

## Statement of Verification

BREG EN EPD No.: 000478

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 green/blue S / MF / MF-RP piping system**

### Company Address

Aquatherm, GmbH  
Biggen 5,  
57439 Attendorn,  
Germany



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: 000478

### 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 green/blue S / MF / MF-RP piping system	Product Average.
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) <sup>a</sup> in combination with the general program rules of BRE.	
Independent verification of the declaration and data according to EN ISO 14025:2010 <input type="checkbox"/> Internal <input checked="" type="checkbox"/> External	
(Where appropriate <sup>b</sup> )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	

## 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
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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

The results of this EPD build on the results of **EPD 1: Aquatherm green/blue S / MF / MF-RP pipe** (average product: from cluster 1 & cluster 2). This report quantifies the results of three representative products, each with the addition of different additive materials to provide specific additional technical qualities for different commercial applications.

The results presented within the body of this EPD document refer to the **Aquatherm green/blue S / MF / MF-RP pipe (TI)**; this product was selected for the main report due to this specification having the most significant environmental impacts of all three product specifications quantified. The results from the other two variations can be found in Annex 1 & 2.

The three variations of the Aquatherm green/blue S/MF pipe are as follows:

Representative product	Additional additive material	Results location
EPD 4a	TI (pre-insulated)	Body of report
EPD 4b	OT (oxygen-tight)	Annex 1
EPD 4c	UV (UV-resistant)	Annex 2

\*S (single-layer), MF (multi-layer, fibre-reinforced), OT (oxygen-tight), UV (UV-resistant), TI (pre-insulated).

## Product Description

### Aquatherm blue / green pipe S / MF / MF-RP

Aquatherm blue pipe made of corrosion-resistant polypropylene (PP-R & PP-RCT) is a specialist for the transport of cooling and heating media in closed systems and is therefore particularly suitable for various industrial applications. The physical properties of the plastic are adapted to the special requirements of the heating and cooling sector. It is characterized by its high temperature and pressure resistance. Added to this are the exceptionally good welding properties and the fusion into a homogeneous and materially cohesive unit, so that a maximum of safety and service life is achieved. The system contains – in combination with the Aquatherm green pipe fittings – all components for the pipe installation of air conditioning and heating systems as well as for the plant engineering.

Aquatherm green pipe has revolutionized the plastic piping sector and has been shaping it for decades. The innovative all-rounder made of corrosion-resistant polypropylene (PP-R & PP-RCT) shows its advantages due to its excellent ecological properties, especially in the field of drinking water applications, because it is completely free of heavy metals and toxic chemicals. Aquatherm green pipe is also suitable for swimming pools, agriculture, shipbuilding or the transport of chemicals considering the chemical resistance. Thanks to the very good welding properties, a form-fit and material-fit and thus secure connection is created.

**Product characteristics:**

**Blue pipe**

- High environmental compatibility
- Free of heavy metals
- Extremely corrosion-resistant
- High stability
- Easy to process
- Air conditioning and heating systems

**Green pipe**

- Extremely corrosion resistant
- Suitable for drinking water
- High environmental compatibility
- Thermal/sound insulation properties
- High stability
- Simple processing
- Drinking water applications

**Technical Information**

Property	Value, Unit
Density of the Piping system's material (PP-R / PP-RCT)	0,9 g/cm <sup>3</sup>
Pipe colour/s	Blue / Green
Weight per meter	1.568 kg/m
Pipe profile diameters	

The results of EPD4c refer to a representative product of pipe diameter of 32mm and product weight 1.568 kg/m. Information on the full product range (0.111 kg/m – 68.044 kg/m & 20mm - 630mm) can be found in Annex 3.

This EPD declares an average product. The average product represents PP-pipes with the same pipe diameter and with the same amount of PP (approx. 90%). Due to the comparability of the material composition between the products the mean value of the green and blue pipes was used. Additional materials are also included for each EPD 4 a-c which are listed in each material input table.



