Gridspertise Srl

ENVIRONMENTAL PRODUCT DECLARATION

PRODUCT NAME:

Single Phase meter (Globy-DM)

SITE:

No.99 Tianquan Rd., Hi-Tech Development Zone, 611730, Chengdu, P.R.C.

In accordance with ISO 14025 and EN 15804:2012+A2:2019/AC:2021

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration Number	Single Phase meter(Globy-DM)
Registration Number	EPDITALY1200

Issue date	11/03/2026
Valid to	11/03/2031

www.epditaly.it

GENERAL INFORMATION

EPD OWNER	
Name of the company	Gridspertise Srl
Registered office	00198 Roma, Via Ombrone 2
Contacts for information on the EPD	Danilo Ferrazza Manufacturing Quality Assurance danilo.ferrazza@gridspertise.com

PROGRAM OPERATOR	
EPDItaly	Via Gaetano De Castillia n° 10 - 20124 Milano, Italy

INFORMATION ON THE EPD	
Product name	Single Phase meter
Site (s)	No.99 Tianquan Rd., Hi-Tech Development Zone 611730, Chengdu, P.R.C.
Short description and technical information of the product (s)	Globy-DM single phase smart meter adopts advanced MCU, electrical power measurement technologies and perfect anti-tampering design. It is designed to register the electricity active energy (include import and export), can be accessed via PLC/IR, which completely compliance with DLMS or Meters and More (only 3M2 version) protocol.
Field of application of the product	Electricity meter permanently installed in low-voltage electrical installations as part of a building-integrated technical system for the measurement of electric energy.
Reference product standards (if applicable)	EN IEC 62052-11:2021/A11:2022 Electricity metering equipment (AC) – General requirements, tests and test conditions – Part 11: Metering equipment EN 50470-3:2022 Electricity metering equipment (a.c.) – Part 3: Particular requirements – Static meters for AC active energy (class indexes A, B and C) EN IEC 62053-21:2021 Electricity metering equipment – Particular requirements – Part 21: Static meters for AC active energy (classes 0,5, 1 and 2) EN 62052-31:2016 Electricity metering equipment (AC) - General requirements, tests and test conditions - Part 31: Product safety requirements and tests.
CPC Code (number) https://unstats.un.org/unsd/classifications/Econ	4621 « electricity distributor or control apparatus »

VERIFICATION INFORMATION	
PCR (title, version, date of publication or update)	Core-PCR: EPDITALY007 " Electronic and electrical product and systems" Rev. 3.2 – 10/12/2025 Sub-PCR: EPDITALY011 Sub-PCR: EPDITALY011 "Electronic and electrical product and systems -Meters" REV. 1 01-07-2024 UNI EN 15804:2012+A2:2019/AC:2021 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
EPDItaly Regulation (version, date of publication or update)	Regulation EPDITALY, Rev 6,-30/10/2023
Project Report LCA	LCA Report for Single Phase meter(Globy-DM)-Version: 2.0 - 2026-03-04

Independent Verification Statement	The PCR review was performed by - info@epditaly.it. Independent verification of the declaration and data, carried out according to ISO 14025: 2010. O Internal ☑ External Third party verification carried out by: ICMQ S.p.A., via Gaetano De Castillia n ° 10 - 20124 Milan, Italy. Accredited by Accredia.
Comparability Statement	Environmental statements published within the same product category, but from different programs, may not be comparable. In particular, EPDs of construction products may not be comparable if they do not comply with EN 15804:2012+A2:2019/AC:2021.
Liability Statement	The EPD Owner releases EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any responsibility for the information, data and results provided by the EPD Owner for lifecycle assessment.

Introduction

This document represents EPD report of product Single Phase meter(Globy-DM) produced by Gridspertise S.r.l. in compliance with EPDItaly program and related regulation. This report is developed in compliance to ISO 14025 aimed to provide rules for development, verification, and publication of Environmental Product declarations.

This study is compliant with "PCR EPDItaly011 – Meters", which identifies the goal, scope, application field of information rules for production of environmental information, life cycle phases to be included in the study, parameters considered, how to collect those parameters and how to perform communication on the report.

Organization

Gridspertise Group is the technological partner that delivers intelligence for grid modernization in a flexible and reliable way, developing integrated devices, cloud-edge-based solutions, and services that enable, manage, and optimize smart grids.Set up in 2021 as a carve-out of Enel' s 20+ year experience in developing and scaling up digital grid technologies, Gridspertise became an independent company in 2022 and, in 2023, acquired Aidon a smart metering leader in the Nordics, which was founded in 2004.

Gridspertise Group, operates globally with headquarters in Italy and subsidiaries in Spain, Finland, Norway, Sweden, Denmark, Germany, Romania, and Brazil. Thanks to its glocal organization approach and its highly skilled and dynamic team, Gridspertise is perfectly positioned to work with utilities everywhere in the world, understanding their needs and offering tailored solutions.

As pioneers in smart energy, Gridspertise drive a powerful convergence of digital systems and operational assets, combining unparalleled cutting-edge technology and operational know-how and expertise.

