Statement of Verification

BREG EN EPD No.: 000476 Issue 01

This is to verify that the

Environmental Product Declaration

provided by:

Aquatherm, GmbH

is in accordance with the requirements of:

EN 15804:2012+A2:2019

and

BRE Global Scheme Document SD207

This declaration is for:

1m of red MF / MF-RP piping system

Company Address

Aquatherm, GmbH
Biggen 5,
57439 Attendorn,
Germany



aquatherm®

Signed for BRE Global Ltd	Emma Baker Operator	10 February 2023 Date of this Issue
10 February 2023 Date of First Issue		09 February 2028 Expiry Date

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Environmental Product Declaration

EPD Number: 000476

General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9XX United Kingdom	BRE Environmental Profiles 2013 Product Category Rules for Type III environmental product declaration of construction products to EN 15804+A2 PN 514 Rev 3.0.
Commissioner of LCA study	**LCA consultant/Tool**
Aquatherm, GmbH Biggen 5, 57439 Attendorn, Germany	Sphera Solutions - GaBi Innovation Centre Warwick Technology Park Gallows Hill, Heathcote CV34 6UW
Declared Unit	**Applicability/Coverage**
1m of red MF / MF-RP piping system	Other (please specify). Specific product
EPD Type	**Background database**
Cradle to Gate, with A5 & Module C1-4 and D	GaBi Software System and Database for Life Cycle Engineering 1992-2022 © Sphera Solutions GmbH

Demonstration of Verification
RIGID AND FLEXIBLE BUILDING PIPING SYSTEMS IN NORTH AMERICA (PCR-1002) [a] in combination with the general program rules of BRE.
Independent verification of the declaration and data according to EN ISO 14025:2010 ☐Internal ☒ External
(Where appropriate [b])Third party verifier: Nigel Jones
a: Product category rules b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4)

Comparability
Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A2:2019. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A2:2019 for further guidance

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Information modules covered

Product			Construction		Use stage							End-of-life					Benefits and loads beyond the system boundary
					Related to the building fabric					Related to the building							
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4		D
Raw materials supply	Transport	Manufacturing	Transport to site	Construction – Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal		Reuse, Recovery and/or Recycling potential
☑	☑	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑		☑

Note: Ticks indicate the Information Modules declared.

Manufacturing sites

Attendorn
Biggen 5,
57439 Attendorn,
Germany

Radeberg
Wilhelm-Rönsch-Strasse 4,
01454 Radeberg,
Germany

Construction Product

Product Description

Aquatherm red pipe MF / MF-RP

Aquatherm red pipe is the first plastic sprinkler pipe system certified by VDS Schadenverhütung GmbH, Europe's largest institute for company safety. The material used, fusiolen® PP-R FS, was developed for the special requirements of sprinkler systems. Aquatherm red pipe offers a high level of safety due to its flame-retardant properties and its corrosion resistance. The welding of pipe and fitting also ensures a tight connection.

Product characteristics:

- Low weight compared to metal piping
- Corrosion resistance and resistance to chemicals
- Short processing time
- Tight connection of pipe and fitting by fusion technology
- No seal: sealing elements are not required
- Invisible fire protection
- Application in sprinkler systems

Technical Information

Property	Value, Unit
Density of the Piping system's material (PP-R / PP-RCT)	0,9 g/cm^3
Pipe colour/s	Red
Weight per meter of specific product	0.294 kg/m
Pipe profile diameters	32mm

The results of this EPD refer to a specific product of pipe diameter of 32mm and product weight 0.294 kg/m. Information on the full product range (0,254 kg/m – 6,472 kg/m & 20mm - 160mm) can be found in Annex 1.

