ZAG EPD

Environmental Product Declaration

According to ISO 14025 and EN 15804

HT PRO™ Push-Fit Polypropylene Wastewater System

EPD number	EPD-22/0008
EPD owner	Huliot d.o.o., Vrhniška cesta 30, 1354 Horjul, Slovenia
EPD Program operator	ZAG EPD
Issue date	8. 5. 2023
Valid until	16. 11. 2027
This EPD replaces	EPD-22/0008 validity from 16. 11. 2022 to 16. 11. 2027

ECO PLATFORM EPD VERIFIED

www.zag.si

General information	HT PRO™ Push-Fit Polypropylene Wastewater System, including pipes, fittings, and gaskets
Program holder: Slovenian National Building And Civil Engineering Institute - ZAG Dimičeva ulica 12 1000 Ljubljana **http://www.zag.si**	**Owner of the Environmental Product Declaration:** Huliot d.o.o. Vrhniška cesta 30 1354 Horjul **https://huliot.com/**
Number of the Environmental Product Declaration: EPD-22/0008	**Declared unit:** The gravity discharge and transport of soil and waste, from a well-defined 100 m^2 apartment to the entrance of a public sewer system, and this by means of a plastic gravity drainage pipe system installation into an apartment, incorporating a bathroom, separate WC, kitchen, and washroom according to EN 12056-2, having a reference service lifetime of 50 years aligned with the lifetime until the first refurbishment of the building calculated per year.
This Environmental Product Declaration is based on the Product Category Rules (PCR): oSIST prEN 16904:2022 Plastics piping systems - Environmental product declarations - Product Category rules complementary to EN 15804, for plastic piping systems inside buildings	**Scope:** A1-A3, A4, A5, B, C and D
Issue date: 8. 5. 2023 **Valid until:** 16. 11. 2027 **Production plant:** Huliot d.o.o. Vrhniška cesta 30 1354 Horjul, Slovenia	**Verification:** The CEN standard SIST EN 15804 serves as the core Product Category Rule (PCR) Independent verification of the EPD according to EN ISO 14025 ☐ external ☒ internal **Title and the handwritten signature of verificator:** *Janez Turk, PhD* Slovenian National Building And Civil Engineering Institute – ZAG
Title and the handwritten signature issuer: *Franc Capuder, MSc* Slovenian National Building And Civil Engineering Institute – ZAG	**Title and handwritten signature of leading expert:** *Anja Lešek, MSc env. civ. eng.* Anja Lešek 2023.05.11 10:45:14 +02'00' Slovenian National Building And Civil Engineering Institute - ZAG

1 Product

1.1 Product description

HT PRO™ is a waste and drainage piping system for the inside of buildings, made of halogen and cadmium free co-polymer polypropylene. Three-layer pipes with thickness matching S16 series have fittings (matching S20 series) that are made with push-fit sockets and elastomer seals. HT PRO™ piping system is used in the construction of waste systems inside the building structure (application area B), anchored externally to the walls or embedded directly in concrete.

HT PRO™ piping systems can also be used for the creation of ventilation systems of wastewater systems and for rainwater drainage (gravity systems only).

HT PRO™ piping system has a B2 fire resistance class in compliance with DIN 4102. The system is manufactured in compliance with DIN EN 1451 and certified by SKZ.

1.2 Technical Data

Three-layer HT PRO™ piping system pipes material is a combination of co-polymer, homo-polymer, and compound of polypropylene. Pipes of diameters between 32 and 160 mm and density of 0.75 – 1.04 g/cm^3 are connected with fittings by push-fit sockets with a SBR rubber lip ring seal. The maximum temperature of wastewater is +95°C (discontinuous) or +80°C (continuous). The system is chemically resistant for discharge media of pH between pH 2 and pH 12. The yield stress equals 33 MPa, the elongation at yield is 12 % and the elasticity modulus equals 1.500 MPa with ISO 527-1,2 test method. The linear thermal expansion equals 0.12 mm/m•C^{-1}. The HT PRO™ piping system is suitable for external installation when protected from direct sun exposure (for instance, by the means of special UV protective coating) and can be stocked outside up to 18 months. The piping system is compliant with the Construction Standard EN 1451-1 and owns a Conformity certificate SKZ 5953, and SKZ A778.

