Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019 for:

Geomembrane for tunnels and basement works – RENOLIT ALKORPLAN Tunnel C (1.5 mm)

from

RENOLIT IBERICA, S.A.

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
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An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com



Programme information

Programme:	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com

Product category rules (PCR): *PCR 2019:14 Construction Products, version 1.11*
PCR review was conducted by: *The Technical Committee of the International EPD® System. See www.environdec.com/TC for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact.*
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: TECNALIA R&I CERTIFICACION, S.L. *info@tecnaliacertificacion.com* *Accredited by: ENAC nº125/C-PR283 accreditation.* Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☒ Yes ☐ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programs may not be comparable.

EPD of construction products may not be comparable if they do not comply with EN 15804.

1. Company information

Owner of the EPD: **RENOLIT** Ibérica, S.A.
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Francisco-Jose.Moreno@renolit.com

Description of the organisation: The **RENOLIT Group** is a leading global specialist for high-quality plastic films, sheets and other plastic products. With more than thirty production sites and sales units in over twenty countries, and with annual sales of around €1,2 billion, the company with headquarters in Worms – around 70 km south of Frankfurt am Main – is one of the world's leading plastic products manufacturers. About 5.000 employees continue to further develop the knowledge and expertise gained from over seventy-five years of business.

RENOLIT Ibérica is headquartered in Sant Celoni, north of Barcelona, manufacturing one million coils of membranes a year. The factory counts on more than 300 employees for the production of waterproofing membranes under the brand **RENOLIT** ALKORPLAN.
In the swimming pools industry, **RENOLIT** is the leading manufacturer of PVC sheets for swimming pool and the leading brand of waterproofing reinforced membrane for swimming pools.
In the roofing industry **RENOLIT** is a worldwide leader in the market of synthetic waterproofing membranes.
Our wide range of products and solutions meets the many demands and needs of architects, installers and facility managers.
In the civil engineering industry, **RENOLIT** has developed waterproofing solutions for all types of works, pioneering some applications that are mainstream today: hydraulic, such as basins, dams and attenuation tanks, as well as underground works, such as tunnels, shafts and foundations.

Product-related or management system-related certifications:

- Organisation certifications:

Factory certified in accordance with the requirements of ISO 9001 and ISO 14001 certificate. EMAS registration number: ES-CAT-000124.
Factory certified under the EuCertPlast Audit Scheme 4.2 in line with EN 15343:2007. Audit Report and Certificate Code: 0076-01-24-ECU-CR.

- Product certifications:

Mechanical properties in accordance with EN 13491. Combustion resistance (B2 – ÖN B 3800/1, B2 – DIN 4102, IV.2 – SIA 280, class E – EN ISO 11925). Root resistance in accordance with EN 14416.

Name and location of production site: RENOLIT ALKORPLAN Tunnel C is produced in **RENOLIT Ibérica** in Sant Celoni (Spain).

2. Product information

Product name and description

Name

RENOLIT ALKORPLAN Tunnel C – 1,5mm thickness

Identification

RENOLIT ALKORPLAN Tunnel C 35034

Brief description

Geomembrane of polyvinyl chloride (PVC-P) bi-colour green (optional totally green or all black). Designed for tunnels and basement work. Not suitable for permanent exposure to UV-radiation. Expected service lifetime: >100 years.

Product specifications

- Not suitable for permanent exposure to UV-radiation
- Mechanical properties in accordance with EN 13491
- CE marking
- Hardly combustible (B2 – ÖN B 3800/1, B2 – DIN 4102, IV.2 – SIA 280, class E – EN ISO 11925)
- Resistant to swelling, rotting and ageing
- Very high level of water tightness, even with permanent deformation
- High capacity for adaptation to irregularities or deformation of support due to its high deformability and welding strength
- High resistance to puncturing
- Root resistance in accordance with EN 14416
- Not resistant to bitumen, oil and tar
- If covered with sand, gravel or concrete, reinforced PVC-P RENOLIT ALKORPLAN 35020 should be placed in between as a suitable separation layer

This geomembrane is available in various thicknesses. This EPD focuses on the 1,5 mm thickness variant.

