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

BEN Dual-AIR

Registration number:	EPD-Kiwa-EE-234956-EN
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 Dual-AIR

1.2 REGISTRATION NUMBER

EPD-Kiwa-EE-234956-EN

1.3 VALIDITY

Issue date: 24-06-2026

Valid until: 24-06-2031

1.4 PROGRAMME OPERATOR

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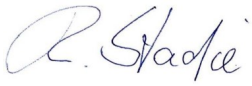


Dr. Ronny Stadie

(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 Dual-AIR ' with the calculation identifier ReTHiNK-134956.

2 Product

2.1 PRODUCT DESCRIPTION

The BEN Dual-AIR is an intelligent, inverter-controlled air-to-water heat pump (Air/Water) without a separate outdoor unit, designed to provide space heating, domestic hot water, and ventilation in an energy-efficient manner. The unit is available as a standalone all-electric or hybrid monobloc heat pump and uses R290 refrigerant.

The heat pump has a nominal heating capacity of 5 kW and is equipped with an integrated back-up heater with a capacity ranging from 1.5 to 6 kW.

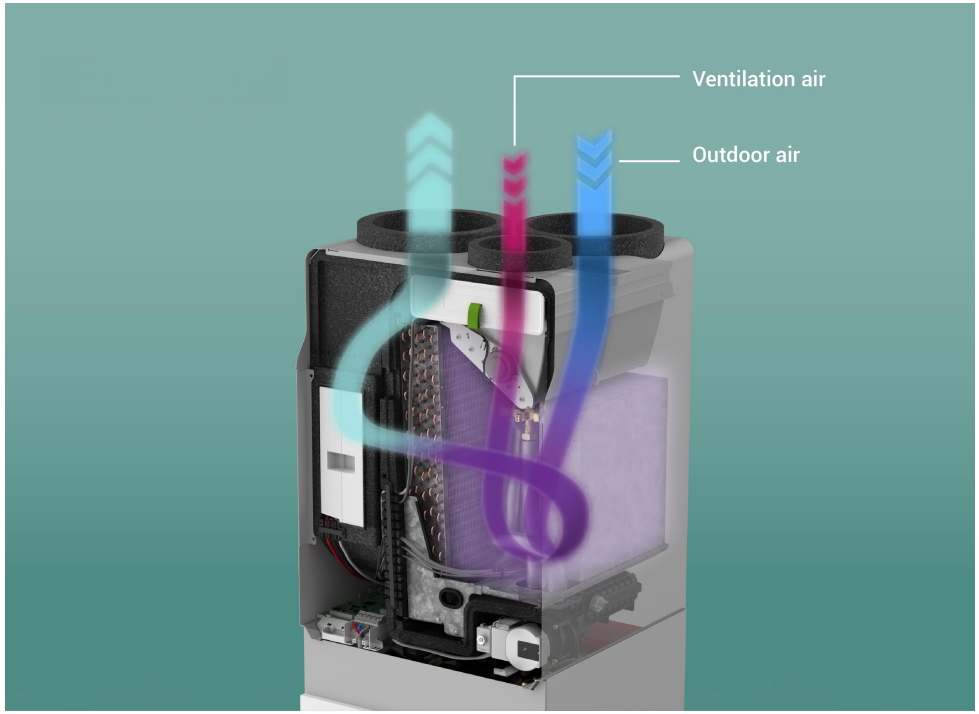
Energy is recovered from ventilation air and/or outdoor air and supplied to the heat pump, significantly reducing overall energy consumption. The product provides ventilation, space heating, and domestic hot water (when combined with a separate hot water storage tank).

The BEN Dual-AIR is intended for use with low-, medium- and high-temperature heating systems, such as underfloor heating and/or radiators. It is suitable for residential buildings or comparable applications, both in new constructions and renovation projects as a replacement system.

Product specification

The composition of the BEN Dual-AIR is described in the following table:

Materials	Weight (%)
Steel and iron	47.0
Copper	20.6
Plastics	9.7
Coatings, resins and adhesives	6.0
Aluminium	6.0
Electronics and electrical components	4.6
Brass and bronze	1.9
Other materials	1.8
Other metals	1.3
Polyurethane foam / insulation	1.1



2.2 APPLICATION (INTENDED USE OF THE PRODUCT)

BEN Dual-AIR heat pump is used for heating and hot water supply in homes. There is also the possibility to provide cooling to give the home-owner more comfort during warm days. Cooling is not included within the system boundaries of this EPD.