As of June 2025, Gridspertise have served over 200 clients worldwide, delivered over 114 million smart meters and connected over one million energy metering points with our metering service.

Scope and goal of EPD

This is a specific product EPD of meter Single Phase meter(Globy-DM): a device for supply control of electrical energy, produced by Shenzhen Kaifa Technology(Chengdu) Co.,Ltd. for Gridspertise S.r.l. and following Gridspertise technical specifications.

The study includes all phases of lifecycle from extraction of raw material to the disposal including recycling processes, reuse and/or recovery of materials at the end-of-life as secondary raw materials.

The system boundaries in this case are actually cradle to grave(with module D).

All declared life cycle stages are marked with" X" in Table 3. Modules not declared will be marked with MND.

Table 1. System boundaries in accordance

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	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	x	x	x	x	x	x	x	x	x	x	x	x
Geography	GLO	GLO	CN	GLO	EU	EU	EU	EU	EU	EU	EU	EU	EU	EU	EU	EU	EU
Specific data used	11%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	0%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	0%					-	-	-	-	-	-	-	-	-	-	-	-

X = included in LCA; MND = Module not declared

Functional unit

The functional unit object of the study is 1 single device designed for the monitoring of electric energy consumption from first measure to 20 years of life.（The conversion factor in 0.59854 kg/DU）

According to PCR EPDItaly, the reference life service (RLS) 20 years. The actual life span of the meter is 15 years; therefore, replacement occurs in the fifteenth year.

Product and processes description

Product description:

GLOBY-DM is a single-phase bidirectional electronic electric meter. Specifically designed for energy metering scenarios in low-voltage power grids, it features accurate metering capabilities, rich functional configurations, and reliable protection performance. Widely applicable to energy management in households and small

commercial premises, it fully complies with relevant EU metrological and safety standards, combining practicality and compliance.

1. Product Application Field

This meter focuses on measuring active and reactive energy in low-voltage power grids (below 10 kW), and is compatible with a reference voltage of 127 V to 230 V, meeting the usage requirements of different low-voltage grid environments and accurately matching the metering needs of various small-scale electricity consumption scenarios. Additionally, the meter supports both remote control mode and standalone operation mode. It can be integrated into remote control systems for centralized management or used independently, adapting to the diverse usage scenarios of Distribution System Operators (DSO) and general users.

As the product has been permanently installed in a building, it can be regarded as falling within the scope of construction products covered by EN 15804, in accordance with the applicable Product Category Rules (PCR). Therefore, this study complies with all additional requirements applicable to construction products.

2、Core Technical Characteristics

Metering Capabilities: Active energy metering accuracy reaches Class 1 of IEC 62053-21 or Class B/A of EN 50470-3; reactive energy metering accuracy reaches Class 2 of IEC 62053-23, ensuring accurate and reliable metering data. It features bidirectional metering functionality, simultaneously recording energy consumption and generation feedback data.

Multiple Communication Interfaces: Equipped with a ZVEI optical interface conforming to EN IEC 62056-21, and a power line communication (PLC) modem, enabling remote communication with low-voltage concentrators. It also reserves communication interfaces for home devices, adapting to the linkage requirements of smart grids.

Reliable Protection Design: IP51 protection rating, employing a double insulation design, Class II protection, effectively resisting external environmental interference and electrical shocks; it features anti-tampering functions such as terminal cover opening detection, case opening detection, and magnetic field interference detection, ensuring the security of metering data.

Processes description

Pick and Place:

SMT (Surface Mount Technology) is a precision assembly technique that involves mounting electronic components directly onto the surface of a printed circuit board (PCB) for soldering. The process consists of three stages: solder paste printing, component placement, and reflow soldering. Solder paste is applied to the PCB pads through a stencil, components are accurately placed using a pick-and-place machine, and finally, soldering connections are achieved through reflow soldering.

AOI Test：

SMT AOI (Automated Optical Inspection) is a critical equipment in SMT (Surface Mount Technology) production, used to detect solder joint defects and component placement quality. Based on optical imaging and machine vision technology, it can inspect circuit board defects on the production line in real time and improve product yield.

Wave soldering：

The DIP (Dual In-line Package) component insertion process is primarily used for larger components that cannot be mounted via SMT. Components are inserted into PCB holes manually or with automated equipment, and then electrical connections between the components and the PCB are achieved through wave soldering, where molten solder forms a wave to complete the soldering process.

Selective wave soldering：

Selective wave soldering is a type of surface mount technology that achieves efficient and high-quality soldering through precise localization of the soldering area.

PCB functional test：

By simulating actual operating conditions, it validates the circuit board's electrical performance, component functionality, and overall reliability.

Assembly phase：

The structural component assembly process utilizes automated equipment such as automatic welding machines and automatic screw fastening machines to achieve the assembly of structural parts and the welding of wires.