Characteristics	Unit	Specifications
Thickness (EN-1849-2)	mm	1 / 1,50 / 2,00 / 3,00
Tensile strength (EN ISO 527)	N/mm^2	≥ 16
Elongation at failure (EN ISO 527)	%	L: ≥ 280 T: ≥ 280
Tear strength (DIN 53363, ISO 34)	N/mm kN/m	≥ 80 ≥ 40
Dimensional stability after accelerated ageing (6h/80ºC) (EN ISO 1107-2)	%	≤ 2
Puncture resistance (CBR) (EN ISO 12236)	kN	≥1,7/≥ 2,4/≥ 3,0
Height of fall without perforation (DIN 16726)	mm	≥750/≥ 1100/≥2000
Cold folding resistance (EN 495-5)		No cracks at -20ºC
Resistant under water pressure (DIN 16726)		Waterproof at 10 bar/10 h Waterproof at 6 bar/72 h
Behaviour after storage in hot water (8 months / 50ºC) -Mass variation -Variation of elongation at failure -Variation of tensile strength -Folding at -20ºC	SIA.V 280 % % % 	 ≤ 4 ≤ 20 ≤ 20 No cracks
Behaviour after long-term ageing 80ºC / 7 days Methods A&B. -General appearance -Dimensional stability, L&T -Variation of tensile strength, L&T -Variation of elongation at failure, L&T -Folding at -20ºC	(DIN 16726) % % % 	 No blister ≤ 3 < ±10 < ±10 No cracks
Behaviour after storage in hot water and alkaline solutions (90d/23ºC) Methods A&B -Variation of tensile strength, L&T -Variation of elongation at failure, L&T -Folding at -20ºC	(EN 14415) % % 	 < ±20 < ±20 No cracks
Oxidation resistance 90d/85ºC (EN 14575)		Fulfilled
Root resistance (EN 14416)		Fulfilled
Behaviour in fire B2 ÖN B 3800/1 SIA 280 DIN 4102 EN ISO 11925		 B2 IV.2 B2 Class E

This product can be grouped in the UN CPC code 363 – Semi-manufactures of plastics, and more specifically in code 36390: plates, sheets, film, foil and strips of plastics.

Geographical scope Global

Product composition

The base raw materials for RENOLIT ALKORPLAN Tunnel C geomembrane for tunnels and basement works are:

- Polyvinyl chloride (PVC) 5-15%
- Reworked PVC-P 60-70%
- Plasticizer 15-25%
- Stabilisers (UV/heat) <1%
- Chalk 1-5%
- Processing aids <1%
- Colour pigments 1-5%
- Soja oil <1%

Manufacturing process

The production process of thermoplastic sheets is carried out with the calendering and extrusion processes, prior to the preparation of mixtures of raw materials according to the type of product to be manufactured. The processes of the establishment are as follows:

• Calendering: process by which the mixture that has been previously prepared and homogenized, in accordance with the formulations provided for each product, undergoes a transformation process through the application of heat, pressure and friction, through a " spindle". Later, the mixture is transformed into a plastic sheet by being rolled by the calender.

• Extrusion: Using this type of technology, the prepared and homogenized mixture, as in the previous case, melts when passing through a "spindle" and being subjected to temperature. The molten mixture is transformed into a plastic sheet when exiting through the nozzle, the length of which corresponds to the width of the sheet.

• The processes for obtaining the thermoplastic sheet described can be followed by one or several finishing processes for the manufactured sheets. The finishing processes can be:

o Printing or lacquering of sheets: This process carries out the printing or lacquering of sheets using the "hologravure" technology.

o Mechanical engraving: In this phase of the production process of the thermoplastic sheets, a mechanical engraving or embossing of the sheets is carried out, sometimes simultaneously with the lacquering.

o Verification and cutting: In this process the products are verified, removing the defective part and giving them the presentation desired by the customer. Transforming the rolls of industrial use into rolls, of length specified by the customer or by the requirements of the product.

• Recovery process of PVC material with polyester mesh: There is a secondary process consisting of the recovery of PVC with polyester mesh by means of grinding in a mill and subsequent separation by gravity of both using two air columns. In a second phase, the segregated PVC is crushed in a second mill and sent to Big-bags, or to two silos for storage or to make mixtures of different types.

