ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	KÖSTER Bauchemie AG
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-KBC-20160014-IBC1-EN
Issue date	01.03.2016
Valid to	28.02.2022

Dach- und Dichtungsbahnen
KÖSTER TPO 1.6 / 1.8 / 2.0 / 2.0 F
KÖSTER BAUCHEMIE AG

Institut Bauen und Umwelt e.V.

www.bau-umwelt.com / https://epd-online.com

1. General Information

KÖSTER BAUCHEMIE AG	KÖSTER TPO 1.6 / 1.8 / 2.0 / 2.0 F
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the Declaration** KÖSTER BAUCHEMIE AG Dieselstraße 1-10 26607 Aurich Deutschland
Declaration number EPD-KBC-20160014-IBC1-EN	**Declared product / Declared unit** 1 m² roofing and sealing membrane on TPO / FPO basis
This Declaration is based on the Product Category Rules: Plastic and elastomer roofing and sealing sheet systems, 07.2014 (PCR tested and approved by the SVR)	**Scope:** This EPD applies to 1 m² of the following roofing membranes of different thicknesses: KÖSTER TPO 1.6 / 1.8 / 2.0 / 2.0 F, whereby in Chapter 5 only the values of KÖSTER TPO 2.0 F are declared. For the other variants, conversion factors are specified in Chapter 3.10. The life cycle assessment is based on the KÖSTER Bauchemie AG data from the year of production 2014, manufactured in the factory in Aurich in Germany. This document is translated from the German Environmental Product Declaration into English. It is based on the German original version EPD-KBC-20160014-IBC1-DE. The verifier has no influence on the quality of the translation.The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Issue date 01.03.2016	**Verification** The CEN Norm /EN 15804/ serves as the core PCR Independent verification of the declaration according to /ISO 14025/ ☐ internally ☒ externally
Valid to 28.02.2022	
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	Matthias Schulz (Independent verifier appointed by SVR)
Dr. Burkhart Lehmann (Managing Director IBU)	

2. Product

2.1 Product description

KÖSTER TPO 1.6 / 1.8 / 2.0 / 2.0 F is a plastic roofing and sealing membrane that can be welded with hot air, made of flexible, thermoplastic polyolefins (FPO / TPO) and with glass fleece as an internal layer and in some cases with polyester fleece on the underside.
The internal glass fleece reinforcement serves as an additional support and thus improves the mechanical properties of the roofing and sealing membrane. The polyester fleece backing allows the membrane to be bonded onto other materials or to be fitted onto rough surfaces.

	eff. thickness	Overall thickness
KÖSTER TPO 1.6 with internal glass fleece layer	1.6 mm	1.6 mm
KÖSTER TPO 1.8 with internal glass fleece layer	1.8 mm	1.8 mm
KÖSTER TPO 2.0 with internal glass fleece layer	2.0 mm	2.0 mm
KÖSTER TPO 2.0 F with internal glass fleece layer and polyester fleece on the underside	2.0 mm	2.8 mm

2.2 Application

KÖSTER TPO and KÖSTER TPO F roofing and sealing membranes serve to seal unventilated and ventilated flat roofs, inclined roofs, green roofs, patios, balconies, rooftop gardens and underground garages in the event of direct exposure to the weather and with top load.
They can also be used to seal damp rooms, sprinkler containers and ponds.
KÖSTER TPO roofing and sealing membranes can be

laid loosely (with top load) or mechanically secured. KÖSTER TPO F roofing and sealing membranes can be laid loosely (with top load), mechanically secured and bonded over the whole area or in strips.

2.3 Technical Data

Designation in accordance with EN 20000-201
KÖSTER TPO 1.6/1.8/2.0: DE/E1-FPO-BV-E-GV-1.6 / 1.8 / 2.0
KÖSTER TPO 2.0 F: DE/E1-FPO-BV-E-GV-K-PV-2.0
Designation in accordance with DIN V 20000-202:
KÖSTER TPO 1.6/1.8 /2.0: BA-FPO-BV-E-GV-1.6 / 1.8 / 2.0

List of technical data
in accordance with DIN EN 13956:2013-03 and DIN EN 13967:2012-07

Note:
These values apply for: KÖSTER TPO 1.6 / KÖSTER TPO 1.8 / KÖSTER TPO 2.0 / KÖSTER TPO 2.0 F
If only one value is specified, this applies to all membranes.