Meter Functional test：

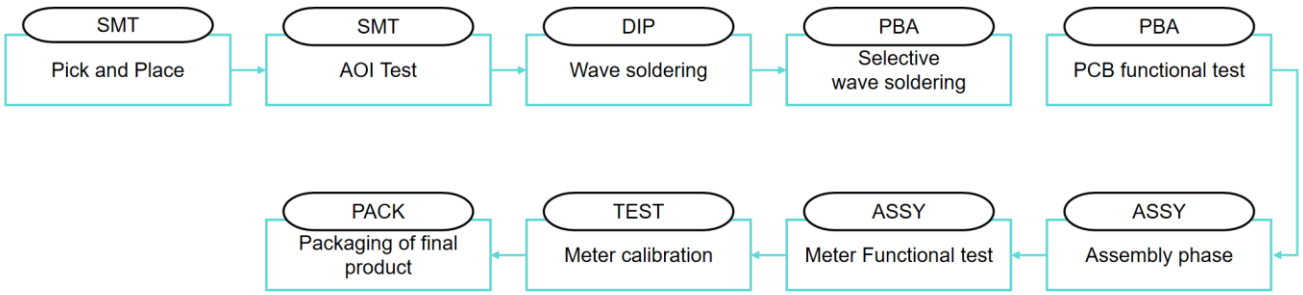
A key verification step after ASSY assembly, primarily used to detect the meter's measurement performance and electrical parameters.

Meter calibration：

Detecting the accuracy error value of electric meters. The core principle of electrical energy accuracy testing is to quantify errors by comparing the output difference between the meter under test and a standard reference instrument, combined with high-precision time and power measurement technology.

Packaging of final product：

The final stage before product shipment involves writing corresponding parameters according to customer requirements and completing the meter locking operation, followed by final packaging and shipping.



Component and characteristics of product

The characteristic data of the meter, based on our current knowledge and verification, are:

Technical specification	Value
Nominal voltage	127V/230V (-15% to +15%)
Frequency	50 Hz (± 2%)
Performance class according to reference standard	Class B, Class 2
Current intensity	Minimum current:0.25A Base current:5A maximum current: 80A

The listed groups of restricted substances in the current version of the European Directive 2011/65/UE (RoHS II) (and last updating 2015/863/UE) and 2011/37/UE (ELV) and their implementations, are not contained or are contained only in homogeneous proportions below the tolerance/exemption values

Table 2. Presence of SVHCs and RoHS exemptions

SVHCs	RoHS exemptions
- 7439-92-1 LEAD - 3147-75-9 2-(2H-benzotriazo1-2-yl)-4-(1,1.3.3-tetramethylbutyl)phenol (UV-329) - 84852-53-9 1,1,1-(ethane-1,2-	6C 7C1

diyl)bis(pentabromobenzene) (DBDPE) - Perfluorobutane sulfonic acid (PFBS) and its salts	

Materials contents by weight are listed in Table 3.

Table 3. Materials contents by weight

Category	Raw material	Value	Unit
Electronic parts	LCD	10	g
	battery	9	g
	transformer	15.58	g
	HALL SENSOR	0.015	g
	CRYSTAL	0.042	g
	SWITCH	0.948	g
	light-sensitive semiconductor	0.21	g
	PCB	28	g
	IC	1.58	g
	INDUCTOR	3.981	g
	MBALL	0.01	g
	DIODE	1.591	g
	Transistor	0.11	g
	Resistor	5.556	g
	Capacitor	24.643	g
Metal parts	Screw	5.31	g
Structural parts	Plastic shell	54.8	g
	Plastic housing	83	g
	Plastic Bottom shell	240.5	g
package materials	Label	0.1925	g
	Box;Carton;ANGLE PROTECTOR;	64.5	g
	Plywood	40	g
Other consumables	DESICCANT/Permanent magnet	8.97	g
Total	/	**598.54**	g

A1 Raw material supply (Product stage):
In this process, the materials and components are manufactured by supplies, and the Single Phase meter(Globy-DM) product can be divided into 3 parts: Electronic parts, Structural parts and package materials as well as indirect emissions from energy consumption. Because production plant has no financial control or operational control over the supplies manufacturing materials above, Upstream production data for materials (eg. Resistor, Capacitor, Printed Circuit Board, plastic parts) refer to Ecoinvent database. The calculation of power modeling will be conducted based on the power structure of the factory: hydropower accounts for 31.72% *(Electricity, high voltage {CN-SC}| electricity production, hydro, run-of-river | Cut-off, S：4.59E-03kg CO2e/kWh)* wind power accounts for 35.15%（*Electricity, high voltage {CN-SC}| electricity production, wind, >3MW turbine, onshore | Cut-off, S：3.96E-02kg CO2e/kWh*）, and the remaining 33.13% is defaulted to China's national grid average（*Electricity, low*

voltage {CN}| market group for electricity, low voltage | Cut-off, S：8.49E-01kg CO2e/kWh). The GWP of the electricity mix is 0.2966 kg CO2e/kWh.

A2 Transport (Product stage):
The mode of transportation of materials is by lorry. However , It's hard for factories to keep track of the load of lorry. In this case, report assumed that the lorry (EURO 6, 7.5-16 t) are in use.