3. LCA information

Declared unit: 1 m^2 of RENOLIT ALKORPLAN Tunnel C geomembrane for waterproofing for a reference service life of 120 years.

Reference service life: 120 years

Service life: 120 years

Data collection period: 2021

Time representativeness: Data as current as possible was used. For generic data, the limit has been established to 10 years and for specific data, a maximum of 5 years was allowed. The time period over which inputs and outputs from the system will be accounted for is 100 years.

Database(s) and LCA software used: Generic data is obtained from GaBi software database. This database is based on the International Reference Life Cycle Data System (ILCD), as required by EN 15804:2012+A2:2019.

- GaBi Professional v. 10.6.2.9
- GaBi database: 2021.2

System diagram: see figure 1

Description of system boundaries: "Cradle-to-gate with options, module B4, modules C1-C4 and module D" according to EN 15804 and the PCR. This includes the following life cycle stages:

- Modules A1-A3: Product stage
  - A1: Raw materials supply
  - A2: Transport
  - A3: Manufacturing
- Modules A4-A5: Construction process stage
  - A4: Transport
  - A5: Construction installation
- Module B Use stage:
  - B4: Replacement
- Module C End of life stage
  - C1: Deconstruction, demolition
  - C2: Transport
  - C3: Waste processing
  - C4: Disposal
- Module D Benefits and loads beyond the system boundary.
  Reuse, recovery, recycling potential

Excluded lifecycle stages: The following processes are excluded from the analysis, according to the PCR selected:

- Inventory flows from infrastructure, construction, production equipment and tools that are not directly consumed in the production process.
- Inventory flows from personnel-related processes, such as transportation to and from work.
- Waste generated during manufacturing process. Material losses are reintroduced in the manufacturing process.
- Waste generated during manufacturing process. Waste represents less than 5% related to the total production

More information: Company website: https://www.renolit.com/es/

LCA practitioners: Alba Bala (UNESCO Chair in Life Cycle and Climate Change ESCI-UPF), Raúl Antúnez (Grup Carles)

The **rules for allocation** employed in this study are the ones stated in ISO 14044:2006, 4.3.4., and include the specifications for construction products detailed in EN 15804:2012+A2:2019. Allocation has been avoided as far as possible by dividing the unit process to be allocated into different sub-processes that can be allocated to each one of the co-products and collecting specific data on those sub-processes. In case it has not been possible, the allocation has been done taking into account the physical relationship among the different products. In this case, due to the similarity in the production

process of all products produced by **RENOLIT**, a weight allocation has been used.

A mass **cut-off rule** has been applied for the fixing materials used to fix the flexible sheets during the installation process. No other specific cut-off rules have been applied.

