Statement of Verification

BREG EN EPD No.: 000613 Issue 01

This is to verify that the

Environmental Product Declaration

provided by:

Kayflow

BRE Global Verified EPD

is in accordance with the requirements of:

EN 15804:2012+A2:2019

and

BRE Global Scheme Document SD207

This declaration is for:

1 kg of PVC Rainwater system

Company Address

Kayflow,
Pioneer House,
Mariner,
Lichfield Road Industrial Estate,
Tamworth,
Staffordshire,
B79 7TF

Kayflow

Signed for BRE Global Ltd	Emma Baker Operator	27 June 2024 Date of this Issue
27 June 2024 Date of First Issue		26 June 2029 Expiry Date

BRE Global Verified EPD

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ECO PLATFORM EPD VERIFIED

Environmental Product Declaration

EPD Number: 000613

General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9XX United Kingdom	BRE 2023 Product Category Rules (PN 514 Rev 3.1) for Type III environmental product declaration of construction products to EN 15804:2012+A2:2019.
Commissioner of LCA study	**LCA consultant/Tool**
Kayflow, Pioneer House, Mariner, Lichfield Road Industrial Estate, Tamworth, Staffordshire, B79 7TF	Bala Subramanian/BRE LINA A2
Declared/Functional Unit	**Applicability/Coverage**
1 kg of PVC Rainwater system	Other (please specify). Product specific
EPD Type	**Background database**
Cradle to Gate with options	Ecoinvent 3.8

Demonstration of Verification
CEN standard EN 15804 serves as the core PCR [a]
Independent verification of the declaration and data according to EN ISO 14025:2010 ☐Internal ☒ External
(Where appropriate [b])Third party verifier: Roger Connick
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
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☐	☐	☑	☑	☑	☑		☑

Note: Ticks indicate the Information Modules declared.

Manufacturing site(s)

Kayflow,
Pioneer House,
Mariner,
Lichfield Road Industrial Estate,
Tamworth,
Staffordshire,
B79 7TF

Construction Product:

Product Description

Traditional rainwater profiles, gutter and downpipes are manufactured by extruding PVC resin and co-extruding a high gloss PVC skin to this core. The inclusion of recycled materials to the core reduces reliance on virgin raw materials and improves the profiles sustainable credentials. The rainwater profiles are complimented by a range of injection moulded PVC ancillary parts.

In this LCA analysis, 1 kg of PVC rainwater system has been modelled. This includes all PVC profiles and ancillary mouldings used to manufacture the PVC system on-site. Rainwater system will be used as traditional rainwater systems for the collection and dispersal of water via downpipes to ground level.

The rainwater system can be used on various types of housing, terraced, semi-detached, and detached houses, both modern or older housing. It can be used on either domestic or commercial projects where capacity has been evaluated to suit roof requirements. As a lightweight system it also lends itself to use on conservatories and garden room style buildings. End users can establish specific performance criteria and design choice by assessing the manufacturers product literature and website.

Kayflow is part of the Epwin Group of businesses, which supplies fascia's, cladding, windows, doors, decking, and many other low-maintenance building products to the new build, social housing, and domestic refurbishment markets. Some of the other brands within the Epwin Group include Ecodek, DekBoard, Swish, Marbrex, Stormking, and many more. In this EPD, the PVC Rainwater systems which are manufactured and sold under the name of Kayflow and Swish have been modelled.

Technical Information

Kayflow and Swish rainwater systems are designed for application in most domestic and light commercial properties throughout the UK.

All systems are fully accredited and covered by Kitemark KM508760 in accordance with the following standards.

Standard	Description
BS EN 607: 2023	Eaves gutters and fittings made of PVC-U. Definitions, requirements, and testing
BS EN 12200/1	Plastics rainwater piping systems for above ground external use. Unplasticized poly (vinyl chloride) (PVC-U) - Specifications for pipes, fittings, and the system
BS EN 1462: 2004	Brackets for eaves gutters. Requirements and testing
The extrusion and moulding facilities have been assessed hold the following accreditations.	
ISO 9001	Quality Management System (QMS)
ISO 14001	Designing and implementing an environmental management system (EMS)
ISO 50001	Energy management
ISO 45001	Health & Safety Management Systems

Note: Please contact Kayflow/Swish technical team for more information or visit http://www.kayflow.co.uk/

Rainwater system specifications:

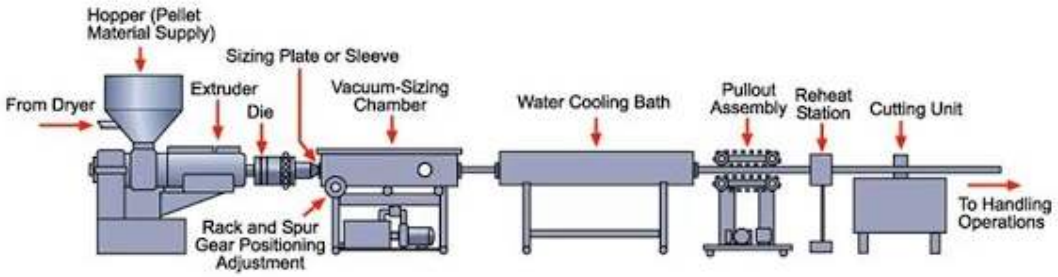
System	Height (mm)	Width (mm)	Flow rate l/sec	Roof area drained m²
Half round	50	112	0.9	43
Square	57	117	1.6	76
Deep	71	114	1.8	86
Ogee	70	120	2.2	105
Commercial Superdeep C170	108	170	4.3	205
Round downpipe	-	68 diameter	-	-
Square downpipe		65x65	-	-

Main Product Contents

Material/Chemical Input	%
Post consumer waste	35-40%
PVC Resin	35-40%
Pre-Mixed Coloured Skins	10-15%
Other additives	10-15%

Manufacturing Process

Rainwater systems comprise of extruded profiles (gutters and downpipes) and injection moulded accessories (unions, corners, brackets, running outlets etc…) to connect and affix the system to the building. Manufactured in various designs (round, ogee, square, deep) and colours, they are engineered to facilitate the diversion of rain fall water build up which could potentially cause erosion and damage to a buildings structure.



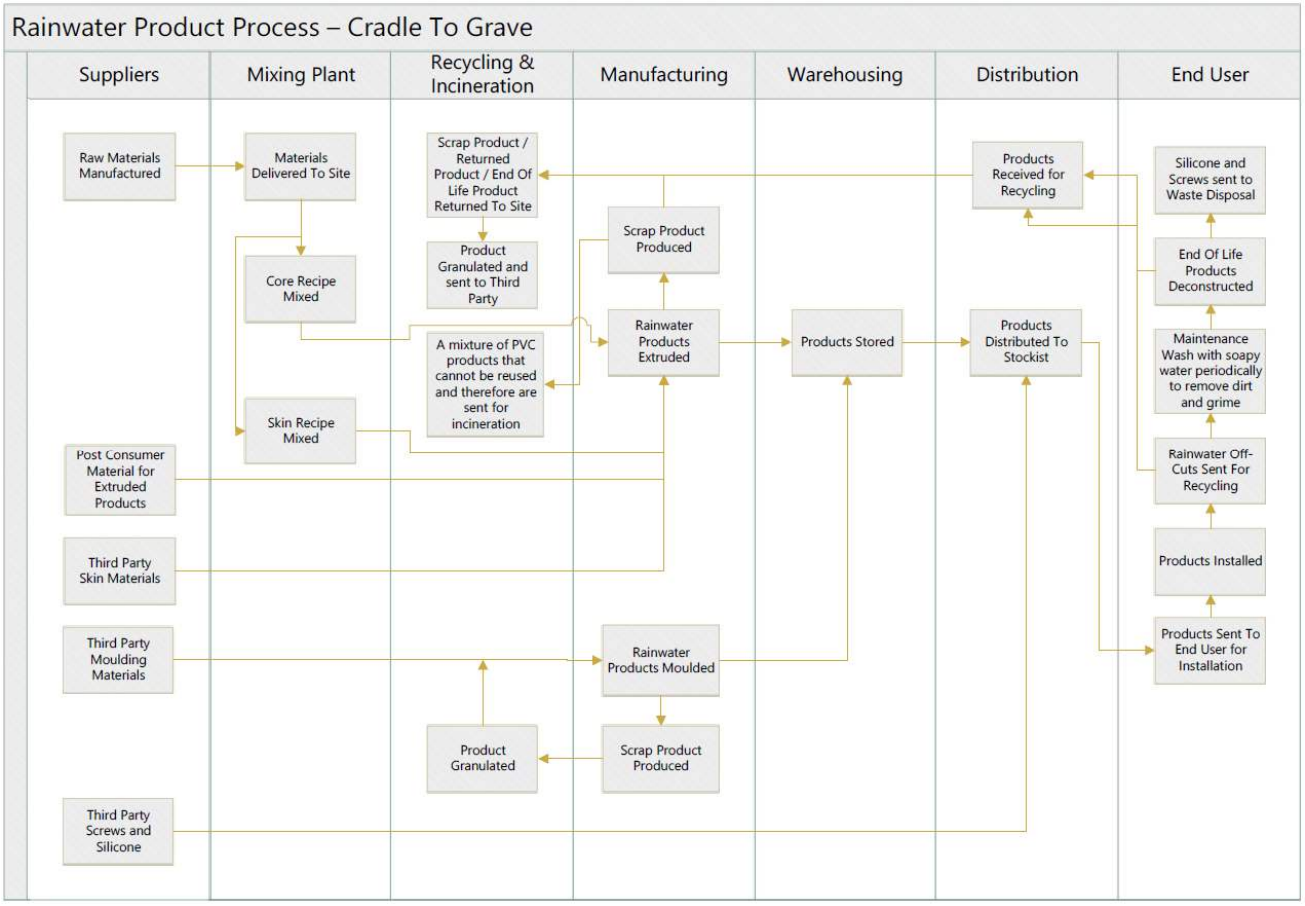
The extrusion process for the rainwater systems is based on a unique PVC formulation fed by an electric motor coupled to a hydraulic drive, continuously turning screws, which are contained in the machines barrel. From the extruder hopper, material is drawn down into the barrel/screws and heated by external heating elements. As the PVC is moved by the screw it melts and is forced through a die which is located at the end of the barrel. The die contains the cross section of the profile of the extrusion required.

