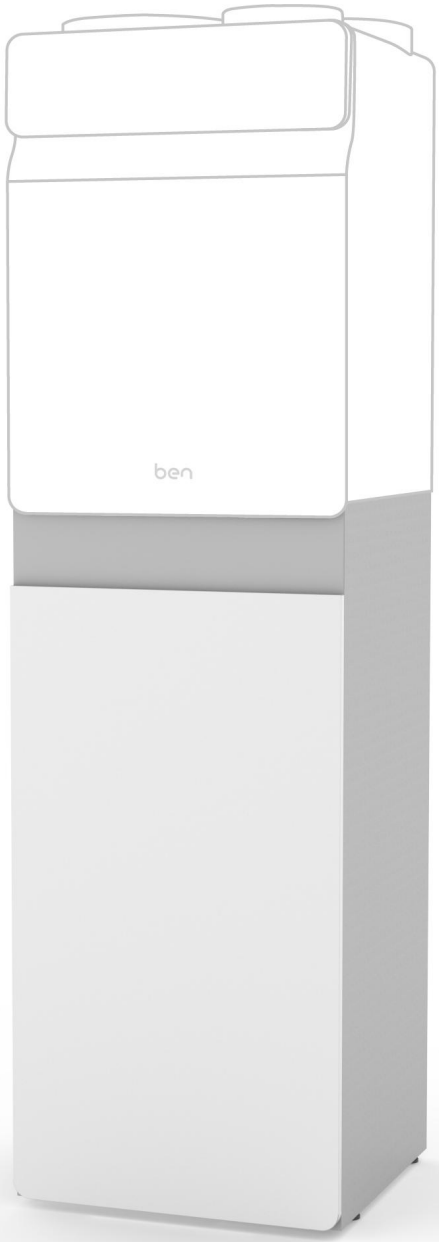
Environmental Product Declaration (EPD)
According to ISO 14025 and EN 15804+A2:2019

BEN Smart Cylinder



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Issue date:	24-06-2026
Valid until:	24-06-2031
Declaration owner:	Joule Group Ltd.
Publisher:	Kiwa-Ecobility Experts
Programme operator:	Kiwa-Ecobility Experts
Status:	verified

1 General information

1.1 PRODUCT

BEN Smart Cylinder

1.2 REGISTRATION NUMBER

EPD-Kiwa-EE-234957-EN

1.3 VALIDITY

Issue date: 24-06-2026

Valid until: 24-06-2031

1.4 PROGRAMME OPERATOR

Kiwa-Ecobility Experts
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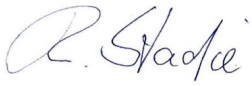
13355 Berlin
DE

Raoul Mancke

(Head of programme operations, Kiwa-Ecobility Experts)



Dr. Ronny Stadie

(Verification body, Kiwa-Ecobility Experts)

1.5 OWNER OF THE DECLARATION

Declaration owner: Joule Group Ltd.

Address: Unit 407 NW Business Park, Ballycoolin, D11HD36 Dublin 15, Ireland

E-mail: sustainability@joule.ie

Website: https://jouleuk.co.uk/joule-group

Production location: Inventum Technologies B.V.

Address production location: Kaagschip 25, 3991 CS Houten, Netherlands

1.6 VERIFICATION OF THE DECLARATION

The independent verification is in accordance with the ISO 14025:2011. The LCA is in compliance with ISO 14040:2006 and ISO 14044:2006. The EN 15804+A2:2019 serves as the core PCR.

☐ Internal ☒ External

Elisabeth Amat Guasch, Greenize

1.7 STATEMENTS

The owner of this EPD shall be liable for the underlying information and evidence. The programme operator Kiwa-Ecobility Experts shall not be liable with respect to manufacturer data, life cycle assessment data and evidence.

1.8 PRODUCT CATEGORY RULES

Kiwa-EE GPI R.3.0 (2025)
Kiwa-Ecobility Experts, General Programme Instructions “Product Level”, SOP EE 1201_R.3.0 (03.06.2025)

Kiwa-EE GPI R.3.0 Annex B1 (2025)
Kiwa-Ecobility Experts, General Programme Instructions “Product Level” – Annex B1 Environmental Information Programme according to EN 15804 / ISO 21930 , SOP EE 1203_R.3.0 (03.06.2025)

PCR
EN 50693 Product category rules for life cycle assessments of electronic and electrical products and systems (28.01.2020)

1 General information

1.9 COMPARABILITY

In principle, a comparison or assessment of the environmental impacts of different products is only possible if they have been prepared in accordance with EN 15804+A2:2019. For the evaluation of the comparability, the following aspects have to be considered in particular: PCR used, functional or declared unit, geographical reference, the definition of the system boundary, declared modules, data selection (primary or secondary data, background database, data quality), scenarios used for use and disposal phases, and the life cycle inventory (data collection, calculation methods, allocations, validity period). PCRs and general program instructions of different EPD program operators may differ. Comparability needs to be evaluated. For further guidance, see EN 15804+A2:2019 and ISO 14025.

1.10 CALCULATION BASIS

LCA method R<THINK: Ecobility Experts | EN15804+A2

LCA software*: Simapro 9.6

Characterization method: RETHINK characterization method (see references for more details)

LCA database profiles: ecoinvent (for version see references)

Version database: v3.20f (20260507)

** Simapro is used for calculating the characterized results of the Environmental profiles within R<THINK.*

1.11 LCA BACKGROUND REPORT

This EPD is generated on the basis of the LCA background report 'BEN Smart Cylinder ' with the calculation identifier ReTHiNK-134957.