The heat pump can be combined with a hot water storage tank (BEN Smart Cylinder) and a balanced ventilation module (BEN Pure-AIR). The EPD for these modules is separately available.

2 Product

2.3 REFERENCE SERVICE LIFE

RSL PRODUCT

The reference service life (RSL) of the BEN Dual-AIR heat pump has been determined based on manufacturer experience with comparable air-source heat pump systems, industry practice for residential heating and cooling equipment, and relevant technical documentation.

USED RSL (YR) IN THIS LCA CALCULATION:

25

RSL PARTS

The BEN Dual-AIR is modular designed with seven internal modules to ensure the 25 years of product lifetime. During the lifetime some of these modules need service to make sure the 25 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)		
Air filter	(ei3.9.1) Polypropylene (PP), injection moulded | production (EU)	1
Water pump	(ei3.9.1) Aluminium, cast alloy | market for (EU)	13
Print circuit boards	Tin {RoW}| tin production | Cut-off, U	15
HP Block	Steel low-alloyed, zinc coated RER	15
Air fan	Polypropylene, granulate+injection molding RER	15

2.4 TECHNICAL DATA

Specification	Unit	BEN Dual-AIR
Dimensions (W x D x H)	mm	600 x 550 x 808
Weight (unpacked)	kg	84
Refrigerant type	-	R290
Refrigerant GWP (CO_2 equivalent)	-	3
Installation options:		
Wall-hung		yes
Floor standing		yes
Main functions:		
Air/Water monobloc		yes
Exhaust air heat pump		yes
Dual-AIR heat pump		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).

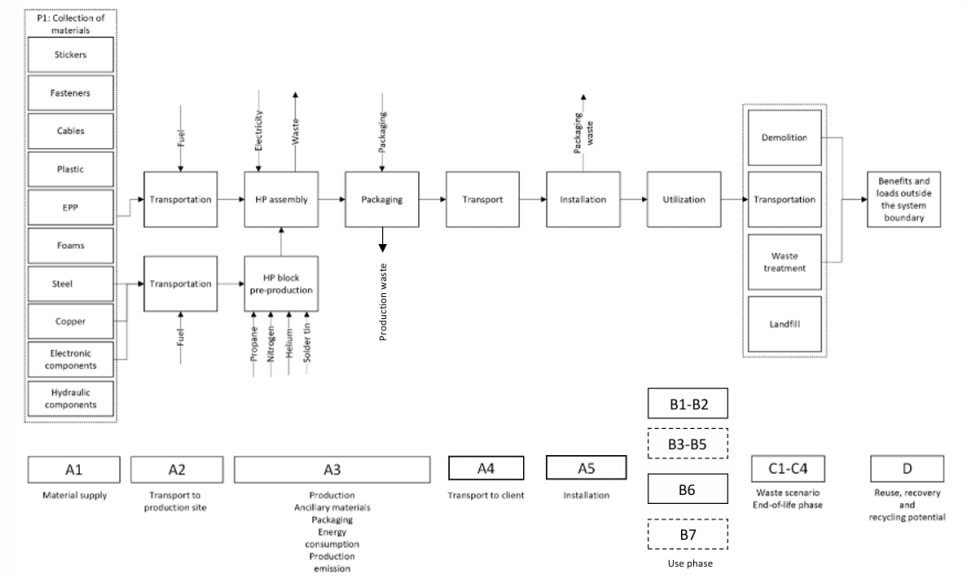
2.6 DESCRIPTION PRODUCTION PROCESS

The production process of the heat pump begins with the purchase of raw materials, components and semi-finished products. All components required for the production of the BEN Dual-AIR 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. Brazing of the heat pump unit
2. Leak testing of the heat pump unit
3. Automatically vacuuming and filling the heat pump unit with refrigerant
4. Connecting electrical components using cable looms
5. Functional and performance test of the heat pump unit
6. Assembly of housing
7. Heat pump unit is placed into the housing
8. Installation of the open manifold, an integrated hydraulic solution
9. Installation of the fan subassembly
10. Installation of the PCB tray subassembly

2 Product

11. Installation of the air valve subassemblies
12. Connection of heat pump unit to the open manifold
13. Installation of electrical wiring
14. Assembly of outer housing parts
15. Functional test of the entire heat pump
16. Packaging of the heat pump for transport



2.7 CONSTRUCTION DESCRIPTION

The construction phase consists of the transport to and the installation of the product at the address where the heat pump will be installed.