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Main Product Contents

Material Input	%
Polypropylene-R Granulate / Polypropylene-RCT Granulate	83.7%
Brass inserts for transition fittings	4.2%
Reinforcement	4.5%
Pigments	0.4%
Flame retardant	7.2%

Material: Fibre composite pipe fusiolen® PP-R FS and fusiolen® PP-RCT FS (polypropylene random copolymer) properties are:

By the manufacturing process developed by Aquatherm the integration of a special fibre mixture within the material polypropylene (PP-R & PP-RCT) is realized.
The result of this innovative technology is the unique direct composite of the material components.

- the linear expansion is reduced by 75 % compared to conventional PP pipes
- the flow rate is increased by 20 % with the same load capacity due to thinner wall thicknesses
- high stability
- the coefficient of linear expansion is almost identical to that of metallic pipelines, so that, compared to all-plastic pipes, support spacing can be increased and fastening clamps can be dispensed with
- optimal price/performance comparison
- lighter in weight
- high impact resistance
- simply cut and weld

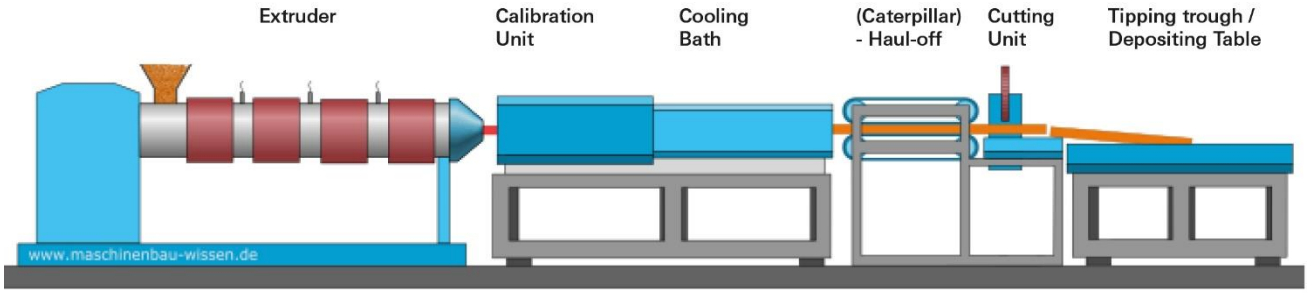
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Manufacturing Process

Pipe production / Extrusion:

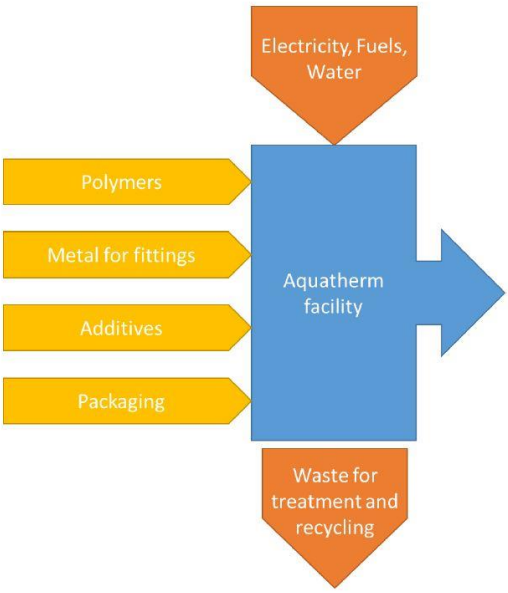
Plastic granulates are continuously melted and pressed through a shaping opening. The ejected semi-finished parts (pipe, profiles, plates, foils) are cooled down immediately after leaving the tool.
The single production steps are as following described:

1. Feeding the granulates to the extruder.
2. Melting of the material while moving it forward with the lead screw.
3. Extrude via jet.
4. Enforcing and cooling.
5. Cutting to the requested length.



Process flow diagram

The following diagram shows the input flows for the production of the pipes:



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Construction Installation

Module A5 Installation has been partially included within the system boundaries of this study. The only impacts considered within module A5 is the end of life of packaging used to package Aquatherm products.

End of Life

Modules C1 – C4 have been included within the system boundaries of this study in accordance with EN 15804 +A2. The EoL scenarios considered within module C3 are 100% recycling of brass fittings and 100% incineration of the remaining piping system.