Table 1: Overview of the products and their properties

Product	Technical characteristics	Photo of the product
Pipes	Diameter: 32-75 mm Thickness: 1.8-2.3 mm Area of use: B Class: S 16	
Pipes with foam in the middle layer	Diameter: 90-160 mm Thickness: 2.8-4.9 mm Area of use: B Class: S 16	

Fittings	Angle: 15° - 87° Diameter: 32-160 mm Class: S20	
Rubber Gasket HTS, HTSW, HTSWL	Diameter 1: 26/32-40 mm Diameter 2: 46-50 mm	

1.3 Application

HT PRO™ is a waste and drainage piping system for the inside of buildings and can also be used for the creation of ventilation systems of wastewater systems and for rainwater drainage (gravity systems only).

1.4 Base materials

The basic materials for the production of HT PRO™ piping system are:

- Polypropylene homopolymer,
- Polypropylene copolymer,
- Additives.

1.5 Manufacturing process

The production process (Figure 1) for pipes is extrusion. The base raw material is Polypropylene granulate. Inside the extruder barrel the material is heated up to the melting point, then moulded into shape, followed by drawing of this shape (the resulting shape is drawn endlessly until cooling), followed by cutting of the tube to the desired lengths and finally forming the socket in a socket forming machine. The machine reheats the tube by pushing it into a suitable mould, where it forms the socket. Finally, a gasket is inserted into the socket in a gasket slot. The fittings are made in plastic injection moulding machines. A mould is used for each product. The seals are applied by hand.

1.6 Packaging

HT PRO™ system components are packed using cardboard, wood, a polypropylene band, plastic bags, and spacers, made from waste material from production.

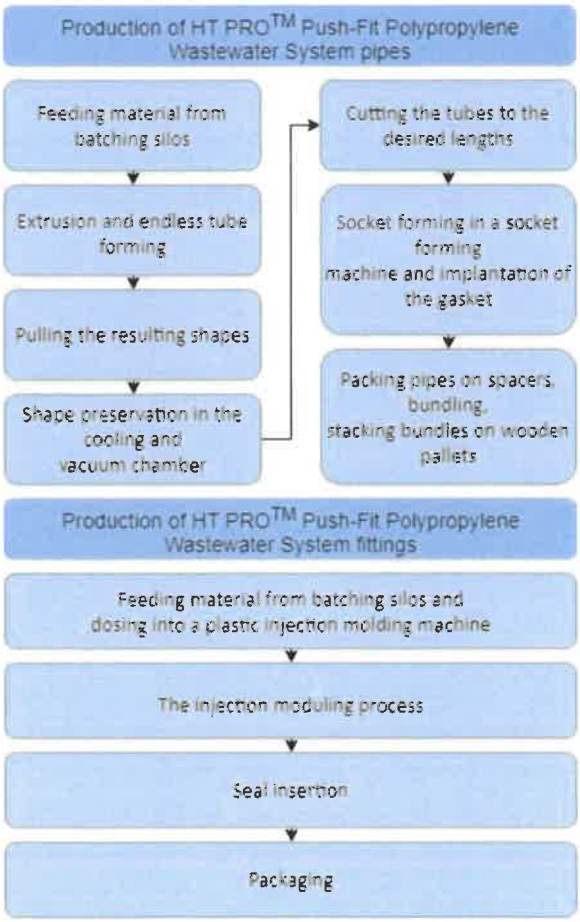

Figure 1: Manufacturing process diagram

1.7 Environment and health during manufacturing

Huliot d.o.o. maintains an integrated quality, environmental, safety and occupational health management system in accordance with ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 standards, thereby ensuring product quality, employee safety and environmental care. There are no special restrictions and requirements in the field of occupational health and safety. Regular measurements of noise, lighting, microclimate, electrical installations, and lightning rods are carried out. The company regularly inspects machines, measures chemical harmfulness and dust in the air, which are both within the permissible limits. The manufacturer also regularly checks the functioning of the cooling devices. The emissions of flue and gas combustion measurements are also carried out.