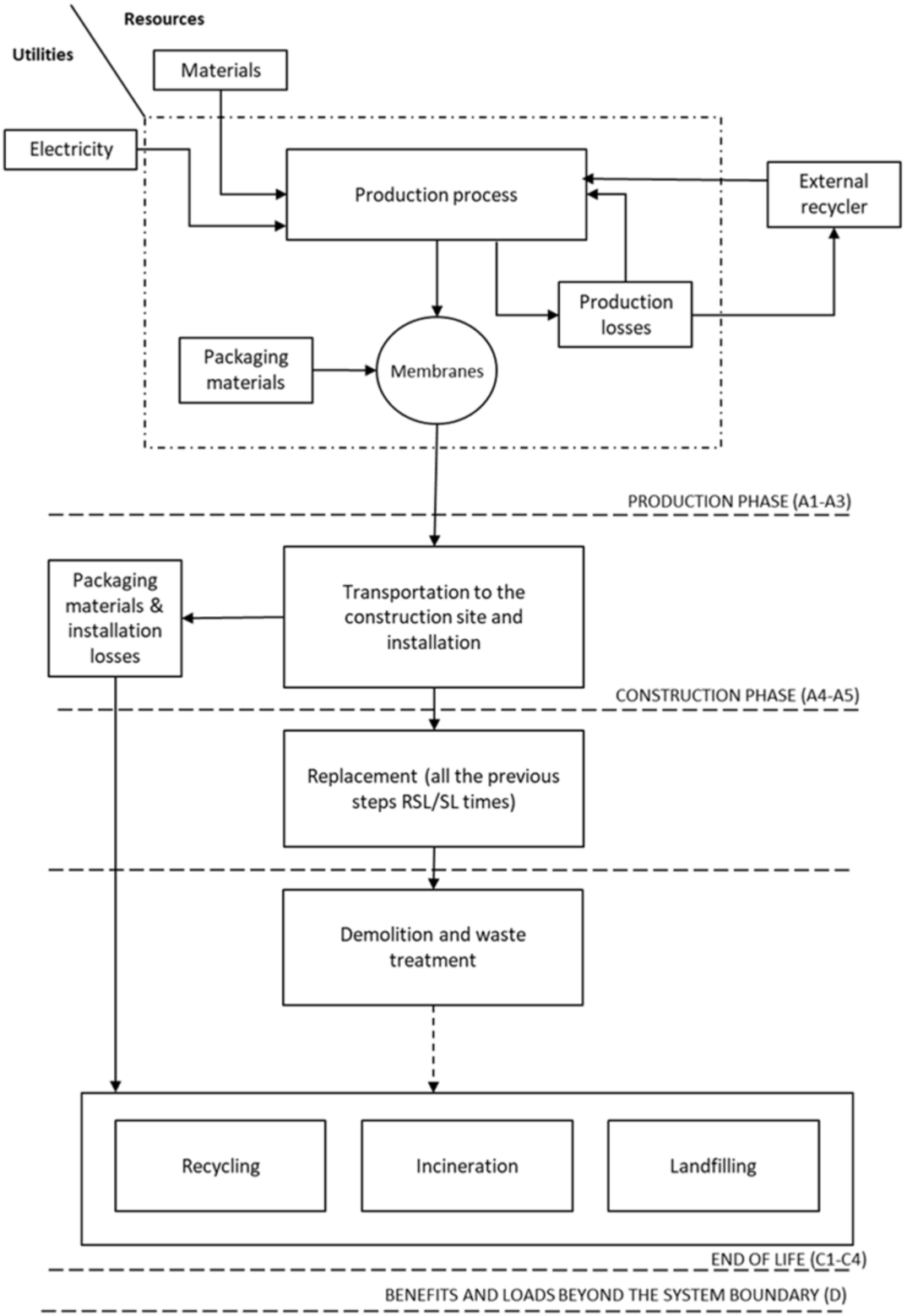
Reference service life

RSL information	Unit (expressed per functional unit or per declared unit)	
Reference Service Life	Years	120
Declared product properties (at the gate) and finishes, etc.	Units as appropriate	Refer to TDS and DoP
Design application parameters (if instructed by the manufacturer), including the references to the appropriate practices and application codes	Units as appropriate	The design of the waterproofing system shall follow EN 13491, EN 13967 and relevant national standards
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Units as appropriate	The membrane shall be installed as per manufacturer instructions
Outdoor environment, (for outdoor applications), e.g. weathering, pollutants, UV and wind exposure, building orientation, shading, temperature	Units as appropriate	The Service Life might be affected by the presence of pollutants, water at high temperatures or other abnormal circumstances different than usual underground conditions. The product is not designed to remain exposed to the atmosphere conditions.
Indoor environment (for indoor applications), e.g. temperature, moisture, chemical exposure	Units as appropriate	N/A
Usage conditions, e.g. frequency of use, mechanical exposure	Units as appropriate	The membrane will remain covered by the concrete structure during the usage
Maintenance e.g. required frequency, type and quality and replacement of components	Units as appropriate	No maintenance is expected

Figure 1. Modules declared

	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	X	ND	ND	ND	X	X	X	X	X
Geography	Global																
Specific data used	More than 99% specific data is used in the EPD.					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	Not relevant																
Variation – sites	Not relevant																

Figure 2. Flow diagram of the system under study



RSL: Reference Service Life
SL: Service Life

A1-A3 PRODUCT STAGE

- **A1 Raw materials supply:** this module takes into account the extraction and processing of raw materials and the energy that is produced prior to the manufacturing process under study.
- **A2 Transport:** this module includes the transport of the different raw materials from the manufacturer to the factory. The distance and type of concrete truck for each raw material has been introduced.
- **A3 Manufacturing:** this module includes the consumption of energy and water used during the manufacturing process, as well as the transport and management of the factory-produced waste.