Life Cycle Assessment Calculation Rules

Declared unit description

The declared unit being evaluated, in accordance with the guiding PCR is: “1 meter of piping system.”

System boundary

The scope of this EPD is “cradle to gate + Module C and D with options (module A5).” It follows the module approach required by EN 15804+A2. Transport to the construction site and impacts from installation and use B1 – B7 were excluded from the study. However, processing of packaging is included in module A5. This EPD also includes modules C and D under the requirements of the revised EN 15804+ A2 standard.

Data sources, quality and allocation

Data for the manufacture of Aquatherm piping systems has been collected by the client. For the data collection a specifically prepared questionnaire by Sphera has been used. The collection of the foreground data refers to the year 2019 (annual average production). Plant-level data is allocated to the declared product based on yearly produced mass. The data acquisition was done by the client considering the following data sources: Measurements of technical machines/equipment and material consumption.
The EPD uses background data from the GaBi database, 2021, v2, and EPD data for the specific primary input material used. The quality of the data used for the EPD is quantified in terms of its temporal, geographical and technological representativeness in accordance with EN 15804:2012+A2:2019. The data quality of this EPD has been determined as being "good".

Background data incl. allocations are documented at http://database-documentation.gabi-software.com/support/gabi/.).There is no allocation key within the GaBi model.

Cut-off criteria

In the assessment, all available data from the production process are considered, i.e all raw materials used, utilized thermal energy, and electric power consumption using best available LCI datasets. For validity for this LCA, the cut-off criteria for material and energy flows are 1% of the consumption of renewable and non-renewable primary energy and 1% of the total mass input of the respective process unit. The sum of the excluded material flows does not exceed 5% of mass, energy or environmental relevance. Machinery, plants and infrastructure required in the manufacturing process were not considered. With acknowledgement of the above exclusions, this EPD complies with the PCR requirements related to the exclusion of inputs and outputs.

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LCA Results

Parameters describing environmental impacts									
			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CFC11 eq	mol H^+ eq	kg $(PO_4)^{3-}$ eq
Product stage	Raw material supply	A1	1.15E+00	1.14E+00	4.29E-03	1.46E-03	5.56E-15	2.63E-02	1.16E-06
	Transport	A2	2.50E-02	2.47E-02	6.97E-05	1.82E-04	4.64E-18	1.15E-04	6.65E-08
	Manufacturing	A3	3.29E-02	3.42E-02	-1.42E-03	5.24E-05	1.01E-15	7.36E-05	7.02E-06
	Total (of product stage)	A1-3	1.21E+00	1.20E+00	2.94E-03	1.69E-03	6.57E-15	2.65E-02	8.25E-06
Construction process stage	Construction	A5	2.25E-03	1.64E-04	2.09E-03	1.87E-07	2.31E-18	6.59E-07	7.27E-09
100% incineration scenario for plastic pipe & 100% recycling scenario for brass fittings									
End of life	Deconstruction, demolition	C1	6.46E-03	6.36E-03	7.82E-05	1.62E-05	2.17E-16	9.12E-06	2.66E-08
	Transport	C2	2.63E-03	2.60E-03	7.79E-06	2.12E-05	5.13E-19	2.76E-06	7.72E-09
	Waste processing	C3	1.12E+00	1.11E+00	1.49E-02	1.61E-05	1.53E-16	1.68E-04	2.98E-08
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-7.80E-01	-7.79E-01	-8.36E-04	-1.44E-04	-9.92E-16	-9.10E-04	-8.87E-08

GWP-total = Global warming potential, total;
GWP-fossil = Global warming potential, fossil;
GWP-biogenic = Global warming potential, biogenic;
GWP-luluc = Global warming potential, land use and land use change;
ODP = Depletion potential of the stratospheric ozone layer;
AP = Acidification potential, accumulated exceedance; and
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

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LCA Results (continued)