When the plastic profile exits the die, it is still molten and is channelled via initial dry calibration (first stage profile hardening and shaping) into a water-baths which contain sizing formers and guides. During its passage through this cooling bath, the plastic solidifies and takes on its final shape. The bath is constantly cooled by chilled water extracting the excess heat. A haul off system controls the speed of the material through the die and ensures consistent shape and form.

Both the Kayflow and Swish Specification rainwater products have a formulation that contains a high percentage of post-consumer recycled PVC derived from old PVC windows and gutter systems that have been removed from buildings when being refurbished or demolished. This core is then encapsulated with a co-extruded virgin, high gloss skin - the production of PVC components from recycled material requires a fraction of the energy needed to manufacture virgin PVC and a high saving in CO^2 output is made during the production of the gutter and pipe profiles when compared to production of 100% virgin material. The extrusion process results in a lightweight, completely weather resistant product that is functional and easy to use.

Strong, compatible accessories are injection moulded using virgin PVC. Components incorporate a simple clip together system for fitting to gutter and pipe profiles. Moulded unions, running outlets, corners and stop ends include a gutter retaining clip and pre-installed seals that are lubricated during manufacture to ease the connection process.

Process flow diagram.



Construction Installation

PVC Rainwater system will be installed by following the manufacturers installation guidance. In this EPD, the PVC rainwater system installed in the semi-detached house as this is more typical house has been taken as a representative and modelled.

Note: Please contact Kayflow/Swish technical team for more information

Use Information

Rainwater and external downpipe installations on a house (see installation guide) are durable finished products designed to withstand exposure conditions with no further inputs. There is no requirement for ongoing

maintenance, except for occasional cleaning or removing of leaves, and only a small amount of water will be required to wash down the surfaces.

End of Life

Rainwater PVC profiles have been manufactured since the late 20th century, and early products remain in service to this date. While in many cases it has yet to reach the point where products are regularly replaced (end of service life), when this occurs, the replacement would be the same as the original installation.

At the point of deconstruction, this will be achieved by manual labour - careful removal of the brackets, clips, and sockets with a screwdriver to minimize disruption to the underlying building structure. Gutters are free-floating, so they can be easily removed. Once pipe clips are removed, pipes can be detached from sockets/joints.

These items can ultimately be collected, cleaned, and repurposed or, more likely, recycled for reuse in new production parts. However, there is currently no process in place to deconstruct or recycle the product. Therefore, an industrial average end-of-life data has been used according to BRE 2023 Product Category Rules (PN 514 Rev 3.1), which is 100% of waste to energy-recovery incineration.

Life Cycle Assessment Calculation Rules

Declared unit description.

