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POLYPROPYLENE (PP-R) AND POLYPROPYLENE WITH GLASS FIBER (PP-R+GF) HOT - COLD WATER PIPELINE SYSTEMS

Environmental Product Declaration

EN ISO 14025:2010

EN 15804:2012+A2:2020

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HELIROMA

HELIROMA PLÁSTICOS S.A.

The holder of this Declaration is responsible for its contents and for keeping the records and the documentation that supports data and statements included during the validity period

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AENOR is a founding member of ECO Platform, the European Association of Environmental Product Declaration Verification Programs.

European Standard UNE-EN 15804:2012+A2:2020 serves as the basis for PCRs
Independent verification of the declaration and data in accordance with EN ISO 14025:2010 ☐ Internal ☒ External
Verification body AENOR Confía

1. General information

1.1. The organisation

Heliroma Plásticos S.A., hereinafter HELIROMA, is one of the leaders in plastic plumbing systems for hot-cold water and air conditioning systems, exporting its products to more than 30 countries.

The history of HELIROMA begins in 1996 at Arrifana with the production of high and low-density polyethylene pipes for construction and agricultural sector., showing from the beginning its innovative nature. the company's strong position in the market, the powerful development and the increased competition makes HELIROMA expand its product range and move our facilities to a larger building.

The investment in the production of plumbing systems for hot-cold water and heating stimulated the increase of highly qualified human resources, which turned into better product quality, making HELIROMA a reference in Europe, especially in the Iberian Peninsula, for the manufacture of PP-R pipes and fittings.

HELIROMA stands out as one of the few Iberian manufacturers of PP-R pipes with fiberglass compound (PP-R+GF), also known as the third-generation pipe. This reality allowed to win a very significant share of the European market, and to produce these pipes for many of the world-renowned manufacturers.

HELIROMA is also one of the few Iberian manufacturers of PE-RT / Al / PE-RT multilayer pipes and fittings and, in addition, manufactures cross-linked polyethylene (PE-Xa pipes) and a high-temperature polyethylene (PE-RT pipes with and without oxygen barriers).

Continuing with its constant evolution, HELIROMA launched two new products in 2020: PPSU fittings, to complete a multilayer system; and RED FIRE pipe and fittings, a system designed for the installation of sprinklers and hydrants on firefighting facilities.

With the best raw material, HELIROMA produces PP-R 100, PP-RCT 125, PPSU, PE-Xa and PE-RT piping systems, offering to all customers a dimension band width of 12-400 mm.

All HELIROMA's products are manufactured using the must advanced technology either extrusion or injection, in line with the most stringent international standards requirements.

The quality of HELIROMA products and services is certified in several European countries, which have distinguished the excellence of the company with their certifications: CERTIF (Portugal), AENOR (Spain), QB (France), DVGW and SKZ (Germany), ICECON (Romania), FM Approval (USA) y WRAS (UK).

All HELIROMA products passes through a demanding and rigorous analysis and respective production tests, to guarantee the conformity of the product. Likewise, sustainability and ecological responsibility play a key role with all entrepreneurial decisions and in the entire value chain, taking responsibility for creating a sustainable supply chain and maximizing the efficiency of supplier logistics.

1.2. Scope of the Declaration.

This environmental product declaration describes environmental information related to the cradle-to-door life cycle with modules A4, C1-C4 and D, of the following pipes and fittings for use in the construction sector:

- PP-R 100 pipes.
- PP-R 100 y PP-RCT 125 fittings (for PP-R 100, PP-R 100 + GF y PP-RCT 125 + GF pipes).
- PP-R 100 y PP-RCT 125 pipes with fiberglass composite.

The specific data of the products' production process included in this LCA study come from the HELIROMA´s facilities in Albergaria-a-Velha and correspond to the production data for the years 2019 and 2020, which are considered representative.

The products for which the EPD is drawn up serves their function as piping systems in plastic materials for construction applications.

1.3. Life cycle and compliance.

This EPD has been developed and verified in accordance with UNE-EN ISO 14025:2010 and UNE-EN 15804: 2012+A2:2020.

This EPD includes the life cycle stages listed in table 1-1. This is a cradle-to-gate EPD with modules A4, C y D.

This EPD may not be comparable with those developed in other Programmes or under different reference documents.

Likewise, the EPDs may not be comparable if the source of the data is different (e.g. databases), not all relevant information modules are included or they are not based on the same scenarios.

Table 1-1. Limits of the system. Information modules considered

Product stage	A1	Supply of raw materials	X
	A2	Transport to factory	X
	A3	Manufacture	X
Construction stage	A4	Transport to construction works	X
	A5	Installation/construction	MNA
Use stage	B1	Use	MNA
	B2	Maintenance	MNA
	B3	Repair	MNA
	B4	Substitution	MNA
	B5	Rehabilitation	MNA
	B6	In-service energy use	MNA
	B7	In-service water use	MNA
End of Life	C1	Deconstruction/demolition	MNR
	C2	Transport	X
	C3	Waste treatment	X
	C4	Disposal	X
	D	Potential for re-use, recovery and/or recycling	X

X = Module included in the LCA;
MNR = Module not relevant;
MNE = MNA = Module not assessed

The comparison of construction products must be made on the same function, applying the same functional unit and at the level of the building (or architectural or engineering work), that is, including the behaviour of the product throughout its life cycle, as well as the specifications of section 6.7.2 of the UNE-EN ISO 14025 standard.

2. The product

2.1. Product identification.

HELIROMA´s products included in this EPD are:

- PP-R 100 pipes.
- PP-R 100 y PP-RCT 125 fittings (for PP-R 100, PP-R 100 + GF y PP-RCT 125 + GF pipes)
- PP-R 100 y PP-RCT 125 pipes with fiberglass composite.

CPC code: 3632

PP-R 100 system - HELISYSTEM

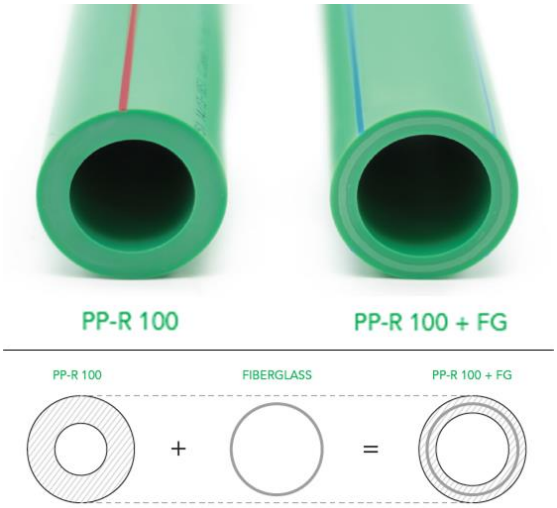
- HELISYSTEM pipes, made with PP-R 100, includes pipes with different wall thicknesses (SDR 6 and SDR 7,4) and more than 250 fittings.
- Mechanical resistance stress (MRS) 10,0 MPa.
- Suitable for applications including drinking water installations, sanitary systems, hot and cold water distribution, heating and cooling systems, district heating, community systems, industrial applications.

