Invertek Drives.com

Member of Sumitomo Drive Technologies

Environmental Product Declaration

In accordance with ISO 14025:2006 and EN 50693.

Version date: 2026-02-20
Validity date: 2031-02-19

Invertek Drives Ltd

Optidrive™ Coolvert Size 4

EPD of multiple products, based on the results of the product group covering all Optidrive™ Coolvert variable frequency drives produced at the manufacturing site using the size 4 as the representative product.

EPD
INTERNATIONAL EPD SYSTEM

Programme: The International EPD System, www.environdec.com
Programme Operator: EPD International AB
EPD Registration Number: EPD-IES-0028601:001

An EPD may be updated or republished if conditions change. To find the latest version of the EPD and to confirm its validity, see www.environdec.com

OPTIDRIVE™ coolvert

General Information

This EPD provides environmental performance indicators for the Optidrive Coolvert variable frequency drive range produced by Invertek Drives Ltd at its manufacturing site. This is a cradle-to-grave lifecycle assessment in accordance with the requirements of PCR 2024-06 v1.0.1 – Electronic and electric equipment, and electronic components (non-construction). This EPD is based on a life cycle assessment (LCA) study completed with data provided by Invertek Drives Ltd (hereafter, Invertek) based on production data obtained for the 2024 calendar year at Welshpool, Powys, SY21 8JF, UK. This EPD presents details of the LCA completed by Tunley Environmental for Invertek.

The EPD owner has sole ownership, liability, and responsibility of the EPD. EPDs within the same product category but registered in different EPD programmes, or not compliant with PCR 2024-06 v1.0.1, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see PCR 2024-06 v1.0.1 and ISO 14025.

Table 1. Full details on the EPD programme and accountabilities.

Programme Information	
EPD programme	The International EPD® System
EPD Programme Operator	EPD International AB, Box 21060, SE-10031 Stockholm, Sweden www.environdec.com support@environdec.com
EPD Registration Number	EPD-IES-0028601:001
Date of Publication	2026-02-20
EPD Valid Until	2031-02-19

Accountabilities for PCR, LCA and independent, third-party verification	
Product Category Rules	PCR 2024-06 v1.0.1 – Electronic and electric equipment, and electronic components (non-construction) UN CPC Codes: 46122 www.environdec.com/pcr-library/pcr_23d2c7b4-04cd-4a57-8ca7-08d9b348866f
PCR Review Conducted by	The Technical Committee of the International EPD System. A full list of members is available on www.environdec.com. The review panel may be contacted via support@environdec.com. Chair of the PCR review: Sophie Kieselbach
LCA Conducted by	Tunley Environmental – www.tunley-environmental.com
LCA software	SimaPro version 9.6.0.1
Background data from	Ecoinvent v3.9.1.9.1 using EF 3.1 factors
Third Party Verification	Independent third-party verification of this EPD and data, according to ISO 14025:2006
Third Party Verifier	Callum Hill, JCH Industrial Ecology Ltd, enquiries@jchindustrial.co.uk
Approved by	The International EPD® System

EPD Owner Information

EPD Owner: Invertek Drives Ltd
Address: Offa's Dyke Business Park, Welshpool, Powys, SY21 8JF, UK
Website: www.invertekdrives.com
Contact Information: +44 (0) 1938 556868
Production Sites: Offa's Dyke Business Park, Welshpool, Powys, SY21 8JF, UK

Detailed information about the company who makes the EPD: Invertek Drives Ltd is a UK-based manufacturer of variable frequency drives (VFDs), also known as variable speed drives or AC drives. The company designs and produces advanced electronic motor control solutions for energy-efficient operation in industrial, commercial, HVAC-R, refrigeration, and other applications. Headquartered in Welshpool, Powys, Wales, with an Innovation Centre in the UK.

Invertek supplies products globally through a network in over 80 countries. Key ranges include the Optidrive™ series, with Optidrive™ Coolvert specifically targeting refrigeration and HVAC applications. It features simplified commissioning, high performance, and compatibility with modern refrigerants and systems.

Founded in 1998, Invertek has grown from a small startup to a significant player in the drives market. It became a member of Sumitomo Drive Technologies in 2021, gaining access to broader resources while maintaining independent operations. The company holds ISO 9001 and ISO 14001 certifications for quality and environmental management in the design, manufacture, and marketing of its drives. Invertek focuses on energy efficiency, compact design, and ease of use. It supplies bespoke solutions for OEMs, installers, and end-users across sectors like food processing, cold storage, heat pumps, and building services. By combining innovative electronics with practical engineering, Invertek delivers reliable, cost-effective motor control that reduces energy consumption and supports decarbonisation goals.

This EPD is owned by Invertek Drives Ltd. The company has sole ownership, liability, and responsibility for it.

Product Information

Product Name: Optidrive™ Coolvert Size 4 variable frequency drive
Product Description: The products covered by this EPD are the Optidrive™ Coolvert variable frequency drive range produced by Invertek Drives Ltd. This covers all variants in the range, including power ratings from 1.5 kW to 40 kW, single-phase and three-phase input options, heatsink and coldplate versions, and frame sizes 2 to 5. The representative reference product is the Size 4 model (CV-440580-3FHE, 30 kW / 40 HP, 380-480 V ±10%, 3-phase, 58 A). The most common configuration is the three-phase input with heatsink or coldplate technology. A list of the products in the Optidrive™ Coolvert range is below with further information provided in **Figure 2**:

Single-phase input (200–240 V ±10%)	
Frame 2	1.5 kW / 2 HP / 7.0 A → CV-220070-1F#P 3 kW / 4 HP / 12 A → CV-220120-1F#P 4 kW / 5.5 HP / 16 A → CV-220160-1F#P 5.5 kW / 7.5 HP / 20 A → CV-220200-1F#P
Three-phase input (380–480 V ±10%)	
Frame 2	5.5 kW / 7.5 HP / 14 A → CV-240140-3F#E 7.5 kW / 10 HP / 18 A → CV-240180-3F#E 11 kW / 15 HP / 24 A → CV-240240-3F#E
Frame 3	15 kW / 20 HP / 30 A → CV-240300-3F#E 18.5 kW / 25 HP / 39 A → CV-240390-3F#E
Frame 4	22 kW / 30 HP / 46 A → CV-240460-3F#E 30 kW / 40 HP / 58 A → CV-240580-3F#E - (representative reference product)
Frame 5	37 kW / 45 HP / 65 A → CV-240650-3F#E 40 kW / 50 HP / 75 A → CV-240750-3F#E

Product UN CPC Code: 46122
Manufacturer Name: Invertek Drives Ltd
Manufacturer Location: Offa's Dyke Business Park, Welshpool, Powys, SY21 8JF, UK
Service Life: 10 years

Technical Picture of Product:

Figure 1. Representative photo of the Coolvert Size 4 variable frequency drive (CV-440580-3FHE).

Technical Description of Product: The Optidrive™ Coolvert is a variable frequency drive designed to control the speed and torque of three-phase asynchronous or synchronous electric motors. It operates in demanding environments such as refrigeration systems, heat pumps, HVAC-R applications, and industrial processes. The drive supports single-phase (200–240 V ±10%) and three-phase (380–480 V ±10%) input voltages.

It delivers power ratings from 1.5 kW to 40 kW across frame sizes 2 to 5. Key features include compact design, IP20 or IP66 enclosure options, integrated EMC filtering, and simplified commissioning via keypad or app. It is compatible with modern refrigerants and systems requiring precise motor control under variable loads.

The representative reference product is the Size 4 model (CV-440580-3FHE, 30 kW / 40 HP, 380–480 V ±10%, 3-phase input, 58 A). This model is used for the LCA calculations. Impacts are extrapolated to the full range using mass proportionality for the product stage (A1-A3) and power rating proportionality for the use stage (B6). Variations across the range are small.

Full technical specifications for the entire Optidrive™ Coolvert range, including power ratings (kW and HP), current (Amps), frame sizes, voltage inputs, heatsink/coldplate options, and model code structure, are shown below.

The functional unit is one Optidrive Coolvert Size 4 variable frequency drive (30 kW / 40 HP, 380–480 V, 3-phase) delivered and installed over a reference service life of 10 years (87,600 operating hours).

The functional unit is to control the speed and torque of three-phase asynchronous or synchronous electric motors with nominal power up to 30 kW over a reference service life of 10 years (87,600 operating hours), according to the reference use scenario.

	kW	HP	Amps	Size	Product Family		Frame Size	Voltage Code	Power Rating Code		Number of Inputs Phases	EMC Filter	Heatsink/Coldplate	Power Technology
200–240V±10% 1 Phase Input	1.5	2	7.0	2	CV	-	2	2	0070	-	1	F	#	P
	3	4	12	2	CV	-	2	2	0120	-	1	F	#	P
	4	5.5	16.0	2	CV	-	2	2	0160	-	1	F	#	P
	5.5	7.5	20.0	2	CV	-	2	2	0200	-	1	F	#	P
380–480V ± 10% 3 Phase Input	5.5	7.5	14	2	CV	-	2	4	0140	-	3	F	#	E
	7.5	10	18	2	CV	-	2	4	0180	-	3	F	#	E
	11	15	24	2	CV	-	2	4	0240	-	3	F	#	E
	15	20	30	3	CV	-	3	4	0300	-	3	F	#	E
	18.5	25	39	3	CV	-	3	4	0390	-	3	F	#	E
	22	30	46	4	CV	-	4	4	0460	-	3	F	#	E
	30	40	58	4	CV	-	4	4	0580	-	3	F	#	E
	37	45	65	5	CV	-	5	4	0650	-	3	F	#	E
	40	50	75	5	CV	-	5	4	0750	-	3	F	#	E

Replace # in model code with colour-coded option

Heatsink/Coldplate

H **Heatsink** Version

C **Coldplate** Version

Figure 2. The Optidrive™ Coolvert range specifications, including power ratings (kW and HP), current (Amps), frame sizes, voltage inputs, and model code breakdown for heatsink and coldplate versions.

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Manufacturing And Packaging (A1-A3)

The environmental impacts considered for the product stage cover the manufacturing of raw materials for all new products, as well as all packaging materials and other ancillary materials. The combustion of fuels for transportation of said products is also considered. Additionally, fuels and electricity used by machines, and handling of waste formed in the production processes at the manufacturing facilities are included in this stage. The UK electricity factor from EcoInvent was employed. 1 kWh Electricity, high voltage {GB}) this gives a GWP-Total of 0.2914 kg CO2e/kWh. The study also considers the material losses occurring during the manufacturing processes as well as losses during electricity transmission.

Information on Assembly Process: The Optidrive™ Coolvert variable frequency drives are assembled at the Invertek Drives Ltd facility in Welshpool, UK. Components from the Bill of Materials (including printed circuit boards, heatsinks/coldplates, fans, capacitors, wiring, and plastics) are integrated into the final unit. The process involves manual and electrically assisted assembly, mounting of electronics, fitting of heatsinks or coldplates, wiring connections, functional testing, and quality checks. Electricity is the primary energy input. Water use and waste generation (e.g. packaging residues, defective components) are scaled from 2024 facility totals to per drive.