**Main Product Contents**

Material Input	%
Polyethylene Granulate	49.8%
PUR foam insulation	19.7%

Material Input	%
Polypropylene-R Granulate / Polypropylene-RCT Granulate	25.4%
Brass inserts for transition fittings	4.2%
Reinforcement	0.7%
Pigments	0.2%

**Material: fusiolen® PP-R and fusiolen® PP-RCT (polypropylene random copolymer) properties are:**

- Combination of carbon and hydrogen
- Polymerized from propene
- Thermoplastic polymer: meltable many a time / weldable
- Suitable for: extrusion process / injection moulding
- Fully recyclable and therefore a valuable raw material
- Contains colours, stabilisers, antioxidants
- Is: long lasting, free of heavy metals, heat stabilised

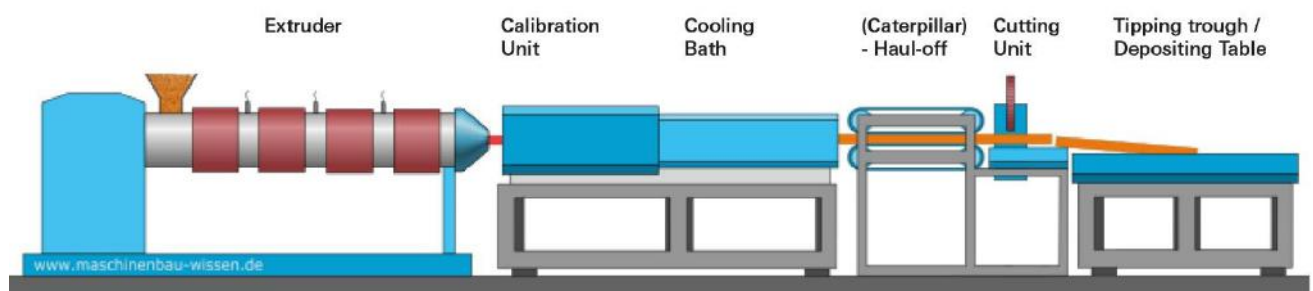
## Manufacturing Process

### 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.

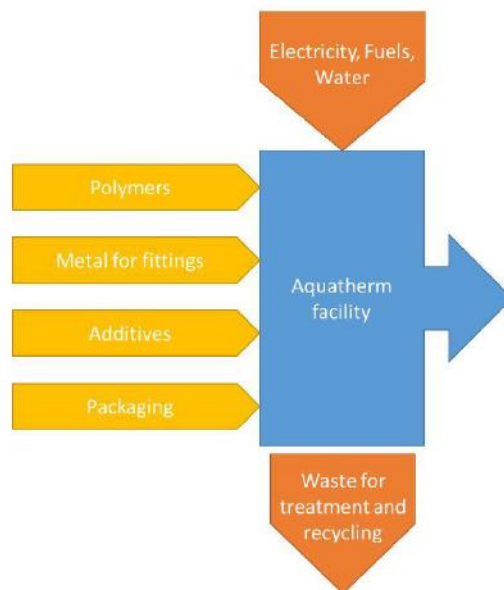
The single production steps are as following described:

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:



### 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.

## LCA Results

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CFC11 eq	mol H <sup>+</sup> eq	kg (PO <sub>4</sub> ) <sup>3-</sup> eq
Product stage	Raw material supply	A1	4.29E+00	4.26E+00	2.70E-02	2.86E-03	6.22E-10	7.16E-03	9.41E-06
	Transport	A2	3.19E-02	3.15E-02	9.29E-05	2.50E-04	6.14E-18	6.62E-05	9.11E-08
	Manufacturing	A3	2.73E-02	3.39E-02	-6.64E-03	5.33E-05	9.87E-16	7.40E-05	6.76E-06
	Total (of product stage)	A1-3	4.35E+00	4.33E+00	2.05E-02	3.16E-03	6.22E-10	7.30E-03	1.63E-05
Construction process stage	Construction	A5	2.16E-03	1.58E-04	2.01E-03	1.79E-07	2.22E-18	6.33E-07	6.98E-09
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>									
End of life	Deconstruction, demolition	C1	2.37E-02	2.34E-02	2.87E-04	5.94E-05	7.96E-16	3.35E-05	9.75E-08
	Transport	C2	9.62E-03	9.52E-03	2.85E-05	7.78E-05	1.88E-18	1.01E-05	2.83E-08
	Waste processing	C3	4.37E+00	4.37E+00	1.78E-04	2.77E-05	3.70E-16	7.74E-04	5.51E-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	-3.02E+00	-3.01E+00	-3.23E-03	-5.41E-04	-3.80E-15	-3.46E-03	-3.32E-07