2 Product

2.1 PRODUCT DESCRIPTION

This is a representative EPD covering the product BEN Smart Cylinder 190 UK/IE, model number 15500219. The worst-case method is used for generating this EPD which ensures all BEN Smart Cylinder variants (up to 190 liters) are covered.

The BEN Smart Cylinder is an indirect heated stainless steel hot water tank. The product needs to be connected to the BEN Dual-AIR heat pump for supplying domestic hot water. The BEN Smart Cylinder is designed as a plug and play product and is available in multiple variants.

Product specification

The composition of the BEN Smart Cylinder is described in the following table:

Materials	Weight (%)
Steel and iron	64.5
Plastics	13.7
Polyurethane foam / insulation	11.8
Brass and bronze	3.9
Copper	3.8
Coatings, resins and adhesives	1.4
Other materials	0.8

2.2 APPLICATION (INTENDED USE OF THE PRODUCT)

BEN Smart Cylinders are primarily used for hot water supply and zone heating in residential homes in combination with the BEN Dual-AIR heat pump.

2.3 REFERENCE SERVICE LIFE

RSL PRODUCT

The reference service life (RSL) of the BEN Smart Cylinder has been determined based on manufacturer experience with comparable hot water storage systems, industry practice for insulated steel storage tanks used in residential heating systems, and relevant technical documentation.

USED RSL (YR) IN THIS LCA CALCULATION:

20

RSL PARTS

The BEN Smart Cylinder is designed for 20 years of product lifetime. During the lifetime some components need service to make sure the 20 years can be reached. The suggested parts, which need to be serviced during the product lifetime, are mentioned in the table below.

Description	Material	RSL [yr]
Maintenance (B2)		
Water pressure safety valve	Steel low-alloyed+working RER	10
CH expansion tank	(ei3.9.1) Brass {CH}| brass production | Cut-off, U	10
Control print circuit board	Tin {RoW}| tin production | Cut-off, U	15

2.4 TECHNICAL DATA

Specification	Unit	BEN Smart Cylinder
Dimensions (W x D x H)	mm	595 x 600 x 1245
Weight (unpacked)	kg	74
Tank Volume	L	190
GWP (CO_2 equivalent)	-	3
Installation options:		
Tower model		yes
Split model		yes
Main functions:		
Domestic hot water		yes

2 Product

Specification	Unit	BEN Smart Cylinder
Zone valves for central heating (CH)		2 standard / 3 optional
Integrated CH expansion tank (8L)		yes

More detailed technical information is to be found in the manufacturer's documentation.

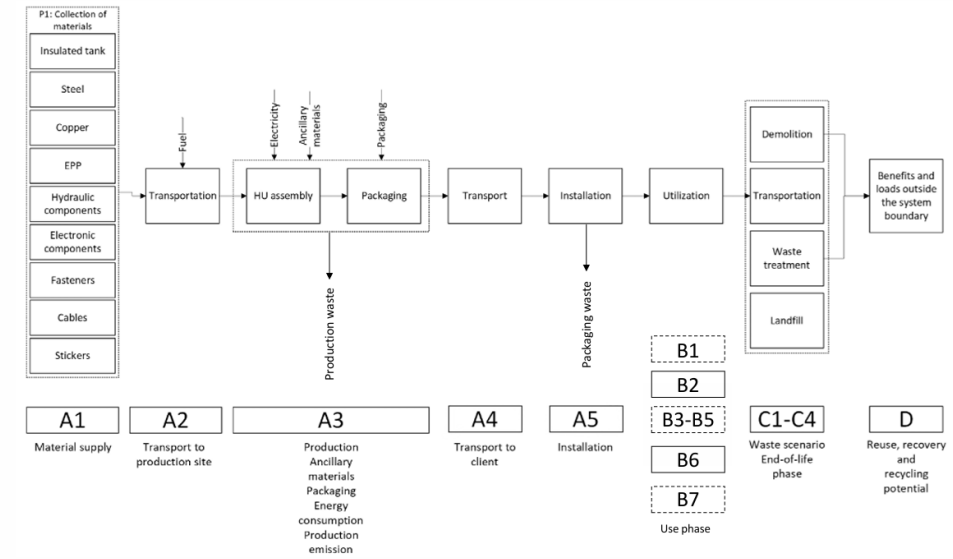
2.5 SUBSTANCES OF VERY HIGH CONCERN

The product does not contain any substances from the “Candidate List of Substances of Very High Concern” (SVHC) in amounts greater than 0.1% (1.000 ppm).

2.6 DESCRIPTION PRODUCTION PROCESS

All components required to produce the BEN Smart Cylinder are delivered from suppliers to the production site in Houten. The production process involves manual assembly on a production line and proceeds as follows:

1. Assemble tank housing parts using pop rivets
2. Install condensation tray
3. Install piping and main hydraulic components
4. Create electrical connections and route wires
5. Connect hoses
6. Leakage & functional testing
7. Assemble steel housing parts
8. Assemble final installation components
9. Packaging of the hot water tank for transport



2.7 CONSTRUCTION DESCRIPTION

The construction phase consists the transport and the installation of the product on the address where the hot water tank will be installed. On location the hot water tank should be connected to the BEN Dual-AIR All-E heat pump.

The installation is carried out using power tools, so the impact has been left out of consideration. The same applies to disassembly at the end of the product’s lifespan. No waste is generated on the construction site related to the product.

Other waste during the construction phase is released packaging materials. These are, where possible, separated for recycling.

3 Calculation rules

3.1 FUNCTIONAL UNIT

1 BEN Smart Cylinder

Funktional unit is defined as one BEN Smart Cylinder over a reference service life of 20 years, including manufacturing, transport, installation, use stage, and end-of-life. 100% of the declared product is assumed to be in operation during the reference service life. Operational energy use is declared in module B6 based on an annual electricity consumption of 896 kWh/year, corresponding to 17,920 kWh over the 20-year reference service life.