1 kg of PVC Rainwater system

System boundary

This is a Cradle-to-Gate with Options EPD, reporting the upstream processing stages A1 to A3, construction stages A4-A5, use stages B1-B5, end-of-life stages C1-C4 and D in accordance with EN 15804:2012+A2:2019 and BRE 2023 Product Category Rules (PN 514 Rev 3.1).

Data sources, quality and allocation

The datasets are derived from Ecoinvent v3.8, and the LCA tool used was BRE LINA A2. The LCA analysis is conducted for the 1 kg PVC rainwater system, and it includes the total amount of PVC profiles and ancillary mouldings used to manufacture the PVC system over the period of one year (from 01/01/2023 to 31/12/2023).

In addition to the PVC rainwater system, other products are manufactured. Therefore, the allocation of electricity, fuel, waste, water consumption, and discharge are required. This allocation has been done according to the provisions of BRE PCR PN514 and EN 15804, using the mass production quantity. Site wide values for energy, water and wastewater have been taken from bills. Figures for the raw materials, ancillary materials and packaging were from actual usages. During the production process, post-consumer PVC is used as a raw material input. However, there is no available dataset for recycled PVC in the backend database. As a result, the dataset for recycled polyethylene was used as a proxy. Upon the data review, it was noted that the production output is slightly higher than the raw material input however it is in the acceptable tolerance range. Secondary data has been obtained for all other upstream and downstream processes that are beyond the control of the manufacturer (i.e. raw material production) from the ecoinvent 3.8 database. All ecoinvent datasets are complete within the context used and conform to the system boundary and the criteria for the exclusion of inputs and outputs, according to the requirements specified in EN 15804:2012+A2:2019.

ISO14044 guidance. Quality Level	Geographical representativeness	Technical representativeness	Time representativeness
Very Good	Data from area under study.	Data from processes and products under study. Same state of technology applied	n/a

ISO14044 guidance. Quality Level	Geographical representativeness	Technical representativeness	Time representativeness
		as defined in goal and scope (i.e., identical technology).	
Very Good	n/a	n/a	There is approximately 1-2 years between the Ecoinvent LCI reference year, and the time period for which the LCA was undertaken.

Specific European datasets have been selected from the ecoinvent LCI for this LCA. Manufacturer uses the national grid electricity and natural gas for production, so therefore the national grid electricity dataset has been used for the LCA modelling (Ecoinvent 3.8). The GWP carbon footprint for using 1 kWh of electricity is 0.239 kgCO2e/kWh and for using the 1 kWh of natural gas is 0.232 kgCO2eq. The quality level of time representativeness is also Very Good as the background LCI datasets are based on ecoinvent v3.8 which was compiled in 2021. Therefore, there is less than 5 years between the ecoinvent LCI reference year and the time period for which the LCA was undertaken.

Cut-off criteria

All raw materials and energy input to the manufacturing process have been included, except for direct emissions to air, water, and soil, which are not measured. The inventory process in this LCA includes all data related to raw material, packaging material and consumable items.

LCA Results

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

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	1.47E+00	1.43E+00	3.73E-02	3.96E-03	5.51E-07	5.97E-03	4.67E-04
	Transport	A2	5.37E-02	5.37E-02	4.74E-05	2.06E-05	1.25E-08	2.22E-04	3.42E-06
	Manufacturing	A3	1.87E-01	2.08E-01	-2.09E-02	2.59E-04	1.84E-08	5.46E-04	3.43E-05
	Total (Consumption grid)	A1-3	1.71E+00	1.69E+00	1.65E-02	4.24E-03	5.82E-07	6.73E-03	5.05E-04
Construction process stage	Transport	A4	5.99E-02	5.98E-02	4.90E-05	2.47E-05	1.37E-08	2.43E-04	4.05E-06
	Construction	A5	1.04E-01	1.03E-01	9.01E-04	2.23E-04	2.99E-08	4.06E-04	2.90E-05
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	1.81E-04	1.79E-04	1.73E-06	3.57E-07	3.79E-11	9.29E-07	9.62E-08
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100% - Incineration with energy recovery									
End of life	Deconstruction, demolition	C1	1.06E-05	1.05E-05	1.04E-08	9.95E-09	4.26E-12	9.90E-08	9.64E-10
	Transport	C2	5.99E-02	5.98E-02	4.90E-05	2.47E-05	1.37E-08	2.43E-04	4.05E-06
	Waste processing	C3	2.38E+00	2.38E+00	2.24E-04	2.02E-05	5.23E-09	5.50E-04	7.08E-06
	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	-3.74E-01	-3.69E-01	-4.82E-03	-3.90E-04	-2.61E-08	-2.15E-03	-2.03E-04