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.

The transport packaging of the BEN Dual-AIR is sustainably designed. BEN comes with reusable, Styrofoam-free packaging, and the carton print only contains a signal colour.

The protective EPP shells are made from recycled EPP (recycled production waste) and can last for multiple transportation cycles. In case they are not reused, the footprint is comparable to EPS (Styrofoam). EPP particles will not easily spread across the construction site.

3 Calculation rules

3.1 FUNCTIONAL UNIT

piece

Funktional unit is defined as one BEN Dual-AIR heat pump over a reference service life of 25 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 2,138 kWh/year, corresponding to 53,450 kWh over the 25-year reference service life.

Reference unit: piece (p)

3.2 CONVERSION FACTORS

Description	Value	Unit
Reference unit	1	p
Weight per reference unit	84.249	kg
Conversion factor to 1 kg	0.011870	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	X	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 Dual-AIR, a product of Joule Group. The results of this EPD are representative for the European Union and United Kingdom.

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 use, 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 includes direct emissions to air from refrigerant leakage during use. A maximum annual propane (R290) leakage of 2.2 g per year was assumed. The initial product filling was considered sufficient to account for this maximum leakage over the reference service life; therefore, no refill was assumed during the lifetime.

Maintenance (B2)

3 Calculation rules

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

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)

The operational energy use in module B6 represents the electricity consumption during the use stage of the product in its intended application in residential buildings. The annual electricity consumption was provided by the manufacturer based on the expected operating scenario of the BEN system.

For the BEN Dual-AIR, the annual electricity consumption is assumed to be 2,138 kWh/year. This includes the electricity required for the heat pump operation under the assumed residential heating and domestic hot water operating profile. Over the reference service life of 25 years, the total electricity consumption declared in B6 is therefore 53,450 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 were selected as they represent the primary markets for the BEN Dual-Air and are the locations where the product is most commonly installed. Since the environmental impacts associated with operational energy use are highly dependent on the electricity generation mix, the results may vary depending on the country-specific grid composition and actual use conditions.

Operational water use (B7)

Module B7 is not declared, as no operational water use is assumed during the use stage.

De-construction / demolition (C1)

Module C1 is declared as zero. No specific resources or energy inputs for de-construction or demolition were considered, as the product is assumed to be disconnected without significant demolition activities at the end of its service life.

End-of-life transport (C2)

Transport scenarios used in modules A4 and C2 are based on standard European transport assumptions for the distribution and end-of-life transport of heating equipment. Average transport distances and typical truck capacities were assumed.

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 of the BEN Dual-AIR heat pump consists of a combination 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 60%, while the remaining 40% of the electricity demand is covered by purchased electricity from the Dutch residual electricity mix.

The purchased electricity is 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	273 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	2.787	kg

4.3 USE STAGE (B1)

Emissions to air/soil/water are applicable, the scenario accounted in module B1 is as follows in the table below:

Description	Cycle (yr)	Number of cycles	Amount per cycle	Total Amount	Unit
Maximum propane (R290) leakage per year	1	25	0.002	0.05	kg

4 Scenarios and additional technical information

4.4 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
Air filter	1	24	0.1015	2.436	kg
Water pump	13	0.923	1.054	0.972842	kg
Print circuit boards	15	0.667	0.512	0.341504	kg
HP Block	15	0.667	1.2	0.8004	kg
Air fan	15	0.667	0.058	0.038686	kg

4.5 OPERATIONAL ENERGY USE (B6)

Description	Service cycle (yr)	Number of cycles (n)	Amount per cycle	Total Amount	Unit
Electricity consumption 25 years	1	25.00	2138	53,450.00	kWh