A3 Manufacturing (Product stage):
Shenzhen Kaifa Technology(Chengdu) Co.,Ltd. (hereinafter referred to as Kaifa Metering) is responsible for SMT, DIP, and other processes. In this process, involving auxiliary materials, as well as waste gas emissions resulting from factory production and solid waste emissions.

A4 Transport (Construction process stage)
The A4 module including the transportation plan is as follows:
Transport Route: Chengdu → Shenzhen (Yantian Port) → Genoa → Rome. Total distance ≈ 1,690 kilometers (road transport) + 24,590 kilometers (sea transport) + 515 kilometers (road transport) ≈ 26,795 kilometers;

A5 Construction installation (Construction process stage)
The A5 module including manufacture and transportation of ancillary materials and any energy or water required for installation or operation of the construction site. At the same time, the transport and disposal of packaging waste is taken into account. The product does not consume any material in the process. The packaging materials are recyclable and 75% package materials are recycled. The remaining 25% is incinerated. The transport distance of packaging materials to the treatment plant is assumed to be 50km.

B1-B3 Use to repair
There are no direct emissions generated from using the Single Phase meter(Globy-DM) , nor is there any maintenance, repair, or replacement of subcomponents required during it’s service lifetime of 15 years. The full unit is replaced in module B4

B4 Replacement (Use stage)
Since the RSL according to PCR EPDItaly011 – Meters is 20 years, and the Single Phase meter(Globy-DM)has a service lifetime of 15years.Therefore, two electric meters are required to support 20 years of service life. During the B4 stage, with the specific unit processes as follows: the complete C1-C4 stages (corresponding to the first electric meter) , and A1-A5 stages (corresponding to the second electric meter)

B5 Refurbishment (Use stage)
No rehabilitaion in B5 module.

B6 Operational energy use (Use stage)
According to PCR EPDItaly, the Reference service life (RSL) 20 years. The following formula show the calculation for electric energy consumption of the device during use phase according to PCR EPDItaly 011.

$$\mathrm{Euse} = \mathrm{P(use)} * 8760 * \mathrm{RLS}/1000$$

The parameter values used in each equation is described according to the following table:

Parameter	Value	Unit	Comment	Source
P(use)	1.025 (idle mode) 1.188 (active mode)	W	99% of working time in idle mode, 1% in active mode	Shenzhen Kaifa Technology(Chengdu) Co.,Ltd.
RSL	20	Years	EPDItaly011 – Meters	EPDItaly011 – Meters

Based on the equations and the input parameters, the following results were obtained:

- **P(use)** = 1.02663W
- **Euse** = 179.865576kWh

B7 Operational water use (Use stage)
No water consumption in B7 module.

C1 De-construction demolition (End of life stage)
C1 deconstruction, including dismantling or demolition, of the product from the building. In this process, the common scenario of manual dismantling for 100% of the product is considered. Refer to the Ecoinvent database for relevant activity data.

C2 Transport (End of life stage)
Assume that the transportation distance for scrapped and dismantled products to the waste treatment plant is 50 km by road transportation, with specific details shown in the table below.

Transport	Distance	Comment
Road	50 km	Transport, freight, lorry, diesel, unspecified {RER}| transport, freight, lorry, all sizes, EURO 6 to generic market for transport, freight, lorry, unspecified | Cut-off, S

C3 Waste processing (End of life stage)
According to the value of R2 in PEF, it is assumed that the recovery rate of Metal Parts is 90%, the recovery rate of Plastic Parts is 29%, and the recovery rate of Packaging Materials is 75%. The default disposal method for electronic components is incineration. A regulatory environmental cost allocation framework deployed under the Polluter Pays Principle (PPP) has been implemented.In the C3 process, the materials subject to Recycling include: 90% of metal materials, 29% of plastic parts, and 45% of batteries.

C4 Disposal (End of life stage)
Products are assumed to be recycled according to the recycling rates presented PEF recycling factors "R2". After the recycling streams are separated, the remaining metals are assumed to go to landfill for inert matter.
In the Circular Flow Formula (CFF) of the Product Environmental Footprint (PEF).
R2: The proportion of material in the product that will be recovered (or reused) in subsequent systems.
PEF Guidelines designate metals, plastics, packaging materials and non-recycled residual matter as subject to landfilling and/or incineration within municipal solid waste (MSW) management systems
In the C4 process, 10% of metal materials are disposed of by Landfill.The materials subject to Incineration include: 55% of batteries and the remaining unrecycled electronic components.

D Reuse-Recovery-Recycling-potential (Resource recovery stage)
In Module D, the metal components, such as wall racks and fan brackets, will be recycled at a rate of 90%. The plastic materials, such as buffer wood and cartons, will be recycled at a rate of 29%

LCA results

This section shows the LCA results calculated according to EN15804 methodologies and the Version of CF Factors (EF 3.1).

Table 4. Results of LCA study for EPD impact categories.