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)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

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	1.17E-03	1.07E-02	4.01E-03	2.05E-05	3.63E+01	9.69E-01	5.36E-08
	Transport	A2	6.70E-05	7.33E-04	2.27E-04	1.69E-07	8.18E-01	3.75E-03	5.08E-09
	Manufacturing	A3	1.65E-04	1.57E-03	4.60E-04	1.08E-06	4.98E+00	4.02E-02	5.41E-09
	Total (Consumption grid)	A1-3	1.40E-03	1.30E-02	4.70E-03	2.18E-05	4.21E+01	1.01E+00	6.41E-08
Construction process stage	Transport	A4	7.25E-05	7.92E-04	2.43E-04	2.21E-07	9.00E-01	4.13E-03	5.04E-09
	Construction	A5	2.13E-04	8.02E-04	2.84E-04	1.37E-06	2.24E+00	5.49E-02	4.24E-09
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	1.80E-07	1.78E-06	5.52E-07	1.18E-09	2.50E-03	1.00E-02	9.69E-12
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100% - Incineration with energy recovery									
End of life	Deconstruction, demolition	C1	3.44E-08	3.77E-07	1.10E-07	2.40E-11	2.94E-04	1.35E-05	1.99E-12
	Transport	C2	7.25E-05	7.92E-04	2.43E-04	2.21E-07	9.00E-01	4.13E-03	5.04E-09
	Waste processing	C3	3.09E-04	2.64E-03	6.40E-04	1.69E-07	4.45E-01	1.51E-01	2.68E-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	-3.13E-04	-3.11E-03	-8.70E-04	-2.18E-07	-5.83E+00	-1.55E-01	-1.50E-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)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

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	2.10E-01	2.05E+01	1.00E-09	2.48E-08	4.39E+00
	Transport	A2	4.19E-03	6.38E-01	1.99E-11	6.77E-10	6.64E-01
	Manufacturing	A3	1.18E-01	2.48E+00	1.36E-10	1.71E-09	3.52E+00
	Total (Consumption grid)	A1-3	3.32E-01	2.36E+01	1.16E-09	2.72E-08	8.57E+00
Construction process stage	Transport	A4	4.58E-03	7.20E-01	2.37E-11	7.42E-10	6.02E-01
	Construction	A5	1.75E-02	1.54E+00	2.88E-10	1.63E-09	5.23E-01
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	3.24E-05	3.79E-03	5.34E-13	7.84E-12	5.55E-04
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100% - Incineration with energy recovery							
End of life	Deconstruction, demolition	C1	1.31E-06	1.86E-04	4.71E-15	1.22E-13	6.17E-04
	Transport	C2	4.58E-03	7.20E-01	2.37E-11	7.42E-10	6.02E-01
	Waste processing	C3	1.36E-03	4.98E+00	2.13E-10	8.08E-09	1.49E-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	-9.44E-02	-5.33E+00	-8.77E-11	-2.75E-09	-1.77E+00

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)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing resource use, primary energy								
			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.62E+00	2.01E-02	1.64E+00	4.27E+00	3.03E+01	3.46E+01
	Transport	A2	1.12E-02	0.00E+00	1.12E-02	8.02E-01	0.00E+00	8.02E-01
	Manufacturing	A3	8.61E-01	3.79E-01	1.24E+00	4.47E+00	7.21E-01	5.19E+00
	Total (Consumption grid)	A1-3	2.50E+00	3.99E-01	2.90E+00	9.54E+00	3.10E+01	4.06E+01
Construction process stage	Transport	A4	1.16E-02	0.00E+00	1.16E-02	8.07E-01	0.00E+00	8.07E-01
	Construction	A5	-1.31E-01	3.02E-01	1.72E-01	-1.26E+00	3.43E+00	2.17E+00
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	2.75E-04	0.00E+00	2.75E-04	2.48E-03	0.00E+00	2.48E-03
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100% - Incineration with energy recovery								
End of life	Deconstruction, demolition	C1	2.51E-06	0.00E+00	2.51E-06	2.89E-04	0.00E+00	2.89E-04
	Transport	C2	1.16E-02	0.00E+00	1.16E-02	8.07E-01	0.00E+00	8.07E-01
	Waste processing	C3	1.73E-02	0.00E+00	1.73E-02	-3.02E+01	3.08E+01	5.43E-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	-8.61E-01	0.00E+00	-8.61E-01	-5.85E+00	0.00E+00	-5.85E+00