This analysis covers all materials (A1), upstream transportation (A2), and manufacturing (A3) of material impact in the above process.

Transportation and Installation (A4-A5)

Transportation impacts occurred from final products delivery to customer site (A4) cover fuel direct exhaust emissions, environmental impacts of fuel production, as well as related infrastructure emissions. Installation (A5) emissions are related to consumption-based processes and additional materials required for installation of said products.

Description of Installation Process: The drive is installed by hand using handheld tools. No additional materials are required beyond the product itself. Only the disposal of cardboard packaging is considered at installation.

Modules A4 and A5 are included in this study. A4 uses actual freight flight data from shipments to customers. A5 is limited to packaging waste (cardboard assumed recycled).

Product Use and Maintenance (B1-B7)

Description of Product Use and Maintenance: The Optidrive™ Coolvert variable frequency drive operates continuously in motor control applications.

No maintenance, repair, replacement, or operational water use is required over the 10-year reference service life. The drive consumes electricity based on motor load.

Modules B1-B5 and B7 are not declared as they are not relevant. B6 operational energy use is included. It is calculated over 87,600 operating hours (8,760 hours per year) with a load profile of 7,000 hours at 100% load and 2,205 hours at 50% load. Power consumption values come from the technical file for the Size 4 reference model. The electricity mix is representative of France as the main market.

End-of-Life (C1-C4, D)

Description of End-of-Life Process: Energy consumption is not considered for the process of drive de-construction from the system, as the process is manual. Transportation distance to treatment is assumed as 1,000 km and the transportation method is assumed to be lorry (C2) per PCR default scenario. 50% of the product mass is recycled and 50% is disposed to landfill in module C3. No activities are noted to be present for module C4 beyond landfill compaction. The benefits and loads of metals (copper, aluminium, steel), plastics and cardboard packaging recycling are included in Module D. It has been calculated according to Section G.4 of Annex G of EN 50693. The rules in Section G.4 (allocation of recycled materials) were applied for the material recovery of metals, plastics and cardboard packaging. This analysis therefore covers deconstruction (C1), transportation (C2), waste processing (C3), disposal (C4), and benefits and loads (D).

Content Declaration

The materials utilised are based on the bill of components provided by Invertek Drives Ltd. A summary of the components and materials as used in the calculations is provided in **Table 2**. Full details of the packaging materials are provided in **Table 3**.

Table 2. Full details on all subcomponents and materials the Optidrive™ Coolvert Size 4 variable frequency drive is composed of.

Components/Materials	Weight (kg/DU)	Percentage of Input (%)
Component: Resistors	0.0266	0.23%
Component: Capacitors	0.2782	2.43%
Component: Transistor	0.0076	0.07%
Component: PCBs	0.2971	2.60%
Component: Cables	0.0052	0.05%
Component: Integrated Circuits	0.008	0.07%
Component: Diodes	0.0016	0.01%
Component: Transformers	0.3839	3.36%
Raw Material for Pillars: Nylon	0.0224	0.20%
Raw Material for Screws Nuts and Bolts: Steel	0.305	2.67%
Raw Material for Coldplates and Heatsinks: Aluminium	4.8114	42.09%
Raw Material: PVC	0.0265	0.23%
Raw Material: Copper	0.2753	2.41%
Raw Material: Aluminium	0.0662	0.58%
Raw Material: Epoxy	0.1096	0.96%
Raw Material: Silver Alloy	0.0273	0.24%
Raw Material: Ceramic	0.0397	0.35%
Raw Material: Steel	1.1466	10.03%
Raw Material: Brass	0.0017	0.01%
Raw Material: Polycarbonate	0.6721	5.88%
Raw Material: Nylon	0.4986	4.36%
Raw Material: ABS	0.6603	5.78%
Raw Material: Ferrite	0.1634	1.43%
Raw Material for Documentation: Paper	0.2	1.75%

Table 3. Full details on the packaging materials used for transporation of the product per declared unit.

Packaging Materials	Weight (kg/DU)	Weight (% of product)	Biogenic material weight (%)	Biogenic material (kg C/DU)
Packaging Cardboard	1.4	13%	Yes	0.16

Reference Service Life

For the purpose of this EPD the reference service life (RSL) of the product is considered to be 10 years. However, with the correct maintenance, the lifetime of the product can reach over 20 years.

Substances of High Concern

The Optidrive™ Coolvert variable frequency drive contains nickel in the Power Semiconductor Modules supplied by Semikron and the PCB's supplied by Guanged.

Nickel and some nickel compounds are listed under California's Proposition 65 as known to cause cancer and reproductive toxicity (soluble compounds specifically for reproductive harm). A Proposition 65 warning is therefore required for products sold or distributed in California:

WARNING: This product can expose you to chemicals including nickel, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

No substances of very high concern (SVHC) are present above the 0.1% threshold per the REACH Candidate List. The product complies with RoHS restrictions. No other high-concern substances (CMR, Prop 65 above thresholds) were identified from the Bill of Materials or manufacturing processes.

This declaration is based on supplier data and industry-typical compositions. The warning label must appear on the product, packaging or documentation where applicable.

LCA Information

This covers the information in which the EPD is based upon.

Databases and LCA Software Used

Material and process environmental impact factors were taken from Ecoinvent v3.9.1. Calculations were carried out in SimaPro version 9.6.0.1 and Excel.

Functional Unit

The functional unit is one Optidrive™ Coolvert Size 4 variable frequency drive (30 kW / 40 HP, 380-480 V, 3-phase) delivered and installed, over a reference service life of 10 years (87,600 operating hours).

