Life cycle inventory results- M-FLEX (1 m)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	4.94E+01	4.71E+01	2.08E-01	5.44E-01	1.22E+00	2.30E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	4.48E+00	4.45E+00	3.92E-03	1.13E-02	5.46E-03	6.40E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	4.17E-02	4.05E-02	4.14E-05	2.53E-04	1.55E-04	7.70E-04
HWD	kg	2.46E-02	2.46E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	3.97E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 41: Life cycle inventory results- K-FLEX K-PROTECT (1 kg)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	8.71E+01	8.36E+01	6.92E-01	6.21E-01	1.79E+00	3.36E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	1.70E+00	1.67E+00	8.80E-03	9.25E-03	7.98E-03	9.35E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	6.15E-02	5.98E-02	1.37E-04	2.34E-04	2.26E-04	1.13E-03
HWD	kg	1.34E-02	1.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	6.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 42: Life cycle inventory results- K-FLEX K-PROTECT (1 m)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	3.60E+01	3.45E+01	2.86E-01	2.57E-01	7.39E-01	1.39E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	7.02E-01	6.88E-01	3.64E-03	3.82E-03	3.30E-03	3.86E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	2.54E-02	2.47E-02	5.67E-05	9.67E-05	9.34E-05	4.65E-04
HWD	kg	5.54E-03	5.54E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	2.55E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 43: Life cycle inventory results- INSULSHEET / INSULTUBE (1 kg)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	8.32E+01	7.98E+01	5.79E-01	6.65E-01	1.79E+00	3.36E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	2.31E+00	2.27E+00	1.30E-02	1.11E-02	7.98E-03	9.36E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	6.11E-02	5.93E-02	1.16E-04	2.68E-04	2.26E-04	1.13E-03
HWD	kg	1.34E-02	1.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	6.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 44: Life cycle inventory results INSULSHEET / INSULTUBE (1 m)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	5.69E+01	5.46E+01	3.96E-01	4.55E-01	1.22E+00	2.30E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	1.58E+00	1.55E+00	8.87E-03	7.59E-03	5.46E-03	6.40E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	4.18E-02	4.06E-02	7.90E-05	1.83E-04	1.55E-04	7.70E-04
HWD	kg	9.18E-03	9.18E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	4.23E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 45: Life cycle inventory results- K-FLEX CLASS 1 (1 kg)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	6.22E+01	5.81E+01	1.33E+00	6.34E-01	1.79E+00	3.36E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	2.02E+00	1.98E+00	1.34E-02	9.91E-03	7.98E-03	9.36E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	4.13E-02	3.94E-02	2.63E-04	2.43E-04	2.26E-04	1.13E-03
HWD	kg	1.42E-03	1.42E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	4.31E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 46: Life cycle inventory results- K-FLEX CLASS 1 (1m)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	4.26E+01	3.98E+01	9.09E-01	4.34E-01	1.22E+00	2.30E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	1.38E+00	1.36E+00	9.17E-03	6.78E-03	5.46E-03	6.40E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	2.82E-02	2.70E-02	1.80E-04	1.66E-04	1.55E-04	7.70E-04
HWD	kg	9.70E-04	9.70E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	2.95E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 47: Life cycle inventory results- FRIGO (1 kg)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	6.22E+01	5.81E+01	1.31E+00	6.34E-01	1.79E+00	3.36E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	2.02E+00	1.98E+00	1.33E-02	9.91E-03	7.98E-03	9.36E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	4.13E-02	3.94E-02	2.60E-04	2.43E-04	2.26E-04	1.13E-03
HWD	kg	1.42E-03	1.42E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	4.31E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 48: Life cycle inventory results- FRIGO (1 m)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	4.25E+01	3.98E+01	8.98E-01	4.34E-01	1.22E+00	2.30E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	1.38E+00	1.36E+00	9.06E-03	6.78E-03	5.46E-03	6.40E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	2.82E-02	2.70E-02	1.78E-04	1.66E-04	1.55E-04	7.70E-04
HWD	kg	9.70E-04	9.70E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	2.95E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 49: Life cycle inventory results- K-FLEX ECO (1 kg)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	6.26E+01	5.81E+01	1.71E+00	6.34E-01	1.79E+00	3.36E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	2.03E+00	1.98E+00	1.72E-02	9.91E-03	7.98E-03	9.36E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	4.14E-02	3.94E-02	3.38E-04	2.43E-04	2.26E-04	1.13E-03
HWD	kg	1.42E-03	1.42E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	4.31E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 50: Life cycle inventory results- K-FLEX ECO (1 m)

