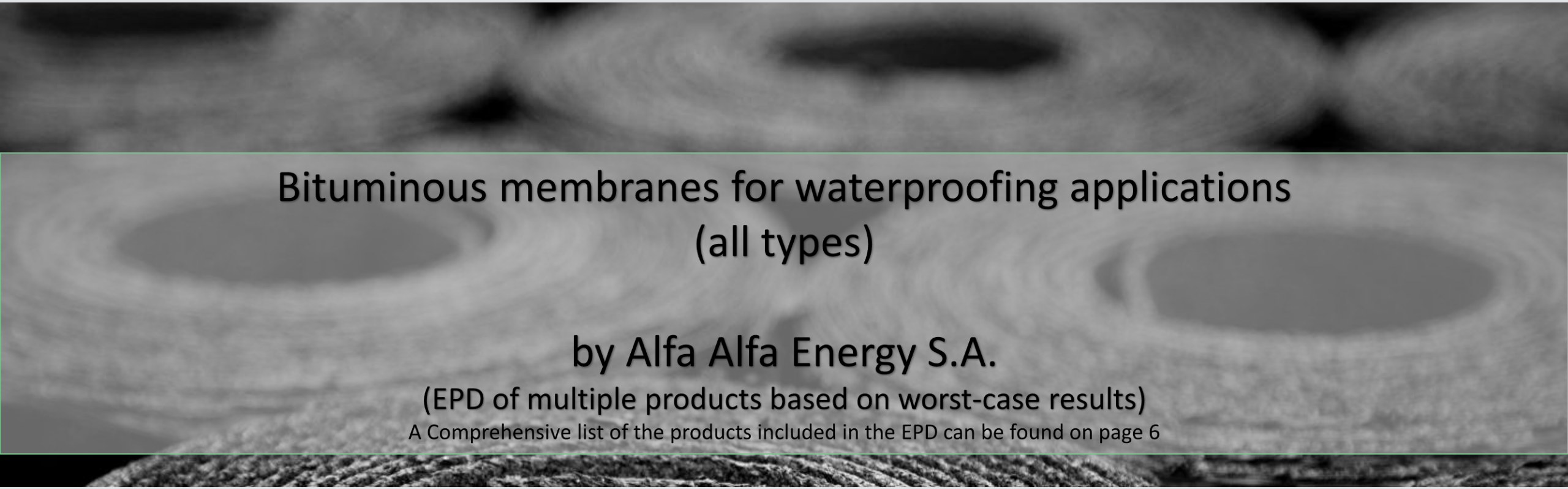
# Environmental Product Declaration

In accordance with ISO 14025:2006 & EN 15804:2012+A2:2019/AC: 2021



# Bituminous membranes for waterproofing applications (all types)

## by Alfa Alfa Energy S.A.

(EPD of multiple products based on worst-case results)

A Comprehensive list of the products included in the EPD can be found on page 6

| EPD Registration Number | Publication Date | Date of Validity | Program | Program operator | UN CPC |
|---|---|---|---|---|---|
| EPD-IES-0017715 | 2024-12-02 | 2029-*11-27* | The International EPD® System www.environdec.com | EPD International AB | Class 5453 |

# PROGRAM INFORMATION

PROGRAM OPERATOR

## EPD International AB

**Address:** Box 210 60. SE-100 31 Stockholm. Sweden
**Website:** www.environdec.com
**Email Address:** info@environdec.com

EPD OWNER

## Alfa Alfa Energy S.A.

Bituminous, Chemical &
Waterproofing Materials Industry

**Production Site :** Paralia Aspropyrgou, 19300 Aspropyrgos Attikis- Greece
**Tel:** (+30) 210 5518700
**Website:** www.esha.gr
**Email address:** info@esha.gr

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

| | |
|---|---|
| **Product Category Rules (PCR)** | CEN Standard EN 15804 serves as the Core Product Category Rules (PCR)<br><br>PCR 2019:14 Construction products version 1.3.4 |
| **PCR Review was conducted by**: | The technical Committee of the International EPD® System. See www.environdec.com/TC for a list of members. Review chairs: Claudia A. Peña. University of Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact. |
| **LCA accountability:** | SustChem Technical Consulting S.A.<br>www.sustchem.gr |
| **Third-party verification**<br>Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: | Business Quality Verification P.C.<br>Approved certification body accountable for the third-party verification<br>www.bqv.gr – info@bqv.gr |
| The certification body is accredited by: | Hellenic Accreditation System ESYD with accreditation number 1218 |
| **Procedure for follow-up of data during EPD validity involves third-party verifier:** | Yes<br>✓ No |

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

## About Us

**Alfa Alfa Energy S.A.** produces and distributes to the Greek market and abroad, under the **ESHA®** trademark, a wide range of bituminous, petroleum and other chemical products, for waterproofing, thermal insulation and protection of civil engineering works, as well as for application in road building works.

Founded in 1962 in Aspropyrgos Attica Greece, the company has significantly contributed for more than 60 years to setting the standards of waterproofing in civil engineering and road building projects.

Esha products have been widely accepted by planners, architects, builders and the private and public sector for so many years that have become synonymous to reliability & high added-value.

**Esha Brand** occupies today the leading position in the Greek market of bituminous waterproofing products.

## Quality and Environmental Commitment

Alfa Alfa Energy S.A. is certified with:

- ❑ ISO 9001:2015 Quality Management System and
- ❑ ISO 14001:2015 Environmental Management System

Our products are manufactured according to the latest European Norms & Requirements and are marked with CE.

Besides, all our products are certified and approved by independent labs and organizations. There is also a very large database of application projects in Greece and abroad which testify ESHA products' supreme quality and long-life expectance.

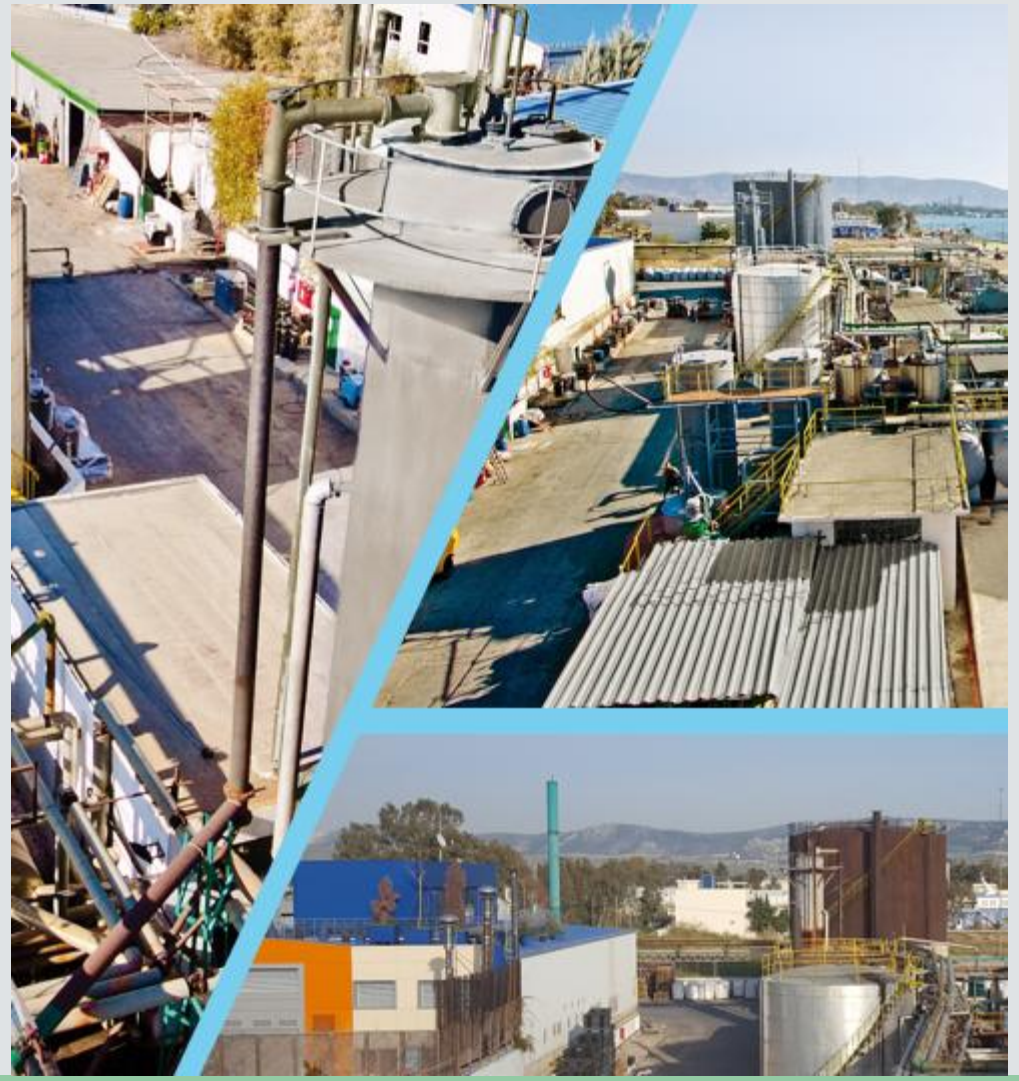
Alfa Alfa Energy is a founding member of the company "Rewarding Recycling S.A." that is the approved commission for the establishment and function of the programs "Rewarding Alternative Management" & "Packages and Wastes Recycling in Greece".

## Product Portfolio

Nowadays, Alfa Alfa Energy S.A. produces and distributes an extensive range of high-quality products, in the manufacturing plant of Aspropyrgos, falling into the presented main product categories:

- **Bituminous membranes**
- Plastic Membranes
- Under-tile waterproofing
- Waterproofing Coatings
- Joint Sealants
- Waterproofing accessories
- Cementitious Waterproofing products
- Thermal Insulation
- Green Roofs
- Drainage Membranes-Geotextiles
- Road Building Materials
- External Thermal Insulation

# PRODUCT INFORMATION- Composition



Bituminous membranes, are composed by three components:

1. Bituminous mixture
2. Rei*nf*orcement Material
3. Finishing Materials

The various products manufactured by Alfa Alfa Energy S.A. differ:

- By type of polymers used to modify bitumen during bituminous mixture production, providing both SBS-type elastomeric membranes and APP-type plastomeric membranes.
- By the composition of the raw materials introduced in the bituminous mixture production offering a wide range of alternatives, based on the intended use.
- By the type of reinforcement material which can be either polyester fiber cloth, composite glass grit or glass fiber sheet.
- By the type of finishing materials which can be a combination of polyethylene/polyethylene films, polyethylene film/mineral granules or polyethylene film/aluminum foil
- By the final weight/density of the bituminous membrane, ranging from 2-6 $kg.m^2$ .