The following table shows the properties of HELIROMA PP-R 100 pipes:

PP-R 100 PIPE PROPERTIES		
PARAMETER	PP-R 100	STANDARD
PHYSICAL		
MRS	10,0 MPa	ISO 9080
σ_{LPL} (20°C)	10,02 MPa	
σ_{LPL} (70°C)	3,63 MPa	
MFI 230°/2,16 kg	0,3 g/10min	ISO 1133
MFI 230°/5,00 kg	1,3 g/10min	ISO 1133
MFI 190°/5,00 kg	0,5 g/10min	ISO 1133
Density	897 kg/m³	ISO 1133
MECHANICAL		
Tensile Modulus	850 MPa	ISO 527
Tensile Stress at Yield	24 MPa	ISO 527
Tensile Strain at Yield	13%	ISO 527
Elongation at Yield	12%	
THERMAL		
Cristalization Point Tc	97,5°C	
DSC Melting Point	139°C	DSC
OIT	40 min	ISO 11357
IMPACT		
IZOD Impact, Notched 0°C	19 KJ/m²	ISO 179
Charpy Impact Strength Notched 23°C	89 KJ/m²	ISO 179
Charpy Impact Strength Notched 0°C	12 KJ/m²	ISO 179
Charpy Impact Strength Notched -20°C	2,7 KJ/m²	ISO 179

PP-R 100 + GF and PP-RCT 125 + GF ROMAFASER, ROMAKLIMA, ROMAFASER CT y ROMAKLIMA CT systems.

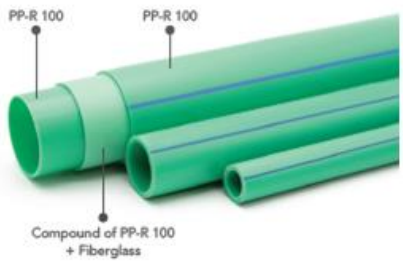
- These systems are made of PP-R 100 y PP-RCT 125 (hexane modified PP-R made on the Spherizone technology), allowing wall thickness reduction without compromising internal pressure resistance.
- Pipes with 3-layerss, the inner and outer layers of PP-R 100/PP-RCT 125 and the middle layer of PP-R 100/PP-RCT 125 + fiberglass, in 3 wall thickness: SDR 7.4 (ROMAFASER), SDR 11 (ROMAKLIMA/ROMAFASER CT) AND SDR 17 (ROMAKLIMA CT).
- Suitable for applications including drinking water installations, sanitary systems, hot - cold water distribution systems, heating systems, community systems and industrial installations.



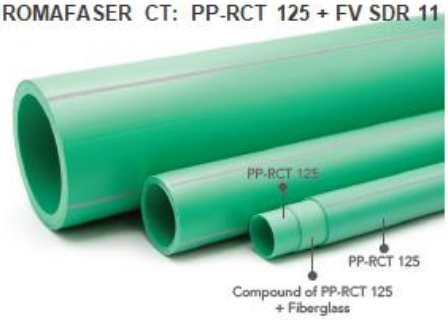
The following table shows the properties of HELIROMA glass fiber PP-R pipes:

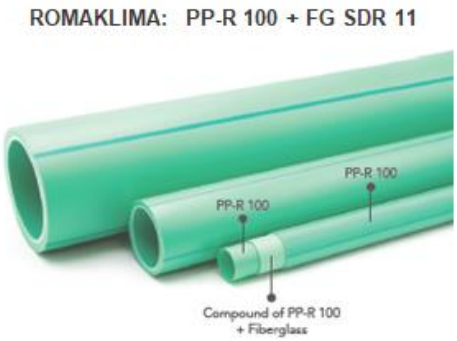
PP-RT 100/PP-RCT 125 + FG PIPE PROPERTIES		
PARAMETER	VALUE	STANDARD
THERMAL		
Thermal Conductivity	0,135 W/mK	DIN 52612
Thermal Expansion Coefficient	0,035 mm/m°C	VDE 0304
OIT	40 min	ISO 11357
Fire Classification	B2	DIN 4102
PHYSICAL		
Roughness	0,007 mm	ISO 5436
Pipe Constant	20	
Opacity	Yes	ISO 7686

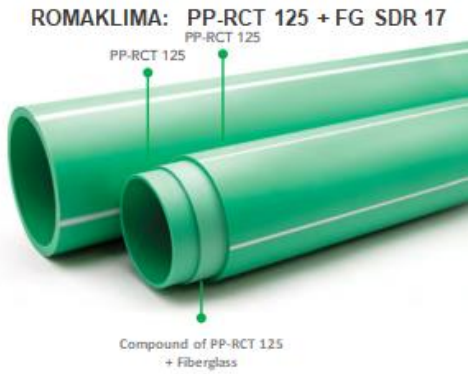
ROMAFASER: PP-R 100 + FG SDR 7,4



ROMAFASER CT: PP-RCT 125 + FV SDR 11

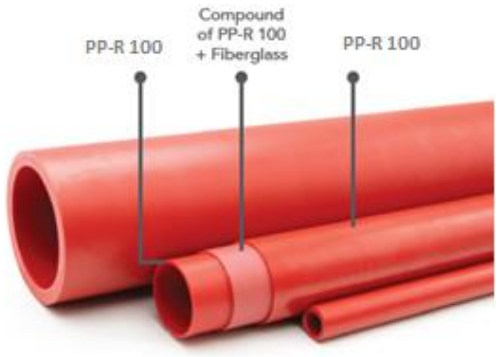






PP-R 100 + FV - RED FIRE system

- ✓ Piping system made of PP-R with fiberglass specially developed for fire suppression (reaction to fire class B-s1, d0).
- ✓ Based on a 3-layer structure: internal layer made of PP-R 100; middle layer made of PP-R 100 with fiberglass and external layer made of PP-R 100, SDR 11 wall thickness. All layers have fire retardant additive integration, which grants fire resistance to the pipe. RED FIRE is resistant to UV radiation.
- ✓ Suitable for applications on fire hydrants and sprinkler systems.



Both the materials and the pipes and fittings made of PP-R (HELISYSTEM, ROMAFASER, ROMAKLIMA, RED FIRE AND ROMAFASER CT/ROMAKLIMA CT systems with PP-RT 125) comply with the specifications of the current applicable standard:

- ✓ UNE-EN ISO 15874-1:2013, Plastics piping systems for hot and cold water installations - Polypropylene (PP) - Part 1: General. (ISO 15874-1:2013).
- ✓ UNE-EN ISO 15874-2:2013/A1:2018, Plastics piping systems for hot and cold water installations - Polypropylene (PP) - Part 2: Pipes (ISO 15874-2:2013/Amd 1:2018)
- ✓ UNE-EN ISO 15874-3:2013/A1:2018, Plastics piping systems for hot and cold water installations - Polypropylene (PP) - Part 3: Fittings (ISO 15874-3:2013/Amd 1:2018).
- ✓ UNE-EN ISO 15874-5:2013/A1:2018, Plastics piping systems for hot and cold water installations - Polypropylene (PP) - Part 5: Fitness for purpose of the system - Amendment 1 (ISO 15874-5:2013/Amd 1:2018).
- ✓ UNE-CEN ISO/TS 15874-7:2018 (Endorsed), lastics piping systems for hot and cold water installations - Polypropylene (PP) - Part 7: Guidance for the assessment of conformity (ISO/TS 15874-7:2018) (Endorsed by

Asociación Española de Normalización in March of 2019).

- ✓ DIN 8077, Polypropylene (PP) pipes - PP-H, PP-B, PP-R, PP-RCT – Dimensions.
- ✓ DIN 8078, Polypropylene (PP) pipes - PP-H, PP-B, PP-R, PP-RCT - General quality requirements and testing.
- ✓ DIN 16962, Pipe fittings and joint assemblies for polypropylene (PP) pressure pipes.
- ✓ ASTM F2389, Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.
- ✓ UNE-EN ISO 15494:2019, Plastics piping systems for industrial applications - Polybutene (PB), polyethylene (PE), polyethylene of raised temperature resistance (PE-RT), crosslinked polyethylene (PE-X), polypropylene (PP) - Metric series for specifications for components and the system. (ISO 15494:2015).
- ✓ RP 01.16: AENOR N Mark Specific Rules for polypropylene (PP) systems for hot and cold water installations.
- ✓ RP 01.72: AENOR Certificate of Conformity Specific Rules for polypropylene (PP-R) and glass fiber (GF) piping systems for hot and cold water installations inside buildings.
- ✓ RP 01.78: AENOR Certificate of Conformity Specific Rules for polypropylene (PP-RCT) and glass fiber (GF) piping systems for hot and cold water installations inside buildings.