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



## 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 <sup>3</sup> world eq deprived	disease incidence
Product stage	Raw material supply	A1	1.97E-03	2.08E-02	7.86E-03	3.23E-05	1.24E+02	1.73E-01	6.49E-08
	Transport	A2	1.93E-05	2.21E-04	5.31E-05	2.74E-09	4.19E-01	2.85E-04	8.00E-10
	Manufacturing	A3	5.17E-05	2.76E-04	7.25E-05	7.86E-09	6.97E-01	4.14E-01	2.93E-09
	Total (of product stage)	A1-3	2.04E-03	2.13E-02	7.99E-03	3.23E-05	1.25E+02	5.87E-01	6.86E-08
Construction process stage	Construction	A5	2.61E-07	2.22E-06	8.61E-07	3.00E-11	2.48E-03	1.06E-04	5.42E-12
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>									
End of life	Deconstruction, demolition	C1	1.07E-05	1.12E-04	2.66E-05	9.55E-09	2.95E-01	5.05E-04	2.66E-10
	Transport	C2	3.22E-06	3.82E-05	8.77E-06	8.43E-10	1.27E-01	8.83E-05	6.95E-11
	Waste processing	C3	2.74E-04	3.98E-03	7.35E-04	5.86E-09	6.68E-01	4.09E-01	3.38E-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	-1.05E-03	-1.14E-02	-2.98E-03	-2.87E-05	-4.71E+01	-3.49E-02	-3.18E-08

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.

## LCA Results (continued)

Parameters describing environmental impacts			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U <sup>235</sup> eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	1.41E-01	6.23E+01	2.08E-09	1.42E-07	6.41E+00
	Transport	A2	1.10E-04	3.11E-01	6.27E-12	3.24E-10	1.40E-01
	Manufacturing	A3	3.42E-03	1.31E+00	5.38E-11	5.27E-09	2.55E+00
	Total (of product stage)	A1-3	1.45E-01	6.39E+01	2.14E-09	1.48E-07	9.10E+00
Construction process stage	Construction	A5	3.56E-05	1.49E-03	6.07E-14	5.61E-12	5.62E-04
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>							
End of life	Deconstruction, demolition	C1	2.18E-03	1.12E-01	4.44E-12	1.77E-10	1.50E-01
	Transport	C2	3.37E-05	9.40E-02	1.90E-12	9.86E-11	4.36E-02
	Waste processing	C3	5.32E-03	2.76E-01	2.87E-11	9.52E-10	1.65E-01
	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	-1.85E-01	-6.93E+00	-3.03E-10	-1.71E-08	-6.79E-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.

## 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	6.93E+00	0.00E+00	6.93E+00	6.22E+01	6.18E+01	1.24E+02
	Transport	A2	2.35E-02	0.00E+00	2.35E-02	4.20E-01	0.00E+00	4.20E-01
	Manufacturing	A3	5.74E-02	2.67E-01	3.24E-01	4.66E-01	2.31E-01	6.98E-01
	Total (of product stage)	A1-3	7.01E+00	2.67E-01	7.28E+00	6.31E+01	6.20E+01	1.25E+02
Construction process stage	Construction	A5	2.68E-01	-2.67E-01	7.51E-04	2.34E-01	-2.31E-01	2.48E-03
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>								
End of life	Deconstruction, demolition	C1	1.93E-01	0.00E+00	1.93E-01	2.95E-01	0.00E+00	2.95E-01
	Transport	C2	7.29E-03	0.00E+00	7.29E-03	1.27E-01	0.00E+00	1.27E-01
	Waste processing	C3	1.18E-01	0.00E+00	1.18E-01	6.25E+01	-6.18E+01	6.68E-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	-6.13E-01	0.00E+00	-6.13E-01	-4.72E+01	0.00E+00	-4.72E+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

## 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 <sup>3</sup>
Product stage	Raw material supply	A1	6.92E-02	0.00E+00	0.00E+00	1.73E-02
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	2.69E-05
	Manufacturing	A3	5.09E-03	0.00E+00	0.00E+00	1.63E-04
	Total (of product stage)	A1-3	7.43E-02	0.00E+00	0.00E+00	1.75E-02
Construction process stage	Construction	A5	0.00E+00	0.00E+00	0.00E+00	2.84E-06
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	9.06E-05
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	8.35E-06
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	9.58E-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	-4.34E-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

## LCA Results (continued)

Other environmental information describing waste categories			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	1.64E-08	7.52E-02	1.31E-03
	Transport	A2	2.16E-11	6.53E-05	7.55E-07
	Manufacturing	A3	1.47E-10	1.07E-02	2.56E-05
	Total (of product stage)	A1-3	1.66E-08	8.60E-02	1.34E-03
Construction process stage	Construction	A5	5.73E-13	6.36E-04	2.21E-07
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>					
End of life	Deconstruction, demolition	C1	1.07E-10	2.30E-04	2.36E-05
	Transport	C2	6.70E-12	2.00E-05	2.31E-07
	Waste processing	C3	1.25E-10	2.48E-02	3.44E-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	-6.04E-09	-3.00E-02	-2.31E-03