Name	Value	Unit
Waterproof in accordance with /DIN EN 1928/ (method B)	400kPa/72 h dicht	-
Exposure to liquid chemicals including water in accordance with DIN EN 1847 (method A/B)	leakproof	-
Peel resistance of the seam joint in accordance with /DIN EN 12316-2/	Type of failure: No failure of the joint	N/50mm
Shear resistance of the seam joint in accordance with /DIN EN 12317-2/ (sealing membranes)	Failure outside the joint	N/50mm
Resistance to impact loads in accordance with /DIN EN 12691/ (method A, hard substrate)	≥ 500/≥ 700/≥ 750/≥ 750	mm
Tear propagation resistance in accordance with /DIN EN 12310-2/	≥ 200/≥ 200/≥ 200/≥ 350	N
Resistance to root penetration (for green roofs) in accordance with /DIN EN 13948/	given	-
Dimensional stability in accordance with /DIN EN 1107-2/	≤ -0,2	%
Folding in the cold in accordance with /DIN EN 495-5/	≤ -50	°C
Artificial ageing in accordance with /DIN EN 1297/ (> 1000 h)	passed	-
Ozone resistance (for EPDM/IIR) in accordance with /DIN EN 1844/	passed	-
Bitumen compatibility in accordance with /DIN EN 1548/	passed	-
Elongation at break longitudinally/transversely in accordance with DIN EN 12311-2 (method A) for TPO 2.0 F	≥ 50	%
Elongation at break longitudinally/transversely in accordance with DIN EN 12311-2 (method B) for TPO 1.6/1.8/2.0	≥ 500	%
Tensile strength longitudinally/transversely in accordance with DIN EN 12311-2 (method A) for TPO 2.0 F	≥ 1000	N/50 mm
Tensile strength longitudinally/transversely in accordance with DIN EN 12311-2 (method B) for TPO 1.6/1.8/2.0	≥ 7	N/mm²

2.4 Placing on the market / Application rules

Directive (EU) No. 305/2011 applies for placing the product on the market in the EU/EFTA (except Switzerland).
The products require a Declaration of Performance taking account of
EN 13956:2012 Flexible sheet for waterproofing - Plastic and rubber sheets for roof waterproofing - Definitions and characteristics and
/EN 13967:2012 Flexible sheets for waterproofing - Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheet - Definitions and characteristics as well as
the CE marking.

For KÖSTER TPO roofing and sealing membranes with thicknesses between 1.6 and 2.0 mm, the technical characteristics in accordance with DIN EN 13956 can be obtained by linear interpolation between the technical data of KÖSTER TPO 1.6 and KÖSTER TPO 2.0.

Use is governed by the respective national guidelines; in Germany:

DIN EN 13956:2013-03
Flexible sheets for waterproofing - Plastic and rubber sheets for roof waterproofing - Definitions and characteristics.

DIN EN 13967: 2012-07
Flexible sheets for waterproofing - Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheet - Definitions and characteristics.

DIN 18531-1: 2010-05
Waterproofing of roofs, Part 1 to Part 4

DIN 18195:
Waterproofing of buildings, Parts 1, 3, 4, 5, 6, 8 and 10 2011-12.
Waterproofing of buildings; Part 2: 2009-04.
Waterproofing of buildings; Part 7: 2009-07.
Waterproofing of buildings; Part 9: 2010-05.

DIN SPEC 20000-201:2015-08
Application of construction products in structures - Part 201: Application standard for flexible sheets for waterproofing according to European product standards for the use as waterproofing of roofs.

DIN SPEC 20000-202: 2016-03
Use of building products in construction works - Part 202: Adaptation standard for flexible sheets for waterproofing according to European standards for use as waterproofing

2.5 Delivery status

Reel of TPO / FPO roofing and sealing membrane

KÖSTER TPO 1.6 / 1.8 / 2.0
Length: 20 m
Width: 2100/1500/1050/750/525/350/250 mm

KÖSTER TPO 2.0 F
Length: 20 m
Width: 1500/1050/525 mm

2.6 Base materials / Ancillary materials

TPO / FPO (85 - 99 %):
is a thermoplastic polyolefin consisting of a mixture of ethylene copolymers as well as colour pigments and stabilisers.

Glass fleece (1-5 %):
On account of their composition, glass fibres do not come under the definition of man-made vitreous (silicate) fibres (they are neither classified as hazardous, nor do they have to be marked as such).