The functional unit is to control the speed and torque of three-phase asynchronous or synchronous electric motors with a nominal power of up to 30 kW over a reference service life of 10 years (87,600 operating hours), according to the reference use scenario.

Time Representativeness

The data collected to complete the analysis for the project was obtained in the 2024 calendar year.

Geographical Scope

This product is exclusively manufactured at Invertek Drives Ltd's facility located in Welshpool, Powys, SY21 8JF, United Kingdom. Therefore, the geographical scope of the LCA is limited to the UK for A3 manufacturing. Transport modelling for both upstream and downstream logistics is also based on UK, Asian and European regional assumptions where applicable. The downstream use of the product is in France.

LCA Scope

This EPD covers the product stage (A1-A3), downstream transport (A4), installation (A5), use stage operational energy use (B6), end-of-life stages (C1-C4), and benefits beyond the system boundary (D). It includes all environmental impacts, resource use, waste generated, and output flows as required by PCR 2024-06 v1.0.1 – Electronic and electric equipment, and electronic components (non-construction).

Installation (A5) is limited to disposal of cardboard packaging (assumed recycled). No energy from tools or on-site processes is included as these fall under cut-off criteria.

The use stage is restricted to B6 (electricity consumption). Modules B1-B5 and B7 are not declared because no maintenance, repair, replacement, refurbishment, or operational water use apply.

End-of-life stages (C1-C4) are included with a conservative scenario (50% recycled / 50% landfill). Module D reports net credits from recycling metals, plastics, and cardboard packaging.

This is cradle-to-grave. Construction/installation details beyond packaging disposal are outside Invertek's direct control and visibility, so they are not modelled beyond A5 packaging waste. The LCA follows the PCR exactly. No heavy assumptions were needed for excluded modules since they are either zero or negligible for this product type.

Module D provides an estimate of the potential benefits that would accrue to a different product system were the product constituents and recycled wastes identified in data for other life cycle modules actually recycled or recovered at current rates and using current technologies.

System Boundaries

This is a cradle-to-grave LCA study with modules A1-A3 (product stage), A4 (downstream transport), A5 (installation), B6 (use stage operational energy use), C1-C4 (end-of-life stage), and module D (benefits and loads beyond the system boundary). This means that all stages from raw material extraction and processing, through manufacturing and packaging of the product, transport to the site, installation, operational energy use over the 10-year reference service life, end-of-life collection, transport, processing, disposal, and any net environmental credits from recycling and recovery are considered. The study covers all environmental impacts, resource use, waste generated, and output flows as required by the International EPD® System PCR 2024-06 v1.0.1 (Electronic and electric equipment, and electronic components (non-construction).

The use stage modules B1-B5 and B7 are not declared (ND) because no significant material impacts, maintenance, repair, replacement, refurbishment, or operational water use apply to this product type. The use stage is limited to B6 (electricity consumption), which dominates impacts for variable frequency drives. All other use stage modules are excluded from the scope.

Table 4 outlines the inclusions and exclusions within the defined system boundary. The Optidrive™ Coolvert Size 4 has a reference service life of 10 years (87,600 operating hours) with no maintenance or replacement requirements assumed in the reference scenario. All excluded modules are marked ND as detailed in **Table 4**.

Module D provides an estimate of the potential benefits that would accrue to a different product system were the product constituents and recycled wastes identified in data for other life cycle modules actually recycled or recovered at current rates and using current technologies.

The system boundary has also been included graphically in **Figure 3**.

Table 4. Modes Declared as part of this Environmental Product Declaration.

	Product stage			Distribution/ installation stage		Use stage							End-of-life stage				Beyond product life cycle
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	X	X	ND	ND	ND	ND	ND	X	ND	ND	X	X	X	X
Geography	Glo	Glo	UK	EU	FR	ND	ND	ND	ND	ND	FR	ND	ND	FR	FR	FR	FR
Share of primary data	-	1.4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	-	+1.5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	-	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