Parameters describing environmental impacts									
			EP-marine	EP-terrestrial	POCP	ADP-mineral& metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m^3 world eq deprived	disease incidence
Product stage	Raw material supply	A1	5.30E-04	5.72E-03	3.27E-03	3.84E-02	3.07E+01	1.25E-01	2.11E-06
	Transport	A2	3.18E-05	3.55E-04	8.84E-05	2.04E-09	3.26E-01	2.10E-04	1.73E-09
	Manufacturing	A3	5.24E-05	2.72E-04	7.16E-05	7.97E-09	7.11E-01	4.29E-01	2.39E-09
	Total (of product stage)	A1-3	6.14E-04	6.35E-03	3.43E-03	3.84E-02	3.17E+01	5.54E-01	2.11E-06
Construction process stage	Construction	A5	2.72E-07	2.30E-06	8.96E-07	3.12E-11	2.58E-03	1.10E-04	5.64E-12
100% incineration scenario for plastic pipe & 100% recycling scenario for brass fittings									
End of life	Deconstruction, demolition	C1	2.92E-06	3.04E-05	7.24E-06	2.60E-09	8.03E-02	1.38E-04	7.25E-11
	Transport	C2	8.80E-07	1.04E-05	2.40E-06	2.30E-10	3.46E-02	2.41E-05	1.90E-11
	Waste processing	C3	5.05E-05	8.19E-04	1.40E-04	2.33E-09	2.50E-01	1.08E-01	1.09E-09
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-2.72E-04	-2.97E-03	-7.72E-04	-8.10E-06	-1.22E+01	-9.61E-03	-8.34E-09

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
EP-terrestrial = Eutrophication potential, accumulated exceedance;
POCP = Formation potential of tropospheric ozone;
ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;
ADP-fossil = Depletion potential of the stratospheric ozone layer;
WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
PM = Particulate matter.

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LCA Results (continued)

Parameters describing environmental impacts							
			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U^{235} eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	4.43E-02	1.52E+01	4.46E-10	1.62E-07	2.38E+00
	Transport	A2	8.36E-05	2.41E-01	4.85E-12	2.49E-10	1.02E-01
	Manufacturing	A3	3.48E-03	1.36E+00	5.53E-11	5.45E-09	1.93E+00
	Total (of product stage)	A1-3	4.79E-02	1.68E+01	5.06E-10	1.68E-07	4.41E+00
Construction process stage	Construction	A5	3.71E-05	1.55E-03	6.31E-14	5.84E-12	5.85E-04
100% incineration scenario for plastic pipe & 100% recycling scenario for brass fittings							
End of life	Deconstruction, demolition	C1	5.95E-04	3.04E-02	1.21E-12	4.82E-11	4.10E-02
	Transport	C2	9.22E-06	2.57E-02	5.20E-13	2.69E-11	1.19E-02
	Waste processing	C3	1.68E-03	9.96E-02	9.01E-12	4.94E-10	5.71E-02
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-4.80E-02	-1.81E+00	-7.91E-11	-4.46E-09	-1.86E-01

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;
HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

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LCA Results (continued)

Parameters describing resource use, primary energy								
			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.49E+00	0.00E+00	1.49E+00	1.41E+01	1.67E+01	3.08E+01
	Transport	A2	1.71E-02	0.00E+00	1.71E-02	3.27E-01	0.00E+00	3.27E-01
	Manufacturing	A3	5.51E-02	2.22E-01	2.78E-01	4.72E-01	2.40E-01	7.12E-01
	Total (of product stage)	A1-3	1.56E+00	2.22E-01	1.79E+00	1.49E+01	1.69E+01	3.18E+01
Construction process stage	Construction	A5	2.23E-01	-2.22E-01	7.81E-04	2.43E-01	-2.40E-01	2.58E-03
100% incineration scenario for plastic pipe & 100% recycling scenario for brass fittings								
End of life	Deconstruction, demolition	C1	5.24E-02	0.00E+00	5.24E-02	8.04E-02	0.00E+00	8.04E-02
	Transport	C2	1.99E-03	0.00E+00	1.99E-03	3.48E-02	0.00E+00	3.48E-02
	Waste processing	C3	4.44E-02	0.00E+00	4.44E-02	1.70E+01	-1.67E+01	2.51E-01
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.64E-01	0.00E+00	-1.64E-01	-1.22E+01	0.00E+00	-1.22E+01