2.2. Product composition.

The composition declared by the manufacturer for 1 kilogram of the product is as follows:

Table 2-2-1 PP-R 100 pipe composition

Material	% in total weight
PP-R	98 - 99%
Color additive	1 - 2%

Table 2-2-2 PP-R 100 y PP-RCT 125 fittings composition

Material	% in total weight
PP-R/PP-RCT	73 - 74%
Color additive	1 - 2%
Brass	24 - 25%

Table 2-2-3 PP-R 100 + GF y PP-RCT 125 + GF pipes composition

Material	% in total weight
PP-R/PP-RCT	91 - 92%
Color additive	1 - 2%
Glassfiber	7 - 8%

The manufacturer declares that none of the components of the final product is included in the "Candidate list of substances of very high concern for authorization" (SVHC) of the REACH regulation in a percentage higher than 0.1% of the weight of the product.

3. LCA information

3.1. Life cycle analysis.

The Life Cycle Analysis Report for the HELIROMA´s PP pipes and fittings EPD was carried out by the company Abaleo S.L. using the Ecoinvent 3.8 database and the SimaPro 9.4.0.2 software, which was the most updated version available at the time the LCA was carried out.

To carry out the study, data was taken from the HELIROMA plant located in Albergaria-a-Velha (Portugal).

The LCA study follows the recommendations and requirements of the international standards ISO 14040:2006, ISO 14044:2006 and the European Standard UNE-EN 15804:2012+A2:2020 as the reference PCR.

3.2. Scope of the study.

The scope of this cradle-to-door LCA with modules A4, C1-C4, and D, is the production of the HELIROMA´s pipes and fittings for their use in construction sector:

- PP-R 100 pipes.
- PP-R 100 y PP-RCT 125 fittings (for PP-R 100, PP-R 100 + GF and PP-RCT 125 + GF pipes)
- PP-R 100 y PP-RCT 125 with fiberglass composite.

The following phases of the product life cycle were studied:

Product stage.

- A1, production of the raw materials that are part of the final product,
- A2, transportation of raw materials to HELIROMA´s facilities.
- A3, production of PP pipes and fittings, including energy consumption at the Albergaria-a–Velha plant; production of auxiliary materials and their transportation to the factory; packaging production; and transport and management of waste generated.

Installation stage.

- A4, transportation of final products from HELIROMA´s facilities to customer.

End of life stage.

- C1, deconstruction.
- C2, transportation of the disassembled materials to the waste treatment or final disposal site.
- C3, treatment of waste for re-use, recovery and/or recycling.
- C4, waste disposal, including physical pre-treatment and management at the disposal site and the associated energy and water use.

Benefits and loads beyond the system.

- D, potential for re-use, recovery and/or recycling, expressed as net benefits and loads.

This LCA does not include:

- All equipment with a service life of more than 3 years.
- The construction of plant buildings, nor other capital assets.
- Business trips; nor staff trip to or from work; and
- Research and development activities.

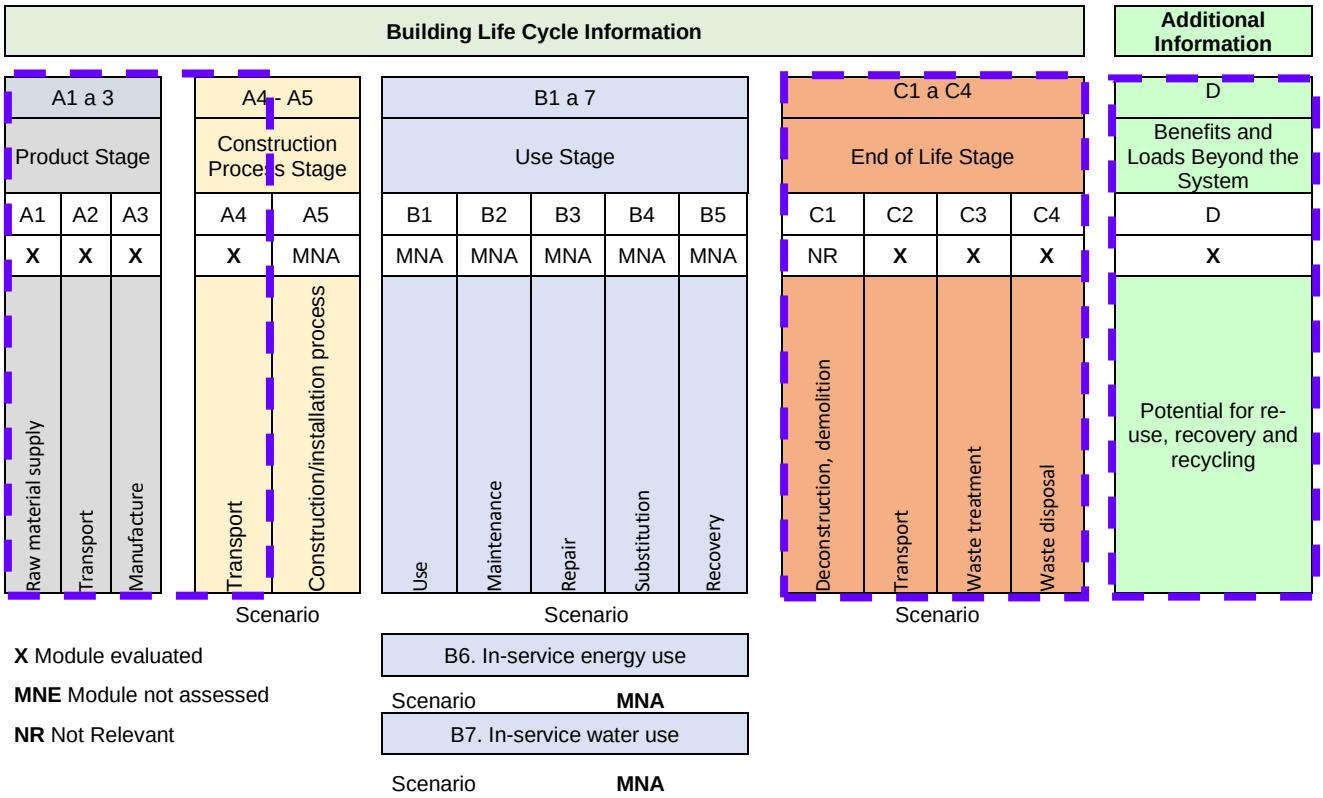


Figure 1. Stages and information modules for building assessment. Building life cycle

3.3. Declared unit.

The declared unit is one kilogram of product, including the relevant part of the packaging.

3.4. Reference service life (RSL).

Products Reference Service Life (RSL): not specified as it is a cradle-to-gate EPD with modules A4, C1-C4 y D. Assembly processes and/or installation are outside the scope of this EPD.

3.5. Allocation criteria.

In accordance with the criterion of the reference standard:

- Where possible, the product system was extended to avoid allocating the environmental impacts of multi-output unit processes.
- Where allocation could not be avoided, the system's inputs and outputs were allocated by mass. This allocation criterion was applied for electricity, oil, gas and packaging consumption, and waste.

It was not necessary to apply financial allocation criteria.

3.6. Cutt-off rule.

The gross weight/volume of all materials used in the manufacturing process was included in the LCA. Consequently, the criterion of including at least 99% of the total weight of the products used for the declared functional unit was fulfilled.