Impact category	Unit	A1-A3	A4	A5	B1-B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-total	kg CO2 eq	1.51 E+01	3.97 E-01	4.67 E-02	0.00 E+00	1.60 E+01	0.00 E+00	6.33 E+01	0.00 E+00	0.00 E+00	5.58 E-03	8.80 E-02	4.16 E-01	-6.46E-01
GWP-fossil	kg CO2 eq	1.50 E+01	3.97 E-01	4.67 E-02	0.00 E+00	1.59 E+01	0.00 E+00	6.31 E+01	0.00 E+00	0.00 E+00	5.58 E-03	8.80 E-02	4.16 E-01	-1.67E-03
GWP-biogenic	kg CO2 eq	5.30 E-02	7.07 E-05	8.30 E-07	0.00 E+00	5.32 E-02	0.00 E+00	1.62 E-01	0.00 E+00	0.00 E+00	1.08 E-06	1.12 E-06	1.01 E-04	-6.44E-01
GWP-luluc	kg CO2 eq	2.70 E-02	1.64 E-04	5.97 E-07	0.00 E+00	2.72 E-02	0.00 E+00	1.34 E-02	0.00 E+00	0.00 E+00	1.88 E-06	1.48 E-06	6.34 E-05	-6.32E-04
ODP	kg CFC 11 eq	3.40 E-07	7.50 E-09	4.03 E-11	0.00 E+00	3.52 E-07	0.00 E+00	1.72 E-06	0.00 E+00	0.00 E+00	1.22 E-10	3.04 E-11	4.00 E-09	-1.98E-08
AP	mol H + eq	4.34 E-01	4.95 E-03	2.42 E-05	0.00 E+00	4.40 E-01	0.00 E+00	2.55 E-01	0.00 E+00	0.00 E+00	1.20 E-05	3.13 E-05	4.59 E-04	-3.17E-03

EP-freshwater	kg P eq	2.43 E-02	2.24 E-05	1.38 E-06	0.00 E+00	2.44 E-02	0.00 E+00	1.86 E-02	0.00 E+00	0.00 E+00	3.87 E-07	3.33 E-07	7.79 E-05	-1.88E-04
EP-marine	kg N eq	2.89 E-02	1.23 E-03	2.93 E-05	0.00 E+00	3.05 E-02	0.00 E+00	4.14 E-02	0.00 E+00	0.00 E+00	2.89 E-06	3.18 E-05	2.37 E-04	-6.34E-04
EP-terrestrial	mol N eq	3.37 E-01	1.36 E-02	1.18 E-04	0.00 E+00	3.53 E-01	0.00 E+00	4.39 E-01	0.00 E+00	0.00 E+00	3.12 E-05	1.49 E-04	1.38 E-03	-6.62E-03
POCP	kg NMVOC eq	1.11 E-01	4.16 E-03	4.28 E-05	0.00 E+00	1.15 E-01	0.00 E+00	1.75 E-01	0.00 E+00	0.00 E+00	1.90 E-05	8.49 E-05	4.45 E-04	-2.53E-03
ADP minerals &metaLs-[1]	kg Sb eq.	6.88 E-03	9.97 E-07	4.08 E-09	0.00 E+00	6.89 E-03	0.00 E+00	8.04 E-04	0.00 E+00	0.00 E+00	1.92 E-08	7.41 E-09	3.50 E-07	-1.96E-05
ADP-fossil-[1]	MJ	2.05 E+02	5.35 E+00	2.37 E-02	0.00 E+00	2.12 E+02	0.00 E+00	1.05 E+03	0.00 E+00	0.00 E+00	7.93 E-02	3.06 E-02	1.30 E+00	-1.04E+01
WDP-[1]	m^3	4.37 E+00	1.80 E-02	1.33 E-03	0.00 E+00	4.42 E+00	0.00 E+00	3.21 E+01	0.00 E+00	0.00 E+00	3.12 E-04	3.84 E-04	2.91 E-02	-1.64E-01

Acronyms:
GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment;
EP marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation weighted water consumption

[1] The results of this environmental impact indicator should be used with caution as uncertainties about these results are high or due to limited experience with this indicator.

The environmental performance results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks

Table 4.1: Contribution analysis results（AP）

This table analyzes the contribution percentage of Processes and individual unit processes to the corresponding environmental indicator AP (Acidification Potential).It can be seen that B4 is the largest contributing unit process, accounting for 38.76%.Meanwhile, among all input processes, Euse accounts for the largest proportion at 22.47%.The logical structure of the following tables is consistent with this one.