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
PERM = Use of renewable primary energy resources used as raw materials;
PERT = Total use of renewable primary energy resources;
PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
PENRM = Use of non-renewable primary energy resources used as raw materials;
PENRT = Total use of non-renewable primary energy resource

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LCA Results (continued)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m^3
Product stage	Raw material supply	A1	1.96E-02	0.00E+00	0.00E+00	5.92E-03
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	1.97E-05
	Manufacturing	A3	5.28E-03	0.00E+00	0.00E+00	1.66E-04
	Total (of product stage)	A1-3	2.49E-02	0.00E+00	0.00E+00	6.11E-03
Construction process stage	Construction	A5	0.00E+00	0.00E+00	0.00E+00	2.95E-06
100% incineration scenario for plastic pipe & 100% recycling scenario for brass fittings						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	2.47E-05
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	2.28E-06
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	2.54E-03
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-1.13E-03

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

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LCA Results (continued)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	5.21E-09	1.13E-01	5.05E-04
	Transport	A2	1.59E-11	4.96E-05	5.72E-07
	Manufacturing	A3	1.48E-10	1.17E-02	2.60E-05
	Total (of product stage)	A1-3	5.37E-09	1.25E-01	5.32E-04
Construction process stage	Construction	A5	5.96E-13	6.62E-04	2.30E-07
100% incineration scenario for plastic pipe & 100% recycling scenario for brass fittings					
End of life	Deconstruction, demolition	C1	2.92E-11	6.26E-05	6.44E-06
	Transport	C2	1.83E-12	5.45E-06	6.30E-08
	Waste processing	C3	4.39E-11	3.17E-02	1.28E-05
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.56E-09	-8.21E-03	-5.96E-04

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed

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LCA Results (continued)

Other environmental information describing output flows – at end of life								
			CRU	MFR	MER	EE	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.50E-03
	Total (of product stage)	A1-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.50E-03
Construction process stage	Construction	A5	0.00E+00	4.94E-04	0.00E+00	9.93E-04	0.00E+00	-5.50E-03
100% incineration scenario for plastic pipe & 100% recycling scenario for brass fittings								
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	1.88E-02	0.00E+00	2.33E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

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Scenarios and additional technical information

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
A4 – Transport to the building site	Transport to the construction site		
	Fuel type / Vehicle type	Vehicle type	Truck-trailer, Euro 6, 34 - 40t gross weight / 27t payload. Diesel
	Distance:	km	100
	Capacity utilisation (incl. empty returns)	%	61%
	Mass of transported piping system	kg	0.427
A5 – Installation in the building	Packaging EoL treatment		
	PE Film to recycling	kg/m	0.0005
	Cardboard to landfill	kg/m	0.0008
	Wood to incineration	kg/m	0.0005
C1 to C4 End of life,	Piping system to incineration, recycling		
	Polypropylene incineration	kg/m	0.3400
	Brass recycling	kg/m	0.0018
	Glass flakes (reinforcement) incineration	kg/m	0.0320
	Flame retardant incineration	kg/m	0.0320
Module D	Credits for module A5. Credits for module C3 from energy substitution.		

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Summary, comments and additional information

Interpretation

The Aquatherm red pipe (specific product) has impacts dominated by module A1 which is the main contributor to impact indicators ODP, AP, EP marine, EP terrestrial, POCP, ADPE and ADPF. Module A3 has significant relative contributions for EP freshwater and WDP and both modules A1 and C3 showed comparable impacts for GWP.