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)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

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	3.70e-1	0.00E+00	0.00E+00	3.24E-02
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	9.28E-05
	Manufacturing	A3	2.15E-03	2.95E-06	0.00E+00	1.51E-03
	Total (Consumption grid)	A1-3	2.24E-03	2.95E-06	0.00E+00	3.40E-02
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	1.02E-04
	Construction	A5	1.97e-2	1.48E-07	0.00E+00	1.82E-03
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	2.33E-04
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100% - Incineration with energy recovery						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	3.15E-07
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	1.02E-04
	Waste processing	C3	3.94E-04	0.00E+00	0.00E+00	3.52E-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	-3.86E-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)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	7.48E-02	2.03E+00	6.46E-05
	Transport	A2	8.90E-04	1.57E-02	1.51E+00
	Manufacturing	A3	7.65E-03	1.34E-01	3.23E-05
	Total (Consumption grid)	A1-3	8.33E-02	2.18E+00	1.51E+00
Construction process stage	Transport	A4	9.06E-04	1.61E-02	5.56E-06
	Construction	A5	1.40E-02	1.89E-01	7.55E-02
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	1.90E-05	4.52E-04	9.51E-09
	Repair	B3	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00
100% - Incineration with energy recovery					
End of life	Deconstruction, demolition	C1	3.06E-07	4.32E-06	1.93E-09
	Transport	C2	9.06E-04	1.61E-02	5.56E-06
	Waste processing	C3	3.64E-02	1.05E+00	1.01E-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	-2.39E-02	-1.27E+00	-2.86E-05

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

LCA Results (continued)

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

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	1.53E-05	4.74E-08	0.00E+00	-4.02E-04	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	3.62E-03	1.03E-02	2.36E-03	1.04E-05	-6.86E-03
	Total (Consumption grid)	A1-3	0.00E+00	3.63E-03	1.03E-02	2.36E-03	-3.91E-04	-6.86E-03
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Construction	A5	0.00E+00	3.92E-02	5.16E-04	1.18E-04	-1.96E-05	8.64E-03
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100% - Incineration with energy recovery								
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	0.00E+00	1.00E+00	0.00E+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	The average distance travelled is 327km to the stockist, plus an additional 10km to the site. Plus, average 3 km by ferry to Ireland, Channel Islands, Isle of Man and Isle of Wight		
	Road transport - Lorry 16-32 metric ton to Stockist	km	337.5
	Capacity utilisation (incl. empty returns)	%	26%
	Fuel consumption	l/km	0.227
	Road transport - Lorry 3.5-7.5 metric ton to construction site	km	10
	Capacity utilisation (incl. empty returns)	%	40%
	Fuel consumption	l/km	0.165
	Water transport – Ferry to Ireland	km	3
	Bulk density of transported products	kg/m^3	1240
A5 – Installation in the building	PVC Rainwater system will be installed by following the manufacturers installation guidance. In this EPD, the PVC rainwater system installed in the semi-detached house as this is more typical house has been taken as a representative and modelled.		
	Installation waste percentage	%	5
	Screws	kg	0.002
B1 – Use	Rainwater and external downpipe installations on a house (see installation guide) are durable, finished products designed to withstand exposure conditions with no further inputs. Therefore, there are no emissions in the B1 stage.		
B2- Maintenance	No requirement for ongoing maintenance - occasional cleaning/ removing of leaves and only a small amount of water will be required to wash down the surfaces.		
	Mains water - Washing down surfaces	Litre	0.01932
B3 – Repair	Once installed products are generally out of scope of contact and therefore will require no repair required.		
B4 – Replacement	Rainwater PVC profiles have been manufactured since the late 20th century, and early products remain in service to this date. While in many cases it has yet to reach the point where products are regularly replaced (end of service life), when this occurs, the replacement would be the same as the original installation. Therefore, the replacement impacts are covered in C1- C4.		
B5 – Refurbishment	No refurbishment required		
B6 – Use of energy; B7 – Use of water	No operational energy and water required.		
Reference service life	Kayflow and Swish rainwater systems have a Reference Service Life (RSL) of 50 years (aligned with the lifetime of the building until its first refurbishment) - see link to The European Plastics Pipes and Fittings Association (TEPPFA) RG03_PVC-U_EPD_2020_final.pdf (teppfa.eu)		