NO.	Processes		Inputs	
	Name	Value(%)	Name	Value(%)
1	B4	38.76%	**Euse**	22.47%
2	A1-A3	38.28%	Capacitor	22.21%
3	B6	22.47%	Resistor	6.14%
4	A4	0.44%	plastic case	6.09%
5	C4	0.04%	IC	1.37%

Table 4.2: Contribution analysis results（GWP- total）

NO.	Processes		Inputs	
	Name	Value(%)	Name	Value(%)
1	B6	67.22%	**Euse**	67.22%
2	B4	16.39%	plastic case	5.37%
3	A1-A3	15.21%	Capacitor	2.64%

4	C3	0.09%	IC	2.47%
5	A4	0.4%	PCB	0.78%

Table 4.3: Contribution analysis results（GWP-fossil）

NO.	Processes		Inputs	
	Name	Value(%)	Name	Value(%)
1	B6	66.76%	**Euse**	66.76%
2	B4	16.98%	plastic case	5.65%
3	A1-A3	15.38%	Capacitor	2.74%
4	C3	0.28%	IC	2.55%
5	A4	0.42%	PCB	0.89%

Table 4.4: Contribution analysis results（GWP-Biogenic）

NO.	Processes		Inputs	
	Name	Value(%)	Name	Value(%)
1	B6	89.04%	**Euse**	89.04%
2	B4	5.24%	Incineration	5.28%
3	C3	5.18%	IC	0.42%

4	A5	0.58%	Capacitor	0.21%
5	C4	0.01%	PCB	0.12%

The sorting of Processes and Inputs for GWP-luluc is consistent with that for GWP-fossil, and no analysis will be conducted here.

Table 4.5: Contribution analysis results（Ozone depletion）

NO.	Processes		Inputs	
	Name	Value(%)	Name	Value(%)
1	B6	70.92%	**Euse**	70.92%
2	B4	14.54%	IC	8.78%
3	A1-A3	14.06%	plastic case	2.34%
4	A4	0.31%	Capacitor	0.94%
5	C4	0.13%	LCD	0.87%

Table 4.7: Contribution analysis results（EP-freshwater）

NO.	Processes		Inputs	
	Name	Value(%)	Name	Value(%)
1	B4	36.2%	**Euse**	36.2%
2	A1-A3	36.05%	plastic case	20.73%
3	B6	27.6%	IC	5.76%
4	C4	0.12%	Capacitor	4.33%
5	C3	0.0005%	PCB	1.31%

The sorting of Processes and Inputs for EP-marine, EP-terrestrial is consistent with that for EP-freshwater, and no analysis will be conducted here.

Other environmental indicators (POCP, ADP minerals&metals, ADP-fossil, WDP) align with GWPtotal in contribution ratios; no further details here.

Additional environmental impact indicators

Impact category	Indicator	Unit(expressed per functionalunit or per declared unit)	GDM (A1-A3)	A4	A5	B1-B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Particulate Mattere missions	Potential incidence of disease due to PMemissions (PM)	Disease incidence	1.27 E-06	2.29 E-08	1.14 E-08	0.00 E+00	1.35 E-06	0.00 E+00	1.03 E-06	0.00 E+00	0.00 E+00	4.18E-10	4.13 E-08	4.68 E-09	-3.36 E-08
Ionizing radiation, humanhealth [1]	Potential Human exposure efficiencyrelative to U235 (IRP)	kBq U235 eq.	1.43 E+00	5.03 E-03	3.72 E-05	0.00 E+00	1.44 E+00	0.00 E+00	8.85 E+00	0.00 E+00	0.00 E+00	9.58E-05	4.94 E-05	3.20 E-03	-3.77 E-02
Eco-toxicity (freshwater)[2]	Potential Comparative Toxic Unit for ecosystems(ETP-fw)	CTUe	3.96 E+03	3.39 E+00	2.74 E+01	0.00 E+00	4.20 E+03	0.00 E+00	2.39 E+03	0.00 E+00	0.00 E+00	5.92E-02	1.67 E+00	2.06 E+02	-1.24 E+01
Human toxicity, cancer effects[2]	Potential Comparative Toxic Unit for humans (HTP-c)	CTUh	1.43 E+00	5.03 E-03	3.71 E-05	0.00 E+00	1.44 E+00	0.00 E+00	8.85 E+00	0.00 E+00	0.00 E+00	9.58E-05	4.93 E-05	3.20 E-03	-2.72 E-07
Human toxicity, non cancer effects[2]	Potential Comparative Toxic Unit for humans (HTP-nc)	CTUh	4.93 E-05	7.56 E-08	1.08 E-07	0.00 E+00	5.02 E-05	0.00 E+00	2.08 E-05	0.00 E+00	0.00 E+00	1.43E-09	5.45 E-08	7.38 E-07	-1.24 E+01

Land use related impacts / soil quality[2]	Potential Soil quality index (SQP)	dimensionless	1.03E+02	2.24E+00	2.76E-02	0.00E+00	1.06E+02	0.00E+00	3.45E+02	0.00E+00	0.00E+00	4.76E-02	7.71E-02	2.47E-01	-2.37E+00

Disclaimer 1 (for IRP): "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 (for ETP-fw, HTP-c, HTP-nc, SQP): "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 experience with the indicator"

Table 5. Results of use of resource.