1.8 Product installation

Pipes are produced in various lengths with one or two sockets and with plain pre-beveled ends. If cutting to length is needed, only proper cutting tools for plastic pipes (manual or mechanical) should be used. The position and integrity of the lip seal in the socket gasket slot must be checked and the seal and the socket cleaned. Fittings should be inserted to maximum socket depth where pipes, after being pushed completely into the socket, have to be pulled back of approximately 10 mm. Horizontal pipes should be installed with a slope of 1 to 5%. Unless differently prescribed by specific country regulation a 2% slope is a good compromise between a good flow and the space needed for the installation. As a general rule straight lengths of pipe must be anchored by the means of fixed-point brackets under each socket while the rest of the pipework and the fittings should be supported by sliding point brackets.

1.9 Condition of use

Polypropylene's intrinsic properties of high-impact resistance combined with good stiffness and excellent chemical and temperature resistance, good tensile strength, inertness toward acids, alkalis and solvents have secured its position for use in a wide range of consumer and industrial applications.

Polyolefin pipes show the lowest abrasion compared to other materials due to a very low surface roughness (approximately 0.007 mm). Due to this, polypropylene pipes have excellent hydraulic capacity, allowing them to drain wastewater even at low gradients.

1.10 Reference service life

The reference service life for HT PRO™ system is 50 years.

1.11 Extraordinary effects

Mechanical damage/earthquake; there is no risk to the environment and to humans from extreme mechanical damage and earthquakes when installed correctly.

Fire: HT PRO™ system belongs to the construction material class B2 according to the DIN 4102 standard.

Flooding: there is no risk to the environment and to humans in the event of a flood when installed correctly.

1.12 Further information

Further information is available on the website https://huliot.com/.

2 LCA: Calculation rules

2.1 Declared unit

The declared unit was defined in accordance with the Product Category Rules (PCR): *oSIST prEN 16904:2022 Plastics piping systems - Environmental product declarations - Product Category rules complementary to EN 15804, for plastic piping systems inside buildings:*

The gravity discharge and transport of soil and waste, from a well-defined 100 m² apartment to the entrance of a public sewer system, and this by means of a plastic gravity drainage pipe system installation into an apartment, incorporating a bathroom, separate WC, kitchen, and washroom according to EN 12056-2, having a reference service lifetime of 50 years aligned with the lifetime until the first refurbishment of the building calculated per year.

An exact bill of components and materials included in the functional unit for HT PRO™ is presented in Table 2.

Conversion to 1 kg or to 1 m of the system can be seen in Table 3.

Table 2: Bill of components and materials included in the functional unit for HT PRO™ piping system

100m² apartment: SYSTEM HT PRO™					
Pipes diameter [mm]	No. of pieces	Pipes length* [m]	Mass of total length per DN [kg]	Total length** [m]	Total mass [kg]
50	2	1.00	0.60		
50	1	2.00	0.58		
75	2	0.25	0.34		
75	2	0.50	0.60		
75	2	2.00	2.16		
110	2	0.25	0.56		
110	1	0.50	0.49		
110	2	1.00	1.82	72.37	88.68
110	2	2.00	3.50		
110	4	3.00	10.37		
125	6	0.50	3.47		
125	3	1.00	3.23		
125	1	2.00	2.07		
125	1	3.00	3.07		
160	10	3.00	55.81		
FITTINGS	64	/	average 0.19	/	10.38
GASKETS	36	/	average 0.07	/	2.39
				Total:	101.45

*Not including sockets, ** Including sockets

Table 3: Conversion factors to 1 kg and 1 m for HT PRO™ system

HT PRO™	Conversion factor to 1 kg	0.009857
	Conversion factor to 1 m	0.013818

2.2 System boundary

The system boundary was defined according to the standard EN 15804. The system boundaries determine the unit processes that are included in LCA analysis.