3.7. Representativeness, quality and selection of data.

To model the manufacturing process of HELIROMA´s PP pipes and fittings, production data of the plant located in Albergaria-a-Velha (Portugal), from the years 2019 y 2020, which is a period with representative production data, were used. Data from this factory have been obtained data on: material and energy consumption; and waste generation.

Where necessary, the Ecoinvent 3.8 database (November 2021), which was the latest version available at the time of the LCA, was used. SimaPro 9.4.0.2 software was used for the inventory data, for modelling the LCA and for calculating the environmental impact categories required by the reference standard, which was the most up-to-date version available at the time of the study.

The following criteria were applied to select the most representative processes:

- Data representing the technological development applied in the manufacturing processes. In case no information was available, a data representing an average technology was chosen.
- Geographic data as close as possible and, where appropriate, regionalized means.
- Data as up to date as possible.

To assess the quality of the primary data from the production of HELIROMA´s PP pipes and fittings, the semi-quantitative data quality assessment criteria, proposed by the European Union in its Guide to the Environmental Footprint of Products and Organizations, were applied. The results obtained were as follows:

- Very good integrity. Score 1.
- Reasonable methodological appropriateness and coherence. Score 3.
- Very good temporal representativeness. Score 1.
- Good technological representativeness. Score 2.
- Very good geographical representativeness. Score 1.
- Low data uncertainty. Score 2.

In accordance with the above data, the Data Quality Rating (DQR) has the following value: 10/6= 1,67, which indicates that the quality of the data is very good.

To better understand the data quality assessment carried out, please note that the score for each of the criteria ranges from 1 to 5 (the lower the score, the higher the quality) and that the following table is applied to obtain the final score:

Overall Data Quality Rating (DQR)	Overall Level of Data Quality
≤ 1,6	Excellent
1,6 a 2,0	Very good
2,0 a 3,0	Good
3 a 4,0	Reasonable
> 4	Insufficient

4. System boundaries, scenarios, and additional technical information.

4.1. Module A1 - Production of raw materials.

This module includes the production processes of raw materials, in which the following is considered:

- Extraction of resources and raw materials production.
- Transport of raw materials to processing/production centers.
- Fuel and energy consumption during the production of raw materials.
- Consumption of other resources (such as water) during the production of raw materials.
- The generation of waste and emissions to air and discharges to water and soil during the production of raw materials.

4.2. Module A2 - Transport of raw materials to the factory.

The transport of all raw materials from the production sites (suppliers) to HELIROMA´s facilities was considered, distinguishing in each case the mode of transport used: trucks and ships. The transport distances of the raw materials were provided by HELIROMA, which knows the location of the plant and its suppliers' facilities.

4.3. Module A3 - Manufacture.

This module includes:

- Pipes and fittings manufacture process.
- The production of ancillary materials and their transportation to the plant.
- The manufacture of packaging and its transportation from the suppliers to the plant.
- Transport and management of waste from the manufacturing process.

Transport distances of the waste were provided by HELIROMA, which knows the location of the plant and its waste managers' facilities.

4.4. Module A4 - Transport.

The transport of the studied products has been considered, from the places of production to the facilities where they are used, distinguishing the mode of transport used: ship or truck.

Table 4-1 Module A4 parameters - PP-R 100 pipes

Parameter	Value (per declared unit)
Fuel: - Diesel in EURO 5 truck (29,96t payload) - Heavy diesel in transoceanic ship (43.000 TPM)	 0,04408 l/tkm 0,00296 l/tkm
Average distance: - Truck - Ship	 139,82 km 3.871,63 km
Capacity utilization (including empty return)	50 %
Density of transported products	897 kg/m^3
Payload factor	0,98 t

Table 4-2 Module A4 parameters - PP-R 100 y PP-RCT-125 fittings

Parameter	Value (per declared unit)
Fuel: - Diesel in EURO 5 truck (29,96t payload) - Heavy diesel in transoceanic ship (43.000 TPM)	 0,04408 l/tkm 0,00296 l/tkm
Average distance: - Truck - Ship	 357,80 km 6.862,19 km
Capacity utilization (including empty return)	50 %
Density of transported products	897 kg/m^3
Payload factor	0,98 t

Table 4-3 Module A4 parameters - PP-R 100 + GF and PP-RCT 125 + GF pipes

Parameter	Value (per declared unit)
Fuel: - Diesel in EURO 5 truck (29,96t payload) - Heavy diesel in transoceanic ship (43.000 TPM)	 0,04408 l/tkm 0,00296 l/tkm
Average distance: - Truck - Ship	 623,86 km 7.317,25 km
Capacity utilization (including empty return)	50 %
Density of transported products	-
Payload factor	0,98 t

4.5. Module C1 – Deconstruction / Demolition.

The LCA considered that the deconstruction module (C1) was not relevant for the quantitative analysis. The consumption of material and energy for the deconstruction and extraction of the pipes and the fittings was not relevant in the context of the building or civil works of which it forms part.

4.6. Module C2: Transport to the waste treatment/recovery plant.

It is considered that the waste deriving from pipes and fittings is transported an average of 50 km to the closest waste management plant in 16-32 tons EURO5 trucks.

4.7. Module C3 - Waste treatment, and Module C4 – Waste disposal.

To determine the percentages of recycling material and material sending to landfill or incineration of the pipes and fittings studied, the criteria of Part C of Annex 2 V2.1 (May 2020) of the Circular Footprint Formula of the Environmental Footprint methodology of the European Union (*RECOMMENDATION (EU) 2021/2279 OF THE COMMISSION of December 15, 2021, on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organizations*) has been used.

Applying the indicated values to the composition of pipes and accessories, results in the following end-of-life scenarios.

Table 4-4 Module C parameters - PP-R 100 pipes

Parameter	Value (per declared unit)
Demolition	It is considered that during the deconstruction and dismantling of the pipes and their fittings the consumption of materials and energy is not relevant in the context of the building or civil works.
Collection process, specified by type	1 kg collected separately 0 kg collected with mixed construction waste.
Recovery system, specified by type	0 kg for re-use 0,183 kg of for recycling 0,114 kg for energy recovery
Disposal, specified by type	0,703 kg of product or material for final disposal in landfill.
Assumptions made to develop scenarios (transport)	Transport of waste in 16-32 tons EURO5 trucks: Average distance of 50 km from the works to the waste management plants.

Table 4-5 Module C parameters - PP-R 100 y PP-RCT-125 fittings

Parameter	Value (per declared unit)
Demolition	It is considered that during the deconstruction and dismantling of the pipes and their fittings the consumption of materials and energy is not relevant in the context of the building or civil works.
Collection process, specified by type	1 kg collected separately 0 kg collected with mixed construction waste.
Recovery system, specified by type	0 kg for re-use 0,138 kg of PP and 0,235 kg of brass for recycling 0,086 kg of PP and 0,002 kg of brass for energy recovery.
Disposal, specified by type	0,529 kg of PP and 0,011 kg of brass for final disposal in landfill.

Parameter	Value (per declared unit)
Assumptions made to develop scenarios (transport)	Transport of waste in 16-32 tons EURO5 trucks: Average distance of 50 km from the works to the waste management plants.

Table 4-6 Module C parameters - PP-R 100/PP-RCT-125 + GF pipes

Parameter	Value (per declared unit)
Demolition	It is considered that during the deconstruction and dismantling of the pipes and their fittings the consumption of materials and energy is not relevant in the context of the building or civil works.
Collection process, specified by type	1 kg collected separately 0 kg collected with mixed construction waste.
Sistema de recuperación, especificado por tipo	0 kg for re-use 0,170 kg of PP for recycling 0,106 kg of PP and 0,010 kg of GF for energy recovery.
Eliminación, especificada por tipo	0,653 kg of PP and 0,060 kg of GF for final disposal in landfill.
Assumptions made to develop scenarios (transport)	Transport of waste in 16-32 tons EURO5 trucks: Average distance of 50 km from the works to the waste management plants.