A4-A5 CONSTRUCTION PROCESS STAGE

- **A4 Transport**

PARAMETER	VALUE/DESCRIPTION
Fuel type and consumption of vehicle or vehicle type used for transport e.g. long ditance truck, boat, etc.	20-26 tons truck with a maximum load capacity of 17,3 tons. This truck complies with the Euro V regulations. 0,0231 KG DIESEL
Distance	Truck: 800 km
Capacity utilisation (including empty returns)	98%
Bulk density of transported products	1,3 kg/m3

- **A5 construction / installation**

PARAMETER	VALUE/DESCRIPTION
Ancilliary materials for installation (specified by material)	No auxiliary material used
Water use	Not used
Other resource use	No other resource consumption
Quantitative description of energy type (regional mix) and consumption during the installation process	Electricity grid mix, ES 0,352 MJ
Waste materials on the building site before waste processing, generated by the product's installation (specified by type)	Components for re-use [kg] 0,106 Materials for recycling [kg] 0,0516 Materials for energy recovery [kg] 0,0126
Output materials (specified by type) as result of waste processing at the building site e.g. of collection for recycling, for energy recovery, disposal	0,0744 kg Disposal
Direct emissions to environment, air, soil and water	No emissions

B1-B7 USE STAGE

- **B4 replacement**

PARAMETER	VALUE/DESCRIPTION
Replacement cycle	NOT APPLICABLE
Energy input during replacement e.g. crane activity, energy carrier type, e.g. electricity and amount if applicable and relevant	NOT APPLICABLE
Exchange of worn parts during the product's life cycle, e.g. zinc galvanized steel sheet, specify materials	NOT APPLICABLE

C1-C4 END OF LIFE STAGE

- **C2-C4. Transport/ disposal**

PARAMETER	VALUE/DESCRIPTION
Collection process specified by type	NOT APPLICABLE
	NOT APPLICABLE
Disposal specified by type	NOT APPLICABLE

After the service life of the product, the geomembranes are left in the construction site. No de-construction is applied. Thus, no extra waste management treatment and associated impact has been considered.
Tunnel products are not applied with de-construction (end of life) stages. The material remains installed forever.

BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY (D)

For calculating the credits due to the recycling of materials, value-correction factors that reflect the difference in functional equivalence of recycled versus virgin materials have been applied. In particular, the ones provided by the Product Environmental Footprint (PEF): 0,85 for cardboard, 1 for wood chips and 0,75 for PVC, in this case corresponding to the lower value for plastics.

In this stage, the credits due to the incineration of the felt blanket with energy recovery have also been considered. In this case, the average mixes to produce electricity and thermal energy from natural gas in Europe (EU-28) have been used. They are representative for the period 2020-2023.

Scenarios included are currently in use and are representative for one of the most probable alternatives. Additional declaration of representative mixes for the relevant region is permissible.

4. Content declaration

Product

Product components	Weight, %	Post-consumer material, weight-%	Renewable material, weight-%
Chalk	1-5%	0%	0%
Processing aids	<1%	0%	0%
Colour Pigments	1-5%	0%	0%
Plasticizer	15-25%	0%	0%
Polyvinyl chloride (PVC)	5-15%	0%	0%
Reworked PVC-P	60-70%	0%	0%
Stabilizers (UV/heat)	<1%	0%	0%
Soja oil	<1%	0%	0%
TOTAL	**100 %**	**0%**	**0%**
Packaging materials	**Weight (gr)**		
Cardboard tubes	46,51		
PVC flexible	0,16		
Cardboard tires	0,12		
Pallet 210x210	96,90		
Wood pieces	0,29		
Felt blanket	11,63		
TOTAL	**115,60**		

None of the final product components are included in the “Candidate list of substances of very high concern for authorisation” of the REACH regulation.