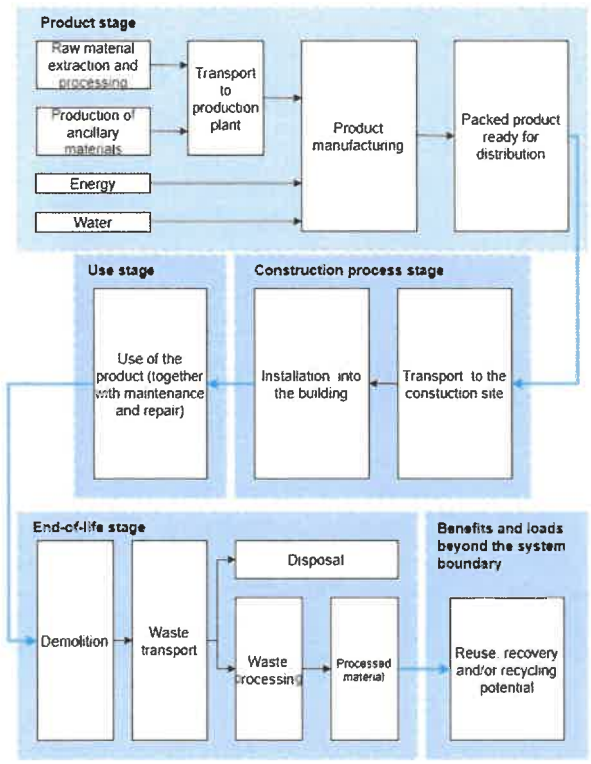

Figure 2: Schematic representation of system boundaries

This LCA study is based on the cradle to grave principle and includes all modules A1-A3, A4-A5, B1-B7, C1-C4 and D. This means, that in the LCA of the HT PRO™ system, the following life cycle stages have been assessed: (i) Product stage, which includes raw material supply (A1), transport to the manufacturer (A2) and production (A3); (ii) Construction process stage, which includes transport from the factory gate to the building site (A4) and installation (A5); (iii) Use stage, which includes the use of the installed product (B1), maintenance (B2), repair (B3), replacement (B4), refurbishment (B5), operational energy use (B6) and operational water use (B7); (iv) End of life stage, which includes de-construction/demolition (C1), transport to waste processing (C2), waste processing for reuse, recovery and/or recycling (C3) and disposal (C4); (v) Benefits and burdens beyond the system boundary, that includes recycling, reusing an recovery (D). The schematic representation of system boundaries can be seen in Figure 2.

2.3 Cut-off rules

The cut-off rules are defined in EN 15804, with the following procedure being followed for the exclusion of inputs and outputs in this LCA study:

- all inputs and outputs to/from the studied system have been included in the calculation, for which data are available;
- in case of insufficient input data or data gaps for a unit process, the cut-off criteria has been 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of that unit process. The total of neglected input flows per module has been a maximum of 5% of energy usage and mass.

Excluded input material is polypropylene band for packaging (at the product stage). This mass input is minor ((0,0004 kg per 1 kg of pipes or fittings) The reason for the exclusion of this input is the lack of a relevant dataset in GaBi database.

2.4 Data quality

The quality of the data used for calculations within the LCA analysis corresponds to the requirements of EN 15804:

- generic data have been checked for plausibility;
- data sets are complete according to the system boundary within the limits set by the criteria for the exclusion of inputs and outputs;

- data is as current as possible. Data sets used for calculations are valid for the current year and represent a reference year within 10 years for generic data and 5 years for producer specific data;

- the reference year refers to the year which the overall inventory best represents, considering the age/representativeness of the various specific and background data included, i.e., not automatically the year of modelling, calculation, or publication year. Validity refers to the date to which the inventory is still judged sufficiently valid with the documented technological and geographical representativeness;

- all datasets are based on 1-year averaged data;

- the time period over which inputs to and outputs from the system has been accounted for is 100 years from the year for which the data set is deemed representative.

2.5 Background data

The LCA analysis of HT PRO™ system has been conducted with the GaBi 10.6 modelling software, developed by Thinkstep (Sphera Solutions GmbH) in collaboration with the University of Stuttgart. All processes have been modelled on the inventory data given in the Professional and extension database (last update: 2022).

2.6 Period under review

Product data are based on average production information collected for the year 2021.

2.7 Allocation

In this specific LCA analysis, no allocation procedure is required.

2.8 Comparability

Comparison of the environmental performance of construction products using the EPD information has to be based on the product's use and its impacts on the building. Comparisons are possible in the sub-building level if the conditions, listed in EN 15804 are met.

2.9 List of substances

HT PRO™ system does not contain substances listed in the »Candidate List of Substances of Very High Concern for authorisation« (http://echa.europa.eu/candidate-list-table). Absence of these substances is declared by the producer.