4.6 DE-CONSTRUCTION, DEMOLITION (C1)

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

4.7 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]
Copper	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	0
(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) PVC, pipes (NMD ID 64)		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) Lorry (Truck), unspecified (default) | market group for (GLO)					
(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
(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) 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) 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) Waste mineral oil (100% Incineration)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(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) coarse ceramic (i.a. brickwork, tiles) (NMD ID 32)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) Corrugated board / Core board (PEF scenario) | (u=10%, glue=2%) corr. acc. EN16449	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) aluminium (GLO), wrought alloy for buildings (i.a. profiles, sheets, pipes) (NMD ID 5)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) Refrigerant R290 (NMD cat3 generic data)	(ei3.9.1) Lorry (Truck), unspecified (default) | market group for (GLO)	0	100	150	50	50
(ei3.9.1) glass wool (insulation) (NMD ID 30)	(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

4 Scenarios and additional technical information

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

	Value and unit
Vehicle type used for transport	(ei3.6) 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

4.8 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 [%]
Copper	NL	0	5	0	95	0
(ei3.9.1) Steel, light (NMD ID 73)	NL	0	1	0	87	12
(ei3.9.1) PVC, pipes (NMD ID 64)	NL	0	10	20	70	0
(ei3.9.1) plastics, via residue (NMD ID 43)	NL	0	20	80	0	0
(ei3.9.1) copper (i.a. sheets, pipes) (NMD ID 41) | benefits Copper, cathode 100% primary (GLO)	NL	0	5	0	95	0
(ei3.9.1) elastomeres (i.a. epdm) (i.a. roofing, foils) (NMD ID 20)	NL	0	10	85	5	0
(ei3.9.1) finishes (adhered to wood, plastic, metal) (NMD ID 2)	NL	0	0	100	0	0
(ei3.9.1) Waste mineral oil (100% Incineration)	NL	0	0	100	0	0
(ei3.9.1) polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	NL	0	10	85	5	0

4 Scenarios and additional technical information

Waste Scenario	Region	Not removed (stays in work) [%]	Landfill [%]	Incineration [%]	Recycling [%]	Re-use [%]
(ei3.9.1) coarse ceramic (i.a. brickwork, tiles) (NMD ID 32)	NL	0	1	0	99	0
(ei3.9.1) Corrugated board / Core board (PEF scenario) | (u=10%, glue=2%) corr. acc. EN16449	NL	0	0	25	75	0
(ei3.9.1) aluminium (GLO), wrought alloy for buildings (i.a. profiles, sheets, pipes) (NMD ID 5)	NL	0	3	3	94	0
(ei3.9.1) Refrigerant R290 (NMD cat3 generic data)	NL	1	0	39.4	59.1	0
(ei3.9.1) glass wool (insulation) (NMD ID 30)	NL	0	85	5	10	0

Waste Scenario	Not removed (stays in work) [kg]	Landfill [kg]	Incineration [kg]	Recycling [kg]	Re-use [kg]
Copper	0.000	0.382	0.000	7.254	0.000
(ei3.9.1) Steel, light (NMD ID 73)	0.000	0.552	0.000	48.032	6.625
(ei3.9.1) PVC, pipes (NMD ID 64)	0.000	0.083	0.166	0.580	0.000
(ei3.9.1) plastics, via residue (NMD ID 43)	0.000	0.722	2.887	0.000	0.000
(ei3.9.1) copper (i.a. sheets, pipes) (NMD ID 41) | benefits Copper, cathode 100% primary (GLO)	0.000	0.071	0.000	1.349	0.000
(ei3.9.1) elastomeres (i.a. epdm) (i.a. roofing, foils) (NMD ID 20)	0.000	0.480	4.077	0.240	0.000
(ei3.9.1) finishes (adhered to wood, plastic, metal) (NMD ID 2)	0.000	0.000	4.589	0.000	0.000
(ei3.9.1) Waste mineral oil (100% Incineration)	0.000	0.000	0.273	0.000	0.000
(ei3.9.1) polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	0.000	0.038	0.325	0.019	0.000
(ei3.9.1) coarse ceramic (i.a. brickwork, tiles) (NMD ID 32)	0.000	0.000	0.000	0.004	0.000
(ei3.9.1) Corrugated board / Core board (PEF scenario) | (u=10%, glue=2%) corr. acc. EN16449	0.000	0.000	0.000	0.001	0.000
(ei3.9.1) aluminium (GLO), wrought alloy for buildings (i.a. profiles, sheets, pipes) (NMD ID 5)	0.000	0.151	0.151	4.743	0.000
(ei3.9.1) Refrigerant R290 (NMD cat3 generic data)	0.004	0.000	0.177	0.266	0.000
Total	**0.004**	**2.483**	**12.646**	**62.489**	**6.625**