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

## 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	1.00E-02
	Total (of product stage)	A1-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-02
Construction process stage	Construction	A5	0.00E+00	4.75E-04	0.00E+00	9.57E-04	0.00E+00	-1.00E-02
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>								
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	6.63E-02	0.00E+00	9.05E+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

## 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	1.568
A5 – Installation in the building	Packaging EoL treatment		
	PE Film to recycling	kg/m	0.0005
	Cardboard to landfill	kg/m	0.0008
C1 to C4 End of life,	Wood to incineration	kg/m	0.0005
	Piping system to incineration, recycling		
	Polypropylene incineration	kg/m	0.3980
	Brass recycling	kg/m	0.0663
	Polypropylene incineration	kg/m	0.7790
	Glass flakes (reinforcement) incineration	kg/m	0.0117
Module D	Polyurethane incineration	kg/m	0.3080
	Credits for module A5. Credits for module C3 from energy substitution.		

## Summary, comments and additional information

### Interpretation

The Aquatherm green/blue S/MF pipe (TI) (representative product) has impacts dominated by module A1 which is the main contributor to impact indicators GWP, ODP, AP, EP freshwater, EP marine, EP terrestrial, POCP, ADPE and ADPF. Module A3 has the most significant relative contributions for WDP.

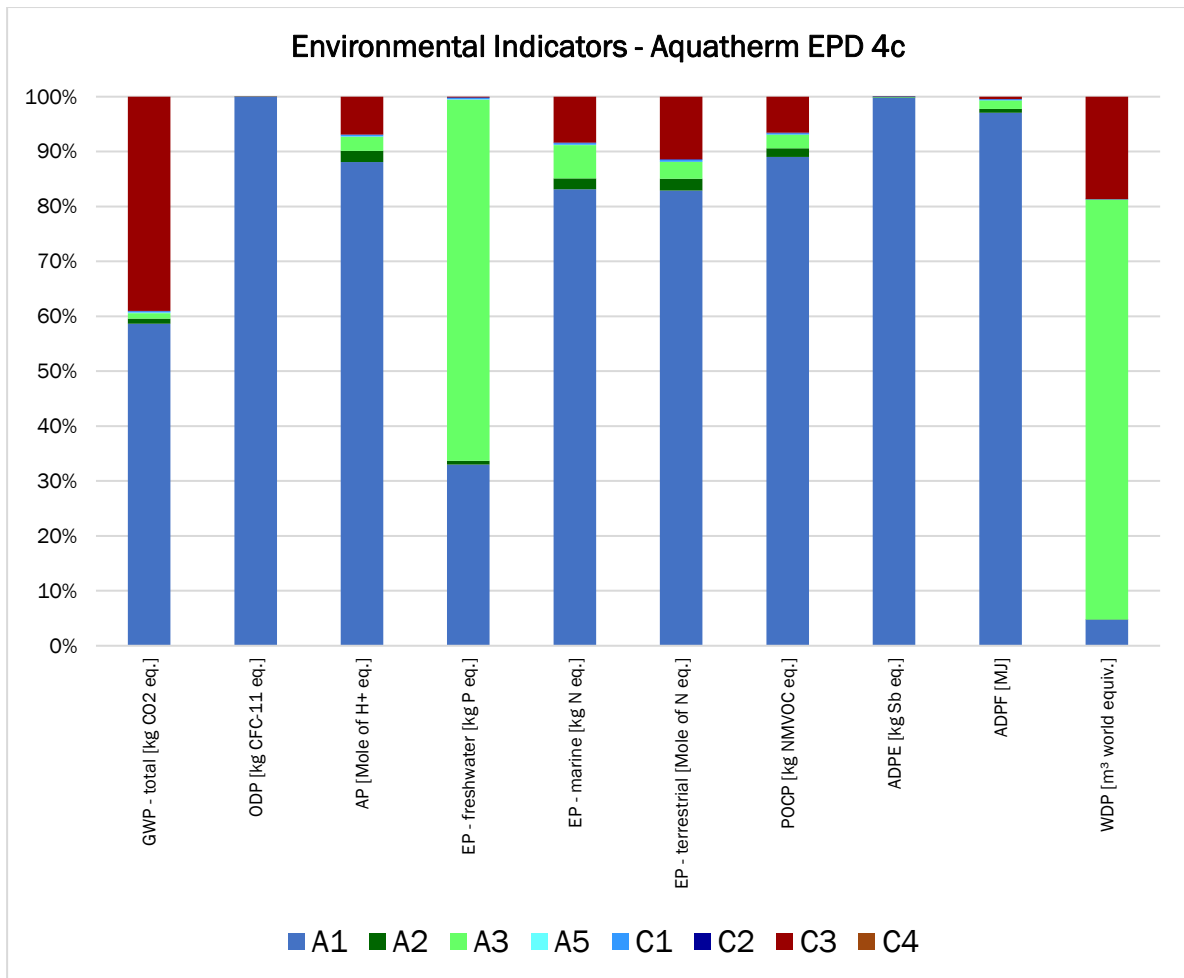


Figure 1: EPD 4c relative contribution of declared modules to EN 15804 +A2 environmental indicators, excluding module D.



## References

BSI. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products. BS EN 15804:2012+A1:2013. London, BSI, 2013.

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## Annex 1

**EPD 4a: Aquatherm green/blue S/MF pipe (OT)** (Representative product: based on data from EPD 1, with the addition of additive material to provide specific technical qualities).

### Technical Information

Property	Value, Unit
Density of Piping system	0,9 kg/m <sup>3</sup>
Pipe colour/s	Blue / Green
Weight per meter	0.443kg
Pipe profile diameters	32mm

The results of EPD4a refer to a representative product of pipe diameter of 32mm and product weight 0.443 kg/m. Information on the full product range (0,111 kg/m - 68,044 kg/m & 20mm - 630mm) can be found in Annex 3.