3 LCA: Scenarios and additional technical information

3.1 Information about biogenic carbon content

Biogenic carbon is present only in the packing materials. Values are presented in Table 4, for the HT PRO™ system mass of 101.45 kg installed in one apartment.

Table 4: Biogenic carbon content

Name	Value	Unit
Biogenic Carbon Content in product	0	kg C
Biogenic Carbon Content in accompanying packaging	33	kg C

**1kg biogenic carbon is equivalent to 44/12 kg of CO_2*

3.2 Technical information

The following technical information for the declared modules can be used for the development of specific scenarios in the context of a building assessment:

3.2.1 Transport to the building site (A4)

Transport from the production gate to the building site is included in the module A4 and is set to the average transport distance from the factory to the installation site in the country where the factory is located. Distance form production gate to the building site is 600 km.

3.2.2 Installation into the building (A5)

The pipes of the HT PRO™ system are installed to the building with pipe brackets that are on average used every 1.8 m of the pipe system.

Apart from brackets, module A5 also includes waste processing of the waste from product packaging and product wastage, during the construction process up to the end-of-waste state. The incineration of plastic, wood and cardboard packaging is therefore considered in module A5.

3.2.3 Use stage (B1-B7)

No relevant environmental impacts are generated in the use stage.

The reference service life is 50 years.

3.2.4 End of life (C1-C4)

End of life includes the demolition of the piping system, by the means of an electric hammer, transport of demolished parts to the landfill in a 50 km radius and landfilling itself. Following the PCR oSIST prEN 16904:2022, the 100 % scenario must be chosen for the end-of-life of the HT PRO™ system. Since the largest share of pipes (globally) is usually landfilled, a 100 % landfill scenario was used. Therefore, the C3 equals zero, since the processing of waste is only done, when the waste gets recycled as material, fuel, or electricity.

3.2.5 Reuse, recovery and recycling potential (D)

Module D includes the reuse, recovery and/or recycling potentials, expressed as net impacts and benefits. The energy produced in A5 from the incineration of cardboard, wood, and plastics was taken into account.

4 LCA: Results

Table 5: Selected phases of the LCA

SYSTEM BOUNDARY																
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
Raw material supply	Transport	Production	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction / demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C 4	D
☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

4.1 Indicators of environmental impacts

According to the standard EN 15804, the environmental impacts are presented with thirteen indicators (Table 6).

Table 6: Abbreviations and units of indicators of environmental impacts

Indicators of environmental impacts	Abbreviation	Unit
Global warming potential total	GWP-total	kg CO_2 eq.
Global warming potential fossil fuels	GWP-fossil	kg CO_2 eq.
Global warming potential biogenic	GWP-biogenic	kg CO_2 eq.
Global warming potential land use and land use change	GWP-luluc	kg CO_2 eq.
Depletion potential of the stratospheric ozone layer	ODP	kg CFC 11 eq.
Acidification potential, accumulated exceedance	AP	mol H^+ eq.
Eutrophication potential, fraction of nutrients reaching freshwater end compartment	EP-freshwater	kg PO_4^- eq.
Eutrophication potential, fraction of nutrients reaching marine end compartment	EP-marine	kg N eq.
Eutrophication potential, accumulated exceedance	EP-terrestrial	kg N eq.
Formation potential of tropospheric ozone	POCP	kg NMVOC eq.

Indicators of environmental impacts	Abbreviation	Unit
Abiotic depletion potential for non-fossil resources	APD-minerals&metals	kg Sb eq.
Abiotic depletion for fossil resources potential	APD-fossil	MJ, net calorific value
Water (user)m deprivation potential, deprivation-weighted water consumption	WDP	m^3 world eq.deprived

The results for the environmental impact indicators for 101.45 kg of the HT PRO™ system installed in one apartment (as states the functional unit) are shown in Table 7:

Table 7: Indicators of environmental impacts

Core indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
GWP-total	[kg CO_2 eq.]	2.06E+02	1.70E+01	1.55E+01	0.00E+00	2.16E+00	1.10E+00	0.00E+00	7.12E+00	-7.61E+00
GWP-fossil	[kg CO_2 eq.]	2.14E+02	1.70E+01	2.46E+00	0.00E+00	2.15E+00	1.10E+00	0.00E+00	7.19E+00	-7.58E+00
GWP-biogenic	[kg CO_2 eq.]	-8.45E+00	-1.67E-01	1.31E+01	0.00E+00	9.56E-03	-1.09E-02	0.00E+00	-7.65E-02	-1.34E-02
GWP-luluc	[kg CO_2 eq.]	7.90E-02	1.15E-01	1.06E-03	0.00E+00	2.87E-04	7.49E-03	0.00E+00	3.50E-03	-3.46E-04
ODP	[kg CFC 11 eq.]	4.66E-08	1.68E-12	1.24E-11	0.00E+00	1.40E-11	1.09E-13	0.00E+00	9.66E-12	-2.72E-13
AP	[mol H^+ eq.]	7.60E-01	5.05E-02	5.86E-03	0.00E+00	1.33E-02	1.25E-03	0.00E+00	2.13E-02	-2.94E-03
EP-freshwater	[kg PO_4 eq.]	5.23E-03	6.10E-05	1.85E-05	0.00E+00	4.50E-06	3.97E-06	0.00E+00	1.34E-03	-5.84E-07
EP-marine	[kg N eq.]	1.38E-01	2.25E-02	1.77E-03	0.00E+00	8.92E-04	4.02E-04	0.00E+00	4.71E-03	-1.07E-03
EP-terrestrial	[kg N eq.]	1.48E+00	2.54E-01	2.13E-02	0.00E+00	9.25E-03	4.85E-03	0.00E+00	5.17E-02	-1.16E-02
POCP	[kg NMVOC eq.]	6.26E-01	4.50E-02	5.32E-03	0.00E+00	2.95E-03	1.07E-03	0.00E+00	1.51E-02	-3.92E-03
APD-minerals &metals	[kg Sb eq.]	1.74E-05	1.72E-06	4.65E-07	0.00E+00	3.19E-07	1.12E-07	0.00E+00	4.99E-07	-2.06E-06
APD-fossil	[MJ]	8.12E+03	2.24E+02	4.92E+01	0.00E+00	3.67E+01	1.46E+01	0.00E+00	1.02E+02	-1.26E+02
WDP	[m^3 world eq. extracted]	1.50E+02	1.91E-01	1.40E+00	0.00E+00	4.61E-02	1.25E-02	0.00E+00	-7.09E-02	8.78E-02

4.2 Indicators of raw material use

The results of the raw materials use indicators are in accordance with the standard EN 15804, shown with ten indicators (Table 8).

Table 8: Abbreviations and units of indicators of raw material use

Indicators of raw material use	Abbreviation	Unit
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	PERM	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PERT	MJ, net calorific value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ, net calorific value
Use of non-renewable primary energy sources used as raw materials	PENRM	MJ, net calorific value
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PENRT	MJ, net calorific value
Use of secondary materials	SM	kg
Use of renewable secondary fuels	RSF	MJ, net calorific value
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value
Net use fresh water	FW	m^3

The results for 101.45 kg of the HT PRO™ system installed in one apartment (as states the functional unit) are shown in Table 9.

Table 9: Indicators of raw material use

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
PERE	[MJ]	5.20E+02	1.55E+01	6.44E+00	0.00E+00	1.70E+01	1.01E+00	0.00E+00	8.39E+00	-8.12E-01
PERM	[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
PENRT	[MJ]	5.20E+02	1.55E+01	6.44E+00	0.00E+00	1.70E+01	1.01E+00	0.00E+00	8.39E+00	-8.12E-01
PENRE	[MJ]	8.12E+03	2.25E+02	4.93E+01	0.00E+00	3.67E+01	1.46E+01	0.00E+00	1.02E+02	-1.26E+02
PENRM	[MJ]	3.11E+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
PERT	[MJ]	8.15E+03	2.25E+02	4.93E+01	0.00E+00	3.67E+01	1.46E+01	0.00E+00	1.02E+02	-1.26E+02
SM	[kg]	1.75E+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
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
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
FW	[m3]	3.72E+00	1.80E-02	4.06E-02	0.00E+00	1.22E-02	1.17E-03	0.00E+00	1.32E-03	1.33E-03

4.3 Other indicators of environmental impacts

According to the standard EN 15804, the results for the indicators of other environmental information (waste disposal data) are presented with three indicators, and the results of the output flows from the system are based on four indicators (Table 10).