4 Scenarios and additional technical information

Waste Scenario	Not removed (stays in work) [kg]	Landfill [kg]	Incineration [kg]	Recycling [kg]	Re-use [kg]
(ei3.9.1) glass wool (insulation) (NMD ID 30)	0.000	0.005	0.000	0.001	0.000
Total	**0.004**	**2.483**	**12.646**	**62.489**	**6.625**

4.9 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.

Waste Scenario	Net output flow [kg]	Energy recovery [MJ]
Copper	7.254	0.000
(ei3.9.1) Steel, light (NMD ID 73)	40.002	0.000
(ei3.9.1) PVC, pipes (NMD ID 64)	0.580	3.566
(ei3.9.1) plastics, via residue (NMD ID 43)	0.000	58.737
(ei3.9.1) copper (i.a. sheets, pipes) (NMD ID 41) | benefits Copper, cathode 100% primary (GLO)	1.120	0.000
(ei3.9.1) elastomeres (i.a. epdm) (i.a. roofing, foils) (NMD ID 20)	0.236	122.707
(ei3.9.1) finishes (adhered to wood, plastic, metal) (NMD ID 2)	0.000	158.673
(ei3.9.1) Waste mineral oil (100% Incineration)	0.000	9.458
(ei3.9.1) polyolefines (i.a. pe,pp) (i.a. pipes, foils) (NMD ID 57)	0.019	10.039
(ei3.9.1) coarse ceramic (i.a. brickwork, tiles) (NMD ID 32)	0.004	0.000
(ei3.9.1) Corrugated board / Core board (PEF scenario) | (u=10%, glue=2%) corr. acc. EN16449	0.001	0.005
(ei3.9.1) aluminium (GLO), wrought alloy for buildings (i.a. profiles, sheets, pipes) (NMD ID 5)	3.209	0.000
(ei3.9.1) Refrigerant R290 (NMD cat3 generic data)	0.266	8.227
(ei3.9.1) glass wool (insulation) (NMD ID 30)	-0.003	0.000
Total	**52.690**	**371.411**