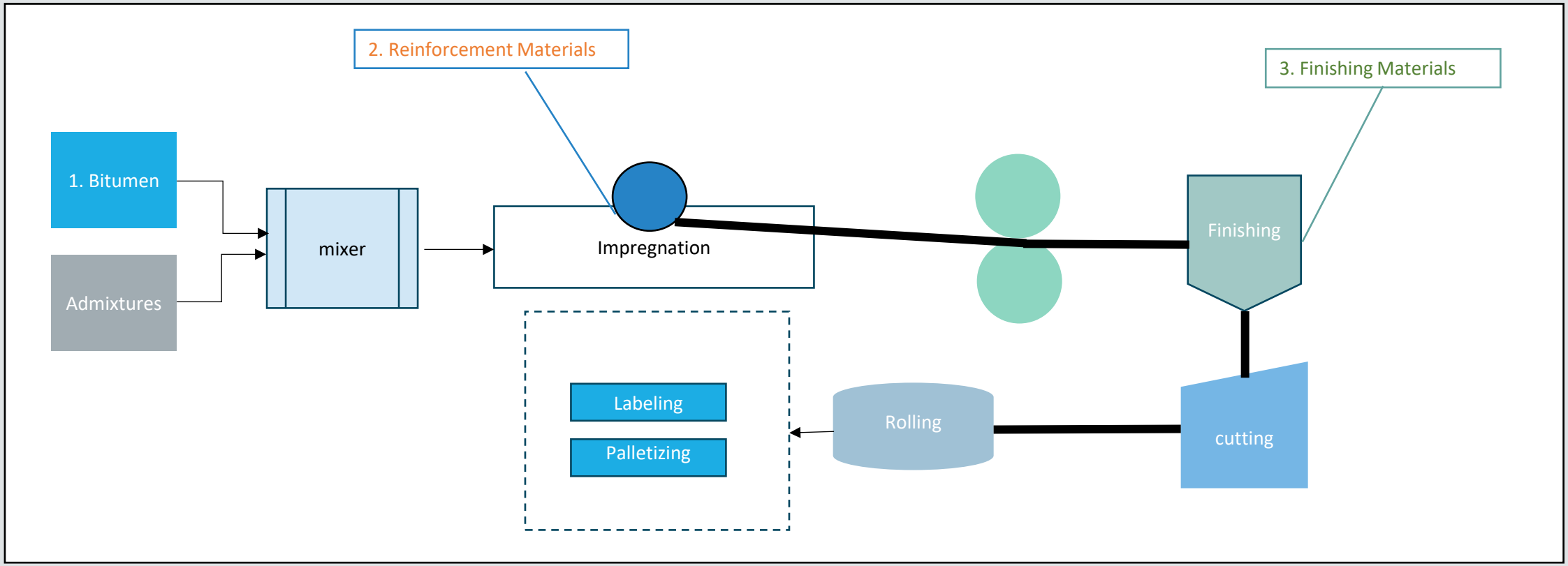
All these variables are adjusted based on the desired properties requested by the customers.

The selection of the appropriate combination of bituminous mixture, reinforcement, surface finishing and weight/thickness of the membrane offers a variety of applications and high-quality solutions in every problem of waterproofing.

# PRODUCT INFORMATION – Production Process

This EPD covers the whole range of waterproofing bituminous membranes manufactured by Alfa Alfa Energy S.A.

Although there are many variations, depending on the intended use, the basic steps of the production process are presented in the following figure:



# PRODUCT INFORMATION-Variables

Based on the available combinations, there can be identified the following bituminous membrane systems, manufactured by Alfa Alfa Energy, divided in two categories based on modifying polymer type.

## SBS-type bituminous membranes

| | Unit | EshaDIEN & Eshadien Ultra White | | | EshaELASTAN & EshaELASTAN- S | | | EshaFIN | | | EshaSTICK & Ultra White | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Available Finishes | - | PP | PG | P-Al | PP | PG | P-Al | PP | PG | P-Al | PP | PG | P-Al |
| Available Reinforcements | - | Polyester Fiber Cloth/ Composite glass grit / Glass Fiber Sheet | | | | | | | | | | | |
| Weight (maximum) | kg.m$^2$ | 5 | 6 | 4.5 | 5 | 6 | 4.5 | 5 | 6 | 4.5 | 5 | 6 | 4.5 |
| Dimensions (width x length) | m x m | 1x10 | | | | | | | | | | | |

## APP-type bituminous membranes

| | Unit | EshaDURO | | EshaGUM & Antiroot B5 | | EshaPROOF | |
|---|---|---|---|---|---|---|---|
| Available Finishes | - | PP | PG | PP | PG | PP | PG |
| Available Reinforcements | - | Polyester Fiber Cloth/ Composite glass grit / Glass Fiber Sheet | | | | | |
| Weight (maximum) | kg.m$^2$ | 5 | 5 | 5 | 5 | 5 | 5 |
| Dimensions (width x length) | m x m | 1x10 | | | | | |

| Abbreviations explanation: | |
|---|---|
| PP | Polyethylene-Polyethylene film |
| PG | Polyethylene film-Mineral Granules |
| P-Al | Polyethylene film- Aluminum Foil |

# PRODUCT INFORMATION-Technical Data – ESHAGUM & ANTIROOT B5

| Characteristics | Standard | T | Nominal values | | | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Glass Fleece | Nonwoven polyester | Polyester combined with reinforcing glass yarns | Spun Bond Polyester (SP) | Spun Bond Polyester (SP250) | |
| Length | EN 1848-1 | | 10 | 10 | 10 | 10 | 10 | m |
| Width | EN 1848-1 | | 1 | 1 | 1 | 1 | 1 | m |
| Upper surface covering | - | | PE film/ mineral granules | PE film/ mineral granules | PE film/ mineral granules | PE film/ mineral granules | PE film/ mineral granules | --- |
| Bottom surface covering | - | | PE film/ Quartz sand | PE film/ Quartz sand | PE film/ Quartz sand | PE film/ Quartz sand | PE film/ Quartz sand | --- |
| Thickness | EN 1849-1 | ±0,2 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | mm |
| Weight | EN 1849-1 | ±10% | 3-6 | 3-6 | 3-6 | 3-6 | 3-6 | $kg/m^2$ |
| Type | - | | Plastomeric (APP) | Plastomeric (APP) | Plastomeric (APP) | Plastomeric (APP) | Plastomeric (APP) | --- |
| Softening Point | EN 1427 | ≥ | 148 | 148 | 148 | 148 | 148 | °C |
| Penetration at 25 °C | EN 1426 | ± 5 | 25 | 25 | 25 | 25 | 25 | dmm |
| Antiroot Agent | | | - | - | - | - | - | |
| Tensile strength L/T | EN 12311-1 | ± 20% | 300/200 | 450/300 | 550/420 | 900/650 | 1100/900 | N/50mm |
| Elongation L/T | EN 12311-1 | ± 15% | 2/2 | 30/50 | 40/55 | 50/60 | 50/60 | % |
| Tear resistance L/T | ASTM D4073- 94 | ± 15% | 100/200 | 200/350 | 300/400 | 350/450 | 600/700 | N |
| Static puncture resistance (concrete) | EN 12730/ UEAtc MOAT27 | | L2 (7-15) | L3 (15-25) | L3 (15-25) | L3 (15-25) | L4 (>25) | kg |
| Dynamic puncture resistance (concrete) | EN 12691/ UEAtc MOAT27 | | I3 (Φ10) | I3 (Φ8) | I3 (Φ8) | I3 (Φ8) | I3 (Φ8) | mm |
| Flexibility to low temperatures | EN 1109 | ± 3 | -10 | -10 | -10 | -10 | -10 | °C |
| Water tightness (72h, 2 bar) | UEAtc/EN 1928 | | Successfully Passed | | | | | |
| Vapor permeability coefficient | EN 1931 | ≥ | 20000 | 20000 | 20000 | 20000 | 20000 | --- |
| Heat resistance | EN 1110 | ≤ | 130 | 130 | 130 | 130 | 130 | °C |
| Reaction to fire | EN 13501-1 | | F | F | F | F | F | --- |
| Dimensional stability L/T | EN 1107-1 | ≤ | -0.1/+0.1 | -0.15/+0.1 | -0.15/+0.1 | -0.4/+0.3 | -0.4/+0.3 | % |
| Thermal conductivity | | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | W/mK |

# PRODUCT INFORMATION-Technical Data - ESHAPROOF

| Characteristics | Standard | T | Nominal values | | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | Glass Fleece | Nonwoven polyester | Polyester combined with reinforcing glass yarns | Spun Bond Polyester (SP) | |
| Length | EN 1848-1 | | 10 | 10 | 10 | 10 | m |
| Width | EN 1848-1 | | 1 | 1 | 1 | 1 | m |
| Upper surface covering | - | | PE film/mineral granules | PE film/mineral granules | PE film/mineral granules | PE film/mineral granules | --- |
| Bottom surface covering | - | | PE film/ Quartz sand | PE film/ Quartz sand | PE film/ Quartz sand | PE film/ Quartz sand | --- |
| Thickness | EN 1849-1 | ±0,2 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | mm |
| Weight | EN 1849-1 | ±10% | 3-6 | 3-6 | 3-6 | 3-6 | kg/m$^2$ |
| Type | - | | Plastomeric (APP) | Plastomeric (APP) | Plastomeric (APP) | Plastomeric (APP) | --- |
| Softening Point | EN 1427 | ≥ | 145 | 145 | 145 | 145 | °C |
| Penetration at 25 °C | EN 1426 | ± 5 | 25 | 25 | 25 | 25 | dmm |
| Antiroot Agent | | | - | - | - | - | |
| Tensile strength L/T | EN 12311-1 | ± 20% | 300/200 | 450/300 | 550/400 | 900/650 | N/50mm |
| Elongation L/T | EN 12311-1 | ± 15% | 2/2 | 30/50 | 40/55 | 45/55 | % |
| Tear resistance L/T | ASTM D4073-94 | ± 15% | 100/200 | 200/350 | 280/400 | 340/440 | N |
| Static puncture resistance (concrete) | EN 12730/ UEAtc MOAT27 | | L2 (7-15) | L3 (15-25) | L3 (15-25) | L3 (15-25) | kg |
| Dynamic puncture resistance (concrete) | EN 12691/ UEAtc MOAT27 | | I3 (Φ 10) | I3 (Φ 8) | I3 (Φ 8) | I3 (Φ 8) | mm |
| Flexibility to low tempera- tures | EN 1109 | ± 5 | -7 | -7 | -7 | -7 | °C |
| Water tightness (72h, 2 bar) | UEAtc/EN 1928 | | Successfully Passed | | | | |
| Vapor permeability coef- ficient | EN 1931 | ≥ | 20000 | 20000 | 20000 | 20000 | --- |
| Heat resistance | EN 1110 | ≤ | 120 | 120 | 120 | 120 | °C |
| Reaction to fire | EN 13501-1 | | F | F | F | F | --- |
| Dimensional stability L/T | EN 1107-1 | ≤ | -0.1/+0.1 | -0.15/+0.1 | -0.15/+0.1 | -0.4/ +0.3 | % |
| Thermal conductivity | | | 0.2 | 0.2 | 0.2 | 0.2 | W/mK |

# PRODUCT INFORMATION-Technical Data - ESHADURO

| Characteristics | Standard | T | Nominal values | | | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Glass Fleece | Glass mat combined with polyester | Nonwoven polyester | Polyester combined with reinforcing glass yarns | Spun Bond Polyester (SP) | |
| **Length** | EN 1848-1 | ± 0.02 | 8 or 10 | 8 or 10 | 8 or 10 | 8 or 10 | 8 or 10 | m |
| **Width** | EN 1848-1 | | 1 | 1 | 1 | 1 | 1 | m |
| **Upper surface covering** | - | | PE film/mineral granules/ Quartz sand | PE film/mineral granules/ Quartz sand | PE film/mineral granules/ Quartz sand | PE film/mineral granules/ Quartz sand | PE film/mineral granules | --- |
| **Bottom surface covering** | - | | PE film/ Quartz sand | PE film/ Quartz sand | PE film/ Quartz sand | PE film/ Quartz sand | PE film | --- |
| **Thickness** | EN 1849-1 | ± 0.2 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | mm |
| **Weight** | EN 1849-1 | ±10% | 3-6 | 3-6 | 3-6 | 3-6 | 3-6 | $kg/m^2$ |
| **Type** | - | | Plastomeric (APP) | Plastomeric (APP) | Plastomeric (APP) | Plastomeric (APP) | Plastomeric (APP) | --- |
| **Softening Point** | EN 1427 | ≥ | 145 | 145 | 145 | 145 | 145 | °C |
| **Penetration at 25 °C** | EN 1426 | ± 5 | 25 | 25 | 25 | 25 | 25 | dmm |
| **Antiroot Agent** | | | - | - | - | - | - | |
| **Tensile strength L/T** | EN 12311-1 | ± 20% | 300/200 | 640/600 | 450/300 | 550/400 | 850/650 | N/50mm |
| **Elongation L/T** | EN 12311-1 | ± 15% | 2/2 | 4/4 | 30/50 | 40/55 | 45/55 | % |
| **Tear resistance L/T** | ASTM D4073-94 | ± 15% | 100/200 | 350/350 | 200/350 | 280/400 | 320/420 | N |
| **Static puncture resis- tance (concrete)** | EN 12730/UEAtc MOAT27 | | L2 (7-15) | L2 (7-15) | L3 (15-25) | L3 (15-25) | L3 (15-25) | kg |
| **Dynamic puncture resistance (concrete)** | EN 12691/UEAtc MOAT27 | | I3 (Φ 10) | I3 (Φ 10) | I3 (Φ 8) | I3 (Φ 8) | I3 (Φ 8) | mm |
| **Flexibility to low temperatures** | EN 1109 | ± 5 | -5 | -5 | -5 | -5 | -5 | °C |
| **Water tightness (72h, 2 bar)** | UEAtc/EN 1928 | | Successfully Passed | | | | | |
| **Vapor permeability coefficient** | EN 1931 | ≥ | 20000 | 20000 | 20000 | 20000 | 20000 | --- |
| **Heat resistance** | EN 1110 | ≤ | 115 | 115 | 115 | 115 | 115 | °C |
| **Reaction to fire** | EN 13501-1 | | F | F | F | F | F | --- |
| **Dimensional stability L/T** | EN 1107-1 | ≤ | -0.1/+0.1 | -0.1/+0.1 | -0.15/+0.1 | -0.15/+0.1 | -0.4/+0.3 | % |
| **Thermal conductivity** | | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | W/mK |