Polyester fleece (approx. 10 %):
Only in KÖSTER TPO 2.0 F.

The substances used are not subject to the labelling requirements of REACH.

2.7 Manufacture

The production of KÖSTER TPO / FPO roofing and sealing membranes is certified in accordance with DIN EN ISO 9001.
The membranes are manufactured on two-nozzle extrusion equipment. The raw material is heated up to the required temperature in an extruder and introduced into the process under pressure.
The two low-viscosity melt streams can be monitored by measuring the temperature and pressure of the mass.
The internal glass fleece insert serves as an additional support and thus improves the mechanical properties of the roofing and sealing membrane.
The required thickness of the roofing and sealing membrane is achieved by regulating the melt streams as they emerge at the ends of the extrusion nozzles.
The sheets are cooled down to below 30 °C after they leave the calendar and before they are wound.
Cooling is effected by means of water-cooled rollers.
The heated water is cooled in a heat exchanger, fed back into the water cycle and reused.

2.8 Environment and health during manufacturing

All of the raw materials used are introduced into the production facility without any environmentally hazardous effects.
Provided the facility is correctly operated, contamination of the environment by waste air, waste water or other waste can be ruled out.
The water is used solely for cooling purposes and does not come into contact with the product.
During production and packaging, no dust emissions that have to be cleaned are created.
At no time is the production personnel exposed to health risks during the production of KÖSTER TPO.
Any material residues created during production, e.g. during start-up or job changes, are fed back into the system during ongoing operation, or are internally recycled as time permits.

2.9 Product processing/Installation

The declared products can be installed as follows:

- Loose installation with top load and wear layer underneath: the sheets are unrolled loosely and the seams are welded using hot air.
- Exposed to weather and mechanically secured: the sheets are installed loosely and mechanically secured with plate anchors for roof sheeting (as a rule in the covered sheet seam), and the seams are welded with hot air.
- Exposed to weather, bonded over the whole area or in strips, and the seams welded using hot air (only KÖSTER TPO 2.0 F).

Optional plate anchors for roof sheeting and adhesives are not part of the life cycle assessment.

2.10 Packaging

KÖSTER TPO roofing and sealing membranes are packed as standard on a wooden pallet with 20 or 10 reels. The wooden pallets can be reused by the recipient.
Materials used for packaging, such as stretch and shrink film, cardboard edge protectors as well as the wooden pallet, are recycled by the recipient using the system "Der Grüne Punkt – Duales System Deutschland GmbH (DSD)" (Green Dot – German Dual System).

2.11 Condition of use

No changes take place in the material during the useful service life of KÖSTER TPO roofing and sealing membranes.

2.12 Environment and health during use

No adverse influence on the environment or health of the users takes place during the useful service life. No release of emissions from the product into air or water is known.

2.13 Reference service life

Provided the product is installed correctly in accordance with KÖSTER TPO processing regulations, a useful service life of more than 30 years can be expected.

2.14 Extraordinary effects

Fire
The declared product has normal flammability.
Classification in accordance with DIN EN ISO 11925-2 and DIN EN 13501-1 – Class E and reaction to fire class $B_{roof}(t1)$.

Fire protection

Name	Value
Building material class	E
Burning droplets	-
Smoke gas development	-

Water
The declared product is resistant to the effects of water.
Classification in accordance with DIN EN 1928 (method B).

Mechanical destruction

The mechanical destruction of KÖSTER TPO roofing and sealing membranes, e.g. through shredding within the framework of product recycling measures, does not lead to any environmentally harmful products or hazardous waste.

2.15 Re-use phase

The material of KÖSTER TPO roofing and sealing membranes is recycled. The mechanically fastened plastic roofing membranes are free of rough dirt and impurities and, after they have been cut open, are rolled up again. The sorted roofing membranes are processed in shredding plants and made into ground material. The ground material is taken back by the raw material manufacturer within the framework of material recycling and is used as an admixture in the production of granules for the polymer modification of asphalt. The material can be used in road asphalt for periods of up to 10 years and longer.

2.16 Disposal

If there is no possibility for the membranes to be taken back, they can be stored in proper landfill sites or used for thermal energy generation (incineration) (EU waste code 170904, mixed construction and demolition wastes).

2.17 Further information

The product data sheets, safety information and other technical information can be downloaded from the website of KÖSTER BAUCHMIE AG.
Homepage: www.koester.eu

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m² of roofing membrane produced.
These are not self-adhesive roofing membranes. The seams are joined together by thermal welding. The weight per unit area is rounded off to two places after the decimal point.