4.8. Module D – Benefits beyond the system

The recovery coefficient indicated in the criteria of Part C of Annex 2 V2.1 (May 2020) of the Circular Footprint Formula of the Environmental Footprint of the European Union methodology (*RECOMMENDATION (EU) 2021/2279 OF THE COMMISSION of December 15, 2021, on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organizations*) has been applied to each waste that is sent for recycling:

- PP-R 100 pipes expressed for declared unit (1 kg): 90% of the 0,183 kg of PP sent to re-use.
- PP-R 100 y PP-RCT 125 fittings, expressed for declared unit (1 kg): 90% of the 0,183 kg of PP and 100% of the 0,235 kg of brass sent to re-use.
- PP-R 100 + GF y PP-RCT 125 + GF pipes expressed for declared unit (1 kg): 90% of the 0,170 kg of PP sent to re-use.

5. LCA and LCI environmental parameter declaration.

The different environmental parameters obtained from the Life Cycle Assessment (LCA) to produce 1 kilogram of each product studied are presented below.

The estimated impact results are relative and do not indicate the final value of the impact categories, nor do they refer to threshold values, safety margins or risks.

5.1. Environmental impacts - 1 kilogram of PP-R 100 pipe.

Table 5-1 Parameters describing the environmental impacts defined in the UNE-EN 15804 Standard to produce 1 kilogram of PP-R 100 pipe.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-fossil	2,28	2,71E-01	3,31E-02	**2,58**	5,43E-02	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	6,91E-03	2,91E-01	1,23E+00	-3,13E-01
GWP-biogenic	5,86E-03	1,58E-05	9,18E-05	**5,97E-03**	3,06E-06	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	4,04E-07	1,90E-06	2,32E-05	-4,38E-04
GWP-luluc	1,54E-03	2,19E-06	5,57E-05	**1,59E-03**	7,21E-07	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,58E-08	1,92E-07	2,45E-06	-5,26E-05
GWP-total	2,28	2,71E-01	3,33E-02	**2,59**	5,43E-02	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	6,91E-03	2,91E-01	1,23E+00	-3,14E-01
ODP	5,34E-08	6,43E-08	1,29E-09	**1,19E-07**	1,19E-08	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	1,64E-09	1,87E-10	2,31E-09	-3,01E-09
AP	7,82E-03	9,41E-04	1,26E-04	**8,88E-03**	1,26E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,40E-05	3,49E-05	2,05E-04	-9,86E-04
EP-freshwater	2,63E-05	1,39E-07	9,86E-07	**2,75E-05**	2,96E-08	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	3,53E-09	9,13E-09	9,11E-08	-3,09E-06
EP-marine	1,39E-03	3,01E-04	2,30E-05	**1,72E-03**	3,15E-04	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	7,68E-06	1,73E-05	1,01E-04	-1,71E-04
EP-terrestrial	1,57E-02	3,31E-03	2,48E-04	**1,92E-02**	3,50E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	8,45E-05	1,87E-04	1,03E-03	-1,86E-03
POCP	6,86E-03	9,03E-04	1,26E-04	**7,89E-03**	8,93E-04	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,30E-05	4,43E-05	3,04E-04	-9,40E-04
ADP-minerals&metals [2]	6,68E-08	1,18E-08	2,01E-09	**8,06E-08**	1,24E-09	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	3,00E-10	4,21E-10	6,90E-09	1,03E-09
ADP-fossil [2]	74,82	3,83	8,20E-01	**79,47**	7,25E-01	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	9,77E-02	1,59E-02	1,81E-01	-11,13
WDP [2]	1,56	-3,66E-04	2,34E-02	**1,58**	-7,14E-05	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	-9,34E-06	4,25E-04	1,23E-03	-2,18E-01

GWP - total (kg CO2 eq.): Global warming potential; **GWP - fossil (kg CO2 eq.)**: Global warming potential of fossil fuels; **GWP - biogenic (kg CO2 eq.)**: Biogenic global warming potential; **GWP - luluc (kg CO2 eq.)**: Global warming potential of soil use and soil-use change; **ODP (kg CFC-11 eq)**: Stratospheric ozone depletion potential; **AP (mol H+ eq)**: Acidification potential, cumulative surplus; **EP-freshwater (kg PO4 eq)**: Eutrophication potential, fraction of nutrients reaching the final freshwater compartment; **EP-marine (kg N eq)**: Eutrophication potential, fraction of nutrients reaching the final marine water compartment; **EP-terrestrial (mol N eq)**: Eutrophication potential, cumulative surplus; **POCP (kg NMVOC eq)**: Tropospheric ozone formation potential; **ADP-minerals&metals (kg Sb eq)**: Abiotic depletion potential for non-fossil resources; **APD-fossil (MJ, n.c.v)**: Abiotic depletion potential for fossil resources; **WDP (m3 eq)**: Water deprivation potential (user), weighted water deprivation consumption.

MNR = Module not relevant. MNA = Module not assessed

Table 5-2 Parameters describing the additional environmental impacts defined in the UNE-EN 15804 Standard to produce 1 kilogram of PP-R 100 pipe.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	7,60E-08	2,02E-08	1,23E-09	**9,75E-08**	2,37E-09	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,16E-10	1,30E-10	4,17E-09	-1,08E-08
IRP [1]	1,42E-01	1,67E-02	1,39E-03	**1,60E-01**	3,17E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	4,25E-04	1,69E-05	4,88E-04	-4,81E-03
ETP-fw [2]	7,64	1,56	2,21E-01	**9,41**	2,56E-01	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	3,97E-02	5,08E-02	1,01E+00	-4,19E-01
HTP-c [2]	1,99E-10	2,18E-11	5,55E-12	**2,26E-10**	7,20E-12	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,57E-13	5,08E-12	1,80E-10	-2,09E-11
HTP-nc [2]	7,40E-09	2,54E-09	1,76E-10	**1,01E-08**	3,04E-10	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	6,48E-11	2,40E-10	2,26E-09	-7,41E-10
SQP [2]	6,55	1,03E-02	2,92E-02	**6,59**	1,92E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,63E-04	1,32E-03	7,79E-02	-6,73E-02

PM (Disease incidence): Particulate matter emissions resulting in potential for diseases; **IRP (kBq U235 eq)**: Efficiency of exposure of human potential related to U235; **ETP-fw (CTUe)**: Comparative ecosystem toxic unit potential - freshwater; **HTP-c (CTUh)**: Comparative ecosystem toxic unit potential - carcinogenic effects; **HTP-nc (CTUh)**: Comparative ecosystem toxic unit potential – non-carcinogenic effects; **SQP (Pt)**: Soil quality potential index.

MNR = Module not relevant. MNA = Module not assessed

Note 1. This impact category deals mainly with the potential impacts of low doses of ionising radiation on human health from the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposure due to the disposal of radioactive waste in underground facilities. The ionising radiation potential of soil, due to radon or some building materials is not measured in this parameter either.

Note 2. The results of this environmental impact indicator should be used carefully as the results are highly uncertain and experience with this parameter is limited.