# PRODUCT INFORMATION-Technical Data – ESHASTICK PP

| Characteristics | Standard | T | Nominal values | | | |
|---|---|---|---|---|---|---|
| **Bituminous Compound** | -- | -- | **Elastomeric (SBS) bitumen with self adhesive properties** | | | -- |
| **Length** | EN 1849-1 | ±0,02 | 10-20 | | | m |
| **Width** | EN 1849-1 | ±0,02 | 1 | | | m |
| **Top Surface Finish** | -- | -- | PE Film | | | -- |
| **Bottom Surface Finish** | -- | -- | Silicone Release PE film | | | -- |
| **Reinforcement** | -- | -- | High stability Polyester | Glass Fleece | Glass Mat | -- |
| **Weight** | EN 1849-1 | ±10% | 1-4 | | | $Kg/m^2$ |
| **Softening Point** | EN 1427 | ≥ | 105 | | | °C |
| **Penetration at 25 °C** | EN 1426 | -- | 75-95 | | | dmm |
| **Tensile strength L/T** | EN 12311-1 | ± 20% | 450/300 | 300/200 | 600/600 | N/50mm |
| **Elongation L/T** | EN 12311-1 | ± 15% | 30/40 | 2/2 | 4/4 | % |
| **Tear resistance L/T** | ASTM D4073-94 | ± 15% | 200/300 | 100/100 | 300/300 | N |
| **Static puncture resistance (concrete)** | EN 12730/UEAtc MOAT27 | -- | L3 (15-25) | L2 (7-15) | | Kg |
| **Dynamic puncture resistance (concrete)** | EN 12691/UEAtc MOAT27 | -- | I3 (Φ 8) | I3 (Φ 10) | | mm |
| **Flexibility to low temperatures** | EN 1109 | ± 5 | -22 | | | °C |
| **Heat Resistance** | EN 1110 | < | 100 | | | °C |
| **Water tightness (60 KPa, 24 h)** | UEAtc/EN 1928 method - 1 | -- | Passed | | | -- |
| **Vapor permeability coefficient** | EN 1931 | > | 20000 | | | -- |
| **Reaction to fire** | EN 13501-1 | -- | F | | | -- |
| **Dimensional stability L/T** | EN 1107-1 | ≤ | -0.1 / +0.1 | | | % |

# PRODUCT INFORMATION-Technical Data – ESHASTICK PG

| Characteristics | Standard | T | Nominal values | | |
|---|---|---|---|---|---|
| **Bituminous Compound** | -- | -- | **Elastomeric (SBS) bitumen with self adhesive properties** | | -- |
| **Length** | EN 1849-1 | ±0,1 | 10 | | m |
| **Width** | EN 1849-1 | ±0,02 | 1 | | m |
| **Top Surface Finish** | -- | -- | Coloured Mineral Chipping | | -- |
| **Bottom Surface Finish** | -- | -- | Silicone Release PE film | | -- |
| **Reinforcement** | -- | -- | High stability Polyester | Glass Fleece | -- |
| **Weight** | EN 1849-1 | ±10% | 3-4 | | $Kg/m^2$ |
| **Softening Point** | EN 1427 | ± 5 | 105 | | °C |
| **Penetration at 25 °C** | EN 1426 | ± 10 | 85 | | dmm |
| **Elastic Recovery of bituminous binder** | EN 13398 | ≥ | 90 | | % |
| **Elastic Recovery of bituminous binder after oxidative aging** | EN 13398 | ≥ | 90 | | % |
| **Tensile strength L/T** | EN 12311-1 | ± 20% | 450/300 | 300/200 | N/50mm |
| **Elongation L/T** | EN 12311-1 | ± 15% | 30/40 | 2/2 | % |
| **Tear resistance L/T** | ASTM D4073-94 | ± 15% | 200/300 | 100/100 | N |
| **Static puncture resistance (concrete)** | EN 12730/UEAtc MOAT27 | -- | L3 (15-25) | L2 (7-15) | Kg |
| **Dynamic puncture resistance (concrete)** | EN 12691/UEAtc MOAT27 | -- | I3 (Φ 10) | I3 (Φ 10) | mm |
| **Flexibility to low temperatures** | EN 1109 | ± 5 | -20 | | °C |
| **Heat Resistance** | EN 1110 | < | 100 | | °C |
| **Water tightness (60 KPa, 24 h)** | UEAtc/EN 1928 method - 1 | -- | Passed | | -- |
| **Vapor permeability coefficient** | EN 1931 | > | 20000 | | -- |
| **Reaction to fire** | EN 13501-1 | -- | F | | -- |
| **Dimensional stability L/T** | EN 1107-1 | ≤ | -0.15 / +0.15 | -0.1 / +0.1 | % |

# PRODUCT INFORMATION-Technical Data – ESHASTICK P-AL & ESHASTIC ULTRA WHITE

| Characteristics | Standards | T | Nominal Values | | | Unit |
|---|---|---|---|---|---|---|
| **Bituminous Compound** | -- | -- | **Elastomeric (SBS) bitumen with self adhesive properties** | | | -- |
| **Length** | EN 1848-1 | ±0,1 | 10 | | | m |
| **Width** | EN 1848-1 | ±0,02 | 1 | | | m |
| **Top Surface Finish** | -- | -- | Aluminium foil | | | -- |
| **Bottom Surface Finish** | -- | -- | Silicone Release PE film | | | -- |
| **Reinforcement** | -- | -- | Nonwoven polyester | Glass Mat | Glass Fleece | -- |
| **Weight** | EN 1849-1 | -- | 3-5 | | | $Kg/m^2$ |
| **Softening Point** | EN 1427 | ± 5 | 105 | | | °C |
| **Penetration at 25 °C** | EN 1426 | ± 10 | 85 | | | dmm |
| **Elastic recovery of the bituminous binder of the membrane** | EN 13398 | ≥ | 90 | | | % |
| **Elastic recovery after the oxidative aging, EN 12607-1** | EN 13398 | ≥ | 90 | | | % |
| **Tensile strength L/T** | EN 12311-1 | ± 20% | 450/300 | 600/600 | 300/200 | N/50mm |
| **Elongation L/T** | EN 12311-1 | ± 15% | 30/40 | 4/4 | 2/2 | % |
| **Tear resistance L/T** | ASTM D4073-94 | ± 15% | 200/300 | 350/350 | 100/100 | N |
| **Static puncture resistance (concrete)** | EN 12730/UEAtc MOAT27 | -- | L3 (15-25) | L3 (15-25) | L3 (15-25) | Kg |
| **Dynamic puncture resistance (concrete)** | EN 12691/UEAtc MOAT27 | -- | I3 (Φ 8) | I3 (Φ 10) | I3 (Φ 10) | mm |
| **Flexibility to low temperatures** | EN 1109 | ± 5 | -20 | | | °C |
| **Heat Resistance** | EN 1110 | < | 100 | | | °C |
| **Dimensional stability L/T** | EN 1107-1 | ≤ | -0.15 / +0.15 | -0.15 / +0.15 | -0.1 / +0.1 | % |

we know how
since 1962

# PRODUCT INFORMATION-Technical Data – ESHADIEN

| Characteristics | Standard | T | Nominal values | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Glass Fleece | Glass mat combined with polyester | Nonwoven polyester | Polyester combined with glass yarns | Spun Bond Polyester (SP-180) | Spun Bond Polyester (SP-250) | |
| Visible defects | | | No defects | | | | | | |
| Length | EN 1848-1 | ±0,2% | 8 or 10 | 8 or 10 | 8 or 10 | 8 or 10 | 8 or 10 | 8 or 10 | m |
| Width | EN 1848-1 | | 1 | 1 | 1 | 1 | 1 | 1 | m |
| Straightness | | | Fulfills requirements | | | | | | |
| Upper surface covering | - | | PE film/mineral granules/ aluminium foil | | | | | | --- |
| Bottom surface covering | - | | PE film / Quartz sand | | | | | | --- |
| Thickness | EN 1849-1 | ±0,2 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | mm |
| Weight | EN 1849-1 | ±10% | 3-6 | 3-6 | 3-6 | 3-6 | 3-6 | 3-6 | $kg/m^2$ |
| Type | - | | Elastomeric (SBS) | | | | | | --- |
| Softening Point | EN 1427 | ± 10 | 130 | 130 | 130 | 130 | 130 | 130 | °C |
| Penetration at 25 °C | EN 1426 | ± 5 | 35 | 35 | 35 | 35 | 35 | 35 | dmm |
| Elastic recovery of the bituminous binder of the membrane | EN 13398 | ≥ | 90 | 90 | 90 | 90 | 90 | 90 | % |
| Elastic recovery after the oxidative aging, EN 12607-1 | EN 13398 | ≥ | 90 | 90 | 90 | 90 | 90 | 90 | % |
| Tensile strength L/T | EN 12311-1 | ± 20% | 320/220 | 650/650 | 480/350 | 560/420 | 900/650 | 1100/900 | N/50mm |
| Elongation L/T | EN 12311-1 | ± 15% | 2/2 | 4/4 | 30/45 | 45/55 | 50/60 | 50/60 | % |
| Tear resistance L/T | ASTM D4073-94 | ± 15% | 100/250 | 375/375 | 220/350 | 250/400 | 360/550 | 600/700 | N |
| Static puncture resistance (concrete) | EN 12730/ UEAtc MOAT27 | | L2 (7-15) | L2 (7-15) | L3 (15-25) | L3 (15-25) | L3 (15-25) | L4 (≥ 25) | kg |
| Dynamic puncture resistance (concrete) | EN 12691/ UEAtc MOAT27 | | I3 (Φ10) | I3 (Φ10) | I3 (Φ8) | I3 (Φ8) | I3 (Φ8) | I3 (Φ8) | mm |
| Flexibility to low temperatures | EN 1109 | ± 5 | -20 | -20 | -20 | -20 | -20 | -20 | °C |
| Water tightness (72h, 2 bar) | UEAtc/EN 1928 | | Successfully passed | | | | | | |
| Vapor permeability coefficient | EN 1931 | ≥ | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | --- |
| Heat resistance | EN 1110 | ≤ | 110 | 110 | 110 | 110 | 110 | 110 | °C |
| Reaction to fire | EN 13501-1 | ≥ | F | F | F | F | F | F | --- |
| Dangerous substances | | | Contains no limestone and coal tar | | | | | | |
| Dimensional stability L/T | EN 1107-1 | ≤ | -0.1/+0.1 | -0.1/+0.1 | -0.15/+0.1 | -0.15/+0.1 | -0.4/+0.3 | -0.4/+0.3 | % |
| Thermal conductivity | | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | W/mK |