Declared Unit

Name	Value	Unit
Declared unit	1	m^2
Grammage KÖSTER TPO 2.0 F	2.22	kg/m^2
Conversion factor to 1 kg (kg/m^2)	2.22	-
Type of sealing (thermal welding)	-	-
Layer thickness	0,002	m

The weight per unit area of the KÖSTER TPO roofing and sealing membrane declared through the factors in Chapter 3.10 are as follows:
KÖSTER TPO 1.6: 1,59 kg/m²
KÖSTER TPO 1.8: 1,74 kg/m²
KÖSTER TPO 2.0: 1,94 kg/m²

3.2 System boundary

Type of EPD: cradle to plant gate - with options. The Life Cycle Assessment takes account of raw material and energy exploitation, raw material transportation and the actual product manufacture (modules A1-A3), transportation to the construction site (module A4), installation taking account of cutting and packaging waste (without optional plate anchors for roof sheeting and adhesives) (module A5), as well as transportation after dismantling (module C2), recycling (modules C3 & D/1) or thermal utilisation (modules C4 and D/2), with the resulting credits and debits beyond the system limit.

There are two scenarios for the *End-of-Life* (modules C2, C3, C4 and D): the first proceeds from 100 % material recycling. The second scenario is based on 100 % thermal utilisation. Individual scenarios for combinations of thermal utilisation and material recycling can then be calculated from the results of these two 100 % scenarios.

3.3 Estimates and assumptions

Except for the assumptions for the scenarios described in Section 4, no estimates or assumptions were made, since GaBi data were available for all relevant raw material production processes.

3.4 Cut-off criteria

All data from the operating data survey were taken into consideration in the analysis, i.e. all source materials used according to the recipe, as well as electricity and water requirements. Assumptions were made as regards transportation expenses associated with all input data taken into consideration.
Accordingly, material and energy flows with a share of less than 1 per cent were also taken into account, in accordance with PCR Part A.

3.5 Background data

All of the background data relevant for the production and disposal of roofing membranes were taken from the GaBi database GaBi 2015, unless otherwise specified. EPD data records were used for the TPO granules and for the granules for the material credit.

3.6 Data quality

The data quality can be regarded as high. The production of the roofing membranes was modelled with primary data from KÖSTER BAUCHEMIE AG. The corresponding background data items were available in the GaBi database for all relevant preliminary products used. The data used was last revised max. 3 years ago.

3.7 Period under review

Average values for 2014 at the Aurich location were taken into account for the quantities of raw materials, energy and process materials used.

3.8 Allocation

In the thermal recycling of production waste in an incineration plant (MVA), credits for electricity and thermal energy from modules A5 and C4 are taken into account in an input-specific manner in module D, and the elementary composition and calorific value are also taken into account. The credited processes relate to Germany on account of the production facilities located there. In module D there is also a credit for the recycling of the roofing membranes in asphalt granules.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

3.10 Factors for calculating the various product variants

The LCA results declared in this EPD refer to the TPO 2.0 F roofing membrane. The following tables comprise the conversion factors required for calculating the results of the other TPO product variants. The multiplication of these conversion factors with the results of modules A1-A3, A4, A5, C2/1, C2/2, C3, C4, D/1 and D/2 of the TPO 2.0 F roofing membrane declared in this EPD gives the LCA results of each of the other variants.

Factors for calculating the results of modules A1- A3 for various TPO roofing membranes

Parameters	TPO 2.0	TPO 1.8	TPO 1.6
GWP	0.80	0.72	0.65
ODP	0.98	0.87	0.80
AP	0.89	0.80	0.73
EP	0.81	0.73	0.67
POCP	0.76	0.68	0.62
ADPE	0.89	0.86	0.85
ADPF	0.84	0.75	0.68
PERT	0.68	0.63	0.58
PENRT	0.84	0.76	0.69

Factors for calculating the results of module A4 for various TPO roofing membranes

Parameter	TPO 2.0	TPO 1.8	TPO 1.6
All parameters	0.87	0.78	0.72

Factors for calculating the results of module A5 for various TPO roofing membranes

Parameter	TPO 2.0	TPO 1.8	TPO 1.6
GWP	0.49	0.46	0.43
ODP	0.44	0.39	0.36
AP	0.44	0.40	0.37
EP	0.45	0.41	0.38
POCP	0.44	0.40	0.37
ADPE	0.44	0.40	0.36
ADPF	0.44	0.40	0.37
PERT	0.48	0.43	0.40
PENRT	0.44	0.40	0.36