System Boundary - Optidrive™ Coolvert

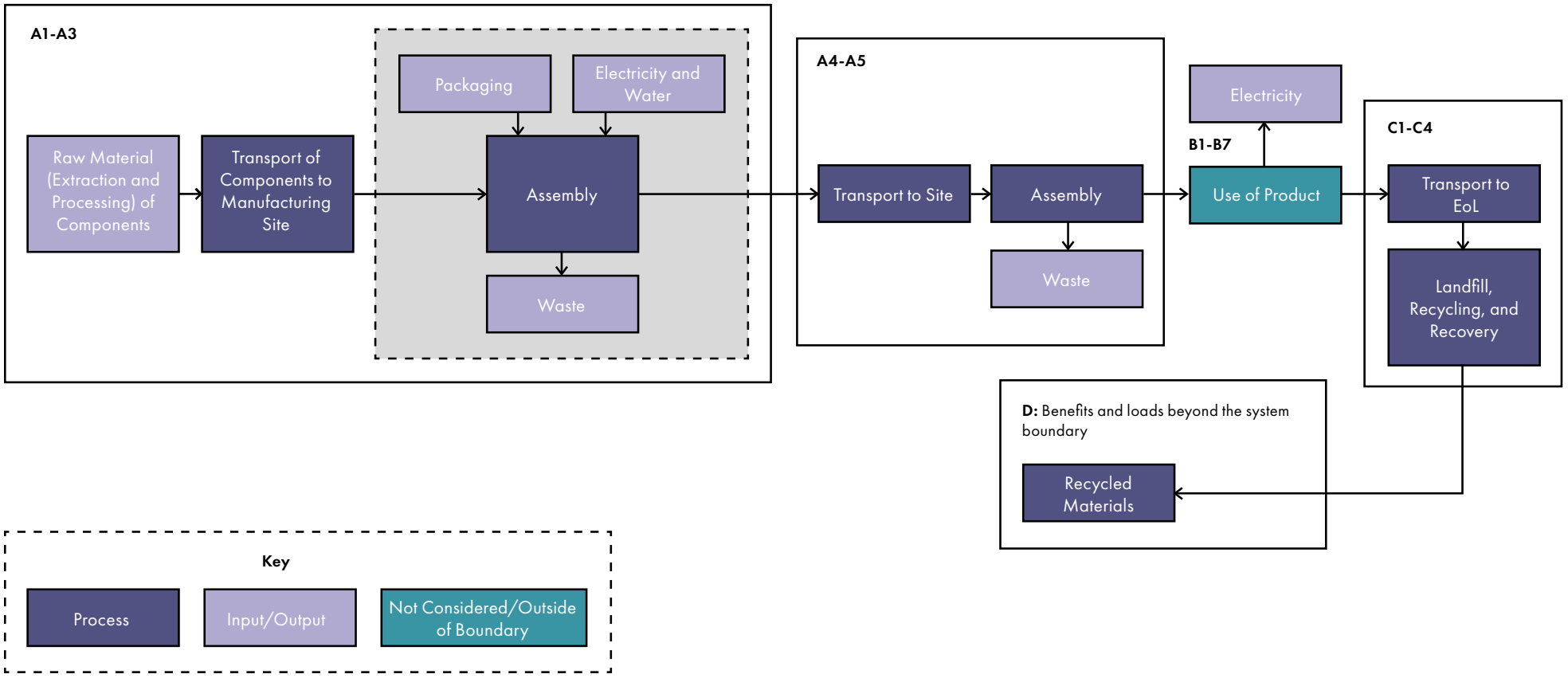

Figure 3. Graphical system boundary of the LCA.

Cut-off Criteria

The collected data covered all raw materials, consumables and packaging materials; associated transport to manufacturing sites; process energy and water use; direct production wastes; emissions to air and water.

According to PCR 2024-06 v1.0.1, the cut-off criterion is set at 1% of the total contribution to each impact category indicator. Flows contributing less than 1% to the total impact per category are excluded. All excluded flows are documented and justified. No flows above this threshold were excluded.

Data Sources & Data Quality

The producer-specific data used in LCA calculations are based on 1-year averaged data and have been updated within the last 5 years. These data were checked to ensure that sufficient materials and water are included within the inputs to account for all products, wastes and emissions.

Item Description Category	Source Type	Source	Reference Year for Data	Data Source	Percentage of A1-A3 GWP-GHG
Raw Material (percentage given)	Bill of materials - direct from Invertek followed by research to estimate material percentages.	EPD Owner, Invertek	2024	Representative Secondary	39.60%
Component (e.g. Resistor)	Bill of materials - direct from Invertek.	EPD Owner, Invertek	2024	Representative Secondary	44.20%
Supplier Manufacturing	Bill of materials - direct from Invertek.	EPD Owner, Invertek	2024	Representative Secondary	6.72%
Raw Material (percentage unknown)	Bill of materials - direct from Invertek followed by research to estimate material percentages.	EPD Owner, Invertek	2024	Representative Secondary	6.39%
HGV Transportation	Bill of materials - direct from Invertek followed by research to estimate material percentages.	EPD Owner, Invertek	2024	Representative Secondary	0.891%
Ocean Transportation	Bill of materials - direct from Invertek followed by research to estimate material percentages.	EPD Owner, Invertek	2024	Representative Secondary	0.695%

Item Description Category	Source Type	Source	Reference Year for Data	Data Source	Percentage of A1-A3 GWP-GHG
Waste from Manufacturing	Bill of materials - direct from Invertek followed by research to estimate material percentages.	EPD Owner, Invertek	2024	Primary	0.968%
Electricity for Manufacturing	Bill of materials - direct from Invertek followed by research to estimate material percentages.	EPD Owner, Invertek	2024	Primary	0.474%
Water for Manufacturing	Bill of materials - direct from Invertek followed by research to estimate material percentages.	EPD Owner, Invertek	2024	Primary	0.000755%

Total share of primary data, of GWP-GHG results for A1-A3 1.4%

Background Data

Background (generic) data from the Ecoinvent database (v3.9.1 using EF 3.1 factors) fulfil the data quality requirements of PCR 2024-06 v1.0.1, including time representativeness within the last 10 years.

The quality of generic data has been reviewed; where necessary, data in the core Ecoinvent v3.9.1 database have been adjusted to better reflect available information about Invertek specific supply chain and about processes that contribute significantly to the LCA results.

Other data were judged fit for purpose. No environmental impact potential stemming from proxy data exceeds 10% for any impact category.

Allocation

In the background data, allocation is applied to all processes except those in which secondary materials are used, where the "cut-off" allocation is applied. This ensures that secondary materials are free of upstream burdens that arise prior to their reaching the "end of waste" state, in accordance with PCR 2024-06 v1.0.1. No other allocation procedures have been applied in this assessment.

Assumptions & Estimates

Inputs to and outputs from the system are accounted for over a 100-year time period, except for biogenic carbon. Long-term emissions are therefore omitted from the impact assessment part of the LCA, except for biogenic carbon releases from waste disposal to which no time cut-off is applied.

The "primary energy used as material" indicators (PERM; PENRM) are calculated using - as characterisation factors - published values for constituent materials which can yield energy on combustion, where available, and from published calorific values where PEM values are not available.

"Primary energy as fuel" indicators (PENRE, PERE) are calculated as the total primary energy demand minus primary energy used as material.