# PRODUCT INFORMATION-Technical Data – ESHADIEN ULTRA WHITE

| Characteristics | Methods | T | Performance | | Units |
|---|---|---|---|---|---|
| | | | ESHADIEN ULTRA WHITE | ESHASTICK ULTRA WHITE | |
| Top surface finish | | | reinforced 3 laminated ultra white PE film | | - |
| Bottom surface finish | | | torchable PE film | peel off siliconized film | - |
| Reinforcement | | | SP polyester | glass fleece | - |
| Length | EN 1848-1 | | 10 | 20 | m |
| Width | EN 1848-1 | | 1 | 1 | m |
| Weight | EN 1849-1 | ± 10 % | 4.0 | 2.0 | $kg/m^2$ |
| Type | | | Elastomeric (SBS) | | - |
| Softening point | EN 1427 | ± 10 | 120 | 105 | ºC |
| Penetration at 25 °C | EN 1426 | ± 5 | 33 | 85 | dmm |
| Tensile strength L/T | EN 12311-1 | ± 20% | 900/650 | 400/300 | N/50mm |
| Elongation L/T | EN 12311-1 | ± 15% | 40 / 55 | 5/5 | % |
| Tear resistance L/T | ASTM D4073-94 | ± 15% | 450/580 | 300/400 | N |
| Puncture resistance static | EN 12730/ UEAtc MOAT27 | | L3 (15-25) | L2 (7-15) | kg |
| Puncture resistance dynamic | EN 12691/ UEAtc MOAT27 | | I3 (Φ 8mm) | I3 (Φ 12mm) | - |
| Cold flexibility | EN 1109 | ± 3 | -20 | -25 | ºC |
| Flow resistance at elevated temperature | EN 1110 | ± 10 | 110 | 95 | ºC |
| Water tightness (72h) | UEAtc/EN 1928 | | passed | | - |
| Solar Reflectance Index | ASTM E 1980-01 | ≥ | 87 | | - |
| Reaction to Fire | EN 13501-1 | ≥ | F | | |
| Dimensional stability (L/T) | EN 1107-1 | ≤ | -0,2 / +0,1 | -0,1 / +0,1 | % |

we know how
since 1962

# PRODUCT INFORMATION-Technical Data – ESHAELASTAN & ESHAELASTAN - S

| Characteristics | Standard | T | Nominal values | | | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Glass Fleece | Glass mat combined with polyester | Nonwoven polyester | Polyester combined with reinforcing glass yarns | Spun Bond Polyester (SP) | |
| Length | EN 1848-1 | ±0,02 | 8 or 10 | 8 or 10 | 8 or 10 | 8 or 10 | 8 or 10 | m |
| Width | EN 1848-1 | | 1 | 1 | 1 | 1 | 1 | m |
| Upper surface covering | - | | PE film/mineral granules/aluminium foil | | | | | --- |
| Bottom surface covering | - | | PE film/Quartz sand | | | | | --- |
| Thickness | EN 1849-1 | ±0,2% | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | mm |
| Weight | EN 1849-1 | ±10% | 3-6 | 3-6 | 3-6 | 3-6 | 3-6 | $kg/m^2$ |
| Type | - | | Elastomeric (SBS) | | | | | --- |
| Softening Point | EN 1427 | ≥ | 120 | 120 | 120 | 120 | 120 | °C |
| Penetration at 25 °C | EN 1426 | ± 5 | 30 | 30 | 30 | 30 | 30 | dmm |
| Elastic recovery of the bituminous binder of the membrane | EN 13398 | ≥ | 90 | 90 | 90 | 90 | 90 | % |
| Elastic recovery after the oxidative aging, EN 12607-1 | EN 13398 | ≥ | 80 | 80 | 80 | 80 | 80 | % |
| Tensile strength L/T | EN 12311-1 | ± 20% | 320/220 | 640/600 | 400/300 | 540/400 | 900/650 | N/50mm |
| Elongation L/T | EN 12311-1 | ± 15% | 2/2 | 4/4 | 30/45 | 45/55 | 50/60 | % |
| Tear resistance L/T | ASTM D4073-94 | ± 15% | 100/250 | 375/375 | 200/320 | 230/380 | 360/550 | N |
| Static puncture resistance (concrete) | EN 12730/ UEAtc MOAT27 | | L2 (7-15) | L2 (7-15) | L3 (15-25) | L3 (15-25) | L3 (15-25) | kg |
| Dynamic puncture resistance (concrete) | EN 12691/ UEAtc MOAT27 | | I3 (Φ10) | I3 (Φ10) | I3 (Φ8) | I3 (Φ8) | I3 (Φ8) | mm |
| Flexibility to low temperatures | EN 1109 | ± 5 | -15 | -15 | -15 | -15 | -15 | °C |
| Water tightness (72h, 2bar) | UEAtc/ EN 1928 | | Successfully Passed | | | | | |
| Vapor permeability coefficient | EN 1931 | ≥ | 20000 | 20000 | 20000 | 20000 | 20000 | --- |
| Heat resistance | EN 1110 | ≤ | 110 | 110 | 110 | 110 | 110 | °C |
| Reaction to fire | EN 13501-1 | | F | F | F | F | F | --- |
| Dimensional stability L/T | EN 1107-1 | ≤ | -0.1/+0.1 | -0.1/+0.1 | -0.15/+0.1 | -0.15/+0.1 | -0.4/+0.3 | % |
| Thermal conductivity | - | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | W/mK |

# PRODUCT INFORMATION-Technical Data – ESHAFIN

| Characteristics | Standard | T | Nominal values | | | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | Glass Fleece | Glass mat combined with polyester | Nonwoven polyester | Polyester combined with reinforcing glass yarns | Spun Bond Polyester (SP) | |
| **Length** | EN 1849-1 | | 8 or 10 | 8 or 10 | 8 or 10 | 8 or 10 | 8 or 10 | m |
| **Width** | EN 1849-1 | | 1 | 1 | 1 | 1 | 1 | m |
| **Upper surface covering** | - | | PE film/mineral granules/ aluminium foil | PE film/mineral granules/ aluminium foil | PE film/mineral granules/ aluminium foil | PE film/mineral granules/ aluminium foil | PE film/mineral granules/ aluminium foil | --- |
| **Bottom surface covering** | - | | PE film/ Quartz sand | PE film/ Quartz sand | PE film/ Quartz sand | PE film/ Quartz sand | PE film/ Quartz sand | --- |
| **Thickness** | EN 1849-1 | ±0,2 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | 2.5-5 | mm |
| **Weight** | EN 1849-1 | ±10% | 3-6 | 3-6 | 3-6 | 3-6 | 3-6 | $kg/m^2$ |
| **Type** | - | | Elastomeric (SBS) | Elastomeric (SBS) | Elastomeric (SBS) | Elastomeric (SBS) | Elastomeric (SBS) | --- |
| **Softening Point** | EN 1427 | ≥ | 110 | 110 | 110 | 110 | 110 | °C |
| **Penetration at 25 °C** | EN 1426 | ± 5 | 30 | 30 | 30 | 30 | 30 | dmm |
| **Elastic recovery of the bituminous binder of the membrane** | EN 13398 | ≥ | 80 | 80 | 80 | 80 | 80 | % |
| **Elastic recovery after the oxidative aging, EN 12607-1** | EN 13398 | ≥ | 70 | 70 | 70 | 70 | 70 | % |
| **Tensile strength L/T** | EN 12311-1 | ± 20% | 320/220 | 600/580 | 390/290 | 530/390 | 900/650 | N/50mm |
| **Elongation L/T** | EN 12311-1 | ± 15% | 2/2 | 4/4 | 30/40 | 40/50 | 50/60 | % |
| **Tear resistance L/T** | ASTM D4073-94 | ± 15% | 100/250 | 360/360 | 190/310 | 220/370 | 350/550 | N |
| **Static puncture resistance (concrete)** | EN 12730/ UEAtc MOAT27 | | L2 (7-15) | L2 (7-15) | L3 (15-25) | L3 (15-25) | L3 (15-25) | kg |
| **Dynamic puncture resistance (concrete)** | EN 12691/ UEAtc MOAT27 | | I3 (Φ10) | I3 (Φ10) | I3 (Φ8) | I3 (Φ8) | I3 (Φ8) | mm |
| **Flexibility to low temperatures** | EN 1109 | ± 5 | -10 | -10 | -10 | -10 | -10 | °C |
| **Water tightness (72h)** | UEAtc/EN 1928 | | Successfully Passed | | | | | --- |
| **Vapor permeability coefficient** | EN 1931 | ≥ | 20000 | 20000 | 20000 | 20000 | 20000 | --- |
| **Heat resistance** | EN 1110 | ≤ | 100 | 100 | 100 | 100 | 100 | °C |
| **Reaction to fire** | EN 13501-1 | | F | F | F | F | F | --- |
| **Dimensional stability L/T** | EN 1107-1 | ≤ | -0.1/+0.1 | -0.1/+0.1 | -0.15/+0.1 | -0.15/+0.1 | -0.4/+0.3 | % |
| **Thermal conductivity** | | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | W/mK |

we know how since 1962

# LCA INFORMATION

## Grouping- EPD of multiple products

This EPD is a multi- product EPD as it covers the whole range of bituminous membranes manufactured by Alfa Alfa Energy S.A. For the reflection of the environmental aspects associated with the whole range of membranes, the worst-case approach was followed.

Towards identification of the the worst-case product, the following procedure was applied:

Step 1: Identification of the possible combinations of components to produce the various types of bituminous membranes
Step 2: Identification of the maximum available weights/thicknesses of the various types of bituminous membranes (kg.m2)
Step 3: LCA analysis and extraction of the environmental results of the heavier available products
Step 4: Selection of the worst-case results for each environmental indicator for each of the examined information module(s)

## Declared unit

The selected declared unit is **1 $m^2$ of bituminous membrane**. It is not possible to provide a conversion factor for the correlation of the declared unit to 1 kg of product, as this is an EPD of multiple products based on worst-case approach, and the worst-case results are related to products with various final weighs ($kg.m^2$).

However, in the Environmental results section are provided conversion factors for the correlation of the worst-case results with selected bituminous membranes.

## Time representativeness

The data used are based on one-year average data, from January 2022 to December 2022.

## Geographical Scope

Europe

## System Boundaries

This LCA study follows a “cradle-to-gate” approach with modules C & D and additional modules A4, A5.

we know how since 1962

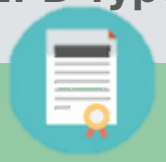
**Databases Used:**
Ecoinvent 3.8.1 & Professional 2021

**Software Used:**
LCA for experts (GaBi)

# LCA INFORMATION

| | Product Stage | | | Construction process stage | | Use Stage | | | | | | | End-of-life stage | | | | Resource Recovery stage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw Material Supply | Transport | Manufacturing | Transport | Construction Installation | use | Maintenance | Repair | Replacement | Refurbishment | Operational Energy Use | Operational Water Use | De-construction demolition | Transport | Waste Processing | Disposal | Reuse-Recovery-Recycling potential |
| Module | A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| Modules Declared | X | X | X | X | X | ND | ND | ND | ND | ND | ND | ND | X | X | X | X | X |
| Geography | EU-28 | EU-28 | GR | EU-28 | EU-28 | - | - | - | - | - | - | - | EU-28 | EU-28 | EU-28 | EU-28 | EU-28 |
| Specific Data used | 4.36% | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Variation-Products | GHG-GWP variations of products from the worst-case (7.42 % - 50.35 %) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Variation-sites | 0% | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

**EPD Type**



Multiple Products

**SOFTWARE**

LCA for Experts Version 10.8.014

**DATABASE**

Ecoinvent Version 3.8 Professional 2021

we know how since 1962

# DESCRIPTION OF THE EXAMINED MODULES

## Module A1

In this Module the emissions related to the following processes are accounted for:

- Production of raw materials; For each product, a different combination of raw materials is introduced; hence inputs are adjusted to each product examined.
- Production of packaging materials; The consumption of packaging materials is irrelevant to the type of membrane produced; hence the same set of results are applicable to every LCA.
- Production of electricity; The electricity grid mix of Greece for the reference period of 2023 was modelled, based on the latest available report published from the Greek administrator of renewable energy, during the initiation of the project.
- Production of LPG; Generic data for the production of LPG in the Greek region were utilized.