Factors for calculating the results of modules C 2/1, C 2/2, C 3 and C 4 for various TPO roofing membranes

Parameter	TPO 2.0	TPO 1.8	TPO 1.6
C 2/1: All parameters	0.88	0.79	0.72
C 2/2: All parameters:	0.88	0.79	0.72
C 3: All parameters:	0,88	0,79	0,72
C 4: All parameters:	0,88	0,79	0,72

Factors for calculating the results of modules D/1 and D/2 for various TPO roofing membranes

Parameter	TPO 2.0	TPO 1.8	TPO 1.6
D/1: All parameters	0.88	0.79	0.72
D/2 All parameters:	0.84	0.76	0.70

4. LCA: Scenarios and additional technical information

The following technical information forms the basis for the declared modules or can be used for developing specific scenarios within the context of a building appraisal if modules are not declared (MND).

There are two scenarios for the *End-of-Life* (modules C2, C3, C4 and D): the first proceeds from 100 % material recycling. The second scenario is based on 100 % thermal utilisation. Individual scenarios for combinations of thermal utilisation and material recycling can then be calculated from the results of these two 100 % scenarios.

Transportation to construction site (A4)

Name	Value	Unit
Litres of fuel (Diesel pro kg Produkt)	0.00159	l/100km
Transport distance	514	km
Capacity utilisation (including empty runs)	85	%
Gross density of products transported	969	kg/m^3
Capacity utilisation volume factor	100	-

Construction installation process (A5)

Name	Value	Unit
Auxiliary	0	kg
Water consumption	0	m^3
Other resources	0	kg
Electricity consumption	0.011	kWh
Other energy carriers	0	MJ
Material loss/waste (TPO 1.6 / 1.8 / 2.0)	3	%
Material loss/waste (TPO 2.0 F)	6	%
Dust in the air	0	kg
VOC in the air	0	kg

Referenz Nutzungsdauer

Name	Value	Unit
Reference service life (minimum)	30	a

End of Life (C1-C4)

Name	Value	Unit
Collected separately Waste type	0	kg
Collected as mixed construction waste	0	kg
Reuse	0	kg
Szenario 1: For material recycling	2,215	kg
Szenario 1: For energy recovery	0	kg
Szenario 2: For material	0	kg
Szenario 2: For energy recovery	2,215	kg
Landfilling	0	kg
Transportation distance zur Wiederverwendung (Szenario 1)	257	km
Transportation distance zur thermischen Verwertung in MVA (Szenario 2)	50	km

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MNR	MNR	MNR	MND	MND	MND	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² roofing membranes TPO 2.0 F

Parameter	Unit	A1-A3	A4	A5	C2/1	C2/2	C3	C4	D/1	D/2
GWP	[kg CO_2-Eq.]	7.01E+0	5.53E-2	6.33E-1	2.67E-2	5.20E-3	1.31E-1	1.90E+0	-4.79E+0	-8.22E-1
ODP	[kg CFC11-Eq.]	3.28E-7	6.81E-14	2.18E-8	3.30E-14	6.41E-15	1.31E-11	4.03E-12	-2.74E-7	-4.01E-11
AP	[kg SO_2-Eq.]	2.83E-2	2.45E-4	1.81E-3	1.18E-4	2.30E-5	2.15E-4	9.61E-4	-1.05E-2	-9.66E-4
EP	[kg $(PO_4)^{3-}$-Eq.]	1.52E-3	6.68E-5	1.02E-4	3.23E-5	6.29E-6	2.81E-5	1.90E-4	-9.18E-4	-1.33E-4
POCP	[kg ethene-Eq.]	2.27E-3	-8.44E-5	1.22E-4	-4.08E-5	-7.94E-6	1.62E-5	6.01E-5	-1.34E-3	-1.02E-4
ADPE	[kg Sb-Eq.]	5.70E-6	2.85E-9	4.21E-7	1.38E-9	2.69E-10	3.20E-8	1.96E-7	-6.33E-7	-1.17E-7
ADPF	[MJ]	1.74E+2	7.53E-1	1.01E+1	3.64E-1	7.09E-2	1.32E+0	1.17E+0	-1.54E+2	-1.09E+1

Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources

RESULTS OF THE LCA - RESOURCE USE: 1 m² roofing membranes TPO 2.0 F

Parameter	Unit	A1-A3	A4	A5	C2/1	C2/2	C3	C4	D/1	D/2
PERE	[MJ]	7.44E+0	IND	IND	IND	IND	IND	IND	IND	IND
PERM	[MJ]	0.00E+0	IND	IND	IND	IND	IND	IND	IND	IND
PERT	[MJ]	7.44E+0	5.77E-2	4.00E-1	2.79E-2	5.43E-3	4.94E-1	1.53E-1	-2.83E+0	-1.51E+0
PENRE	[MJ]	1.19E+2	IND	IND	IND	IND	IND	IND	IND	IND
PENRM	[MJ]	7.46E+1	IND	IND	IND	IND	IND	IND	IND	IND
PENRT	[MJ]	1.94E+2	7.56E-1	1.14E+1	3.66E-1	7.12E-2	1.79E+0	1.32E+0	-1.68E+2	-1.23E+1
SM	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	IND	IND	IND	IND	IND	IND	IND	IND	IND

Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² roofing membranes TPO 2.0 F

Parameter	Unit	A1-A3	A4	A5	C2/1	C2/2	C3	C4	D/1	D/2
HWD	[kg]	IND	IND	IND	IND	IND	IND	IND	IND	IND
NHWD	[kg]	IND	IND	IND	IND	IND	IND	IND	IND	IND
RWD	[kg]	IND	IND	IND	IND	IND	IND	IND	IND	IND
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.22E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.22E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	2.90E-1	0.00E+0	0.00E+0	0.00E+0	2.06E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	7.51E-1	0.00E+0	0.00E+0	0.00E+0	5.63E+0	0.00E+0	0.00E+0

Caption	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EEE = Exported thermal energy

The Expert Committee (SVA) at IBU clearly defined the calculation rules for declaring waste at its meeting on 4 October 2012. The data on which the background data used are based must be revised accordingly. This Environmental Product Declaration therefore pursues the transition solution approved by the SVA and is created without a water or waste declaration.

6. LCA: Interpretation

In order to interpret the results of the LCA, both the aggregate indicators of the Life Cycle Inventory Analysis and the estimated impact were analysed in a dominance analysis. Since with all indicators the product stage (modules A1-A3) accounts for the largest share by far, this will be dealt with in greater detail in the following interpretation. The figures refer to KÖSTER TPO 2.0 F roofing membrane. The absolute

figures for the other membranes can be calculated on the basis of the factors specified at the end of Chapter 3.

Indicators of the life cycle inventory analysis:
The use of primary energy from non-renewable energy carriers **(PENRT)** is many times higher than the use of primary energy from renewable energy carriers **(PERT)**. The largest contribution of the product stage to PENRT comes from the production of the raw material granules (approx. 80 %); the contribution of the PES fleece is moderately important, and the electricity consumed is of little importance.

Indicators of estimated impacts:
The product stage (modules A1-A3) makes the largest contribution to the environmental impact of the production of 1 m² KÖSTER roofing and sealing membrane, and the granules account for most of this. The interpretation of the various impact categories is as follows:
The **Global Warming Potential (GWP)** of the product stage is highly probably dominated by the production of the granules, the PES fleece has a certain impact, the electricity mix has a small impact and the impact of the glass fleece is negligible.

The **Ozone Depletion Potential (ODP)** of the product stage is caused solely by the production of the TPO granules.
The **Acidification Potential (AP)** is 85 % attributable to the granules, 9 % attributable to the PES fleece and 3 % attributable to electricity and 2 % to the glass fleece.
The TPO granules make a significant contribution to the **Eutrification Potential (EP)**. The PES fleece is only moderately important for the EPD, electricity consumption and the glass fleece are of little importance and the transportation of the granules is negligible.
The **Photochemical Ozone Creation Potential (POCP)** of the product stage is significantly influenced by the granules. The glass fleece has a certain influence, electricity consumption has only a minor influence.
Approx. 20 % of the elementary **Abiotic Depletion Potential (ADPE)** results from the granules <2.5 % from electricity, but approx. two thirds from the glass fleece, which thus plays the largest part here.
A good 80 % of the **Abiotic Depletion Potential fossil fuels (ADPF)** of the product stage results from the granules. The PES fleece only plays a moderately important role here, and electricity consumption is of little importance.

7. Requisite evidence

No evidence is required

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