Reference unit: piece (p)

3.2 CONVERSION FACTORS

Description	Value	Unit
Reference unit	1	p
Weight per reference unit	78.163	kg
Conversion factor to 1 kg	0.012794	p

3.3 SCOPE OF DECLARATION AND SYSTEM BOUNDARIES

This is a Cradle to gate with options, modules C1-C4 and module D EPD. The life cycle stages included are as shown below:

(X = module included, ND = module not declared)

A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	ND	X	ND	ND	ND	X	ND	X	X	X	X	X

The modules of the EN 15804 contain the following:

Module A1 = Raw material supply	Module B5 = Refurbishment
Module A2 = Transport	Module B6 = Operational energy use
Module A3 = Manufacturing	Module B7 = Operational water use
Module A4 = Transport	Module C1 = De-construction / Demolition
Module A5 = Construction - Installation process	Module C2 = Transport
Module B1 = Use	Module C3 = Waste Processing
Module B2 = Maintenance	Module C4 = Disposal
Module B3 = Repair	Module D = Benefits and loads beyond the product system boundaries
Module B4 = Replacement	

3.4 REPRESENTATIVENESS

This EPD is representative for BEN Smart Cylinder, a product of Joule Group. The results of this EPD are representative for the European Union and United Kingdon.

3.5 CUT-OFF CRITERIA

Product stage (A1-A3)

All input flows (e.g. raw materials, transportation, energy use, packaging, etc.) and output flows (e.g. production waste) are considered in this LCA. The total neglected input flows do therefore not exceed the limit of 5% of energy use and mass.

3 Calculation rules

The following processes are excluded:

- Manufacturing of equipment used in production, buildings or any other capital asset
- Transportation of personnel to the plant
- The transportation of personnel within the plant
- Research and development activities
- Long-term emissions

Construction process stage (A4-A5)

All input flows (e.g. transportation to the construction site, additional raw material use for construction, installation energy (use)of energy use for assembly , etc.) and output flows (e.g. construction waste, packaging waste, etc.) are considered in this LCA. The total neglected input flows do therefore not exceed the limit of 5% of energy use and mass.

Use stage (B1-B3)

All (known) input flows (e.g. raw materials, transportation, energy use, packaging, etc.) and output flows (e.g. emissions to soil, air and water, construction waste, packaging waste, end-of-life waste, etc.) related to the building fabric are considered in this LCA. The total neglected input flows do therefore not exceed the limit of 5% of energy use and mass.

End of life stage (C1-C4)

All input flows (e.g. energy use for demolition or disassembly, transport to waste processing, etc.) and output flows (e.g. end-of-life waste processing of the product, etc.) are considered in this LCA. The total neglected input flows do therefore not exceed the limit of 5% of energy use and mass.

Benefits and loads beyond the system boundary (Module D)

All benefits and loads beyond the system boundary resulting from reusable products, recyclable materials and/or useful energy carriers leaving the product system are considered in this LCA.

3.6 ALLOCATION

Allocations were avoided as far as possible. There are no coproducts or by-product in the manufacturing of the examined product. Based on energy consumption measurements, the energy requirements of the production were allocated to the individual products. Specific information about allocations within the background data is included in the documentation of the ecoinvent datasets.

3.7 DATA COLLECTION & REFERENCE PERIOD

Primary data were collected directly from the manufacturing facility and represent production conditions in the Netherlands.

All primary data were collected during the accounting period 01.01.2025 – 31.12.2025.

3.8 ESTIMATES AND ASSUMPTIONS

Manufacturing (A1–A3)

Primary data for the manufacturing stage (modules A1–A3) were collected from the production facility in Houten, the Netherlands, and include electricity consumption, compressed air usage, and material inputs.

Transport to construction site (A4)

The product is delivered to different markets. Therefore, transport to the construction site in module A4 was calculated as a weighted average distribution distance based on the share of product delivered to each market. The calculation was based on a road transport dataset.

Assembly / installation (A5)

The construction stage includes transport and installation of the product at the building site. Installation impacts from power tools were excluded from consideration.

Use stage emissions (B1)

Module B1 is not declared, as no direct emissions to air, water, or soil are assumed during use.

Maintenance (B2)

Maintenance requirements were modelled in accordance with the intended use of the product over its reference service life.

3 Calculation rules

Repair (B3)

Module B3 is not declared. Under the assumption that the product is installed, operated, and maintained in accordance with the manufacturer's instructions, no repair is expected during the reference service life.

Replacement (B4)

Module B4 is not declared. Under the assumption that the product is installed, operated, and maintained in accordance with the manufacturer's instructions, no replacement is expected during the reference service life.

Refurbishment (B5)

Module B5 is not declared. Under the assumption that the product is installed, operated, and maintained in accordance with the manufacturer's instructions, no refurbishment is expected during the reference service life.

Operational energy use (B6)

For the BEN Smart Cylinder, the annual electricity consumption is assumed to be 896 kWh/year, based on the Air/Water installation scenario and the expected domestic hot water operation of the cylinder. Over the reference service life of 20 years, the total electricity consumption declared in B6 is therefore 17,920 kWh.

Module B6 was modelled using an electricity mix composed of equal shares (25% each) from Sweden (SE), Ireland (IE), Great Britain (GB), and the Netherlands (NL). These countries represent the main markets for the BEN Smart Cylinder and are where the product is most commonly installed. Since the impacts of operational energy use are highly dependent on the underlying electricity scenario, the results may vary depending on the country-specific grid composition and actual use conditions.