### Main Product Contents

Material Input	%
Polypropylene-R Granulate	85.4%
Brass fittings	4.2%
Reinforcement	2.7%
Pigments	0.7%
Oxygen barrier layer	7.0%

## LCA Results

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CFC11 eq	mol H <sup>+</sup> eq	kg (PO <sub>4</sub> ) <sup>3-</sup> eq
Product stage	Raw material supply	A1	1.16E+00	1.15E+00	8.09E-03	5.58E-04	5.90E-15	1.78E-03	2.38E-06
	Transport	A2	2.76E-02	2.73E-02	7.62E-05	1.96E-04	5.08E-18	1.47E-04	7.20E-08
	Manufacturing	A3	2.73E-02	3.39E-02	-6.64E-03	5.33E-05	9.87E-16	7.40E-05	6.76E-06
	Total (of product stage)	A1-3	1.21E+00	1.21E+00	1.53E-03	8.07E-04	6.89E-15	2.00E-03	9.21E-06
Construction process stage	Construction	A5	3.47E-03	1.86E-04	3.28E-03	2.11E-07	2.57E-18	9.00E-07	7.03E-09
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>									
End of life	Deconstruction, demolition	C1	5.95E-03	5.86E-03	7.20E-05	1.49E-05	2.00E-16	8.40E-06	2.45E-08
	Transport	C2	2.43E-03	2.40E-03	7.19E-06	1.96E-05	4.74E-19	2.55E-06	7.13E-09
	Waste processing	C3	1.12E+00	1.12E+00	4.07E-05	7.54E-06	9.16E-17	1.16E-04	1.54E-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	-7.92E-01	-7.91E-01	-8.52E-04	-1.41E-04	-1.00E-15	-9.02E-04	-8.72E-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

## 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 <sup>3</sup> world eq deprived	disease incidence
Product stage	Raw material supply	A1	4.81E-04	4.97E-03	1.75E-03	1.02E-05	3.53E+01	1.74E-02	1.36E-08
	Transport	A2	4.04E-05	4.50E-04	1.12E-04	2.23E-09	3.60E-01	2.28E-04	2.26E-09
	Manufacturing	A3	5.17E-05	2.76E-04	7.25E-05	7.86E-09	6.97E-01	4.14E-01	2.93E-09
	Total (of product stage)	A1-3	5.73E-04	5.70E-03	1.93E-03	1.02E-05	3.64E+01	4.32E-01	1.88E-08
Construction process stage	Construction	A5	3.28E-07	3.36E-06	1.04E-06	3.51E-11	2.84E-03	2.47E-04	7.21E-12
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>									
End of life	Deconstruction, demolition	C1	2.69E-06	2.80E-05	6.67E-06	2.39E-09	7.40E-02	1.27E-04	6.68E-11
	Transport	C2	8.12E-07	9.64E-06	2.21E-06	2.13E-10	3.20E-02	2.23E-05	1.75E-11
	Waste processing	C3	2.53E-05	5.42E-04	7.46E-05	1.42E-09	1.65E-01	1.05E-01	7.31E-10
	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	-2.75E-04	-3.00E-03	-7.81E-04	-7.21E-06	-1.24E+01	-8.88E-03	-8.31E-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.