5.2. Environmental impacts - 1 kilogram of PP-R 100 y PP-RCT 125 fittings

Table 5-3 Parameters describing the environmental impacts defined in the UNE-EN 15804 Standard to produce 1 kilogram of PP-R 100 and PP-RCT 125 fittings.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-fossil	2,91	2,88E-01	3,02E-02	**3,23**	1,10E-01	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	6,91E-03	2,19E-01	9,25E-01	-1,41
GWP-biogenic	9,36E-03	1,67E-05	4,88E-04	**9,87E-03**	6,21E-06	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	4,04E-07	1,45E-06	1,74E-05	-5,10E-03
GWP-luluc	3,92E-03	2,69E-06	1,46E-04	**4,07E-03**	1,38E-06	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,58E-08	1,45E-07	1,85E-06	-2,66E-03
GWP-total	2,93	2,88E-01	3,08E-02	**3,25**	1,10E-01	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	6,91E-03	2,19E-01	9,25E-01	-1,42
ODP	1,07E-07	6,72E-08	2,16E-09	**1,76E-07**	2,43E-08	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	1,64E-09	1,43E-10	1,74E-09	-6,57E-08
AP	1,03E-01	2,35E-03	1,44E-04	**1,06E-01**	2,25E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,40E-05	2,64E-05	1,54E-04	-9,34E-02
EP-freshwater	4,51E-04	1,50E-07	1,79E-06	**4,53E-04**	5,93E-08	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	3,53E-09	6,90E-09	6,86E-08	-4,12E-04
EP-marine	5,68E-03	6,41E-04	3,31E-05	**6,35E-03**	5,66E-04	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	7,68E-06	1,31E-05	7,64E-05	-4,54E-03
EP-terrestrial	7,89E-02	7,10E-03	3,49E-04	**8,64E-02**	6,29E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	8,45E-05	1,41E-04	7,80E-04	-6,53E-02
POCP	2,35E-02	1,86E-03	1,39E-04	**2,55E-02**	1,61E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,30E-05	3,35E-05	2,29E-04	-1,82E-02
ADP-minerals&metals [2]	2,45E-03	1,11E-08	5,29E-09	**2,45E-03**	2,81E-09	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	3,00E-10	3,17E-10	5,19E-09	-2,32E-03
ADP-fossil [2]	68,16	4,02	5,73E-01	**72,76**	1,48	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	9,77E-02	1,21E-02	1,37E-01	-20,99
WDP [2]	2,81	-3,87E-04	1,73E-02	**2,83**	-1,45E-04	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	-9,34E-06	3,21E-04	9,26E-04	-1,75

GWP - total (kg CO2 eq.): Global warming potential; **GWP - fossil (kg CO2 eq.)**: Global warming potential of fossil fuels; **GWP - biogenic (kg CO2 eq.)**: Biogenic global warming potential; **GWP - luluc (kg CO2 eq.)**: Global warming potential of soil use and soil-use change; **ODP (kg CFC-11 eq)**: Stratospheric ozone depletion potential; **AP (mol H+ eq)**: Acidification potential, cumulative surplus; **EP-freshwater (kg PO4 eq)**: Eutrophication potential, fraction of nutrients reaching the final freshwater compartment; **EP-marine (kg N eq)**: Eutrophication potential, fraction of nutrients reaching the final marine water compartment; **EP-terrestrial (mol N eq)**: Eutrophication potential, cumulative surplus; **POCP (kg NMVOC eq)**: Tropospheric ozone formation potential; **ADP-minerals&metals (kg Sb eq)**: Abiotic depletion potential for non-fossil resources; **APD-fossil (MJ, n.c.v.)**: Abiotic depletion potential for fossil resources; **WDP (m3 eq)**: Water deprivation potential (user), weighted water deprivation consumption.

MNR = Module not relevant. MNA = Module not assessed

Table 5-4 Parameters describing the additional environmental impacts defined in the UNE-EN 15804 Standard to produce 1 kilogram of PP-R 100 and PP-RCT 125 fittings.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	2,64E-07	1,94E-08	2,98E-09	**2,86E-07**	5,25E-09	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,16E-10	1,02E-10	3,14E-09	-2,05E-07
IRP [1]	1,85E-01	1,75E-02	1,91E-03	**2,04E-01**	6,44E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	4,25E-04	1,34E-05	3,69E-04	-7,86E-02
ETP-fw [2]	813,49	1,58	4,65E-01	**815,54**	5,32E-01	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	3,97E-02	4,24E-02	7,60E-01	-766,99
HTP-c [2]	1,84E-08	2,68E-11	1,01E-11	**1,84E-08**	1,38E-11	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,57E-13	3,83E-12	1,35E-10	-1,73E-08
HTP-nc [2]	1,33E-06	2,45E-09	3,42E-10	**1,33E-06**	6,70E-10	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	6,48E-11	1,81E-10	1,70E-09	-1,25E-06
SQP [2]	31,97	1,08E-02	7,65	**39,63**	3,91E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,63E-04	1,23E-03	5,91E-02	-25,86

PM (Disease incidence): Particulate matter emissions resulting in potential for diseases; **IRP (kBq U235 eq)**: Efficiency of exposure of human potential related to U235; **ETP-fw (CTUe)**: Comparative ecosystem toxic unit potential - freshwater; **HTP-c (CTUh)**: Comparative ecosystem toxic unit potential - carcinogenic effects; **HTP-nc (CTUh)**: Comparative ecosystem toxic unit potential – non-carcinogenic effects; **SQP (Pt)**: Soil quality potential index.

MNR = Module not relevant. MNA = Module not assessed

Note 1. This impact category deals mainly with the potential impacts of low doses of ionising radiation on human health from the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposure due to the disposal of radioactive waste in underground facilities. The ionising radiation potential of soil, due to radon or some building materials is not measured in this parameter either.

Note 2. The results of this environmental impact indicator should be used carefully as the results are highly uncertain and experience with this parameter is limited.

5.3. Environmental impacts - 1 kilogram of PP-R 100 + GF y PP-RCT 125 + GF pipe.

Table 5-5 Parameters describing the environmental impacts defined in the UNE-EN 15804 Standard to produce 1 kilogram of PP-R 100 + GF y PP-RCT 125 + GF pipe.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-fossil	2,28	2,88E-01	3,38E-02	**2,60**	1,50E-01	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	6,91E-03	2,71E-01	1,14E+00	-2,91E-01
GWP-biogenic	5,93E-03	1,68E-05	9,24E-05	**6,04E-03**	8,57E-06	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	4,04E-07	1,93E-06	2,35E-05	-4,07E-04
GWP-luluc	1,63E-03	2,33E-06	5,58E-05	**1,69E-03**	1,74E-06	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,58E-08	1,80E-07	2,40E-06	-4,88E-05
GWP-total	2,29	2,88E-01	3,39E-02	**2,61**	1,51E-01	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	6,91E-03	2,71E-01	1,14	-2,92E-01
ODP	6,42E-08	6,84E-08	1,36E-09	**1,34E-07**	3,38E-08	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	1,64E-09	1,91E-10	2,20E-09	-2,80E-09
AP	8,49E-03	1,00E-03	1,28E-04	**9,62E-03**	2,51E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,40E-05	3,30E-05	1,93E-04	-9,16E-04
EP-freshwater	3,06E-05	1,47E-07	9,98E-07	**3,18E-05**	8,03E-08	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	3,53E-09	8,56E-09	8,85E-08	-2,87E-06
EP-marine	1,53E-03	3,21E-04	2,35E-05	**1,88E-03**	6,41E-04	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	7,68E-06	1,63E-05	9,55E-05	-1,59E-04
EP-terrestrial	1,72E-02	3,53E-03	2,54E-04	**2,10E-02**	7,11E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	8,45E-05	1,76E-04	9,75E-04	-1,73E-03
POCP	7,09E-03	9,61E-04	1,28E-04	**8,18E-03**	1,83E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,30E-05	4,19E-05	2,87E-04	-8,73E-04
ADP-minerals&metals [2]	1,76E-06	1,25E-08	2,01E-09	**1,78E-06**	4,46E-09	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	3,00E-10	3,95E-10	6,43E-09	9,61E-10
ADP-fossil [2]	71,49	4,08	8,33E-01	**76,40**	2,05	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	9,77E-02	1,59E-02	1,73E-01	-10,34
WDP [2]	1,49	-3,90E-04	2,37E-02	**1,51**	-2,00E-04	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	-9,34E-06	3,96E-04	1,15E-03	-2,02E-01