All material and energy inputs are included.

## Module A2

In this Module the emissions related to the transportation of raw and packaging materials to the plant are accounted for. No primary data were retrieved from the suppliers. Means of transportation and km covered were calculated based on actual distances. Transportations are represented by generic datasets.

## Module A3

Module A3 the covers the environmental impacts associated with the manufacturing processes of APP and SBS bituminous membranes, Membranes

## Module A4

Module A4 includes the emissions related to the following processes are accounted for: transport of Bituminous membranes (APP & SBS) to clients/Building sites. Average distances to clients have been considered for trucks and vessels.

## Module A5

Module A5 addresses the environmental impacts related to the use of propane cylinders and torches during the application of SBS and APP bituminous membranes at customer sites. Propane is employed as a fuel source to provide the necessary heat for melting the surfaces, ensuring effective adhesion of the membranes.

## Modules C1-C4

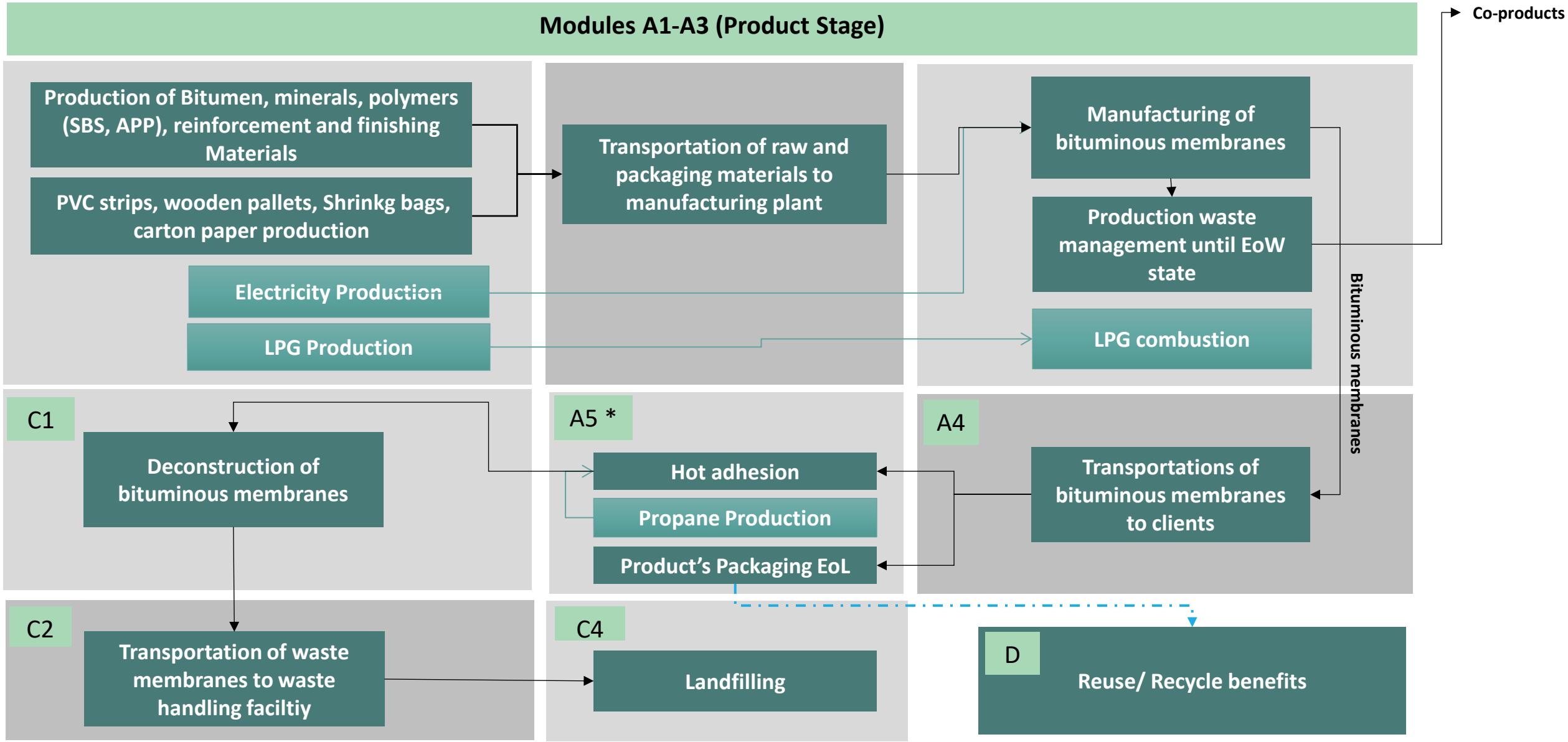
- Module C1 includes Processes related to the deconstruction of bituminous membranes. Particularly the production of the fuel utilized by the deconstruction work machine is accounted.
- Module C2 includes the transportation of deconstructed bituminous membranes to the waste handling facility is considered. Assumptions were made for the mean distance of construction sites from waste handling facilities and the means of transportation.
- Module C3 is neutral for all the examined products, bituminous membranes are not recovered or recycled.
- Module C4 includes, emissions related to the landfilling of bituminous membranes are declared.

## Module D

In this module, the net benefits from recycling and recovery of product's packaging wastes are considered. Specifically, the benefits of the reuse of pallets and the use of recovered PVC strips, PE shrink film and carton paper as secondary materials

# SYSTEM DIAGRAM

A representation of the modeling of the life cycle of bituminous membranes regarding the included information modules is provided below:




* Module A5 is different for Eshastick which is cold-self-adhered

# Content Declaration

This Environmental Product Declaration (EPD) serves as a multiple product EPD, encompassing the entire range of bituminous membranes manufactured by Alfa Alfa Energy S.A. To capture the environmental aspects associated with the full life cycle of these membranes, a worst-case scenario approach was employed, as mandated by the criteria set forth in PCR 2019:14 for Construction Products (version 1.3.4).

This approach was adopted due to significant variations in the environmental results among the examined products. As a result, an average content declaration is provided. Additionally, this EPD incorporates an evaluation of the Candidate List of Substances of Very High Concern (SVHC) as defined by the European Chemicals Agency (ECHA). Content declaration table displaying the raw materials utilized in the production of APP and SBS bituminous membranes.

A thorough inventory of these raw materials was conducted to identify any substances that may be listed on the Candidate List of Substances of Very High Concern. Each raw material was evaluated against the current SVHC list to detect any potential substances of concern, following the concentration limits specified by REACH regulations. Our assessment indicates that the materials used in the production of APP and SBS bituminous membranes do not contain any SVHCs at concentrations exceeding the thresholds established by REACH.

| Content Declaration | |
|---|---|
| **Product Components** | **Average kg/m$^2$** |
| | |
| Bitumen | 1.91E+00 |
| SBS | 1.73E-01 |
| APP | 1.39E-01 |
| Flux Oil | 3.99E-01 |
| Calcium Carbonate | 1.90E+00 |
| **Reinforcement Materials** | |
| Polyester fiber cloth 150g/m$^2$ | 1.50E-01 |
| Polyethylene (upper) | 3.89E-03 |
| **Finishing Coats** | |
| Polyethylene (bottom) | 1.00E-02 |
| Mineral Granules | 3.89E-01 |
| Aluminum foil | 3.71E-02 |
| **Packaging Materials** | |
| PVC strips | 1.50E-03 |
| Carton Paper (core) | 1.95E-02 |
| Wooden Pallets | 8.80E-02 |
| PE shrink film | 8.00E-03 |

# ADDITIONAL LCA INFORMATION – SCENARIOS - ASSUMPTIONS

- Three scenarios based on membrane thicknesses of 4.5, 5 and 6 kg/m² were considered for modules A4 (Transport products to Client), and End of Life (C1 – C4)
- An assumption for a mean type of truck used for road transportations was made. The truck is assumed to be a diesel driven, Euro 6, 12-14t gross weight, of 9.3t payload capacity, distance of 400 Km.
- An assumption for a mean type of vessel used for marine transportations was made. The vessel is assumed to be a diesel driven, average ship of 3,500 t payload capacity, distance of 1558 Km.
- The assumption regarding the bulk density of transported products is based on a weighted average derived from the modes of transportation used. Specifically, data provided by the company indicates that 11% of the total product is transported by ship, while 89% is transported by truck. This distribution reflects the reliance on different transportation methods to deliver the products, allowing for a more accurate estimation of the overall bulk density. Additionally, the density of the products ranges from 4.5 to 6. This range should be considered in conjunction with the transportation distribution, as it affects the overall bulk density calculation for the transported products.
- Assumptions regarding waste generated from installations indicate that the only types of waste considered are packaging materials. Specifically, the estimated waste is as follows: wooden pallets contribute 0.088 kg, carton paper accounts for 0.0195 kg, PVC strips make up 0.0015 kg, and PE shrink film adds 0.008 kg. These values reflect the packaging waste produced during installations.
- For the transportation of the final bituminous membranes to the clients, the transportation routes were assumed based on the location. In particular, whenever the final destination is an island marine transportation was assumed. Elsewhere, road transportation was assumed, based also on the fact that road transportations are related with higher environmental impacts (worst case approach).
- Transportation to waste handling facilities for reuse (pallets) recycling or energy recovery. The end-of-waste state is reached at the reception of the waste handling facility
- Assumptions were made for the end-of-life of packaging wastes. Specifically, wooden pallets are assumed to be led for reuse, while all the others for recycling.
- An assumption for the distance of waste handling facilities from construction sites was made. In particular, a distance of 100km was assumed. The same assumption was applied for the distance of the landfilling facility from the site where deconstruction of bitumen occurs.
- The deconstruction of bituminous membrane is considered to occur along with the rest of the building, and as such, the operation of a deconstruction work machine was assumed. The selected work machine is a diesel driven Excavator, of 100kW, which is the most suitable based on the available datasets.
- Bituminous membranes are assumed to be led for landfilling as part of the CDW, based on current waste handling situation in Greece.