Electricity used in manufacturing is processes is assumed to be from the UK national grid and inclusive of transmission and distribution losses.

For raw material supply (A1), when a component in the BOM was not covered by a generic ecoinvent part dataset and Invertek did not specify it as 100% one material, assumptions were made to estimate the percentage breakdown of each material in that part. This was done to complete the material inventory and enable LCA modelling. Breakdowns were based on typical composition for similar electronic/mechanical parts (e.g. fan guards as steel and nylon; other mixed components researched from manufacturer data or industry standards). Upstream manufacturing processes for those materials (e.g. metal working, injection moulding) were included via appropriate LCI datasets.

Upstream transport (A2) uses the generic default distances from PCR section 2.5.3 based on each component's country of origin classification (international, intracontinental, or local/domestic). Only container ship (for international) and lorry (>27 t at 85% load) are modelled. No ferry, air freight or other modes are included. Distances are combined with component masses to give tonne-km flows.

Manufacturing (A3) data (electricity, water, waste) is scaled from 2024 annual facility totals to per-drive basis using total drives produced that year.

Downstream transport (A4) uses actual freight flight data from shipments to customers, with tonne-km calculated from product mass and real distances.

Installation (A5) includes only disposal of cardboard packaging (assumed recycled). No energy from hand tools or on-site processes is modelled (cut-off criteria applied).

Use stage (B6) assumes 87,600 operating hours over 10 years (8,760 h/year). The load profile is 7,000 hours at 100% load and 2,205 hours at 50% load. Power consumption comes from the technical file for the Size 4 reference model. Electricity mix is France representative.

End-of-life (C1-C4) uses a conservative 50% recycled / 50% landfill split for the product mass. Transport to treatment (C2) is 1,000 km by lorry per PCR default scenario in section 2.5.6. Recycling applies typical French rates for electronics (high for metals, circuit boards; lower for plastics).

Recycling losses are assumed at 20% for cardboard and steel (material not recovered during sorting/ reprocessing).

If any plastic fractions are incinerated, 22% losses are assumed based on UK WRAP waste-to-energy guidance.

Module D benefits use the substitution method (PCR Table 1 page 16) for avoided virgin production of metals (copper, aluminium, steel), plastics, and cardboard packaging. No reuse or energy recovery beyond recycling is modelled.

Results for the representative Size 4 model are scaled to the full Coolvert family (Sizes 1 to 5) as per PCR 2024:06 v1.0.1, section 2.6, to enable a family EPD. Individual A1-A3 results have been calculated for each Coolvert size (1 to 5) using the specific bill of materials provided for every model. This enables a tailored process flow and accurate representation of material for each product in the family. Manufacturing impacts in A3 remain consistent across sizes due to the per-unit allocation method. For the use stage (B6), results are scaled from Size 4 using power rating proportionality, since energy consumption in the use phase varies directly with the device's nominal power. Calculations confirm that A1-A3 variations across the family are small (maximum +1.5% from the Size 4 reference) and well within acceptable limits for family EPD representation per PCR 2024:06 v1.0.1, section 2.6. The Size 4 model remains the declared reference product for the EPD.

Environmental Performance Indicators

This EPD contains environmental information in the form of quantitative indicator values for a number of parameters, which encompass calculated environmental impact potentials, resource and energy use, waste generation and material and energy outputs from the product system that may be reused, recycled or recovered into other, unspecified product life cycles. These parameters are listed below along with the abbreviations used for them in the tables of indicator values that follow.

Table 5. 1 - Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Environmental Impact	Acronym	Unit
Climate Change - Total	GWP-Total	kg CO2 eq
Climate Change - Fossil	GWP-Fossil	kg CO2 eq
Climate Change - Biogenic	GWP-Biogenic	kg CO2 eq

Climate Change - Land Use and Land Use Change	GWP-Luluc	kg CO2 eq
Acidification Potential	AP	mol H+ eq
Eutrophication freshwater	EP-freshwater	kg P eq
Eutrophication marine	EP-marine	kg N eq
Eutrophication terrestrial	EP-terrestrial	mol N eq
Photochemical Ozone Formation	POCP	kg NMVOC eq
Ozone Depletion	ODP	kg CFC11 eq
Depletion of Abiotic Resources - Minerals and Metals	**ADPMM**	**kg Sb eq**
Depletion of Abiotic Resources - Fossil Fuels	ADPFF	MJ
Water Deprivation Potential	WDP	m3 depriv
Resource Use	Acronym	Unit
Renewable primary energy as energy carrier	**PERE**	**MJ**
Renewable primary energy resources as material utilisation	PERM	MJ
Total renewable primary energy use	PERT	MJ
Non-renewable primary energy as energy carrier	PENRE	MJ
Non-renewable primary energy resources as material utilisation	PENRM	MJ
Total non-renewable primary energy use	PENRT	MJ
Use of secondary material	**SM**	**MJ**
Use of renewable secondary fuels	RSF	MJ
Environmental Impact	**Acronym**	**Unit**
Use of non-renewable secondary fuels	NRSF	MJ
Net use of fresh water	FW	m3
Waste Generated	Acronym	Unit
Hazardous waste disposed	HWD	kg
Non-hazardous waste disposed	NHWD	kg
Radioactive waste disposed	RWD	kg
Output Flows	Acronym	Unit
Components for re-use	CRU	kg
Materials for recycling	MFR	kg
Materials for energy recovery	MER	kg
Exported Energy - Electrical	**EEE**	**MJ**
Exported Energy - Thermal	EET	MJ
Additional Indicators	Acronym	Unit
Global Warming Potential - Green House Gases - Non Biogenic	GWP-GHG	kg CO2 eq
Particulate Matter emissions (Disease incidence)	**PM**	**Disease incidence**
Ionizing radiation, human health (kBq U235 eq)	IRP	kBq U235 eq
Eco-toxicity (CTUe)	ETP-Total	CTUe