GWP - total (kg CO2 eq.): Global warming potential; **GWP - fossil (kg CO2 eq.)**: Global warming potential of fossil fuels; **GWP - biogenic (kg CO2 eq.)**: Biogenic global warming potential; **GWP - luluc (kg CO2 eq.)**: Global warming potential of soil use and soil-use change; **ODP (kg CFC-11 eq)**: Stratospheric ozone depletion potential; **AP (mol H+ eq)**: Acidification potential, cumulative surplus; **EP-freshwater (kg PO4 eq)**: Eutrophication potential, fraction of nutrients reaching the final freshwater compartment; **EP-marine (kg N eq)**: Eutrophication potential, fraction of nutrients reaching the final marine water compartment; **EP-terrestrial (mol N eq)**: Eutrophication potential, cumulative surplus; **POCP (kg NMVOC eq)**: Tropospheric ozone formation potential; **ADP-minerals&metals (kg Sb eq)**: Abiotic depletion potential for non-fossil resources; **APD-fossil (MJ, n.c.v)**: Abiotic depletion potential for fossil resources; **WDP (m3 eq)**: Water deprivation potential (user), weighted water deprivation consumption.

MNR = Module not relevant. MNA = Module not assessed

Tabla 5-6 Parameters describing the additional environmental impacts defined in the UNE-EN 15804 Standard to produce 1 kilogram of PP-R 100 + GF y PP-RCT 125 + GF pipe.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	8,01E-08	2,15E-08	1,27E-09	**1,03E-07**	8,10E-09	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,16E-10	1,48E-10	3,95E-09	-1,00E-08
IRP [1]	1,49E-01	1,77E-02	1,42E-03	**1,68E-01**	8,93E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	4,25E-04	2,03E-05	4,73E-04	-4,46E-03
ETP-fw [2]	8,75	1,66	2,25E-01	**10,63**	7,59E-01	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	3,97E-02	4,89E-02	9,42E-01	-3,89E-01
HTP-c [2]	3,33E-10	2,33E-11	5,63E-12	**3,62E-10**	1,74E-11	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,57E-13	4,78E-12	1,67E-10	-1,94E-11
HTP-nc [2]	1,66E-08	2,71E-09	1,81E-10	**1,95E-08**	1,03E-09	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	6,48E-11	2,25E-10	2,10E-09	-6,88E-10
SQP [2]	6,73	1,10E-02	2,94E-02	**6,77**	5,45E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,63E-04	2,98E-03	8,30E-02	-6,25E-02

PM (Disease incidence): Particulate matter emissions resulting in potential for diseases; **IRP (kBq U235 eq)**: Efficiency of exposure of human potential related to U235; **ETP-fw (CTUe)**: Comparative ecosystem toxic unit potential - freshwater; **HTP-c (CTUh)**: Comparative ecosystem toxic unit potential - carcinogenic effects; **HTP-nc (CTUh)**: Comparative ecosystem toxic unit potential – non-carcinogenic effects; **SQP (Pt)**: Soil quality potential index.

MNR = Module not relevant. MNA = Module not assessed

Note 1. This impact category deals mainly with the potential impacts of low doses of ionising radiation on human health from the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposure due to the disposal of radioactive waste in underground facilities. The ionising radiation potential of soil, due to radon or some building materials is not measured in this parameter either.

Note 2. The results of this environmental impact indicator should be used carefully as the results are highly uncertain and experience with this parameter is limited.

5.4. Use of resources - 1 kilogram of PP-R 100 pipe.

Table 5-7 Parameters describing the use of resources to produce of 1 kilogram of PP-R 100 pipe.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	3,13	5,88E-03	3,22E-02	**3,17**	1,02E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	1,50E-04	3,65E-04	1,76E-03	-1,22E-01
PERM	9,23E-01	8,38E-04	2,68E-03	**9,26E-01**	1,44E-04	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,14E-05	4,14E-05	2,64E-04	-8,51E-03
PERT	4,05	6,72E-03	3,49E-02	**4,10**	1,17E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	1,71E-04	4,06E-04	2,02E-03	-1,30E-01
PENRE	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
PENRM	78,14	3,89	9,00E-01	**82,93**	7,37E-01	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	9,93E-02	1,70E-02	1,91E-01	-11,59
PENRT	78,14	3,89	9,00E-01	**82,93**	7,37E-01	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	9,93E-02	1,70E-02	1,91E-01	-11,59
SM	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
RSF	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
NRSF	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
FW	5,33E-03	1,94E-04	1,03E-04	**5,63E-03**	3,42E-05	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	4,94E-06	6,06E-05	2,52E-04	-5,06E-04

PERE (MJ, n.c.v.): Use of renewable primary energy excluding renewable primary energy resources used as raw materials; **PERM (MJ, n.c.v.):** Use of renewable primary energy as raw materials; **PERT (MJ, n.c.v.):** Total use of renewable energy; **PENRE (MJ, n.c.v.):** Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials; **PENRM (MJ, n.c.v.):** Use of non-renewable primary energy as raw materials; **PENRT (MJ, n.c.v.):** Total use of non-renewable energy; **SM (kg)**: Use of secondary materials; **RSF (MJ, n.c.v.):** Use of renewable secondary fuels; **NRSF (MJ, n.c.v.):** Use of non-renewable secondary fuels; **FW (m^3)**: Net use of flowing water resources.

MNR = Module not relevant. MNA = Module not assessed

5.5. Use of resources - 1 kilogram of PP-R 100/PP-RCT 125 fittings

Table 5-8 Parameters describing the use of resources to produce of 1 kilogram of PP-R 100/PP-RCT 125 fittings.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	6,41	6,07E-03	1,44E+00	**7,86**	2,11E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	1,50E-04	2,76E-04	1,33E-03	-3,97
PERM	8,19E-01	8,62E-04	9,52E-01	**1,77**	2,97E-04	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,14E-05	3,17E-05	2,03E-04	-1,45E-01
PERT	7,23	6,93E-03	2,40	**9,64**	2,41E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	1,71E-04	3,08E-04	1,54E-03	-4,12
PENRE	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
PENRM	74,36	4,09	6,55E-01	**79,11**	1,50	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	9,93E-02	1,29E-02	1,44E-01	-24,91
PENRT	74,36	4,09	6,55E-01	**79,11**	1,50	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	9,93E-02	1,29E-02	1,44E-01	-24,91
SM	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
RSF	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
NRSF	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
FW	5,60E-02	2,00E-04	5,48E-04	**5,67E-02**	7,03E-05	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	4,94E-06	4,56E-05	1,90E-04	-4,98E-02

PERE (MJ, n.c.v.): Use of renewable primary energy excluding renewable primary energy resources used as raw materials; **PERM (MJ, n.c.v.):** Use of renewable primary energy as raw materials; **PERT (MJ, n.c.v.):** Total use of renewable energy; **PENRE (MJ, n.c.v.):** Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials; **PENRM (MJ, n.c.v.):** Use of non-renewable primary energy as raw materials; **PENRT (MJ, n.c.v.):** Total use of non-renewable energy; **SM (kg)**: Use of secondary materials; **RSF (MJ, n.c.v.):** Use of renewable secondary fuels; **NRSF (MJ, n.c.v.):** Use of non-renewable secondary fuels; **FW (m^3)**: Net use of flowing water resources