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	B1	B2	B6	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq.	3.45E+2	4.81E+0	2.27E+0	3.52E+2	3.54E+0	1.76E+1	5.55E-2	2.16E+1	1.81E+4	0.00E+0	8.35E-1	3.62E+1	1.66E-1	-1.75E+2
GWP-f	kg CO_2 eq.	3.42E+2	4.81E+0	4.28E+0	3.51E+2	3.53E+0	1.55E+1	5.54E-2	2.15E+1	1.79E+4	0.00E+0	8.31E-1	3.61E+1	1.66E-1	-1.75E+2
GWP-b	kg CO_2 eq.	1.25E+0	1.80E-3	-2.05E+0	-7.90E-1	1.15E-3	2.14E+0	5.14E-5	5.05E-2	3.70E+1	0.00E+0	2.71E-4	3.21E-2	1.09E-4	-2.43E-2
GWP-luluc	kg CO_2 eq.	1.08E+0	2.09E-3	3.04E-2	1.12E+0	1.26E-2	3.45E-2	4.34E-5	6.02E-2	6.51E+1	0.00E+0	2.96E-3	3.39E-3	2.17E-5	-8.87E-2
ODP	kg CFC 11 eq.	1.44E-5	1.04E-6	1.69E-7	1.56E-5	6.28E-8	5.99E-7	4.10E-9	5.62E-7	8.36E-4	0.00E+0	1.48E-8	3.64E-7	6.73E-10	-5.25E-6
AP	mol H+ eq.	5.48E+0	5.47E-2	2.61E-2	5.56E+0	1.69E-2	1.70E-1	2.34E-4	1.09E-1	5.61E+1	0.00E+0	3.98E-3	1.76E-2	2.09E-4	-2.06E+0
EP-fw	kg P eq.	3.25E-1	4.25E-5	5.52E-4	3.25E-1	3.51E-5	9.78E-3	1.24E-6	8.71E-4	4.76E-1	0.00E+0	8.27E-6	1.06E-4	5.08E-7	-7.29E-3
EP-m	kg N eq.	8.62E-1	1.58E-2	6.66E-3	8.84E-1	6.42E-3	2.76E-2	4.70E-5	2.14E-2	1.03E+1	0.00E+0	1.51E-3	4.41E-3	1.21E-4	-2.07E-1
EP-T	mol N eq.	1.24E+1	1.75E-1	7.15E-2	1.26E+1	6.84E-2	3.91E-1	5.23E-4	2.66E-1	1.24E+2	0.00E+0	1.61E-2	4.92E-2	8.01E-4	-2.82E+0
POCP	kg NMVOC eq.	2.31E+0	4.75E-2	1.80E-2	2.37E+0	2.34E-2	7.48E-2	3.67E-4	7.95E-2	3.70E+1	0.00E+0	5.51E-3	1.48E-2	1.65E-3	-9.90E-1
ADP-mm	kg Sb-eq.	1.08E-1	1.04E-4	8.97E-4	1.09E-1	1.10E-5	3.28E-3	4.38E-7	9.63E-3	2.47E-1	0.00E+0	2.60E-6	5.46E-5	6.16E-8	-1.92E-2
ADP-f	MJ	4.95E+3	7.02E+1	6.27E+1	5.08E+3	5.05E+1	1.60E+2	2.78E+0	3.48E+2	3.94E+5	0.00E+0	1.19E+1	3.22E+1	6.20E-1	-1.77E+3
WDP	m3 world eq.	2.15E+2	2.24E-1	3.56E+0	2.19E+2	2.76E-1	6.80E+0	5.42E-3	3.35E+0	3.23E+3	0.00E+0	6.50E-2	8.49E-1	2.07E-2	-8.90E+1

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	B1	B2	B6	C1	C2	C3	C4	D
PM	disease incidence	4.19E-5	3.73E-7	2.62E-7	4.26E-5	3.48E-7	1.32E-6	2.37E-9	1.16E-6	2.75E-4	0.00E+0	8.21E-8	2.16E-7	4.30E-9	-1.56E-5
IR	kBq U235 eq.	2.15E+1	2.95E-1	1.22E-1	2.19E+1	1.97E-2	6.78E-1	7.78E-4	7.70E-1	5.42E+3	0.00E+0	4.65E-3	9.97E-2	5.12E-4	-5.37E-1
ETP-fw	CTUe	1.21E+4	5.94E+1	4.16E+1	1.22E+4	3.73E+1	4.20E+2	1.94E-1	3.14E+2	5.30E+4	0.00E+0	8.79E+0	1.65E+2	6.20E+0	-1.83E+3
HTP-c	CTUh	1.99E-6	2.23E-9	3.66E-9	1.99E-6	1.87E-9	6.13E-8	3.40E-11	2.58E-8	7.92E-6	0.00E+0	4.40E-10	1.75E-8	2.13E-11	8.53E-9
HTP-nc	CTUh	8.96E-5	6.26E-8	1.33E-7	8.98E-5	4.06E-8	2.71E-6	6.25E-10	7.43E-7	3.07E-4	0.00E+0	9.57E-9	1.26E-7	8.14E-10	-2.33E-5
SQP	Pt	3.23E+3	5.15E+1	8.57E+1	3.37E+3	3.99E+1	1.05E+2	1.67E-1	7.92E+1	1.21E+5	0.00E+0	9.40E+0	2.19E+1	1.30E+0	-6.89E+2