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
C1 - Deconstruction	At the point of deconstruction, this will be achieved by manual labour - careful removal of the brackets, clips, and sockets with a screwdriver to minimize disruption to the underlying building structure. Gutters are free-floating, so they can be easily removed. Once pipe clips are removed, pipes can be detached from sockets/joints. These items can ultimately be collected, cleaned, and repurposed or, more likely, recycled for reuse in new production parts. However, there is currently no process in place to deconstruct or recycle the product. Therefore, an industrial average end-of-life data has been used according to BRE 2023 Product Category Rules (PN 514 Rev 3.1), which is 100% of waste to energy-recovery incineration		
C2 – Transportation to waste processing facility	This involves the reverse process of the initial delivery. Once removed, the profiles can be returned to the manufacturing factory (on similar vehicles as those that delivered to construction site) for reprocessing/regrind and ultimately added back into the product formulation at appropriate levels. Moulded material can be reground on site for recycled use. Recycled gutters and pipes are sent to Poly-Pure (in group recycling company) for processing and then returned to site as Post Consumer Waste.		
	Road transport - Lorry 16-32 metric ton to Stockist	km	337.5
	Road transport - Lorry 3.5-7.5 metric ton to construction site	km	10
	Water transport – Ferry to Ireland	km	3
C3 – Pre-processing	Ultimate aim is end of life recovery and waste material returned to Production site for granulation/pulverised prior to re-use in new production. However, this is yet to be regularly achieved as end of life not achieved therefore industrial average scenario for PVC products is used according to BRE PCR (100% to incineration with energy recovery). 100% of product will be incinerated at waste processing facility, therefore no waste to end up in landfilling. Hence, no impacts form C4- Disposal.		
	Waste plastic to incineration with energy recovery	kg	1
Module D	The Rainwater PVC system is made up of post-consumer PVC waste and virgin PVC materials. In calculating the benefits of incinerating the waste PVC at the end of life, the pre-existing recycled content has been removed, and the incineration benefits have been calculated for only virgin inputs. The benefits of Module D include the energy credits from waste incineration of plastic for energy generation at the end-of-life.		

Individual product calculations:

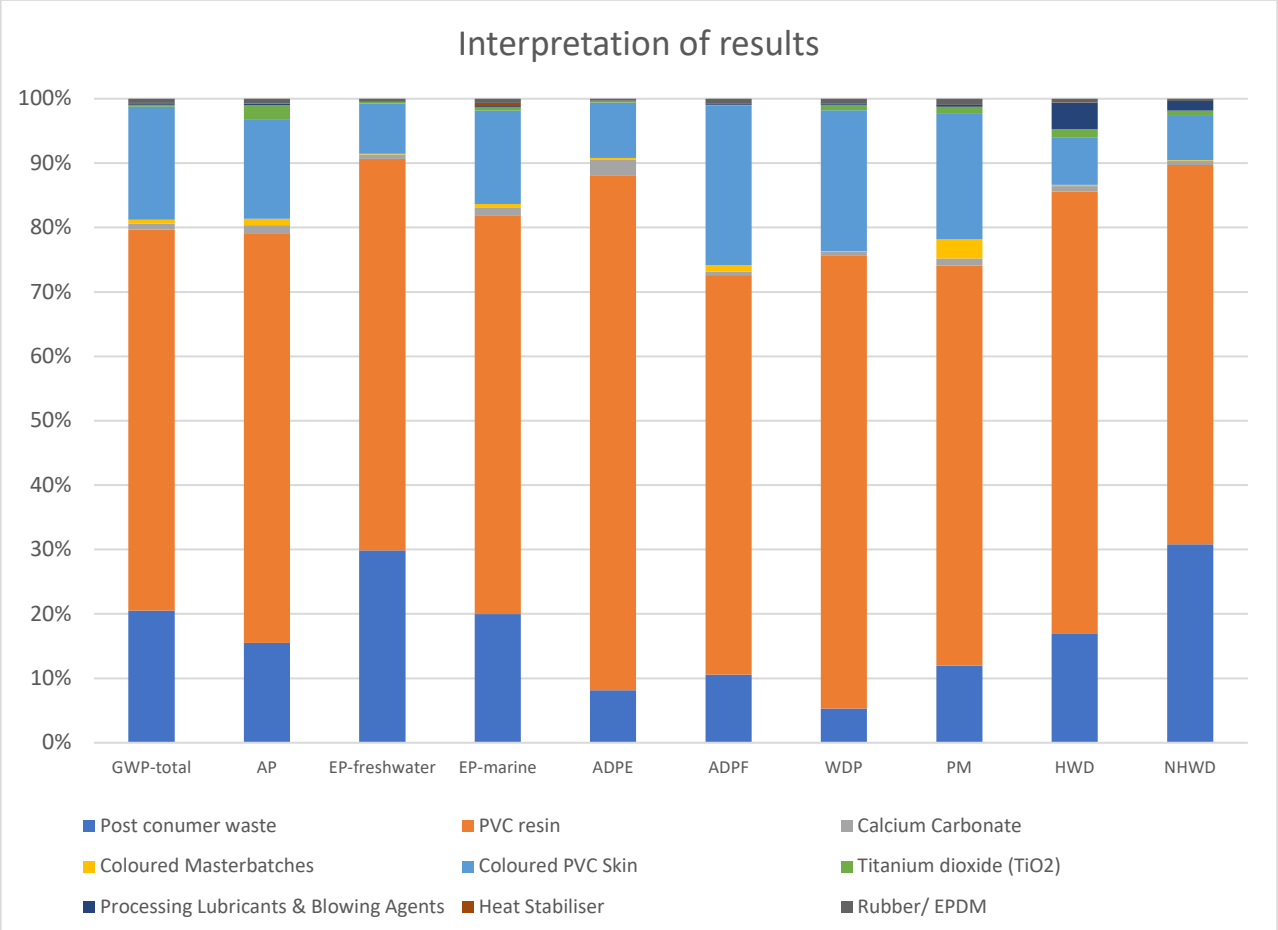
The LCA results listed in the EPD is for 1 kg of PVC Rainwater system. The end-user of this EPD can therefore use these results to calculate the impacts for each rainwater system used in the different buildings using the weight of the system.