Parameter	Unit	A1-A3	A4	A5	B1-B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ, lower calorific value	4.35 E+01	6.94 E-02	5.19 E-04	0.00 E+00	4.81 E-03	0.00 E+00	4.43 E+02	0.00 E+00	0.00 E+00	1.27 E-03	4.95 E-02	3.66 E-06	-3.92 E+01
PERM	MJ, lower calorific value	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00
PERT	MJ, lower calorific value	4.35 E+01	6.94 E-02	5.19 E-04	0.00 E+00	4.81 E-03	0.00 E+00	4.43 E+02	0.00 E+00	0.00 E+00	1.27 E-03	4.95 E-02	3.66 E-06	-3.92 E+01
PENRE	MJ, lower calorific value	3.51 E+02	5.35 E+00	2.20 E+00	0.00 E+00	1.27 E+02	1.06 E+01	1.07 E+03	0.00 E+00	0.00 E+00	7.92 E-02	1.54 E+01	1.69 E-04	-3.16 E+02
PENRM	MJ, lower calorific value	1.93 E+01	0.00 E+00	2.18 E+00	0.00 E+00	0.00 E+00	1.06 E+01	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	1.42 E+01	0.00 E+00	-1.74 E+01
PENRT	MJ, lower calorific value	3.70 E+02	5.35 E+00	2.37 E-02	0.00 E+00	1.27 E+02	0.00 E+00	1.05 E+03	0.00 E+00	0.00 E+00	7.92 E-02	1.27 E+00	1.69 E-04	-3.33 E+02
SM	kg	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00

RSF	MJ	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00
NRSF	MJ	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00
FW	M3	2.37 E+01	3.77 E-02	2.60 E-04	0.00 E+00	1.46 E+01	0.00 E+00	2.31 E-04	0.00 E+00	0.00 E+00	6.93 E-04	2.60 E-02	1.91 E-06	-2.13 E+01

Legenda:

- PENRE = Use of non-renewable primary energy resources excluding non-renewable primary energy resources used as raw materials.
- PERE = Use of renewable primary energy resources excluding renewable primary energy resources used as raw materials.
- PENRM = Use of non-renewable primary energy resources used as raw materials.
- PERM = Use of renewable primary energy resources used as raw materials.
- PENRT = Total use of non-renewable primary energy resources.
- PERT = Total use of renewable primary energy resources.
- FW = Use of freshwater.
- SM = Use of secondary materials.
- RSF = Use of secondary renewable fuels.
- NRSF = Use of secondary non-renewable fuels.

**Considering impact category SM, RSF, NRSF for the use of secondary materials, we have specific secondary raw material usage in the BoM for recycled polycarbonate. All the value calculated are totally reasonable but are related to specific Ecoinvent datasets used for the model.*

Table 6. Results for waste production and output flux.

Parameter	**Unit**	**A1-A3**	**A4**	**A5**	**B1-B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
HWD	kg	2.79 E-03	3.34 E-05	2.07 E-07	0.00 E+00	9.70 E-04	0.00 E+00	6.25 E-03	0.00 E+00	0.00 E+00	5.40 E-07	2.84 E-05	1.19 E-09	-2.51 E-03
NHWD	kg	1.50 E+00	1.72 E-01	1.45 E-03	0.00 E+00	6.00 E-01	0.00 E+00	4.78 E+00	0.00 E+00	0.00 E+00	3.87 E-03	3.72 E-02	5.34 E-04	-1.35 E+00
RWD	kg	6.81 E-04	1.24 E-06	9.47 E-09	0.00 E+00	2.28 E-04	0.00 E+00	2.31 E-03	0.00 E+00	0.00 E+00	2.36 E-08	8.16 E-07	6.12 E-11	-6.13

														E-04
MER	kg	0.00 E+00	0.00 E+00	1.70 E+01	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	2.38 E+01	0.00 E+00	0.00 E+00
MFR	kg	0.00 E+00	0.00 E+00	8.10 E-02	0.00 E+00	0.00 E+00	2.52 E-01	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	7.56 E-01	1.94 E+00	0.00 E+00
CRU	kg	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00
ETE	MJ	0.00 E+00	0.00 E+00	7.67 E+01	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	1.07 E+02	0.00 E+00	0.00 E+00
EEE	MJ	0.00 E+00	0.00 E+00	6.75 E+01	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	0.00 E+00	9.43 E+01	0.00 E+00	0.00 E+00

Legenda:

- HWD = Hazardous waste disposal
- NHWD = Non-hazardous waste disposal
- RWD = Radioactive waste disposal
- MER = Materials for energy recovering
- MFR = Materials for recycling
- CRU = Components for reuse
- ETE = Thermal energy exported
- EEE = Electric energy exported

Table 9 — Information describing the biogenic carbon content at the factory gate

Biogenic carbon content	Unit (expressed per functional unit or per declared unit)
Biogenic carbon content in product	0 kg C
Biogenic carbon content in accompanying packaging	0.061 kg C
NOTE: 1 kg biogenic carbon is equivalent to 44/12 kg of CO2	

Calculation rules

The evaluation was carried out in accordance with the reference standard for lifecycle analysis (ISO 14040:2021 ISO 14044:2021) and others reference documents previously mentioned (PCR EPDItaly011 - Meters).

Data quality

The LCA results are based on primary data collected over a 12-month period from January 2024 to December 2024, ensuring high temporal representativeness. The data collection focused on specific product models,

covering 100% of the production volume for these models within the reporting period, which ensures excellent completeness and coverage.