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

5 Results

ILCD classification	Indicator	Disclaimer
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	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	B1	B2	B6	C1	C2	C3	C4	D
PERE	MJ	8.26E+2	8.05E-1	2.59E+1	8.53E+2	7.14E-1	2.61E+1	3.44E-2	3.15E+1	1.16E+5	0.00E+0	1.68E-1	3.59E+0	2.01E-2	-1.25E+2
PERM	MJ	1.69E+1	0.00E+0	1.99E+1	3.68E+1	0.00E+0	1.11E+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
PERT	MJ	8.43E+2	8.05E-1	4.58E+1	8.90E+2	7.14E-1	2.72E+1	3.44E-2	3.15E+1	1.16E+5	0.00E+0	1.68E-1	3.59E+0	2.01E-2	-1.25E+2
PENRE	MJ	4.52E+3	7.45E+1	1.05E+1	4.61E+3	5.06E+1	1.46E+2	4.60E-1	2.68E+2	3.92E+5	0.00E+0	1.19E+1	3.22E+1	6.20E-1	-1.77E+3
PENRM	MJ	4.65E+2	0.00E+0	5.23E+1	5.17E+2	0.00E+0	1.56E+1	2.32E+0	7.99E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	-1.20E+0
PENRT	MJ	4.99E+3	7.45E+1	6.28E+1	5.12E+3	5.06E+1	1.61E+2	2.78E+0	3.48E+2	3.92E+5	0.00E+0	1.19E+1	3.22E+1	6.20E-1	-1.77E+3
SM	Kg	6.23E+0	0.00E+0	1.42E+0	7.65E+0	0.00E+0	2.30E-1	0.00E+0	7.19E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.19E-1
RSF	MJ	8.05E-1	0.00E+0	0.00E+0	8.05E-1	0.00E+0	2.42E-2	0.00E+0	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	0.00E+0
FW	m^3	2.55E+1	7.66E-3	1.08E-1	2.56E+1	1.22E-2	7.75E-1	1.81E-4	1.27E-1	1.70E+2	0.00E+0	2.88E-3	4.37E-2	6.40E-4	-1.94E+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	B1	B2	B6	C1	C2	C3	C4	D
HWD	Kg	1.58E+1	1.57E-4	5.67E-4	1.58E+1	3.22E-4	4.82E-1	1.25E-5	1.29E-2	1.02E+0	0.00E+0	7.59E-5	3.04E-1	2.92E-6	3.90E-2
NHWD	Kg	1.29E+2	3.67E+0	6.77E-1	1.33E+2	3.34E+0	6.54E+0	7.20E-3	5.44E+0	1.48E+3	0.00E+0	7.87E-1	1.38E+1	2.49E+0	-1.85E+1
RWD	Kg	1.77E-2	4.66E-4	9.62E-5	1.83E-2	1.16E-5	5.67E-4	4.98E-7	6.03E-4	2.51E+0	0.00E+0	2.72E-6	7.52E-5	3.05E-7	-4.92E-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	B1	B2	B6	C1	C2	C3	C4	D
CRU	Kg	0.00E+0	0.00E+0	3.60E-3	3.60E-3	0.00E+0	1.99E-1	0.00E+0	1.42E-1	0.00E+0	0.00E+0	0.00E+0	6.63E+0	0.00E+0	0.00E+0
MFR	Kg	3.93E+0	0.00E+0	1.56E-1	4.09E+0	0.00E+0	3.06E+0	0.00E+0	2.06E+0	0.00E+0	0.00E+0	0.00E+0	6.25E+1	0.00E+0	5.16E+0
MER	Kg	3.60E-4	0.00E+0	0.00E+0	3.60E-4	0.00E+0	1.08E-5	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EET	MJ	1.68E+0	0.00E+0	0.00E+0	1.68E+0	0.00E+0	5.04E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.52E+2
EEE	MJ	5.25E-1	0.00E+0	0.00E+0	5.25E-1	0.00E+0	1.57E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	8.83E+1

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:

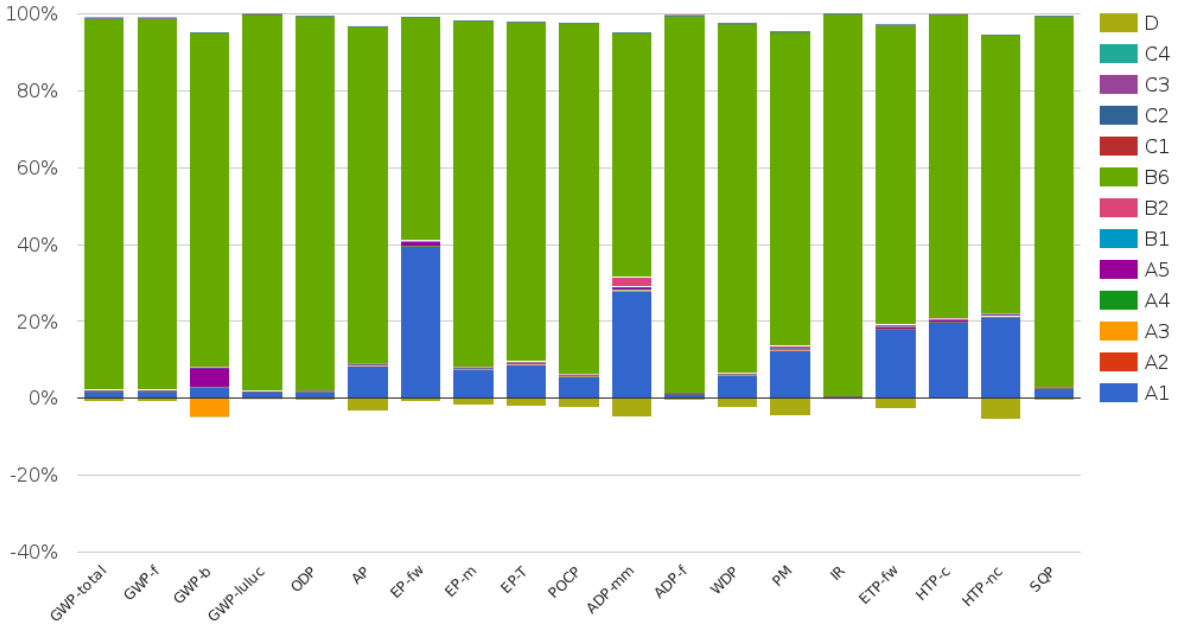
Biogenic carbon content	Amount	Unit
Biogenic carbon content in the product	0.0006248	kg C
Biogenic carbon content in accompanying packaging	0.5688	kg C

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
product	0.002291	kg CO2 (biogenic)
Packaging	2.086	kg CO2 (biogenic)

6 Interpretation of results



The results show that the use stage, and especially module B6 (operational energy use), is by far the dominant life cycle phase for the BEN Dual-AIR across nearly all environmental impact categories. This is clearly visible for GWP-total, acidification, eutrophication, fossil resource use, particulate matter, ionising radiation, ecotoxicity and water deprivation. The high electricity demand during the 25-year reference service life therefore determines the overall environmental profile of the product.

The product stage (A1–A3) is the second most important contributor in most categories. The main impacts in this stage come from raw material supply and component production, particularly steel, copper, aluminium, plastics, electronic parts, refrigerant-related components and the heat pump assembly. Within A1–A3, module A1 is the main contributor, while A2 and A3 are comparatively small. This indicates that upstream material production has a greater influence than factory assembly itself.

6 Interpretation of results

The construction stage (A4–A5) has only a limited effect on the total results. Module A4 represents transport to the installation site, and module A5 is mainly related to installation-related packaging waste. Their contribution is visible in some categories, but remains small compared with both the use stage and the product stage.

Module B1 has only a very small contribution. This module represents direct emissions during use from assumed annual leakage of the refrigerant R290. Module B2 has a small influence and is linked to maintenance and replacement of service parts such as air filters, water pump, print circuit boards, HP block and air fan during the service life.

The end-of-life stages (C1–C4) show small to moderate contributions. Module C1 is negligible because no demolition energy is considered. Modules C2–C4 account for transport to waste treatment, waste processing and disposal. These impacts are visible, especially due to treatment of mixed material fractions and metals, but they are still much smaller than the impacts from operational electricity use. Module D provides significant negative contributions due to recycling and recovery benefits beyond the system boundary, mainly from steel, copper, aluminium and other recoverable materials.

7 References

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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)

8 Contact information

Publisher	Operator	Owner of declaration

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Kiwa-Ecobility Experts is established member of the ECO PLATFORM