The list below shows several generic house types and the weight of materials required to achieve a full installation. These indicative values are for house types commonly built as there will be a vast number of variations, so these give a flavour of weights/house type. Please contact Kayflow (www.kayflow.co.uk) or Swish (www.swishbp.co.uk) for further information.

2 bed terraced house = 10.56kg
2 bed semi-detached house = 26.30kg
4 bed detached house = 57.94kg

Interpretation of results:

The bulk of the environmental impacts and primary energy demand are attributed to the manufacturing phase, covered by information modules A1-A3 of EN15804:2012+A2:2019. In a 1kg PVC Rainwater system, PVC resin comprises 35-40% of its composition, post-consumer waste plastic accounts for 35-40%, coloured PVC skin makes up 10-15%, with the remaining composition consisting of other additives. When calculating environmental impacts, it's observed that virgin PVC incurs the majority of impacts during the production phase, followed by post-consumer plastics and coloured resins.



References

BSI. Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products. BS EN 15804:2012+A2:2019. London, BSI, 2019.

BSI. Environmental labels and declarations – Type III Environmental declarations – Principles and procedures. BS EN ISO 14025:2010 (exactly identical to ISO 14025:2006). London, BSI, 2010.

BSI. Environmental management – Life cycle assessment – Principles and framework. BS EN ISO 14040:2006. London, BSI, 2006.

BSI. Environmental management – Life cycle assessment – requirements and guidelines. BS EN ISO 14044:2006. London, BSI, 2006.

Pre-Consultants by. SimaPro 9 LCA Software 2022. http://www.pre-sustainability.com

ecoinvent Centre. Swiss Centre for life Cycle Inventories. http://www.ecoinvent.org

BS EN 607: 2023 - Eaves gutters and fittings made of PVC-U. Definitions, requirements, and testing.

BS EN 12200/1 - Plastics rainwater piping systems for above ground external use. Unplasticized poly (vinyl chloride) (PVC-U) - Specifications for pipes, fittings, and the system

BS EN 1462: 2004 - Brackets for eaves gutters. Requirements and testing

TEPPFA - European Communication Format – B2B, Environmental Product Declaration, polyvinylchloride (PVC-u) rain gutter system.

ISO 9001 – Data quality management

ISO 14001: Environmental Management systems

ISO 50001 – Energy Management systems

ISO 45001 - Occupational health and safety management systems — Requirements with guidance for use