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Human toxicity, cancer effects (CTUh)	HTP-c	CTUh
Human toxicity, non-cancer effects (CTUh)	HTP-ncw	CTUh
Land use related impacts/Soil quality (dimensionless)	SQP	dimensionless

Environmental Performance Indicator Results

Environmental indicator results for the declared modules are shown in the tables below per one Optidrive™ Coolvert Size 4 variable frequency drive (declared unit: one drive delivered and installed over 10 years / 87,600 operating hours). The estimated impact results are only relative statements. They do not indicate the endpoints of the impact categories, exceedance of threshold values, safety margins or risks.

The results of the end-of-life stage (modules C1-C4) should be considered when using the results of the product stage (modules A1-A3). Biogenic carbon from packaging is balanced by adding equivalent virtual biogenic CO_2 emissions in the manufacturing module as required for cradle-to-grave EPDs under this PCR.

Full results tables are provided in the LCA report. Use-stage energy consumption (B6) dominates most indicators, as expected for variable frequency drives. Manufacturing (A1-A3) is the next largest contributor. End-of-life credits (D) are small but positive.

Interpretation

Indicator values obtained for resource depletion (ADPE, ADPF), stratospheric ozone depletion (ODP) and water deprivation (WDP) potential should be used with caution; all are subject to uncertainties in data or method which limit the scope for their use as the basis for comparisons.

Activities upstream in Invertek supply networks contribute strongly to the environmental indicator values reported in this EPD. Evaluation of the data available to represent these activities identified various sources of uncertainty which influence those indicator values. The uncertainty associated with the declared values is considered to be at least +/-10% for the climate change category and is likely higher for other categories.

No untreated wastes leave the modelled system, which includes waste treatment activities as required by PCR 2024-06 v1.0.1.. The waste indicators HWD, NHWD and TRWD presented in this EPD therefore represent waste flows within the modelled system.

Environmental indicator results are shown in **Table 6** for the one Optidrive™ Coolvert Size 4 variable frequency drive; modules A1 - A3 are shown on an aggregated basis.

Product Variability and Representativeness of the Average EPD

The Optidrive Coolvert variable frequency drives form a coherent product family sharing a common technical function, material composition, manufacturing route, assembly site (UK), and end-of-life profile. The Size 4 model serves as the representative reference for the family EPD.

A1-A3 GWP-Fossil results have been calculated individually for each size using specific bills of materials:

- Size 2a = 208 kg CO2e
- Size 2b = 205 kg CO2e
- Size 3 = 228 kg CO2e
- Size 4 = 269 kg CO2e
- Size 5 = 273 kg CO2e

The observed variability is primarily due to differences in the mass of the aluminium heatsink, which scales with device size and dominates the embodied carbon in A1-A2. Manufacturing impacts (A3) remain consistent per unit across the family due to the allocation method described earlier.

The maximum deviation increase from the Size 4 reference is +1.5% (Size 5), with smaller sizes showing reductions of up to -23.8%. This limited variability is not considered significant under EN 50693 requirements (and aligns with PCR 2024:06 v1.0.1 Section 4.9 thresholds for family representativeness). Therefore, the declared results for Size 4 are representative of the full product family, and separate EPDs for individual sizes are not required.

Table 6. Full environmental impact, resource use, waste generated, and output flow metrics measured for one declared unit of the Coolvert product.