MNR = Module not relevant. MNA = Module not assessed

5.6. Use of resources - 1 kilogram of PP-R 100/PP-RCT 125 + GF pipe

Table 5-9 Parameters describing the use of resources to produce of 1 kilogram of PP-R 100 + GF y PP-RCT 125 + GF pipe.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	3,24	6,26E-03	3,25E-02	**3,28**	2,98E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	1,50E-04	3,48E-04	1,73E-03	-1,13E-01
PERM	9,33E-01	8,92E-04	2,70E-03	**9,36E-01**	4,21E-04	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,14E-05	4,25E-05	2,54E-04	-7,90E-03
PERT	4,17	7,15E-03	3,52E-02	**4,22**	3,40E-03	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	1,71E-04	3,91E-04	1,99E-03	-1,21E-01
PENRE	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
PENRM	74,98	4,14	9,14E-01	**80,04**	2,08	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	9,93E-02	1,69E-02	1,82E-01	-10,77
PENRT	74,98	4,14	9,14E-01	**80,04**	2,08	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	9,93E-02	1,69E-02	1,82E-01	-10,77
SM	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
RSF	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
NRSF	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
FW	6,55E-03	2,06E-04	1,05E-04	**6,86E-03**	9,89E-05	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	4,94E-06	5,64E-05	2,35E-04	-4,70E-04

PERE (MJ, n.c.v.): Use of renewable primary energy excluding renewable primary energy resources used as raw materials; **PERM (MJ, n.c.v.):** Use of renewable primary energy as raw materials; **PERT (MJ, n.c.v.):** Total use of renewable energy; **PENRE (MJ, n.c.v.):** Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials; **PENRM (MJ, n.c.v.):** Use of non-renewable primary energy as raw materials; **PENRT (MJ, n.c.v.):** Total use of non-renewable energy; **SM (kg)**: Use of secondary materials; **RSF (MJ, n.c.v.):** Use of renewable secondary fuels; **NRSF (MJ, n.c.v.):** Use of non-renewable secondary fuels; **FW (m^3)**: Net use of flowing water resources

MNR = Module not relevant. MNA = Module not assessed

5.7. Waste category.

Table 5-10 Parameters describing the waste categories to produce 1kilogram of PP-R pipe.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	6,58E-06	1,01E-05	1,63E-07	**1,68E-05**	1,00E-06	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,57E-07	1,79E-07	1,31E-06	-3,83E-07
NHWD	2,74E-02	2,01E-04	7,90E-04	**2,84E-02**	4,10E-05	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,13E-06	4,53E-03	2,12E-01	-2,76E-03
RWD	9,89E-05	2,74E-05	1,14E-06	**1,28E-04**	5,22E-06	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	7,00E-07	1,76E-08	7,63E-07	-4,20E-06

HWD (kg): Hazardous waste disposed; **NHWD (kg)**: Non-hazardous waste disposed; **RWD (kg)**: Radioactive waste disposed.

Table 5-11 Parameters describing the waste categories to produce 1kilogram of PP-R-100/PP-RCT 125 fittings.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	6,94E-04	9,45E-06	5,31E-07	**7,04E-04**	2,31E-06	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,57E-07	1,35E-07	9,87E-07	-6,55E-04
NHWD	4,36E-01	2,15E-04	1,22E-03	**4,37E-01**	8,26E-05	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,13E-06	4,96E-03	1,70E-01	-3,92E-01
RWD	1,31E-04	2,88E-05	1,75E-06	**1,62E-04**	1,06E-05	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	7,00E-07	1,43E-08	5,77E-07	-5,79E-05

HWD (kg): Hazardous waste disposed; **NHWD (kg)**: Non-hazardous waste disposed; **RWD (kg)**: Radioactive waste disposed.

Table 5-12 Parameters describing the waste categories to produce 1kilogram of PP-R 100 + GF y PP-RCT 125 + GF pipe

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
HWD	8,87E-06	1,07E-05	1,73E-07	**1,98E-05**	3,71E-06	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	2,57E-07	1,69E-07	1,23E-06	-3,56E-07
NHWD	3,86E-02	2,14E-04	7,99E-04	**3,96E-02**	1,13E-04	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	5,13E-06	1,55E-02	2,58E-01	-2,57E-03
RWD	1,05E-04	2,92E-05	1,17E-06	**1,35E-04**	1,47E-05	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	7,00E-07	2,39E-08	7,36E-07	-3,91E-06

HWD (kg): Hazardous waste disposed; **NHWD (kg)**: Non-hazardous waste disposed; **RWD (kg)**: Radioactive waste disposed.

MNR = Module not relevant. MNA = Module not assessed

5.9. Outputs flows.

Table 5-13 Parameters describing the outputs flows to produce of 1 kilogram of PP-R pipe.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
CRU	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
MFR	0,00	0,00	2,33E-02	**2,33E-02**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	1,83E-01	0,00	0,00
MER	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	1,14E-01	0,00	0,00
EE	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00

CRU (kg): Components for re-use; **MFR (kg**): Materials for recycling; **MER (kg**): Materials for energy recovery; **EE (MJ):** Exported energy

Table 5-14 Parameters describing the outputs flows to produce of 1 kilogram of PP-R-100/PP-RCT 125 fittings.

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
CRU	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
MFR	0,00	0,00	2,11E-02	**2,11E-02**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	3,73E-01	0,00	0,00
MER	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	8,78E-02	0,00	0,00
EE	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00

CRU (kg): Components for re-use; **MFR (kg**): Materials for recycling; **MER (kg**): Materials for energy recovery; **EE (MJ):** Exported energy

Table 5-15 Parameters describing the outputs flows to produce of 1 kilogram of PP-R 100 + GF y PP-RCT 125 + GF pipe

Parameter	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
CRU	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00
MFR	0,00	0,00	4,80E-02	**4,80E-02**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	1,70E-01	0,00	0,00
MER	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	1,16E-01	0,00	0,00
EE	0,00	0,00	0,00	**0,00**	0,00	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNR	0,00	0,00	0,00	0,00

CRU (kg): Components for re-use; **MFR (kg**): Materials for recycling; **MER (kg**): Materials for energy recovery; **EE (MJ):** Exported energy

MNR = Module not relevant. MNA = Module not assessed

6. Additional environmental information.

6.1. Indoor air emissions.

The manufacturer declares that the PP pipes and PP fittings do not generate emissions into the indoor air during their service life.

6.2. Discharge to land and water.

The manufacturer declares that PP pipes, PP fittings do not generate emissions to soil or water, during their service life.

6.3. Information on Biogenic Carbon Content.

The manufacturer declares that the products studied do not contain materials with biogenic carbon.

Packaging of HELIROMA´s PE and PP pipes and fittings is less than 5% of the total weight of the corresponding final product, therefore, following the indications of the reference standard, the declaration of the biogenic carbon content of the product packaging is omitted.

References

[1] Standard UNE-EN 15804:2012+A2:2020. Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.

[2] General Rules of the GlobalEPD Programme, 2nd Revision. AENOR. February 2016.

[3] Standard UNE-EN ISO 14025:2010. nvironmental labels and declarations - Type III environmental declarations - Principles and procedures (ISO 14025:2006).

[4] Standard UNE-EN ISO 14040:2006/A1:2021. Environmental management - Life cycle assessment - Principles and framework - Amendment 1 (ISO 14040:2006/Amd 1:2020).

[5] Standard UNE-EN ISO 14044:2006/A2:2021. Environmental management - Life cycle assessment - Requirements and guidelines - Amendment 2 (ISO 14044:2006/Amd 2:2020).

[6] Life Cycle Assessment Report for HELIROMA S.A.´s PP, PE and PPSU pipes and fittings, drafted by Abaleo S.L. October 2022. Version 5.

[7] Ecoinvent 3.8 database (November 2021).

[8] Environmental impact assessment methodologies applied through SimaPro 9.4.0.2

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