Packaging

Distribution packaging: This distribution packaging is the same as the consumer packaging. Primarily, the geomembranes are rolled around a cardboard tube of 70x83x2170 mm and protected with PVC film. Each role contains 25 linear meters of geomembrane. Secondly, a wood pallet of 210x210 mm is prepared with a couple of nailed wooden pieces attached. Afterwards, a blanket is placed at the bottom of the pallet. Finally, 12 rolls of geomembranes are arranged in a single pallet and fixed with cardboard tires of 1400x100x1,5 mm.

Recycled material

Provenience of recycled materials (pre-consumer or post-consumer) in the product: The recycled PVC is recycled in the internal process. For calculating the credits due to the recycling of materials, value-correction factors that reflects the difference in functional equivalence of recycled versus virgin materials have been applied. In particular, the ones provided by the Product Environmental Footprint (PEF): 0,75 for PVC, corresponding to the lower value for plastics.

Electric mix. kg CO_2 eq./kWh

- MIX RENOLIT (production): 0,000247 kg CO2 eq./kWh.
- Spanish Mix (installation): 0,412 Kg CO2 eq/kWh.
- Mix EU-28 (packaging recycling process-installation): 0,401 kg CO2 eq./kWh.

5. Environmental performance

Potential environmental impact

Indicator		Manufacture			Installation		Use	End of life				Module
	Unit	A1	A2	A3	A4	A5	B4	C1	C2	C3	C4	D
EN 15804 +A1												
Global warming potential (GWP) - A1	[kg CO2 eq.]	1,39E+00	4,44E-02	9,37E-05	8,21E-02	8,90E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	9,20E-02
EN 15804 +A2												
Global warming potential (GWP) -Total	[kg CO2 eq.]	1,44E+00	4,55E-02	9,67E-05	8,41E-02	9,04E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	9,01E-02
Global warming potential (GWP) - fossil	[kg CO2 eq.]	1,67E+00	4,52E-02	9,65E-05	8,35E-02	9,04E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-7,38E-02
Global warming potential (GWP) - biogenic	[kg CO2 eq.]	-2,33E-01	-5,39E-05	1,89E-08	-9,98E-05	-4,07E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,64E-01
Global warming potential (GWP) -luluc	[kg CO2 eq.]	1,21E-03	3,70E-04	2,43E-07	6,85E-04	7,23E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,60E-04
Ozone depletion	[kg CFC-11 eq.]	2,65E-11	8,93E-18	1,05E-16	1,65E-17	6,70E-16	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-5,93E-13
Acidification	[Mole of H+ eq.]	3,46E-03	1,59E-04	4,89E-07	8,37E-05	1,34E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,81E-04
Eutrophication - freshwater	[kg P eq.]	3,80E-06	1,34E-07	1,67E-09	2,49E-07	1,05E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-8,43E-07
Eutrophication - marine	[kg N eq.]	8,69E-04	7,38E-05	1,63E-07	2,57E-05	3,21E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-7,22E-05
Eutrophication - terrestrial	[Mole of N eq.]	9,26E-03	8,24E-04	1,62E-06	3,07E-04	3,58E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-7,54E-04
Photochemical ozone formation, human health	[kg NMVOC eq.]	5,33E-03	1,44E-04	4,39E-07	7,20E-05	9,20E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,99E-04
Resource use, mineral and metals - minerals&metals	[kg Sb eq.]	2,51E-06	4,01E-09	1,25E-09	7,42E-09	1,06E-08	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-2,06E-08
Resource use - fossil	[MJ]	4,40E+01	6,02E-01	7,34E-04	1,12E+00	8,78E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,16E+00
Water use	[m³ world equiv.]	1,89E-01	4,20E-04	3,28E-03	7,77E-04	3,34E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-6,17E-03