Operational water use (B7)

The stated volume of 190 L refers to the nominal storage capacity of the cylinder. It is not the total water consumption during the reference service life. The environmental impact associated with the use of domestic hot water is represented in the EPD through the electricity consumption required to heat the water, which is included in the declared use-stage energy consumption.

De-construction / demolition (C1)

Module C1 is declared as zero. No specific resources or energy inputs for de-construction or demolition were considered, as no inputs are needed for the product at the de-construction / demolition phase.

End-of-life transport (C2)

Transport scenarios used in module C2 are based on standard European transport assumptions for end-of-life treatment of heating equipment. In the absence of exact logistics data, average transport distances and typical truck capacities were assumed. The modelling uses lorry transport with 50% capacity utilisation including empty returns.

3.9 DATA QUALITY

Secondary data were taken from the ecoinvent database (3.9.1) and represent background processes such as material production, energy supply and transport.

Whenever possible, datasets with a geographical reference to the Netherlands were used. If datasets specific to the Netherlands were not available, datasets were selected according to the following geographical hierarchy: Europe, then Global.

Overall, the data quality can be considered good, as the data are representative in terms of geographical, technological and temporal coverage.

3.10 POWER MIX

The electricity used in the manufacturing process consists of a mix of self-generated electricity from on-site photovoltaic panels and purchased electricity from the Dutch electricity grid.

The share of self-generated electricity from photovoltaic systems is 23.25%, while the remaining 76.75% of the electricity demand is covered by purchased electricity from the Dutch residual electricity mix.

The purchased electricity was modelled using a market-based approach, representing the residual electricity mix for the Netherlands.

The electricity generated by the photovoltaic installation has a GWP-total impact of 0.1315 kg CO_2 eq per kWh.

The purchased electricity from the Dutch residual mix has a GWP-total impact of 0.4828 kg CO_2 eq per kWh.

4 Scenarios and additional technical information

4.1 TRANSPORT TO CONSTRUCTION SITE (A4)

For the transport from production place to assembly/user, the following scenario is assumed for module A4 of this EPD.

	Value and unit
Vehicle type used for transport	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)
Fuel type and consumption of vehicle	not available
Distance	411 km
Capacity utilisation (including empty returns)	50 % (loaded up and return empty)
Bulk density of transported products	inapplicable
Volume capacity utilisation factor	1

4.2 ASSEMBLY (A5)

The following information describes the scenarios for flows entering the system and flows leaving the system at module A5.

FLOWS ENTERING THE SYSTEM

There are no significant environment impacts as a result of materials or energy used in the construction stage (A5).

FLOWS LEAVING THE SYSTEM

The following output flows leaving the system at module A5 are assumed.

Description	Value	Unit
Output materials as result of loss during construction	3	%
Output materials as result of waste processing of materials used for installation/assembly at the building site	0.000	kg
Output materials as result of waste processing of used packaging	14.078	kg

4.3 MAINTENANCE (B2)

Technical maintenance is needed during Use Stage. For maintenance the scenario(s) as mentioned below are included in this EPD.

Description	Service cycle (yr)	Number of cycles (n)	Amount per cycle	Total Amount	Unit
Water pressure safety valve	10	1	3.7	3.7	kg

4 Scenarios and additional technical information

Description	Service cycle (yr)	Number of cycles (n)	Amount per cycle	Total Amount	Unit
CH expansion tank	10	1	0.246	0.246	kg
Control print circuit board	15	0.333	1.027	0.341991	kg

4.4 OPERATIONAL ENERGY USE (B6)

Description	Service cycle (yr)	Number of cycles (n)	Amount per cycle	Total Amount	Unit
Electricity consumption 20 years	1	20.00	896	17,920.00	kWh

4.5 DE-CONSTRUCTION, DEMOLITION (C1)

No inputs are needed for the product at the de-construction / demolition phase

4.6 TRANSPORT END-OF-LIFE (C2)

The following distances and transport conveyance are assumed for transportation during end of life for the different types of waste processing.

Waste Scenario	Transport conveyance	Not removed (stays in work) [km]	Landfill [km]	Incineration [km]	Recycling [km]	Re-use [km]
(ei3.9.1) elastomeres (i.a. epdm) (i.a. roofing, foils) (NMD ID 20)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) copper (i.a. sheets, pipes) (NMD ID 41) | benefits Copper, cathode 100% primary (GLO)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) Metals, others (i.a. fasteners, fittings) (NMD ID 50)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) Metals, mixed (via residue (NMD ID 49)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) Waste mineral oil (100% Incineration)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) plastics, via residue (NMD ID 43)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50

4 Scenarios and additional technical information

Waste Scenario	Transport conveyance	Not removed (stays in work) [km]	Landfill [km]	Incineration [km]	Recycling [km]	Re-use [km]
(ei3.9.1) polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) Steel, light (NMD ID 73)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) finishes (adhered to wood, plastic, metal) (NMD ID 2)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) PVC, pipes (NMD ID 64)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50

The transport conveyance(s) used in the scenario(s) for transport during end of life has the following characteristics.

	Value and unit
Vehicle type used for transport	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)
Fuel type and consumption of vehicle	not available
Capacity utilisation (including empty returns)	50 % (loaded up and return empty)
Bulk density of transported products	inapplicable
Volume capacity utilisation factor	1

4.7 END OF LIFE (C3, C4)

The scenario(s) assumed for end of life of the product are given in the following tables.
First the assumed percentages per type of waste processing are displayed, followed by the assumed amounts.