Impact category	Unit	Total	Production A1-A3	Transport of Product A4	Installation A5	Transport of Waste C2	Disposal C4
$NRPR_M$	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_E$	MJ	4.28E+01	3.98E+01	1.17E+00	4.34E-01	1.22E+00	2.30E-01
RPR_M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_E	MJ	1.39E+00	1.36E+00	1.18E-02	6.78E-03	5.46E-03	6.40E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	2.83E-02	2.70E-02	2.31E-04	1.66E-04	1.55E-04	7.70E-04
HWD	kg	9.70E-04	9.70E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	0.00E+00	2.95E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ, heating value ([Hi] lower heating value) per energy carrier	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

5. LCA Interpretation

The stage contribution analysis of the pipe insulation products on various impact categories reveals that production and the treatment of waste products are the main contributions to environment impact categories.

The process contribution analysis reveals that raw material supply and landfill process for waste treatment contributes to most of the environmental impacts.

Sensitivity analysis shows that the changes in assumptions such as substituted raw materials and transportation distance and installation inputs can lead to certain fluctuation of the final LCA results, hence it is recommended to continuously update the model to get up-to-date results, in case the assumption or process parameters will be changed in the future, or better data would be provided, especially regarding the substituted material where the background data for the raw material is not available.

The LCA study has been carried out based on available data, information, regional and global knowledge and experience to achieve best possible accuracy, completeness and representative of the results.

6. Additional Environmental Information

6.1. Environment and Health During Manufacturing

Production at K-FLEX adheres to the according national guidelines and regulations during all manufacturing steps, and in all facilities. Certification of the environmental management system is in accordance with ISO 14001.

6.2. Environment and Health During Installation

When handling and installing insulation material, one should practice reasonable care as a normal safety precaution. When applying adhesives, the information given in the relevant safety data sheets is to be heeded.

- Toxicological information: After contact with skin or eyes, no special measures are required. No hazards in terms of normal handling and skin contact.

- Ecological information: Environmentally harmless

- Insoluble in water: no contamination

6.3. Extraordinary Effects

Fire

K-FLEX pipe insulation products have been fire tested at the Naval Research Laboratory (NRL) in controlled comparisons with baseline materials.

K-FLEX pipe insulation products meet EB 4013 and IMO SOLAS requirements, and it does not support progressive flaming, will not melt and drip.

Water

The closed cell structure of K-FLEX pipe insulation products prevents moisture from wicking and makes it an efficient insulation. For most applications, K-FLEX requires no supplemental vapor retarder. An additional vapor retarder may be necessary when installed on very cold lines or where exposed to continuous high humidity.

Mechanical Destruction

At temperatures below -20° F (-29° C), elastomeric insulation starts to become less flexible. However, this characteristic does not affect thermal efficiency or water vapor permeability of K-FLEX insulation.

6.4. Environmental Activities and Certifications

The certifications of K-FLEX pipe products are as follow：

- Environmentally-friendly without CFCs, HFCs, HCFCs, PBDEs, formaldehyde and fibers.
- An EPA-registered antimicrobial agent is incorporated into the product providing additional protection against mold, fungal and bacterial growth.
- Not contain carbon black or PVC in accordance with United States Navy Environmental Department standards.

6.5. Further Information

The additional information of K-FLEX pipe insulation materials can be found on the website: https://corporate.kflex.com

7. Project Report and Supporting Documentation

Since the amount of input and output has a linear relationship with the total output of production, i.e. the more the product manufactured, the more raw material, energy, water and natural gas will be consumed. To simplify, in this analysis, the annual total input and output flow are distributed among the different product specifications using a production weight-ratio based distribution model, due to lack of monitoring record results for different brands of product, the distribution of flow among the various specifications is based on calculations.

As the insulation products are produced in 3 sites, all the energy used for the manufacturing of foaming products, local energy data are used to the best extent to reflect the accuracy and representativeness of results and weighted average by the production. For instance, for the products produced in China, the electricity are based on Grid Electricity of average China inventory, taking into account the power plant efficiency, emission factor, power grid loss and also traced back to raw energy materials such as coal and natural gas.

8. References

ISO 14025 - ISO14025:2011-10, Environmental labels and declarations - Type III environmental declarations - Principles and procedures

ISO 14040 - Environmental management - Life cycle assessment - Principles and framework

ISO 14044 - Environmental management - Life cycle assessment – Requirements and guidelines

SimaPro - LCA Computer Software http://www.pre-sustainability.com/