Use of resources

		Manufacture			Installation		Use	End of life				Module
Resource use indicators	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**B4**	**C1**	**C2**	**C3**	**C4**	**D**
Use of renewable primary energy (PERE)	[MJ]	6,23E+00	3,47E-02	4,49E-02	6,42E-02	3,96E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-2,10E+00
Use of renewable primary energy resources used as raw materials (PERM)	[MJ]	6,22E-05	0,00E+00	0,00E+00	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]	6,23E+00	3,47E-02	4,49E-02	6,42E-02	3,96E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-2,10E+00
Use of non-renewable primary energy (PENRE)	[MJ]	4,40E+01	6,04E-01	7,35E-04	1,12E+00	8,78E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,17E+00
Use of non-renewable primary energy resources used as raw materials PENREM	[MJ]	1,01E+01	0,00E+00	0,00E+00	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 non-renewable primary energy resources (PENRT)	[MJ]	4,40E+01	6,04E-01	7,35E-04	1,12E+00	8,78E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,17E+00
Use of secondary material SM	[kg]	1,32E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of net fresh water (FW)	[m3]	8,38E-03	3,97E-05	4,27E-05	7,35E-05	5,07E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-5,78E-04
Use of renewable secondary fuels RSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of non-renewable secondary fuels NRSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

Waste production and output flows

Waste production

		Manufacture			Installation		Use	End of life				Module
Output flows and waste categories	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**B4**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed (HWD)	[kg]	2,24E-07	3,18E-11	9,10E-12	5,90E-11	1,58E-10	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,34E-08
Non-hazardous waste disposed (NHWD)	[kg]	1,40E-01	9,48E-05	2,02E-05	1,76E-04	7,46E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-1,49E-03
Radioactive waste disposed (RWD)	[kg]	5,13E-04	1,10E-06	2,96E-08	2,03E-06	9,93E-05	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-6,19E-05

Output flows

Parameter	A1	A2	A3	A4	A5	B4	C1	C2	C3	C4	D
Components for re-use [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,06E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for recycling [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	5,16E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Materials for energy recovery [kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,26E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported energy [MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,33E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

Other environmental indicators

Optional indicators	Unit	A1	A2	A3	A4	A5	B4	C2	C4	D
Particulate matter	[Disease incidences]	5,86E-08	9,16E-10	3,95E-12	5,96E-10	1,12E-09	0,00E+00	0,00E+00	0,00E+00	-2,31E-08
Ionising radiation, human health	[kBq U235 eq.]	6,60E-02	1,60E-04	3,72E-06	2,97E-04	9,35E-03	0,00E+00	0,00E+00	0,00E+00	-9,38E-03
Ecotoxicity, freshwater	[CTUe]	1,58E+01	4,47E-01	5,84E-04	8,28E-01	3,61E-01	0,00E+00	0,00E+00	0,00E+00	-3,50E-01
Human toxicity, cancer	[CTUh]	2,62E-09	9,04E-12	6,66E-13	1,67E-11	1,37E-11	0,00E+00	0,00E+00	0,00E+00	-1,46E-10
Human toxicity, non-cancer	[CTUh]	2,57E-07	5,39E-10	7,38E-12	8,65E-10	5,70E-10	0,00E+00	0,00E+00	0,00E+00	-7,44E-10
Land Use	[Pt]	4,29E+01	2,07E-01	8,84E-03	3,83E-01	1,91E-01	0,00E+00	0,00E+00	0,00E+00	-3,07E+01

Biogenic carbon content	Unit	A1	A2	A3	A4	A5	B4	C2	C4	D
Biogenic carbon content in product	[Kg C]	1,39E-04			0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Biogenic carbon content in accompanying packaging	[Kg C]	6,81E-02			0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

In order to further analyse the results, the characterized results have been normalized by the average emissions of a European citizen. For doing this, the normalization factors of the Product Environmental Footprint (PEF) of the European Union, adapted to the indicators of EN 15804 have been used. The 3 most relevant impact categories are Human Toxicity, non-cancer effects (HTP-nc), Resource Use Fossil (ADP-fossil), and Ecotoxicity Freshwater (ETP-fw), as can be seen in the following figure.