Waste Scenario	Region	Not removed (stays in work) [%]	Landfill [%]	Incineration [%]	Recycling [%]	Re-use [%]
(ei3.9.1) elastomeres (i.a. epdm) (i.a. roofing, foils) (NMD ID 20)	NL	0	10	85	5	0
(ei3.9.1) copper (i.a. sheets, pipes) (NMD ID 41) | benefits Copper, cathode 100% primary (GLO)	NL	0	5	0	95	0

4 Scenarios and additional technical information

Waste Scenario	Region	Not removed (stays in work) [%]	Landfill [%]	Incineration [%]	Recycling [%]	Re-use [%]
(ei3.9.1) Metals, others (i.a. fasteners, fittings) (NMD ID 50)	NL	0	5	5	90	0
(ei3.9.1) Metals, mixed (via residue (NMD ID 49)	NL	0	5	5	90	0
(ei3.9.1) Waste mineral oil (100% Incineration)	NL	0	0	100	0	0
(ei3.9.1) plastics, via residue (NMD ID 43)	NL	0	20	80	0	0
(ei3.9.1) polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	NL	0	10	85	5	0
(ei3.9.1) Steel, light (NMD ID 73)	NL	0	1	0	87	12
(ei3.9.1) finishes (adhered to wood, plastic, metal) (NMD ID 2)	NL	0	0	100	0	0
(ei3.9.1) PVC, pipes (NMD ID 64)	NL	0	10	20	70	0

Waste Scenario	Not removed (stays in work) [kg]	Landfill [kg]	Incineration [kg]	Recycling [kg]	Re-use [kg]
(ei3.9.1) elastomeres (i.a. epdm) (i.a. roofing, foils) (NMD ID 20)	0.000	0.036	0.303	0.018	0.000
(ei3.9.1) copper (i.a. sheets, pipes) (NMD ID 41) | benefits Copper, cathode 100% primary (GLO)	0.000	0.239	0.000	4.539	0.000
(ei3.9.1) Metals, others (i.a. fasteners, fittings) (NMD ID 50)	0.000	1.543	1.543	27.773	0.000
(ei3.9.1) Metals, mixed (via residue (NMD ID 49)	0.000	0.000	0.000	0.001	0.000
(ei3.9.1) Waste mineral oil (100% Incineration)	0.000	0.000	0.003	0.000	0.000
(ei3.9.1) plastics, via residue (NMD ID 43)	0.000	1.951	7.806	0.000	0.000
(ei3.9.1) polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	0.000	0.057	0.483	0.028	0.000
(ei3.9.1) Steel, light (NMD ID 73)	0.000	0.270	0.000	23.518	3.244
(ei3.9.1) finishes (adhered to wood, plastic, metal) (NMD ID 2)	0.000	0.000	4.669	0.000	0.000
(ei3.9.1) PVC, pipes (NMD ID 64)	0.000	0.014	0.028	0.097	0.000
Total	**0.000**	**4.110**	**14.834**	**55.975**	**3.244**

4.8 BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY (D)

The presented Benefits and loads beyond the system boundary in this EPD are based on the following calculated Net output flows in kilograms and Energy recovery displayed in MJ Lower Heating Value.

4 Scenarios and additional technical information

Waste Scenario	Net output flow [kg]	Energy recovery [MJ]
(ei3.9.1) elastomeres (i.a. epdm) (i.a. roofing, foils) (NMD ID 20)	0.018	8.230
(ei3.9.1) copper (i.a. sheets, pipes) (NMD ID 41) | benefits Copper, cathode 100% primary (GLO)	1.671	0.000
(ei3.9.1) Metals, others (i.a. fasteners, fittings) (NMD ID 50)	27.550	0.000
(ei3.9.1) Metals, mixed (via residue (NMD ID 49)	0.001	0.000
(ei3.9.1) Waste mineral oil (100% Incineration)	0.000	0.097
(ei3.9.1) plastics, via residue (NMD ID 43)	0.000	239.116
(ei3.9.1) polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	0.028	15.587
(ei3.9.1) Steel, light (NMD ID 73)	14.631	0.000
(ei3.9.1) finishes (adhered to wood, plastic, metal) (NMD ID 2)	0.000	164.324
(ei3.9.1) PVC, pipes (NMD ID 64)	0.097	0.597
Total	**43.996**	**427.951**

5 Results

For the impact assessment long-term emissions (>100 years) are not considered. The results of the impact assessment are only relative statements that do not make any statements about end-points of the impact categories, exceedance of threshold values, safety margins or risks. The following tables show the results of the indicators of the impact assessment, of the use of resources as well as of waste and other output flows.