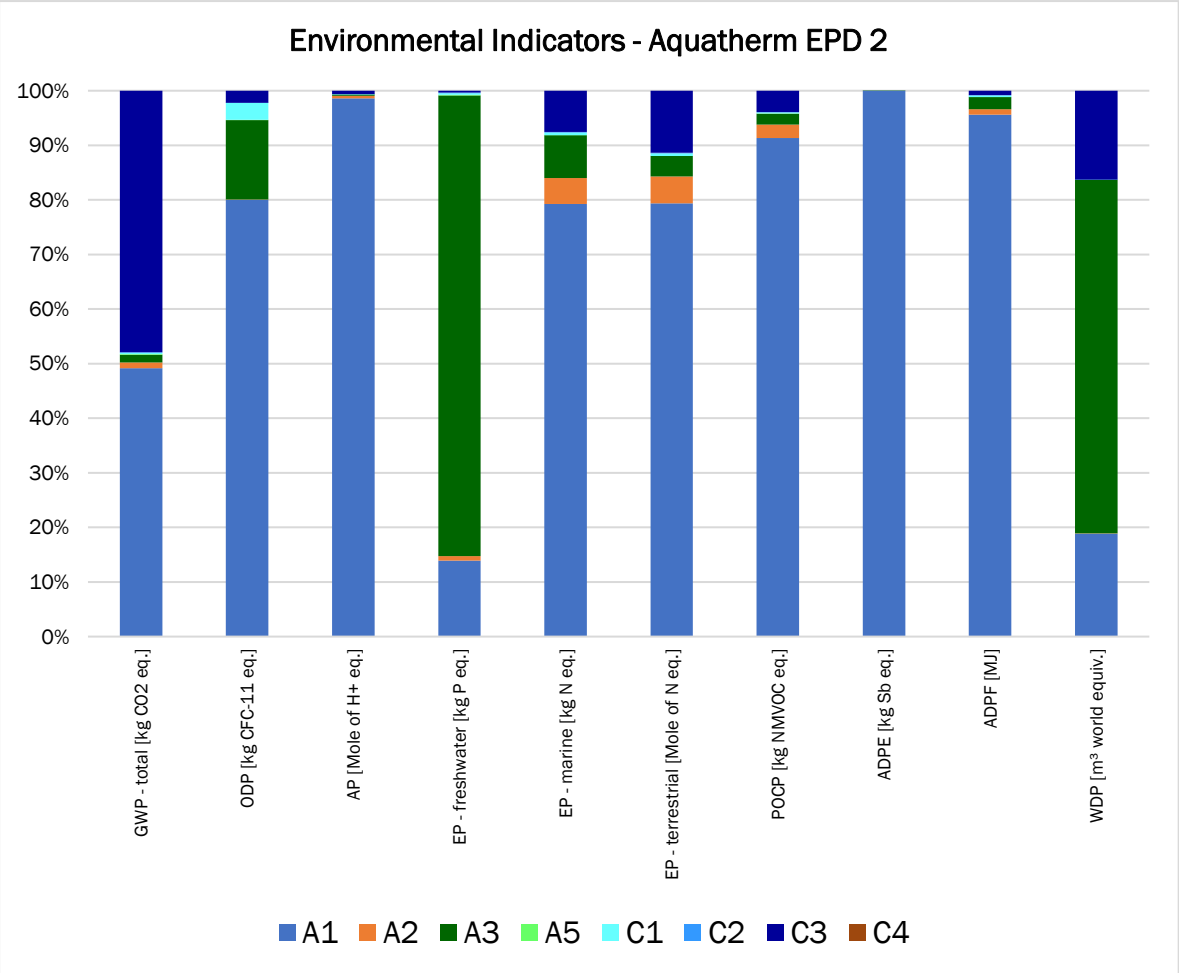


Figure 1: Relative contribution of declared modules to EN 15804 +A2 environmental indicators, excluding module D.

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