# ADDITIONAL LCA INFORMATION - ALLOCATIONS

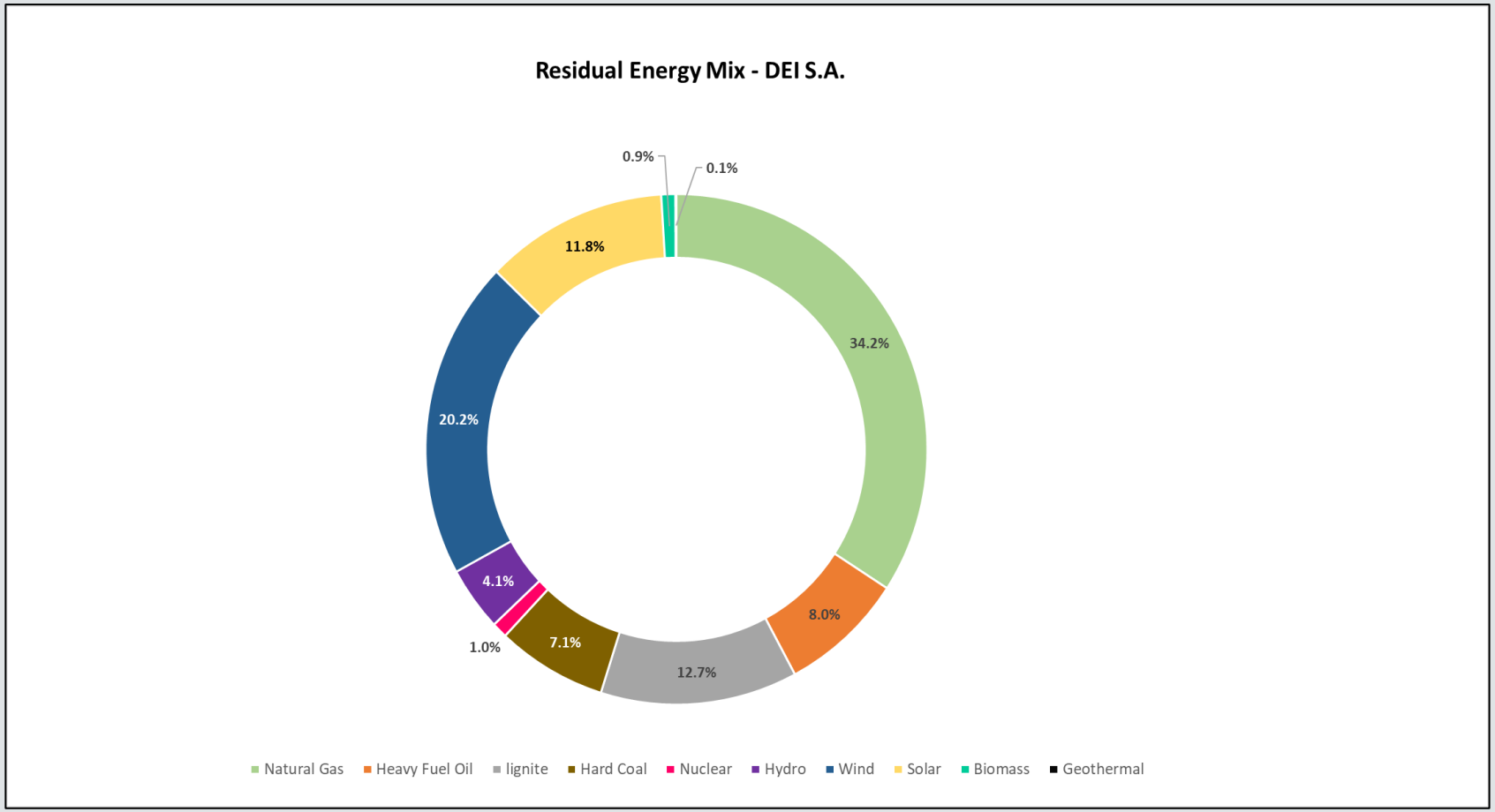
- Electricity consumption as calculated by Alfa Alfa Energy was mass allocated to the total production of bituminous mixtures and normalized to the declared unit for each LCA based on the consumption of bituminous mixture for the production of the respective bituminous membranes. This allocation was based on the fact that bituminous mixtures are the only components of the final membranes produced by Alfa Alfa Energy and their production is related with the highest share of electricity consumption. This allocation is also the only possible way to allocate electricity since it was not feasible to allocate directly to the declared unit, due to different weights of the final membranes.
- The consumption of LPG was mass allocated to the total production of bituminous mixtures and normalized to the declared unit for each LCA based on the consumption of bituminous mixture for the production of bituminous membranes.
- The production wastes were mass allocated to the total production of bituminous mixtures, for the reasons outlined in the first bullet.
- Output waste flows identified in Module A3 are allocated as co-products, in accordance with EN 15804 section 6.4.3.2. Since these materials are routed for recycling, they cease to be classified as waste and achieve end-of-waste status within Module A3. This module specifically addresses processes related to the treatment of production waste until they reach this status. In industrial processes, various materials may be produced alongside the intended product, commonly referred to as co-products in business terminology. Within the context of this standard, these terms are considered equivalent. However, it is important to distinguish between co-products and products when allocating environmental aspects and impacts. Ultimately, the key point is that the weight of the waste materials is equivalent to that of the products, reflecting their co-product status in terms of environmental consideration.

# ADDITIONAL LCA INFORMATION – CUT-OFFS

- There are rare cases where the quality assessment rejects some production outputs as off-specification products. These rejected products are sold for specific applications. The amount of these products is negligible compared to the production capacity of the plant and even though they are allocated as co-products, they are not accounted in the LCA studies.
- In-house transportations of work machines are not included in the study.
- Infrastructure and capital goods are out of the product system

# ENERGY BREAKDOWN - CLIMATE IMPACT

The origin of imported energy, specifically imported electricity, is sourced from the grid. According to data obtained from the Greek Administrator of Renewable Energy and Guarantees of Origin (DAPEEP), the following figure illustrates the energy breakdown of electricity usage in Greece.




| Name | Data Source | Environmental Effect GWP Excluding Biogenic (kg $CO_2$ eq. /kWh) |
|---|---|---|
| Electricity Residual Mix – Greece | DAPEEP | 0.5423 |

# STATEMENT

EPD of multiple products, based on worst-case results. The system boundaries on manufacturing of infrastructure/capital goods and for employees are excluded in the product system. The estimated impact results from EPD report are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.

Note: additional environmental impact data may be presented

# ENVIRONMENTAL PERFORMANCE INDICATORS

| Potential Environmental Impacts/ 1 m² OF BITUMINOUS MEMBRANES "WORST-CASE APPROACH" | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Core Environmental Impact Indicators** | | Unit | A1-A3 | A4 | A5 | C1 | C2 | C3 | C4 | D |
| Global Warming Potential – total | GWP-total | kg $CO_2$ eq. | 5.22E+00 | 2.37E+00 | 2.17E-02 | 3.75E-03 | 6.62E-01 | 0.00E+00 | 8.99E-01 | 7.93E-02 |
| Global Warming Potential – fossil | GWP-fossil | kg $CO_2$ eq. | 5.33E+00 | 2.27E+00 | 2.08E-02 | 3.88E-03 | 6.33E-01 | 0.00E+00 | 8.98E-01 | -7.76E-02 |
| Global Warming Potential – biogenic | GWP-biogenic | kg $CO_2$ eq. | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Global Warming Potential – land use and land use change | GWP-luluc | kg $CO_2$ eq. | 4.20E-03 | 2.25E-03 | 3.91E-05 | 3.05E-05 | 5.98E-04 | 0.00E+00 | 7.40E+02 | -3.07E-04 |
| Global Warming Potential – GHG[1] | GWP-GHG | kg $CO_2$ eq. | 5.32E+00 | 2.37E+00 | 2.17E-02 | 3.75E-03 | 6.62E-01 | 0.00E+00 | 8.99E-01 | 7.93E-02 |
| Ozone Depletion Potential | ODP | kg CFC 11 eq. | 2.40E-06 | 5.33E-17 | 9.53E-10 | 7.37E-19 | 1.44E-17 | 0.00E+00 | 1.93E-08 | -5.61E-09 |
| Acidification Potential | AP | Mole of H+ eq. | 1.30E+02 | 1.31E-03 | 4.50E-05 | 1.87E-05 | 3.29E-04 | 0.00E+00 | 9.61E-04 | -4.43E-04 |
| Eutrophication Potential – freshwater | EP-freshwater | kg P eq. | 2.84E-04 | 8.18E-07 | 1.58E-06 | 1.11E-08 | 2.17E-07 | 0.00E+00 | 1.08E-05 | -2.38E-05 |
| Eutrophication Potential – marine | EP-marine | kg N eq. | 4.24E-03 | 6.10E-04 | 1.59E-05 | 8.77E-06 | 1.52E-04 | 0.00E+00 | 1.06E-02 | -1.01E-04 |
| Eutrophication Potential – terrestrial | EP-terrestrial | mol N eq. | 4.47E-02 | 6.93E-03 | 1.61E-04 | 9.71E-05 | 1.73E-03 | 0.00E+00 | 2.05E-03 | -9.80E-04 |
| Photochemical Oxidant Formation Potential | POCP | kg NMVOC eq. | 9.95E+02 | 1.54E-03 | 4.38E-05 | 2.46E-05 | 3.23E-04 | 0.00E+00 | 8.09E-04 | -3.13E-04 |
| Abiotic Depletion Potential – elements[2] | ADPe | kg Sb eq. | 9.98E-06 | 2.42E-08 | 3.27E-08 | 3.31E-10 | 6.48E-09 | 0.00E+00 | 2.23E-07 | -3.43E-07 |
| Abiotic Depletion Potential. fossil resources[2] | ADPf | MJ net calorific value | 1.91E+02 | 3.67E+00 | 1.39E-01 | 4.97E-02 | 9.74E-01 | 0.00E+00 | 1.56E+00 | -1.71E+00 |
| Water Deprivation Potential[2] | WDP | m3 world eq. deprived | 1.59E+00 | 2.55E-03 | 1.54E-03 | 3.46E-05 | 6.79E-04 | 0.00E+00 | 6.88E-02 | -6.34E-02 |

*[1] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic $CO_2$ is set to zero.*
*[2] The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

# ENVIRONMENTAL PERFORMANCE INDICATORS

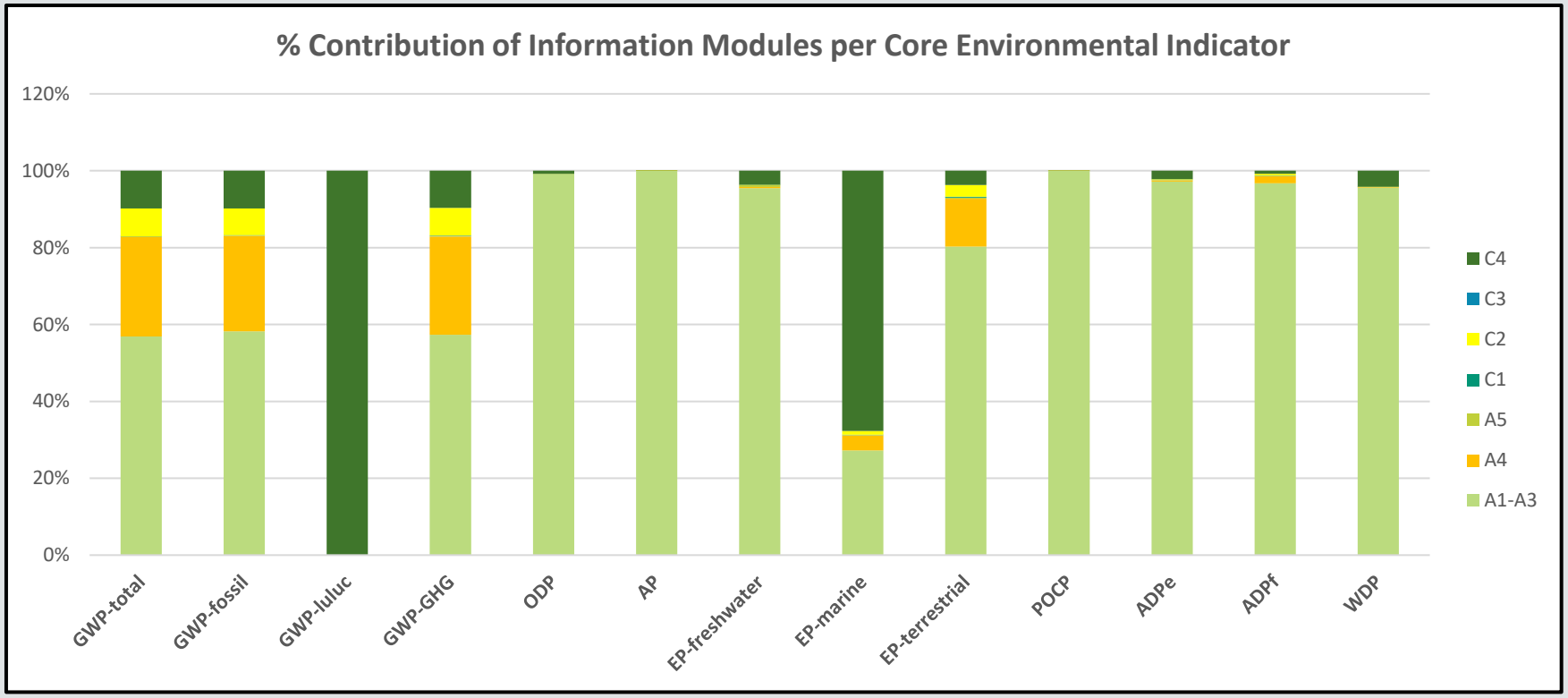
| Potential Environmental Impacts/ 1 m² OF BITUMINOUS MEMBRANES "WORST-CASE APPROACH" | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Resource Use Indicators** | | Unit | A1-A3 | A4 | A5 | C1 | C2 | C3 | C4 | D |
| Use of renewable primary energy excluding renewable primary energy resources used as raw materials | PERE | MJ. net calorific value | 1.43E+01 | 2.11E-01 | 6.59E-03 | 2.86E-03 | 5.61E-02 | 0.00E+00 | 3.33E-02 | -2.35E+00 |
| Use of renewable primary energy resources used as raw materials | PERM | MJ. net calorific value | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Total use of renewable primary energy resources | PERT | MJ. net calorific value | 1.43E+01 | 2.11E-01 | 6.59E-03 | 2.86E-03 | 5.61E-02 | 0.00E+00 | 3.33E-02 | -2.35E+00 |
| Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials | PENRE | MJ. net calorific value | 1.91E+02 | 3.68E+00 | 1.39E-01 | 4.99E-02 | 9.78E-01 | 0.00E+00 | 1.56E+00 | -1.71E+00 |
| Use of non-renewable primary energy resources used as raw materials | PENRM | MJ. net calorific value | 2.35E-01 | 0.00E+00 | 1.00E-04 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Total use of non-renewable primary energy resources | PENRT | MJ. net calorific value | 1.91E+02 | 3.68E+00 | 1.39E-01 | 4.99E-02 | 9.78E-01 | 0.00E+00 | 1.56E+00 | -1.71E+00 |