5.1 ENVIRONMENTAL IMPACT INDICATORS PER PIECE

CORE ENVIRONMENTAL IMPACT INDICATORS EN 15804+A2

Abbr.	Unit	A1	A2	A3	A1-A3	A4	A5	B2	B6	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq.	2.66E+2	5.89E+0	-1.65E+1	2.55E+2	5.65E+0	3.36E+1	1.29E+1	6.05E+3	0.00E+0	8.34E-1	3.44E+1	2.49E-1	-1.00E+2
GWP-f	kg CO_2 eq.	2.65E+2	5.89E+0	6.54E+0	2.77E+2	5.63E+0	1.02E+1	1.27E+1	6.02E+3	0.00E+0	8.31E-1	3.44E+1	2.49E-1	-1.00E+2
GWP-b	kg CO_2 eq.	7.32E-1	2.36E-3	-2.32E+1	-2.24E+1	1.83E-3	2.34E+1	2.31E-1	1.24E+1	0.00E+0	2.71E-4	7.10E-3	1.50E-4	-2.07E-2
GWP-luluc	kg CO_2 eq.	3.01E-1	2.19E-3	1.05E-1	4.08E-1	2.01E-2	1.41E-2	1.79E-2	2.18E+1	0.00E+0	2.96E-3	2.37E-3	2.45E-5	-6.02E-2
ODP	kg CFC 11 eq.	7.68E-6	1.30E-6	2.09E-7	9.18E-6	1.00E-7	3.20E-7	3.82E-7	2.80E-4	0.00E+0	1.48E-8	6.18E-7	1.17E-9	-3.22E-6
AP	mol H+ eq.	3.65E+0	3.67E-2	4.50E-2	3.74E+0	2.69E-2	1.19E-1	1.77E-1	1.88E+1	0.00E+0	3.98E-3	1.19E-2	3.15E-4	-3.10E+0
EP-fw	kg P eq.	1.09E-1	5.88E-5	1.50E-3	1.10E-1	5.60E-5	3.32E-3	1.34E-3	1.60E-1	0.00E+0	8.26E-6	7.21E-5	5.55E-7	-9.86E-3
EP-m	kg N eq.	4.75E-1	1.26E-2	1.59E-2	5.03E-1	1.02E-2	1.79E-2	2.24E-2	3.46E+0	0.00E+0	1.51E-3	3.45E-3	2.11E-4	-1.71E-1
EP-T	mol N eq.	9.42E+0	1.39E-1	1.55E-1	9.72E+0	1.09E-1	3.22E-1	2.85E-1	4.17E+1	0.00E+0	1.61E-2	3.85E-2	1.31E-3	-2.58E+0
POCP	kg NMVOC eq.	1.30E+0	3.95E-2	4.36E-2	1.38E+0	3.73E-2	5.07E-2	7.94E-2	1.24E+1	0.00E+0	5.50E-3	1.09E-2	5.19E-4	-9.21E-1
ADP-mm	kg Sb-eq.	4.04E-2	1.47E-4	4.84E-5	4.06E-2	1.76E-5	1.22E-3	1.06E-2	8.28E-2	0.00E+0	2.60E-6	1.80E-5	1.01E-7	-3.77E-2
ADP-f	MJ	4.23E+3	8.86E+1	1.04E+2	4.42E+3	8.06E+1	1.43E+2	1.81E+2	1.32E+5	0.00E+0	1.19E+1	1.93E+1	1.01E+0	-1.13E+3
WDP	m3 world eq.	1.47E+2	3.14E-1	7.75E+0	1.55E+2	4.40E-1	4.78E+0	-5.91E-1	1.08E+3	0.00E+0	6.50E-2	9.85E-1	2.60E-2	-1.02E+2

GWP-total=Global Warming Potential total (GWP-total) | **GWP-f**=Global Warming Potential fossil fuels (GWP-fossil) | **GWP-b**=Global Warming Potential biogenic (GWP-biogenic) | **GWP-luluc**=Global Warming Potential land use and land use change (GWP-luluc) | **ODP**=Depletion potential of the stratosperic ozon layer (ODP) | **AP**=Acidification potential, Accumulated Exceedance (AP) | **EP-fw**=Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater) | **EP-m**=Eutrophication potential, fraction of nutrients reaching marine end compartment (EP-marine) | **EP-T**=Eutrophication potential, Accumulated Exceedance (EP-terrestrial) | **POCP**=Formation potential of tropospheric ozone (POCP) | **ADP-mm**=Abiotic depletion potential for non fossil resources (ADP mm) | **ADP-f**=Abiotic depletion for fossil resources potential (ADP fossil) | **WDP**=Water (user) deprication potential, deprivation-weighted water consumption (WDP)

5 Results

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS EN 15804+A2

Abbr.	Unit	A1	A2	A3	A1-A3	A4	A5	B2	B6	C1	C2	C3	C4	D
PM	disease incidence	3.56E-5	5.24E-7	6.62E-7	3.67E-5	5.56E-7	1.20E-6	1.27E-6	9.20E-5	0.00E+0	8.20E-8	1.12E-7	7.01E-9	-1.11E-5
IR	kBq U235 eq.	1.28E+1	3.71E-1	3.15E-1	1.34E+1	3.14E-2	4.14E-1	7.50E-1	1.82E+3	0.00E+0	4.64E-3	6.41E-2	9.31E-4	-9.14E-1
ETP-fw	CTUe	8.01E+3	7.87E+1	6.80E+1	8.15E+3	5.95E+1	2.63E+2	2.96E+2	1.78E+4	0.00E+0	8.78E+0	2.66E+2	1.70E+1	-2.97E+3
HTP-c	CTUh	1.54E-6	2.58E-9	2.48E-8	1.56E-6	2.98E-9	5.08E-8	6.95E-8	2.66E-6	0.00E+0	4.40E-10	1.82E-8	3.54E-11	-3.52E-9
HTP-nc	CTUh	4.20E-5	8.58E-8	1.22E-7	4.22E-5	6.47E-8	1.28E-6	2.78E-6	1.03E-4	0.00E+0	9.56E-9	9.34E-8	2.03E-9	-3.48E-5
SQP	Pt	1.80E+3	7.59E+1	1.61E+3	3.49E+3	6.36E+1	1.12E+2	1.13E+2	4.04E+4	0.00E+0	9.39E+0	8.47E+0	2.30E+0	-1.59E+3

PM=Potential incidence of disease due to PM emissions (PM) | **IR**=Potential Human exposure efficiency relative to U235 (IRP) | **ETP-fw**=Potential Comparative Toxic Unit for ecosystems (ETP-fw) | **HTP-c**=Potential Comparative Toxic Unit for humans (HTP-c) | **HTP-nc**=Potential Comparative Toxic Unit for humans (HTP-nc) | **SQP**=Potential soil quality index (SQP)

CLASSIFICATION OF DISCLAIMERS TO THE DECLARATION OF CORE AND ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS

ILCD classification	Indicator	Disclaimer
ILCD type / level 1	Global warming potential (GWP)	None
	Depletion potential of the stratospheric ozone layer (ODP)	None
	Potential incidence of disease due to PM emissions (PM)	None
ILCD type / level 2	Acidification potential, Accumulated Exceedance (AP)	None
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	None
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	None
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	None
	Formation potential of tropospheric ozone (POCP)	None
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD type / level 3	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2