Regarding geographical representativeness, the primary data for the production stage reflects the specific energy and resource consumption of the manufacturing site located in Sichuan, China, utilizing localized background datasets for energy consumption to enhance accuracy. For upstream raw materials, the data represents a global supply chain context, aligning with the actual sourcing strategy of the enterprise.

The technological representativeness is considered high, as primary data includes actual consumption figures for materials, energy, and transport activities directly related to the specific manufacturing processes. Background data is sourced from the Ecoinvent database v3.10.1 (2023/2024), which provides up-to-date and technologically relevant datasets for the industry.

According to the quality criteria , the overall data quality is evaluated as "Good." No data points were identified as "poor" or "very poor," and the reliance on actual measured primary data significantly reduces the uncertainty of the core environmental impact indicators.

Cut-off

The study does not exclude any modules or processes which are stated mandatory in the EN 15804:2012+A2:2019/AC:2021:2012+A2:2019/AC:2021（Date 18-Aug-2021） and the applied PCR. The study does not exclude any hazardous materials or substances. In the study, The consumption of a small amount of label-like materials and workshop consumables such as lint-free paper, insulating paper, conductive fabric was disregarded. The weight of the disregarded items accounts for 0.08% of the total weight of raw material input.

Discarded materials (such as protective gloves) fall under consumable supplies. As these items cannot be reasonably allocated to specific product models, they have been excluded from allocation. Using a high background emission factor (e.g., for nylon-based consumables) for such discarded materials, their Global Warming Potential (GWP) contribution accounts for 0.001% of total emissions.

Allocation

Allocation is required if some material, energy, and waste data cannot be measured separately for the product under investigation. According to PCR EPDItaly007, the following stepwise procedure shall be applied for allocation of co-products:

・Allocation shall be avoided, if possible, by dividing the unit process into two or more sub-processes and collecting the environmental data related to these sub-processes.

・Allocation shall be based on physical properties (e.g. mass, volume) when the difference in revenue from the co-products is low.

・In all other cases, including joint co-production processes, where no relevant underlying physical relationships between the products and co-products can be identified, the inputs and outputs of the remaining parts of process should be allocated between the products and co-products in a way that reflects the economic value of the co-products when they leave the unit process.

In this study, There are no co-products in the production of manufactured by Kaifa Metering. Hence, there is no need for materials allocation. According to PCR EPDItaly007, the allocation of waste shall follow the polluter-pays principle that is made operational.

Limitation and assumption

Data completeness and accuracy: The representativeness of the data sets differ from the actual situation, which is also a point that needs to be improved in future research. Due to the availability of data, calculations using global data rather than local data may overestimate or underestimate environmental impacts.
Scenarios uncertainty: Primary data cannot be obtained for scenarios of use stage and end of life stage, and assumptions can only be made based on product design parameters and the common recovery rate of materials in Europe.

Since there is no directly corresponding background factor for relays in the system, the previously selected dataset of Electronic component, passive, unspecified yielded an overestimated result in our evaluation. This is because the dataset incorporates a large number of precious metals (e.g., gold, palladium, silver) and complex ceramic sintering processes in its modeling—these attributes are targeted at capacitors (especially MLCCs) or resistors. In contrast, a relay is essentially an electromechanical component, whose material composition is dominated by copper, steel and engineering plastics.
Therefore, through comparative analysis, we propose to equate relays with toggle switches for substitution; the specific supporting arguments are as follows:
Material Equivalence
Both relays and toggle switches are mechanical on-off components, with a copper-based alloy as the base material, precious metals for plating, pure copper for spring contacts, and wear-resistant PBT engineering plastic for the housing.
Functional Equivalence
Relays and toggle switches share the same core function: both act as actuators for controlling circuit on-off, capable of supporting multiple types of contact switching to complete single-circuit on-off or multi-circuit gating. Both feature state retention—no continuous triggering is required after actuation, and they can maintain the current on-off state of the circuit. Additionally, both serve as the actuation terminal for circuit control, only performing on-off actions in accordance with trigger commands and not participating in signal processing or energy conversion.

Reference period

The reference period for LCA study is from Jan 2024 to Dec 2024.

Reference documents

» UNI EN ISO 14040:2021 Environmental management - Lifecycle assessment - Principles and framework

» UNI EN ISO 14044:2021 Environmental management - Lifecycle assessment - Requirements and guidelines

» ISO 14020:2000 Environmental labels and declarations -- General principles

» UNI EN ISO 14025:2010, Etichette edichiarazioni ambientali - Dichiarazioni ambientalidiTipo III - Principi e procedure

» EN 15804:2012+A2:2019/AC:2021: Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

» Regolamento EPDItaly rev. 6 - 30/10/2023

» Core-PCR: EPDITALY007 " Electronic and electrical product and systems" Rev. 3.2 – 10/12/2025

» Sub-PCR: EPDITALY011 "Electronic and electrical product and systems -Meters" Revision REV. 1 01-07-2024

» Report LCA: 2026_03_04 LCA REPORT Single Phase meter(Globy-DM)