## LCA Results (continued)

Parameters describing environmental impacts			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U <sup>235</sup> eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	4.20E-02	1.51E+01	4.03E-10	2.19E-08	1.23E+00
	Transport	A2	9.15E-05	2.66E-01	5.34E-12	2.74E-10	1.10E-01
	Manufacturing	A3	3.42E-03	1.31E+00	5.38E-11	5.27E-09	2.55E+00
	Total (of product stage)	A1-3	4.55E-02	1.67E+01	4.62E-10	2.74E-08	3.89E+00
Construction process stage	Construction	A5	3.66E-05	1.64E-03	7.32E-14	6.38E-12	6.72E-04
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>							
End of life	Deconstruction, demolition	C1	5.48E-04	2.80E-02	1.11E-12	4.44E-11	3.77E-02
	Transport	C2	8.51E-06	2.37E-02	4.80E-13	2.49E-11	1.10E-02
	Waste processing	C3	1.39E-03	7.17E-02	7.49E-12	2.49E-10	4.14E-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	-4.85E-02	-1.82E+00	-7.96E-11	-4.47E-09	-1.75E-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.

## 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	1.43E+00	0.00E+00	1.43E+00	1.70E+01	1.83E+01	3.53E+01
	Transport	A2	1.85E-02	0.00E+00	1.85E-02	3.61E-01		3.61E-01
	Manufacturing	A3	5.74E-02	2.67E-01	3.24E-01	4.66E-01	2.31E-01	6.98E-01
	Total (of product stage)	A1-3	1.51E+00	2.67E-01	1.77E+00	1.78E+01	1.85E+01	3.64E+01
Construction process stage	Construction	A5	2.68E-01	-2.67E-01	8.38E-04	2.34E-01	-2.31E-01	2.84E-03
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>								
End of life	Deconstruction, demolition	C1	4.83E-02	0.00E+00	4.83E-02	7.40E-02	0.00E+00	7.40E-02
	Transport	C2	1.84E-03	0.00E+00	1.84E-03	3.21E-02	0.00E+00	3.21E-02
	Waste processing	C3	2.92E-02	0.00E+00	2.92E-02	1.84E+01	-1.83E+01	1.66E-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	-1.60E-01	0.00E+00	-1.60E-01	-1.24E+01	0.00E+00	-1.24E+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

## 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 <sup>3</sup>
Product stage	Raw material supply	A1	1.96E-02	0.00E+00	0.00E+00	5.68E-03
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	2.13E-05
	Manufacturing	A3	5.09E-03	0.00E+00	0.00E+00	1.63E-04
	Total (of product stage)	A1-3	2.47E-02	0.00E+00	0.00E+00	5.86E-03
Construction process stage	Construction	A5				6.18E-06
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	2.27E-05
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	2.11E-06
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	2.46E-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	-1.14E-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

## LCA Results (continued)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	5.35E-09	2.04E-02	4.87E-04
	Transport	A2	1.72E-11	5.44E-05	6.27E-07
	Manufacturing	A3	1.47E-10	1.07E-02	2.56E-05
	Total (of product stage)	A1-3	5.51E-09	3.12E-02	5.13E-04
Construction process stage	Construction	A5	6.54E-13	6.55E-04	2.32E-07
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>					
End of life	Deconstruction, demolition	C1	2.69E-11	5.77E-05	5.93E-06
	Transport	C2	1.69E-12	5.03E-06	5.82E-08
	Waste processing	C3	2.81E-11	1.05E-02	9.32E-06
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.59E-09	-7.68E-03	-6.05E-04

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



## 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	6.63E-03
	Total (of product stage)	A1-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.63E-03
Construction process stage	Construction	A5	0.00E+00	4.75E-04	0.00E+00	2.48E-03	0.00E+00	-6.63E-03
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>								
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	2.37E+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

## 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	0.4433
A5 – Installation in the building	Packaging EoL treatment		
	PE Film to recycling	kg/m	0.0005
	Cardboard to landfill	kg/m	0.0008
C1 to C4 End of life,	Wood to incineration	kg/m	0.0005
	Piping system to incineration, recycling		
	Polypropylene incineration	kg/m	0.3754
	Brass recycling	kg/m	0.0188
	Glass flakes (reinforcement) incineration	kg/m	0.0117
Module D	Oxygen barrier layer incineration	kg/m	0.0308
	Credits for module A5. Credits for module C3 from energy substitution.		