Table 10: Abbreviations and units of other indicators of environmental impacts

Indicators for other environmental information	Abbreviation	Units
Hazardous waste disposal	HWD	kg
Non-hazardous waste disposal	NHWD	kg
Radioactive waste disposal	RWD	kg
Output flow indicators	Abbreviation	Units
Components for re-use	CRU	kg
Material for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported energy	EE	MJ per energy carrier

Results in indicators for other environmental information and output flow indicators for 101.45 kg of the HT PRO™ system installed in one apartment (as states the functional unit) are shown in Table 11.

Table 11: Other indicators of environmental impacts

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
HWD	[kg]	5.38E-08	1.19E-09	5.17E-09	0.00E+00	1.41E-09	7.75E-11	0.00E+00	1.57E-08	-2.57E-08
NHWD	[kg]	4.74E-01	3.66E-02	1.31E+00	0.00E+00	1.62E-02	2.38E-03	0.00E+00	1.01E+02	-1.96E-02
RWD	[kg]	1.10E-01	4.18E-04	9.11E-04	0.00E+00	6.20E-03	2.72E-05	0.00E+00	1.26E-03	-1.68E-04
CRU	[kg]	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
MFR	[kg]	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
MER	[kg]	0.00E+00	0.00E+00	7.86E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	[MJ]	0.00E+00	0.00E+00	1.36E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.36E+02

4.4 Additional impact categories and indicators

According to the standard EN 15804, the results for additional impact categories and indicators are presented with six indicators (Table 12).

Table 12: Abbreviations and units of additional impact categories and indicators

Indicators for additional impact	Abbreviation	Unit
Potential incidence of disease due to PM emissions	PM	disease incidence
Potential human exposure efficiency relative to U235	IRP	kBq U235 equiv
Potential comparative toxic unit for ecosystems	ETP-fw	CTUe
Potential comparative toxic unit for humans-cancerogenic	HTP-c	CTUh
Potential comparative toxic unit for humans-non-cancerogenic	HTP-nc	CTUh
Potential soil quality index	SQP	-

Results for indicators for additional impact for 101.45 kg of the HT PRO™ system installed in one apartment (as states the functional unit) are shown in Table 13.

Table 13: Additional impact

Indicator	Unit	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
PM	[disease incidence]	9.03E-06	2.98E-07	4.77E-08	0.00E+00	9.22E-08	8.57E-09	0.00E+00	2.05E-07	-3.01E-08
IRP	[kBq U235 eq.]	2.12E+02	6.31E-02	1.14E-01	0.00E+00	4.08E-01	4.10E-03	0.00E+00	1.85E-01	-2.62E-02
ETP-fw	[CTUe]	1.75E+03	1.59E+02	2.01E+01	0.00E+00	1.39E+01	1.03E+01	0.00E+00	9.98E+01	-1.57E+00
HTP-c	[CTUh]	2.66E-07	3.27E-09	1.14E-09	0.00E+00	5.83E-10	2.13E-10	0.00E+00	4.48E-09	-3.45E-09
HTP-nc	[CTUh]	1.76E-06	1.99E-07	4.30E-08	0.00E+00	1.73E-08	1.15E-08	0.00E+00	3.75E-07	-4.15E-08
SQP	[-]	1.87E+03	9.49E+01	5.44E+00	0.00E+00	9.22E+00	6.17E+00	0.00E+00	7.34E+00	-6.03E-01

Disclaimer 1 –IRP impact category deals mainly with the eventual impact of low dose ionizing radiation on the human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure or 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 – for the indicators ADPE, ADPF, WDP, ETP-fw, HTP-c, HTP-nc, SQP the results shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

5 Interpretation of results

The presented results show that the product stage (i.e., modules A1-A3) contributes the most to the impact categories in life cycle of HT PRO™ Push-Fit Polypropylene Wastewater System with the exception of the impact on global warming – biogenic (GWP-biogenic), where module A5 yields the most significant burdens due to the incineration of packaging.