Figure 3. Normalized results of the environmental impact categories

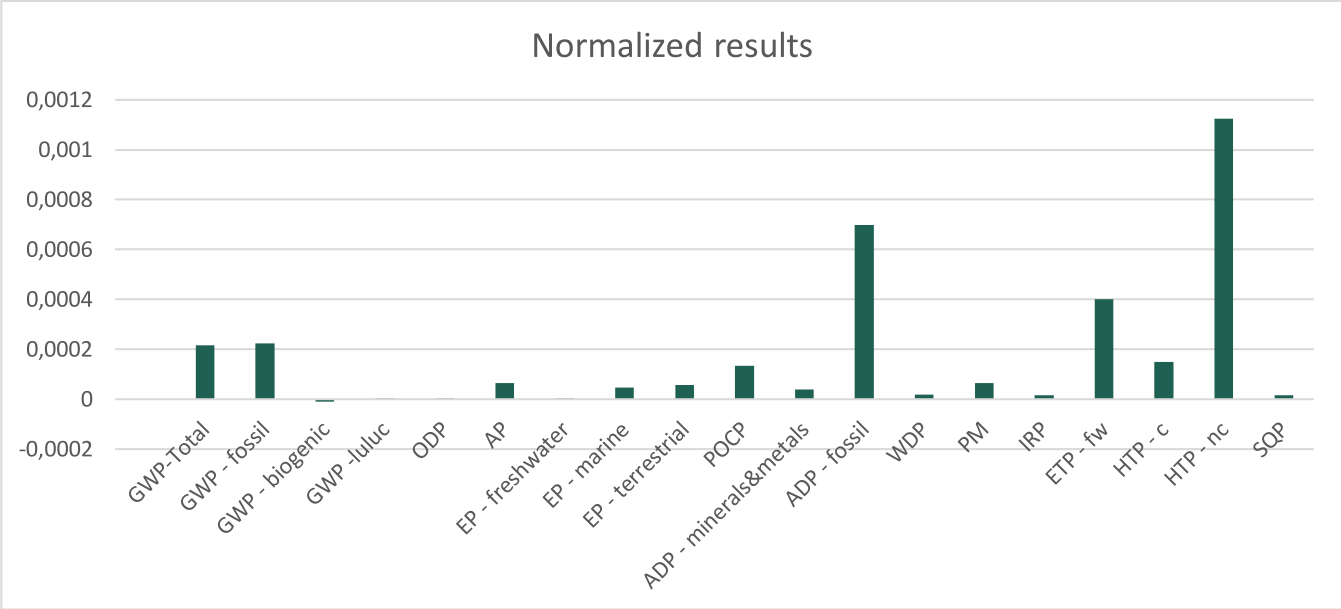


Table 5 — Classification of disclaimers to the declaration of core and additional environmental impact indicators

ILCD classification	Indicator	Disclaimer
ILCD Type 1	Global warming potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD Type 2	Acidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD Type 3	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2
Disclaimer 1 – 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 by this indicator.		
Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.		

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VERIFICATION STATEMENT CERTIFICATE

CERTIFICADO DE DECLARACIÓN DE VERIFICACIÓN

Certificate No. / Certificado nº: EPD07903

TECNALIA R&I CERTIFICACION S.L., confirms that independent third-party verification has been conducted of the Environmental Product Declaration (EPD) on behalf of:
TECNALIA *R&I CERTIFICACION S.L., confirma que se ha realizado verificación de tercera parte independiente de la Declaración Ambiental de Producto (DAP) en nombre de:*

RENOLIT Ibérica S.A.
Ctra. Del Montnegre S/N
08470 SANT CELONI (Barcelona) - SPAIN

for the following product(s):
para el siguiente(s) producto(s):

Geomembrane for tunnels and basement works –
RENOLIT ALKORPLAN Tunnel C (1,5 mm)

Geomembrana para túneles y obras subterráneas - RENOLIT ALKORPLAN Tunnel C (1,5 mm)

with registration number **S-P-08521** in the International EPD® System *(www.environdec.com).*
*con número de registro **S-P-08521** en el Sistema International EPD® (www.environdec.com).*

it´s in conformity with:
es conforme con:

- **ISO 14025:2010 Environmental labels and declarations. Type III environmental declarations.**
- **General Programme Instructions for the International EPD® System v.3.01.**
- **PCR 2019:14 Construction products (EN 15804:A2) v1.11.**
- **UN CPC 36390 Plates, sheets, film, foil and strip of plastics.**

Carlos Nazabal Alsua
Manager

Issued date / *Fecha de emisión:*	14/03/2023
Update date / *Fecha de actualización:*	14/03/2023
Valid until / *Válido hasta:*	13/03/2028
Serial Nº / *Nº Serie:*	EPD0790300-E

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