## Annex 2

**EPD 4b: Aquatherm green/blue S/MF pipe (UV)** (Representative product: based on data from EPD 1, with the addition of material for specific technical qualities)

### Technical Information

Property	Value, Unit
Density of Piping system	0,9 kg/m <sup>3</sup>
Pipe colour/s	Blue / Green
Weight per meter	0.502 kg/m
Pipe profile diameters	32mm

The results of EPD4b refer to a representative product of pipe diameter of 32mm and product weight 0.502 kg/m. Information on the full product range (0,111 kg/m - 68,044 kg/m & 20mm - 630mm) can be found in Annex 3.

### Main Product Contents

Material Input	%
Polypropylene-R Granulate	75.7%
PE granulate	17.1%
Brass fittings	4.2%
Reinforcement	2.3%
Pigments	0.6%

## LCA Results

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CO <sub>2</sub> eq	kg CFC11 eq	mol H <sup>+</sup> eq	kg (PO <sub>4</sub> ) <sup>3-</sup> eq
Product stage	Raw material supply	A1	1.10E+00	1.10E+00	7.03E-03	5.48E-04	5.53E-15	1.87E-03	1.23E-06
	Transport	A2	2.53E-02	2.50E-02	7.34E-05	1.97E-04	4.86E-18	5.93E-05	7.19E-08
	Manufacturing	A3	2.73E-02	3.39E-02	-6.64E-03	5.33E-05	9.87E-16	7.40E-05	6.76E-06
	Total (of product stage)	A1-3	1.15E+00	1.16E+00	4.63E-04	7.98E-04	6.52E-15	2.00E-03	8.06E-06
Construction process stage	Construction	A5	3.47E-03	1.86E-04	3.28E-03	2.11E-07	2.57E-18	9.00E-07	7.03E-09
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>									
End of life	Deconstruction, demolition	C1	5.95E-03	5.86E-03	7.20E-05	1.49E-05	2.00E-16	8.40E-06	2.45E-08
	Transport	C2	2.43E-03	2.40E-03	7.19E-06	1.96E-05	4.74E-19	2.55E-06	7.13E-09
	Waste processing	C3	1.14E+00	1.14E+00	4.05E-05	7.40E-06	9.13E-17	1.17E-04	1.50E-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	-8.12E-01	-8.11E-01	-8.75E-04	-1.43E-04	-1.02E-15	-9.22E-04	-8.89E-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

## 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 <sup>3</sup> world eq deprived	disease incidence
Product stage	Raw material supply	A1	4.75E-04	4.94E-03	1.72E-03	1.13E-05	3.63E+01	2.67E-02	1.50E-08
	Transport	A2	1.71E-05	1.94E-04	4.71E-05	2.16E-09	3.32E-01	2.25E-04	7.52E-10
	Manufacturing	A3	5.17E-05	2.76E-04	7.25E-05	7.86E-09	6.97E-01	4.14E-01	2.93E-09
	Total (of product stage)	A1-3	5.44E-04	5.41E-03	1.84E-03	1.13E-05	3.73E+01	4.41E-01	1.87E-08
Construction process stage	Construction	A5	3.28E-07	3.36E-06	1.04E-06	3.51E-11	2.84E-03	2.47E-04	7.21E-12
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>									
End of life	Deconstruction, demolition	C1	2.69E-06	2.80E-05	6.67E-06	2.39E-09	7.40E-02	1.27E-04	6.68E-11
	Transport	C2	8.12E-07	9.64E-06	2.21E-06	2.13E-10	3.20E-02	2.23E-05	1.75E-11
	Waste processing	C3	2.52E-05	5.48E-04	7.48E-05	1.41E-09	1.63E-01	1.07E-01	7.35E-10
	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	-2.82E-04	-3.08E-03	-8.01E-04	-7.21E-06	-1.27E+01	-8.95E-03	-8.50E-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.