# ENVIRONMENTAL PERFORMANCE INDICATORS

| Potential Environmental Impacts/ 1 m² OF BITUMINOUS MEMBRANES "WORST-CASE APPROACH" | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Waste Indicators** | | Unit | A1-A3 | A4 | A5 | C1 | C2 | C3 | C4 |
| Hazardous waste disposed | HWD | kg | 9.21E-09 | 1.94E-10 | 1.07E-12 | 2.63E-12 | 5.15E-11 | 0.00E+00 | 0.00E+00 |
| Non-hazardous waste disposed | NHWD | kg | 4.42E-01 | 5.76E-04 | 3.78E-06 | 7.83E-06 | 1.53E-04 | 0.00E+00 | 0.00E+00 |
| Radioactive waste disposed | RWD | kg | 1.57E-03 | 6.56E-06 | 4.31E-08 | 9.05E-08 | 1.77E-06 | 0.00E+00 | 0.00E+00 |
| **Output Flows** | | **Unit** | | | | | | | |
| Components for re-use | CRU | kg | 0.00E+00 | 0.00E+00 | 8.80E-02 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Material for recycling | MFR | kg | 0.00E+00 | 0.00E+00 | 2.00E-02 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for energy recovery | MER | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported energy | EE | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| **Additional Environmental Impact Indicators** | | **Unit** | | | | | | | |
| Particulate matter emissions | PM | Disease incidence | 2.24E-07 | 1.01E-08 | 5.82E-10 | 2.13E-10 | 1.58E-09 | 0.00E+00 | 1.07E-08 |
| Ionizing radiation human[3] | IRP | kBq U235 eq. | 3.64E-01 | 9.58E-04 | 7.06E-04 | 1.32E-05 | 2.59E-04 | 0.00E+00 | 8.02E-03 |
| Eco-toxicity. Freshwater[2] | ETP-fw | CTUe | 1.31E+02 | 2.72E+00 | 1.33E-01 | 3.69E-02 | 7.23E-01 | 0.00E+00 | 2.02E+00 |
| Human toxicity. cancer effects[2] | HTP-c | CTUh | 5.35E-09 | 5.52E-11 | 7.91E-12 | 7.46E-13 | 1.47E-11 | 0.00E+00 | 4.83E-11 |
| Human toxicity. non-cancer effects[2] | HTP-nc | CTUh | 2.88E+00 | 3.27E-09 | 1.17E-10 | 4.48E-11 | 8.58E-10 | 0.00E+00 | 7.69E-10 |
| Land use related impacts/Soil quality[2] | SQP | dimensionless | 2.00E+01 | 1.26E+00 | 8.40E-02 | 1.71E-02 | 3.35E-01 | 0.00E+00 | 3.56E+00 |

*[2] The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*
*[3] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured*

# INTERPRETATION – DOMINANCE ANALYSIS




The following diagram illustrates the impacts of the assessed modules (A1-A3, A4-A5 & C1-C4) on key environmental indicators.

• Contribution of Modules A1-A3 ranges from 27% regarding Eutrophication potential - marine (EP-marine) to 100% Acidification Potential (AP) and Photochemical Oxidant Formation Potential (POCP). Modules A1-A3 contain the production process of Bituminous Membranes.

• The contribution of the remaining modules is considered minimal except for indicators GWP – Total, GWP – Fossil & GWP Luluc. More specifically, Module A4 contributes less than 26% in the environmental impacts GWP - Total & GWP – Fossil. Module C4, predominantly influence GWP LULUC (GWP - LULUC) and Eutrophication potential - marine (EP-marine) where their contribution exceed 100% and 68% respectively.

# DOMINANCE ANALYSIS

| Modules Contribution to Environmental Performance Indicators - 1 m² OF BITUMINOUS MEMBRANES "WORST-CASE APPROACH" | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Core Environmental Impact Indicators** | | A1-A3  | A4  | A5  | C1  | C2  | C3  | C4  |
| Global Warming Potential – total | GWP-total | 57% | 26% | 0% | 0% | 7% | 0% | 10% |
| Global Warming Potential – fossil | GWP-fossil | 58% | 25% | 0% | 0% | 7% | 0% | 10% |
| Global Warming Potential – biogenic | GWP-biogenic | - | - | - | - | - | - | - |
| Global Warming Potential – land use and land use change | GWP-luluc | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| Global Warming Potential – GHG[1] | GWP-GHG | 57% | 26% | 0% | 0% | 7% | 0% | 10% |
| Ozone Depletion Potential | ODP | 99% | 0% | 0% | 0% | 0% | 0% | 1% |
| Acidification Potential | AP | 100% | 0% | 0% | 0% | 0% | 0% | 0% |
| Eutrophication Potential – freshwater | EP-freshwater | 95% | 0% | 1% | 0% | 0% | 0% | 4% |
| Eutrophication Potential – marine | EP-marine | 27% | 4% | 0% | 0% | 1% | 0% | 68% |
| Eutrophication Potential – terrestrial | EP-terrestrial | 80% | 12% | 0% | 0% | 3% | 0% | 4% |
| Photochemical Oxidant Formation Potential | POCP | 100% | 0% | 0% | 0% | 0% | 0% | 0% |
| Abiotic Depletion Potential – elements[2] | ADPe | 97% | 0% | 0% | 0% | 0% | 0% | 2% |
| Abiotic Depletion Potential. fossil resources[2] | ADPf | 97% | 2% | 0% | 0% | 0% | 0% | 1% |
| Water Deprivation Potential[2] | WDP | 96% | 0% | 0% | 0% | 0% | 0% | 4% |

*[1] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic $CO_2$ is set to zero.*

*[2] The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

*[3] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured*

# DOMINANCE ANALYSIS

| Modules Contribution to Environmental Performance Indicators - 1 m² OF BITUMINOUS MEMBRANES "WORST-CASE APPROACH" | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Resource Use Indicators** | | A1-A3  | A4  | A5  | C1  | C2  | C3  | C4  |
| Use of renewable primary energy excluding renewable primary energy resources used as raw materials | PERE | 98% | 1% | 0% | 0% | 0% | 0% | 0% |
| Use of renewable primary energy resources used as raw materials | PERM | - | - | - | - | - | - | - |
| Total use of renewable primary energy resources | PERT | 98% | 1% | 0% | 0% | 0% | 0% | 0% |
| Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials | PENRE | 97% | 2% | 0% | 0% | 0% | 0% | 1% |
| Use of non-renewable primary energy resources used as raw materials | PENRM | 100% | 0% | 0% | 0% | 0% | 0% | 0% |
| Total use of non-renewable primary energy resources | PENRT | 97% | 2% | 0% | 0% | 0% | 0% | 1% |

# DOMINANCE ANALYSIS

| Modules Contribution to Environmental Performance Indicators - 1 m² OF BITUMINOUS MEMBRANES "WORST-CASE APPROACH" | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Waste Indicators** | | A1-A3  | A4  | A5  | C1  | C2  | C3  | C4  |
| Hazardous waste disposed | HWD | 97% | 2% | 0% | 0% | 1% | 0% | 0% |
| Non-hazardous waste disposed | NHWD | 100% | 0% | 0% | 0% | 0% | 0% | 0% |
| Radioactive waste disposed | RWD | 99% | 0% | 0% | 0% | 0% | 0% | 0% |
| **Output Flows** | | | | | | | | |
| Components for re-use | CRU | - | - | - | - | - | - | - |
| Material for recycling | MFR | - | - | - | - | - | - | - |
| Materials for energy recovery | MER | - | - | - | - | - | - | - |
| Exported energy | EE | - | - | - | - | - | - | - |
| **Additional Environmental Impact Indicators** | | | | | | | | |
| Particulate matter emissions | PM | 91% | 4% | 0% | 0% | 1% | 0% | 4% |
| Ionizing radiation human[3] | IRP | 97% | 0% | 0% | 0% | 0% | 0% | 2% |
| Eco-toxicity. Freshwater[2] | ETP-fw | 96% | 2% | 0% | 0% | 1% | 0% | 1% |
| Human toxicity. cancer effects[2] | HTP-c | 98% | 1% | 0% | 0% | 0% | 0% | 1% |
| Human toxicity. non-cancer effects[2] | HTP-nc | 100% | 0% | 0% | 0% | 0% | 0% | 0% |
| Land use related impacts/Soil quality[2] | SQP | 79% | 5% | 0% | 0% | 1% | 0% | 14% |

*[2] The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*
*[3] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured*

# IMPACT INDICATORS VARIATIONS PER EXAMINED PRODUCT

| Variance of the examined products from the declared for Modules A-C | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ENVIRONMENTAL IMPACTS | EshaDIEN | EshaDIEN | EshaDIEN | Esha ELASTAN | Esha ELASTAN | Esha ELASTAN | EshaFIN | EshaFIN | EshaFIN | Esha STICK | Esha STICK | Esha STICK | Esha GUM | Esha GUM | Esha PROOF | Esha PROOF | Esha DURO | Esha DURO |
| | PP | PG | P-AL | PP | PG | P-AL | PP | PG | P-AL | PP | PG | P-AL | PP | PG | PP | PG | PP | PG |
| | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **5,00** | **5,00** | **5,00** | **5,00** | **5,00** |
| **Climate Change - Total** | -20% | -10% | -12% | -27% | -16% | -18% | -32% | -23% | -22% | -26% | -12% | -16% | -23% | -26% | -28% | -31% | -35% | -36% |
| **Climate Change - Fossil** | -20% | -10% | -11% | -27% | -16% | -17% | -32% | -23% | -22% | -26% | -12% | -16% | -22% | -26% | -27% | -30% | -34% | -36% |
| **Climate Change - Biogenic** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Climate Change - Land Use and Land Use Change** | -17% | 0% | -25% | -17% | 0% | -25% | -17% | 0% | -25% | -17% | 0% | -25% | -17% | -17% | -17% | -17% | -17% | -17% |
| **Global Warming Potential- GWP-GHG (Total-biogenic)** | -20% | -10% | -12% | -27% | -16% | -17% | -32% | -23% | -22% | -26% | -11% | -16% | -22% | -26% | -28% | -30% | -34% | -35% |
| **Ozone Depletion** | -1% | 0% | -1% | -1% | 0% | -1% | -1% | 0% | -1% | -2% | 0% | -2% | -1% | -1% | -1% | -1% | -1% | -1% |
| **Acidification** | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **Eutrophication, fresh water** | -12% | -7% | -14% | -12% | -8% | -14% | -13% | -8% | -15% | -20% | -7% | -19% | -1% | -3% | -4% | -6% | -9% | -10% |
| **Eutrophication, marine** | -20% | -4% | -21% | -22% | -7% | -23% | -24% | -9% | -25% | -22% | -5% | -23% | -21% | -20% | -23% | -22% | -25% | -24% |
| **Eutrophication, terrestrial** | -26% | -12% | -13% | -34% | -20% | -20% | -41% | -29% | -26% | -33% | -15% | -19% | -30% | -27% | -36% | -33% | -44% | -39% |
| **Photochemical Ozone Formation, human health** | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **Resource use, mineral and metals** | -6% | 0% | -8% | -7% | -1% | -9% | -8% | -2% | -10% | -16% | 0% | -15% | -7% | -8% | -8% | -8% | -9% | -9% |
| **Resource use, fossils** | -3% | 0% | -5% | -25% | -22% | -23% | -35% | -32% | -32% | -7% | -1% | -8% | -7% | -21% | -23% | -34% | -42% | -49% |
| **Water Use** | -58% | -57% | -47% | -59% | -58% | -48% | -61% | -64% | -50% | -60% | -58% | -48% | -1% | -15% | -19% | -30% | -43% | -49% |