The product stage for example represents 83% of the total environmental impact in terms of GWP–total (sum of GWP-fossil, GWP-biogenic and GWP-luluc), nearly 100% of the ODP parameter, 89% of the total environmental impact in terms of AP, 81% in terms of eutrophication (freshwater, marine and terrestrial), in terms of POCP (90%), ADP-minerals&metals (85%), ADP-fossil (95%) and WDP (98%).

The module A4 (transport to the building site) contributes between <1% - 14% of the impact in all assessed parameters.

Module A5 (installation in the building) is most significant in the terms of GWP-biogenic (contributing almost 60%). These impacts are associated with the incineration of wooden and cardboard packaging.

In the use stage (module B1-B7) no relevant environmental impacts have been generated, therefore they have a value of zero in all environmental parameters assessed.

The end-of-life stage (modules C1-C4) contributes between <1% - 4% in all parameters except EP-freshwater, where the module C4 contributes 20% of all environmental burdens in this category. Since there is no waste processing in preparation for recycling (C3) this module does not hold any environmental burdens. The major contributor of environmental burdens from modules C1-C4 is the module C4 (landfill od waste).

Potential environmental benefits have been calculated for module D, representing benefits and loads beyond the system boundary. The potential benefits are related to the incineration with heat recovery of wooden, plastic, and cardboard packaging in module A5 (with benefits in module D). These potential environmental benefits are significant in parameters ADP minerals and metals and GWP; compared to burdens related to other parts of the life cycle, the benefits are minor in other environmental parameters.

5.1 Contribution analysis

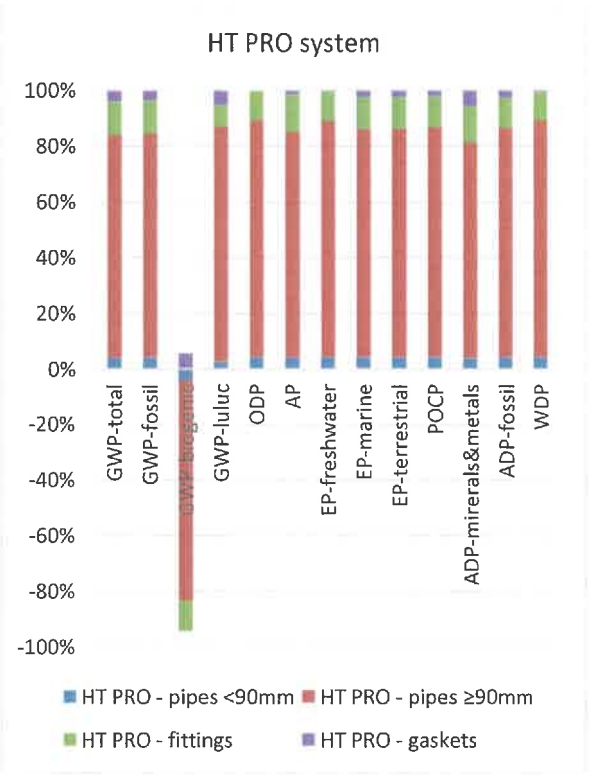

Figure 3: Contribution analysis for core environmental impacts of the product stage of HT

PRO™ system (total, per functional unit of the system used in one apartment)

Summarising all parts to the system HT PRO™ in Figure 3, we notice, that pipes with the diameter greater than 90 mm contribute the most to the environmental impacts of the product stage of HT PRO™ system, as installed in a standard apartment. These pipes also have a greater mass comparing to the other parts of the system (pipes with smaller diameters, gaskets, and fittings) as can be seen in the functional unit description in chapter Declared unit.

6 References

1. GaBi 10.6 modelling software
2. EN 15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
3. EN ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework (EN ISO 14040:2006)
4. EN ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines (EN ISO 14044:2006)
5. EN ISO 14025:2010 Environmental labels and declarations - Type III environmental
6. oSIST prEN 16904:2022 Plastics piping systems – Environmental product declarations – Product Category rules complementary to EN 15804, for plastic piping systems inside buildings
7. Report No. 373/23-520-1-EN: Life Cycle Assessment of HT PRO™ and Ultra Silent™, dated 8. 5. 2023

The data specified in the EPD are calculated on the basis of the data provided by the manufacturer. In the event that the manufacturer's information is incorrect, calculations do not apply.