## LCA Results (continued)

Parameters describing environmental impacts			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U <sup>235</sup> eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	4.45E-02	1.69E+01	4.24E-10	2.20E-08	1.19E+00
	Transport	A2	8.73E-05	2.46E-01	4.97E-12	2.57E-10	1.10E-01
	Manufacturing	A3	3.42E-03	1.31E+00	5.38E-11	5.27E-09	2.55E+00
	Total (of product stage)	A1-3	4.80E-02	1.85E+01	4.83E-10	2.75E-08	3.85E+00
Construction process stage	Construction	A5	3.66E-05	1.64E-03	7.32E-14	6.38E-12	6.72E-04
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>							
End of life	Deconstruction, demolition	C1	5.48E-04	2.80E-02	1.11E-12	4.44E-11	3.77E-02
	Transport	C2	8.51E-06	2.37E-02	4.80E-13	2.49E-11	1.10E-02
	Waste processing	C3	1.38E-03	7.11E-02	7.60E-12	2.51E-10	4.13E-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	-4.97E-02	-1.86E+00	-8.15E-11	-4.58E-09	-1.77E-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.

## 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	1.35E+00	0.00E+00	1.35E+00	1.50E+01	2.13E+01	3.63E+01
	Transport	A2	1.85E-02	0.00E+00	1.85E-02	3.34E-01		3.34E-01
	Manufacturing	A3	5.74E-02	2.67E-01	3.24E-01	4.66E-01	2.31E-01	6.98E-01
	Total (of product stage)	A1-3	1.43E+00	2.67E-01	1.69E+00	1.58E+01	2.15E+01	3.73E+01
Construction process stage	Construction	A5	2.68E-01	-2.67E-01	8.38E-04	2.34E-01	-2.31E-01	2.84E-03
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>								
End of life	Deconstruction, demolition	C1	4.83E-02	0.00E+00	4.83E-02	7.40E-02	0.00E+00	7.40E-02
	Transport	C2	1.84E-03	0.00E+00	1.84E-03	3.21E-02	0.00E+00	3.21E-02
	Waste processing	C3	2.91E-02	0.00E+00	2.91E-02	2.15E+01	-2.13E+01	1.63E-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	-1.63E-01	0.00E+00	-1.63E-01	-1.27E+01	0.00E+00	-1.27E+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

## 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 <sup>3</sup>
Product stage	Raw material supply	A1	2.21E-02	0.00E+00	0.00E+00	4.12E-03
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	2.12E-05
	Manufacturing	A3	5.09E-03	0.00E+00	0.00E+00	1.63E-04
	Total (of product stage)	A1-3	2.72E-02	0.00E+00	0.00E+00	4.30E-03
Construction process stage	Construction	A5	0.00E+00	0.00E+00	0.00E+00	6.18E-06
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	2.27E-05
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	2.11E-06
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	2.50E-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	-1.16E-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



## LCA Results (continued)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	4.88E-09	1.88E-02	4.92E-04
	Transport	A2	1.71E-11	5.17E-05	5.97E-07
	Manufacturing	A3	1.47E-10	1.07E-02	2.56E-05
	Total (of product stage)	A1-3	5.04E-09	2.96E-02	5.18E-04
Construction process stage	Construction	A5	6.54E-13	6.55E-04	2.32E-07
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>					
End of life	Deconstruction, demolition	C1	2.69E-11	5.77E-05	5.93E-06
	Transport	C2	1.69E-12	5.03E-06	5.82E-08
	Waste processing	C3	2.78E-11	9.83E-03	9.19E-06
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.63E-09	-7.76E-03	-6.21E-04

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

## 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	6.63E-03
	Total (of product stage)	A1-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.63E-03
Construction process stage	Construction	A5	0.00E+00	4.75E-04	0.00E+00	2.48E-03	0.00E+00	-6.63E-03
<b>100% incineration scenario for plastic pipe &amp; 100% recycling scenario for brass fittings</b>								
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	2.13E-02	0.00E+00	2.44E+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

## 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	0.5016
A5 – Installation in the building	Packaging EoL treatment		
	PE Film to recycling	kg/m	0.0005
	Cardboard to landfill	kg/m	0.0008
C1 to C4 End of life,	Wood to incineration	kg/m	0.0005
	Piping system to incineration, recycling		
	Polypropylene incineration	kg/m	0.3754
	Brass recycling	kg/m	0.0213
	Glass flakes (reinforcement) incineration	kg/m	0.0117
Module D	Polyethylene incineration	kg/m	0.0855
	Credits for module A5. Credits for module C3 from energy substitution.		