# IMPACT INDICATORS VARIATIONS PER EXAMINED PRODUCT

| Variance of the examined products from the declared for Modules A-C | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ENERGY USE** | **EshaDIEN** | **EshaDIEN** | **EshaDIEN** | **Esha ELASTAN** | **Esha ELASTAN** | **Esha ELASTAN** | **EshaFIN** | **EshaFIN** | **EshaFIN** | **Esha STICK** | **Esha STICK** | **Esha STICK** | **Esha GUM** | **Esha GUM** | **Esha PROOF** | **Esha PROOF** | **Esha DURO** | **Esha DURO** |
| | PP | PG | P-Al | PP | PG | P-Al | PP | PG | P-Al | PP | PG | P-Al | PP | PG | PP | PG | PP | PG |
| | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **5,00** | **5,00** | **5,00** | **5,00** | **5,00** |
| **Use of renewable primary energy excluding renewable primary energy resources used as raw materials** | -58% | -56% | -1% | -60% | -58% | -3% | -63% | -68% | -6% | -60% | -57% | -2% | -61% | -62% | -62% | -65% | -64% | -65% |
| **Total use of renewable primary energy resources** | -58% | -56% | -1% | -60% | -58% | -3% | -63% | -68% | -6% | -60% | -57% | -2% | -61% | -62% | -62% | -65% | -64% | -65% |
| **Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials** | -3% | 0% | -5% | -25% | -22% | -23% | -35% | -32% | -32% | -7% | -1% | -8% | -7% | -22% | -23% | -34% | -42% | -49% |
| **Use of non-renewable primary energy resources used as raw materials** | -100% | -100% | -100% | -100% | -100% | -100% | -100% | -100% | -100% | -100% | -100% | -100% | 0% | -20% | -28% | -43% | -68% | -74% |
| **Total use of non-renewable primary energy resources** | -3% | 0% | -5% | -25% | -22% | -23% | -35% | -32% | -32% | -7% | -1% | -8% | -7% | -21% | -22% | -34% | -42% | -49% |

# IMPACT INDICATORS VARIATIONS PER EXAMINED PRODUCT

| Variance of the examined products from the declared for Modules A-C | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OUTPUT FLOWS | EshaDIEN | EshaDIEN | EshaDIEN | Esha ELASTAN | Esha ELASTAN | Esha ELASTAN | EshaFIN | EshaFIN | EshaFIN | Esha STICK | Esha STICK | Esha STICK | Esha GUM | Esha GUM | Esha PROOF | Esha PROOF | Esha DURO | Esha DURO |
| | PP | PG | P-Al | PP | PG | P-Al | PP | PG | P-Al | PP | PG | P-Al | PP | PG | PP | PG | PP | PG |
| | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **5,00** | **5,00** | **5,00** | **5,00** | **5,00** |
| **Components for re-use** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Material for recycling** | 0% | 0% | -8% | 0% | 0% | -8% | 0% | 0% | -8% | 0% | 0% | -8% | 0% | -11% | 0% | -11% | 0% | -11% |
| **Materials for energy revovery** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Exported energy, electricity** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Exported energy, thermal** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

we know how
since 1962

# IMPACT INDICATORS VARIATIONS PER EXAMINED PRODUCT

| Variance of the examined products from the declared for Modules A-C | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ADDITIONAL ENVIRONMENTAL IMPACTS** | **EshaDIEN** | **EshaDIEN** | **EshaDIEN** | **Esha ELASTAN** | **Esha ELASTAN** | **Esha ELASTAN** | **EshaFIN** | **EshaFIN** | **EshaFIN** | **Esha STICK** | **Esha STICK** | **Esha STICK** | **Esha GUM** | **Esha GUM** | **Esha PROOF** | **Esha PROOF** | **Esha DURO** | **Esha DURO** |
| | PP | PG | P-Al | PP | PG | P-Al | PP | PG | P-Al | PP | PG | P-Al | PP | PG | PP | PG | PP | PG |
| | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **6,00** | **4,50** | **5,00** | **5,00** | **5,00** | **5,00** | **5,00** | **5,00** |
| **Particulate Matter emissions** | -37% | -24% | -13% | -41% | -27% | -16% | -45% | -32% | -20% | -44% | -26% | -18% | -36% | -32% | -40% | -36% | -46% | -40% |
| **Ionizing radiation human** | -65% | -64% | -1% | -69% | -67% | -4% | -72% | -71% | -7% | -68% | -65% | -3% | -65% | -68% | -69% | -71% | -73% | -74% |
| **Eco-toxicity, freshwater** | -4% | -1% | -10% | -25% | -21% | -28% | -33% | -30% | -35% | -8% | 0% | -13% | -21% | -32% | -31% | -40% | -43% | -49% |
| **Human toxicity, cancer effects** | -9% | -7% | -1% | -21% | -19% | -11% | -28% | -26% | -17% | -14% | -8% | -4% | -27% | -31% | -31% | -35% | -37% | -39% |
| **Human toxicity, non-cancer effects** | 0% | -50% | -50% | 0% | -50% | -50% | 0% | -50% | -50% | 0% | -50% | -50% | 0% | -50% | 0% | -50% | 0% | -50% |
| **Land use related impacts/Soil quality** | -10% | -4% | -7% | -12% | -6% | -9% | -15% | -10% | -11% | -13% | -6% | -9% | -15% | -14% | -15% | -15% | -17% | -16% |

# IMPACT INDICATORS VARIATIONS EXTREME POINTS OF EXAMINED PRODUCTS

| Min & Max of the examined products for Modules A-C | | | |
|---|---|---|---|
| Core Environmental Impact Indicators | | MIN | MAX |
| Global Warming Potential – total | GWP-total | -36% | -10% |
| Global Warming Potential – fossil | GWP-fossil | -36% | -10% |
| Global Warming Potential – biogenic | GWP-biogenic | 0% | 0% |
| Global Warming Potential – land use and land use change | GWP-luluc | -25% | 0% |
| Global Warming Potential – GHG | GWP-GHG | -35% | -10% |
| Ozone Depletion Potential | ODP | -2% | 0% |
| Acidification Potential | AP | 0% | 0% |
| Eutrophication Potential – freshwater | EP-freshwater | -20% | -1% |
| Eutrophication Potential – marine | EP-marine | -25% | -4% |
| Eutrophication Potential – terrestrial | EP-terrestrial | -44% | -12% |
| Photochemical Oxidant Formation Potential | POCP | 0% | 0% |
| Abiotic Depletion Potential – elements[2] | ADPe | -16% | 0% |
| Abiotic Depletion Potential. fossil resources[2] | ADPf | -49% | 0% |
| Water Deprivation Potential[2] | WDP | -64% | -1% |

# IMPACT INDICATORS VARIATIONS EXTREME POINTS OF EXAMINED PRODUCTS

| Min & Max of the examined products for Modules A-C | | | |
|---|---|---|---|
| **Energy Use Indicators** | | **MIN** | **MAX** |
| Use of renewable primary energy excluding renewable primary energy resources used as raw materials | PERE | -68% | -1% |
| Use of renewable primary energy resources used as raw materials | PERM | 0% | 0% |
| Total use of renewable primary energy resources | PERT | -68% | -1% |
| Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials | PENRE | -49% | 0% |
| Use of non-renewable primary energy resources used as raw materials | PENRM | -100% | 0% |
| Total use of non-renewable primary energy resources | PENRT | -49% | 0% |
| Use of net fresh water | FW | -60% | -1% |
| **Waste Indicators** | | **MIN** | **MAX** |
| Hazardous waste disposed | HWD | -65% | -1% |
| Non-hazardous waste disposed | NHWD | -98% | 0% |
| Radioactive waste disposed | RWD | -93% | 0% |
| **Output Flow Indicators** | | **MIN** | **MAX** |
| Components for re-use | CRU | 0% | 0% |
| Material for recycling | MFR | -11% | 0% |
| Materials for energy recovery | MER | 0% | 0% |
| Exported energy | EE | 0% | 0% |

# IMPACT INDICATORS VARIATIONS EXTREME POINTS OF EXAMINED PRODUCTS

| Min & Max of the examined products for Modules A-C | | | |
|---|---|---|---|
| **Additional Environmental Impacts** | | **MIN** | **MAX** |
| Particulate Matter emissions | PM | -46% | -13% |
| Ionizing radiation human | IRP | -74% | -1% |
| Eco-toxicity, freshwater | ETP-fw | -49% | 0% |
| Human toxicity, cancer effects | HTP-c | -39% | -1% |
| Human toxicity, non-cancer effects | HTP-nc | -50% | 0% |
| Land use related impacts/Soil quality | SQP | -17% | -4% |

# DISCLAIMER

This report are subject to several limitations and uncertainties, and caution should be taken when using the results for comparison or making commitments based on them. The results are only informational for the analyzed Bituminous Membranes modules in this report and referenced year and may not be representative of other Bituminous Membranes modules or production processes outside the studied scope.

The indicator Ionising radiation deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured
by this indicator.

The use of the results of modules A1-A3 (A1-A5 for services) without considering the results of module C is discouraged

# REFERENCES


- Ecoinvent/ Ecoinvent Centre – www.Eco-invent.org
- EN 15804:2012+A2:2019/AC 2021 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
- International EPD® System, PCR 2019:14 Construction Products, version 1.3.4 (EN 15804: A2)
- International EPD® System, General Program Instructions for the International EPD System, version 4.01
- ISO 14025:2006 - Environmental labels and declarations – Type III environmental declarations – Principles and procedures
- ISO 14040:2006 - Environmental management – Life Cycle assessment – Principles and framework, ISO 14044:2006 - Environmental management – Life Cycle assessment – Requirements and guidelines
- ISO 14044:2006 - Environmental management – Life Cycle assessment – Requirements and guidelines
- REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC
- Residual Energy Mix 2023 from Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP SA) - https://www.dapeep.gr/dimosieuseis/eguiseis-proeleusis-energeiako/
- Sphera –LCA for experts (GaBi). – www.sphera.com
- Thanh Ba Ho. 2018. Evaluation of biodegradability of polystyrene materials in the managed landfill and soil. School of Environmental and Life Sciences Faculty of Science University of Newcastle (UON). New South Wales, Australia.
- The International EPD® System – The International EPD System is a programme for type III environmental declarations, maintaining a system to verify and register EPDs as well as keeping a library of EPDs and PCRs in accordance with ISO 14025. www.environdec.com