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ILCD classification	Indicator	Disclaimer
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2

Disclaimer 1 – This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

5.2 INDICATORS DESCRIBING RESOURCE USE AND ENVIRONMENTAL INFORMATION BASED ON LIFE CYCLE INVENTORY (LCI)

PARAMETERS DESCRIBING RESOURCE USE

Abbr.	Unit	A1	A2	A3	A1-A3	A4	A5	B2	B6	C1	C2	C3	C4	D
PERE	MJ	5.63E+2	1.10E+0	1.05E+2	6.69E+2	1.14E+0	2.04E+1	2.48E+1	3.89E+4	0.00E+0	1.68E-1	2.23E+0	3.92E-2	-2.34E+2
PERM	MJ	5.18E+0	0.00E+0	2.03E+2	2.08E+2	0.00E+0	6.25E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	MJ	5.69E+2	1.10E+0	3.08E+2	8.78E+2	1.14E+0	2.67E+1	2.48E+1	3.89E+4	0.00E+0	1.68E-1	2.23E+0	3.92E-2	-2.34E+2
PENRE	MJ	3.76E+3	9.40E+1	1.02E+2	3.95E+3	8.07E+1	1.29E+2	1.81E+2	1.31E+5	0.00E+0	1.19E+1	1.93E+1	1.01E+0	-1.13E+3
PENRM	MJ	4.85E+2	0.00E+0	2.27E+0	4.87E+2	0.00E+0	1.46E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-2.84E+0
PENRT	MJ	4.24E+3	9.40E+1	1.05E+2	4.44E+3	8.07E+1	1.44E+2	1.81E+2	1.31E+5	0.00E+0	1.19E+1	1.93E+1	1.01E+0	-1.13E+3
SM	Kg	1.18E+1	0.00E+0	0.00E+0	1.18E+1	0.00E+0	3.53E-1	3.39E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.61E-5
RSF	MJ	2.47E-1	0.00E+0	0.00E+0	2.47E-1	0.00E+0	7.40E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	MJ	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	m^3	9.96E+0	1.07E-2	2.15E-1	1.02E+1	1.95E-2	3.14E-1	3.39E-2	5.69E+1	0.00E+0	2.88E-3	3.31E-2	1.13E-3	-2.22E+0

PERE=Use of renewable primary energy excluding renewable primary energy resources 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 resources | **SM**=Use of secondary material | **RSF**=Use of renewable secondary fuels | **NRSF**=Use of non-renewable secondary fuels | **FW**=Net use of fresh water

5 Results

OTHER ENVIRONMENTAL INFORMATION DESCRIBING WASTE CATEGORIES

Abbr.	Unit	A1	A2	A3	A1-A3	A4	A5	B2	B6	C1	C2	C3	C4	D
HWD	Kg	4.77E+0	2.22E-4	4.41E-4	4.77E+0	5.14E-4	1.43E-1	1.28E-3	3.42E-1	0.00E+0	7.59E-5	2.89E-3	4.84E-6	-9.55E-3
NHWD	Kg	1.53E+2	5.54E+0	1.59E+0	1.60E+2	5.33E+0	1.68E+1	3.64E+0	4.97E+2	0.00E+0	7.86E-1	1.55E+1	4.12E+0	-6.66E+0
RWD	Kg	1.05E-2	5.82E-4	2.55E-4	1.13E-2	1.84E-5	3.47E-4	5.80E-4	8.41E-1	0.00E+0	2.72E-6	4.59E-5	5.29E-7	-5.19E-4

HWD=Hazardous waste disposed | **NHWD**=Non-hazardous waste disposed | **RWD**=Radioactive waste disposed

ENVIRONMENTAL INFORMATION DESCRIBING OUTPUT FLOWS

Abbr.	Unit	A1	A2	A3	A1-A3	A4	A5	B2	B6	C1	C2	C3	C4	D
CRU	Kg	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	9.73E-2	4.85E-1	0.00E+0	0.00E+0	0.00E+0	3.24E+0	0.00E+0	0.00E+0
MFR	Kg	1.21E+0	0.00E+0	0.00E+0	1.21E+0	0.00E+0	5.36E+0	3.74E+0	0.00E+0	0.00E+0	0.00E+0	5.60E+1	0.00E+0	0.00E+0
MER	Kg	1.10E-4	0.00E+0	0.00E+0	1.10E-4	0.00E+0	3.31E-6	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EET	MJ	5.15E-1	0.00E+0	0.00E+0	5.15E-1	0.00E+0	1.54E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.80E+2
EEE	MJ	1.61E-1	0.00E+0	0.00E+0	1.61E-1	0.00E+0	4.82E-3	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.05E+2

CRU=Components for re-use | **MFR**=Materials for recycling | **MER**=Materials for energy recovery | **EET**=Exported Energy, Thermic | **EEE**=Exported Energy, Electric

5 Results

5.3 INFORMATION ON BIOGENIC CARBON CONTENT PER PIECE

BIOGENIC CARBON CONTENT

The following Information describes the biogenic carbon content in (the main parts of) the product at the factory gate per piece:

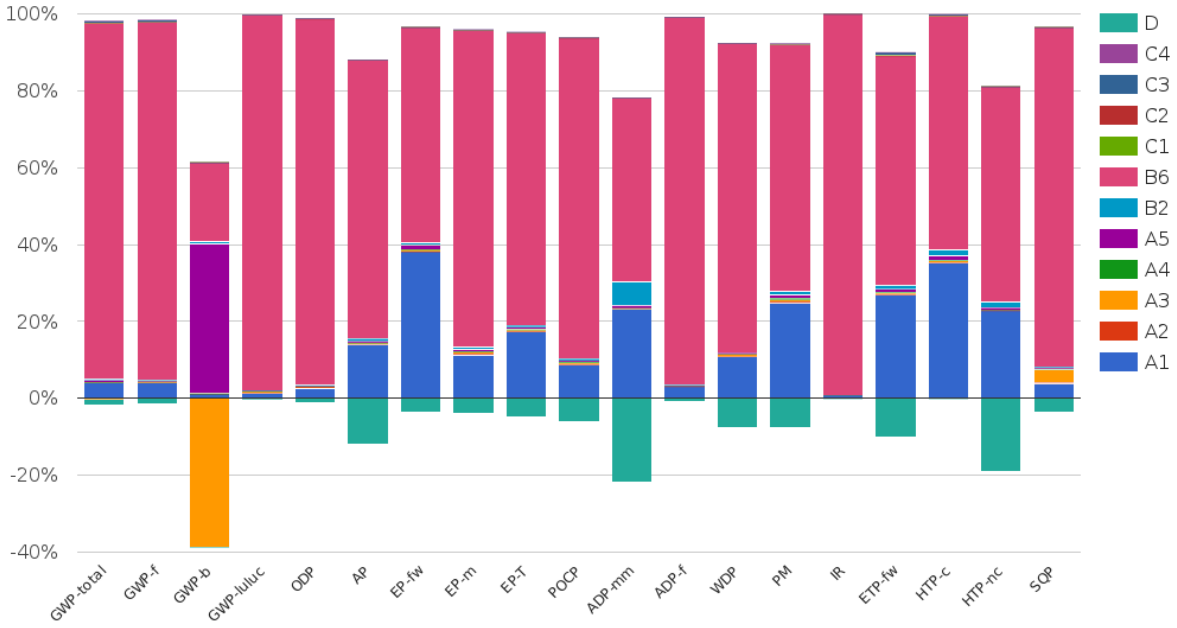
Biogenic carbon content	Amount	Unit
Biogenic carbon content in the product	0	kg C
Biogenic carbon content in accompanying packaging	6.349	kg C

UPTAKE OF BIOGENIC CARBON DIOXIDE

The following amount of carbon dioxide uptake is taken into account. Related uptake and release of carbon dioxide in downstream processes are not taken into account in this number although they do appear in the presented results. One kilogram of biogenic Carbon content is equivalent to 44/12 kg of biogenic carbon dioxide uptake.

Uptake Biogenic Carbon dioxide	Amount	Unit
Packaging	23.28	kg CO2 (biogenic)

6 Interpretation of results



The results show that the use stage, and in particular module B6 (operational energy use), is the dominant life cycle phase for the BEN Smart Cylinder across nearly all environmental impact categories. This is especially visible for GWP-total, acidification, eutrophication, fossil resource use and water deprivation, where the electricity consumption during the 20-year reference service life clearly outweighs the contributions from the other modules. The operational electricity demand of the product therefore drives the overall environmental profile.

The product stage (A1–A3) is the second most important contributor for most impact categories. Within this stage, the main impacts are associated with raw material supply and manufacturing, including the production of stainless steel, copper, plastics, electronic parts and other hydraulic and housing components, as well as the electricity used during assembly. Module A1 makes the largest contribution within the product stage, while A3 is

6 Interpretation of results

partly reduced by the influence of packaging-related biogenic carbon effects, which can be seen in the negative value for GWP-biogenic and the lower contribution to GWP-total.

The construction stage (A4–A5) has a relatively small influence on the total results. A4 reflects transport of the product to site, while A5 is mainly related to packaging waste generated during installation. Although A5 is visible in some categories, its contribution remains minor compared with the product stage and especially the use stage.

The maintenance stage (B2) contributes only moderately to the overall impacts. These impacts are mainly caused by the replacement of service parts.

The end-of-life stages (C1–C4) show small to moderate contributions. Module C1 is negligible because no specific demolition energy is considered. Modules C2–C4 represent transport to waste treatment, waste processing and disposal. Module D shows a relevant negative contribution due to recycling and energy recovery benefits beyond the system boundary, mainly from recovered metals and other recyclable fractions.

7 References

ISO 14040
ISO 14040:2006-10, Environmental management - Life cycle assessment - Principles and framework; EN ISO 14040:2006

ISO 14044
ISO 14044:2006-10, Environmental management - Life cycle assessment - Requirements and guidelines; EN ISO 14044:2006

ISO 14025
ISO 14025:2011-10, Environmental labels and declarations — Type III environmental declarations — Principles and procedures

EN 15804+A2
EN 15804:2012+A2:2019/AC:2021, Sustainability of Buildings - Environmental Product Declarations - Framework Development Rules by Product Category

Kiwa-EE GPI R.3.0 (2025)
Kiwa-Ecobility Experts, General Programme Instructions “Product Level”, SOP EE 1201_R.3.0 (03.06.2025)

Kiwa-EE GPI R.3.0 Annex B1 (2025)
Kiwa-Ecobility Experts, General Programme Instructions “Product Level” – Annex B1 Environmental Information Programme according to EN 15804 / ISO 21930 , SOP EE 1203_R.3.0 (03.06.2025)

EN 50693
EN 50693:2019, Product category rules for life cycle assessments of electronic and electrical products and systems (28.01.2020)

Ecoinvent
ecoinvent Version 3.9.1 (December 2022)

R<THINK characterization method
ecoinvent 3.9.1: EN 15804+A1 indicators (CML-IA Baseline v3.09), EN 15804+A2 indicators (EF 3.1)

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