EI Factor	Unit	A1-A3	A4	A5	B6	C2	C3	C4	Total (A1-C4)	D
GWP-Total	kg CO_2 eq	2.72E+02	9.05E+00	2.78E-01	3.25E+03	1.78E+00	9.38E-03	2.83E-03	3.53E+03	-4.98E+00
GWP-Fossil	kg CO_2 eq	2.69E+02	9.05E+00	2.77E-01	3.17E+03	1.78E+00	9.36E-03	2.82E-03	3.45E+03	-5.25E+00
GWP-Biogenic	kg CO_2 eq	2.77E+00	1.67E-03	2.52E-04	8.04E+01	1.61E-03	1.43E-05	3.89E-06	8.32E+01	2.98E-01
GWP-Luluc	kg CO_2 eq	4.44E-01	7.15E-04	1.35E-04	1.76E+00	8.63E-04	5.31E-06	7.66E-07	2.21E+00	-2.47E-02
AP	mol H+ eq	2.09E+00	3.95E-02	9.12E-04	1.25E+01	5.79E-03	8.51E-05	3.45E-05	1.47E+01	-1.90E-02
EP-Freshwater	kg P eq	2.23E-01	1.26E-04	1.94E-05	5.35E-01	1.24E-04	6.19E-07	1.54E-07	7.58E-01	-1.71E-03
EP-Marine	kg N eq	3.52E-01	1.60E-02	3.15E-04	4.07E+00	1.99E-03	3.69E-05	1.55E-05	4.44E+00	-6.76E-03
EP-Terrestrial	mol N eq	3.59E-01	1.60E-02	3.15E-04	4.07E+00	1.99E-03	3.69E-05	1.55E-05	4.44E+00	-6.76E-03
POCP	kg NMVOC eq	1.15E+00	5.39E-02	1.36E-03	1.03E+01	8.66E-03	1.12E-04	4.68E-05	1.16E+01	-1.63E-02
ODP	kg CFC11 eq	8.98E-06	1.42E-07	6.05E-09	1.16E-04	3.87E-08	2.51E-10	4.41E-11	1.25E-04	-1.88E-07
ADPMM	kg Sb eq	4.59E-02	1.82E-06	8.88E-07	9.73E-03	5.71E-06	2.53E-08	9.85E-09	5.57E-02	-1.54E-05
ADPFF	MJ	3.15E+03	1.20E+02	3.94E+00	4.91E+05	2.52E+01	1.60E-01	3.60E-02	4.94E+05	-1.06E+02
WDP	m^3 depriv	5.47E+01	2.02E-01	1.60E-02	1.03E+03	1.03E-01	3.06E-04	8.26E-05	1.08E+03	-1.47E+00
Resource Use	**Unit**	**A1-A3**	**A4**	**A5**	**B6**	**C2**	**C3**	**C4**	**Total (A1-C4)**	**D**
PERE	MJ	2.94E+02	3.90E-01	2.40E+01	3.43E+04	3.92E-01	4.55E+00	1.06E-04	3.46E+04	-2.89E+01
PERM	MJ	2.84E+01	0.00E+00	-2.39E+01	0.00E+00	0.00E+00	-4.53E+00	0.00E+00	-8.88E-16	0.00E+00
PERT	MJ	3.23E+02	3.90E-01	6.62E-02	3.43E+04	3.92E-01	1.80E-02	1.06E-04	3.46E+04	-2.89E+01
PENRE	MJ	3.30E+03	1.28E+02	4.18E+00	4.95E+05	2.68E+01	5.21E+01	1.06E-02	4.98E+05	-1.12E+02
PENRM	MJ	5.20E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.20E+01	0.00E+00	7.11E-15	0.00E+00
PENRT	MJ	3.35E+03	1.28E+02	4.18E+00	4.95E+05	2.68E+01	1.07E-01	1.06E-02	4.98E+05	-1.12E+02
SM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.85E+00	7.20E-03	5.61E-04	1.32E+02	3.59E-03	1.63E-05	9.30E-07	1.34E+02	-5.64E-02
Waste Generated	**Unit**	**A1-A3**	**A4**	**A5**	**B6**	**C2**	**C3**	**C4**	**Total (A1-C4)**	**D**
HWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD	kg	2.16E+00	0.00E+00	1.46E+00	0.00E+00	0.00E+00	4.72E+00	4.72E+00	1.31E+01	0.00E+00
RWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Output Flows	**Unit**	**A1-A3**	**A4**	**A5**	**B6**	**C2**	**C3**	**C4**	**Total (A1-C4)**	**D**
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	5.28E-01	0.00E+00	1.46E+00	0.00E+00	0.00E+00	4.72E+00	0.00E+00	6.71E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Additional Indicators	**Unit**	**A1-A3**	**A4**	**A5**	**B6**	**C2**	**C3**	**C4**	**Total (A1-C4)**	**D**
GWP-GHG	kg CO2 eq	2.70E+02	9.05E+00	2.77E-01	3.17E+03	1.78E+00	9.37E-03	2.82E-03	6.98E+03	-5.28E+00
PM	Disease incidence	1.84E-05	8.45E-08	2.19E-08	1.84E-04	1.41E-07	1.95E-10	6.54E-11	2.03E-04	-2.74E-07
IRP	kBq U235 eq	1.95E+01	3.76E-02	6.07E-03	2.23E+04	3.37E-02	2.77E-03	2.01E-05	2.24E+04	-2.90E+00
ETP-Total	CTUe	8.58E+03	1.17E+02	3.87E+00	1.84E+04	2.49E+01	8.76E-02	3.58E-02	2.71E+04	-5.71E+01
HTP-c	CTUh	3.55E-07	9.52E-10	1.25E-10	1.40E-06	8.07E-10	2.53E-12	8.33E-13	1.76E-06	-7.63E-08
HTP-nc	CTUh	1.16E-05	9.65E-08	2.76E-09	2.49E-05	1.77E-08	4.45E-11	1.36E-11	3.66E-05	-6.01E-08
SQP	dimensionless	1.03E+03	7.53E+00	2.33E+00	1.41E+04	1.50E+01	4.05E-02	2.84E-03	1.51E+04	-8.64E+01

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Abbreviations

Abbreviation	Definition
EN	European Norm (Standard)
EF	Environmental Footprint
GPI	General Programme Instructions
ISO	International Organization for Standardization
CEN	European Committee for Standardization
CLC	Co-location centre
CPC	Central product classification
GHS	Globally harmonized system of classification and labelling of chemicals
GRI	Global Reporting Initiative
SVHC	Substances of Very High Concern
ND	Not Declared
LCA	Life cycle assessment
PCR	Product Category Rules
c-PCR	Complementary Product Category Rules
CEN	European Committee for Standardization
GHG	Greenhouse Gas
PEF	Product Environmental Footprint

References

Ecoinvent database – www.ecoinvent.ch

General Program Instructions, Version 5.01, 2025-02-27 - The International EPD® System - EPD International AB

ISO 14001:2015 - Environmental management systems – Requirements with guidance for use.

ISO 14025:2009-11 - Environmental labels and declarations - Type III environmental declarations - Principles and procedures.

PCR 2024-06 v1.0.1 – Electronic and electric equipment, and electronic components (non-construction)

Annex

The International EPD® System: a programme for Type III environmental declarations, maintaining a system to verify and register EPDs as well as keeping a library of EPDs and PCRs in accordance with ISO 14025. (www.environdec.com).

Life cycle assessment (LCA): LCA studies the environmental aspects and quantifies the potential impacts (positive or negative) of a product (or service) throughout its entire life. ISO standards ISO 14040 and ISO 14044 set out conventions for conducting LCA.

Version History

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