



Huawei Technologies Co., Ltd.



ENVIRONMENTAL PRODUCT DECLARATION

**SMART STRING ESS
(LUNA2000-5015-2S)**

Building A and B, No. 375 Zhenxing Road,
Shiwan Town, Boluo County, 516123
Huizhou City, Guangdong Province,
PEOPLE'S REPUBLIC OF CHINA

In accordance with ISO 14025 and EN50693:2019

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration Number	EPDESS_2025_rev.1.1
Registration Number	EPDITALY1534

Issue date	26/08/2026
Valid to	26/08/2031
Update date	09/10/2026



GENERAL INFORMATION

EPD OWNER

Name of the company	Huawei Technologies Co., Ltd.
Registered office	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, Guangdong, 518129, P.R.C
Contacts for information on the EPD	support_e@huawei.com

PROGRAM OPERATOR

EPDItaly	Via Gaetano De Castilia n° 10 - 20124 Milano, Italy
-----------------	---

INFORMATION ON THE EPD

Product name (s)	SMART STRING ESS (LUNA2000-5015-2S)
Site (s)	Building A and B, No. 375 Zhenxing Road, Shiwan Town, Boluo County, 516123 Huizhou City, Guangdong Province, China
Short description and technical information of the product (s)	The declared products is intelligent string-type grid-forming energy-storage system with the cell technology of lithium iron phosphate, manages the charging and discharging of DC energy transmitted from the external power grid via the intelligent energy-storage controller, and supports application scenarios such as peak-shaving and frequency regulation of the power grid. The total energy system storage energy is 5015 kWh.
Field of application of the product (s)	The declared products are mainly used in commercial energy storage scenarios. Storage of solar power, then connected to the grid, can also be used for frequency modulation. These products are mainly used in large photovoltaic power plants and have the function of storing electricity and regulating the frequency of the grid. The characteristics of the products are shown in following table.
CPC Code (number) https://unstats.un.org/unsd/classifications/Econ	464 Accumulators, primary cells and primary batteries, and parts thereof (Electric accumulators)

VERIFICATION INFORMATION

PCR	EN 50693:2019 – Product category rules for life cycle assessment of electronic and electrical products and systems EPDItaly007 - CORE PCR for electronic and electrical products and systems, Rev. 3.2(2025/12/10) EPDItaly021 – PCR for Electronic and Electrical Products and Systems - Energy Storage, Rev. 5(03/10/2024)
EPDItaly Regulation	EPDItaly Regulations Rev 7.1 – 05/09/2025
Project Report LCA	SGS/2026/LCAR/E/0602 – 25/09/2026

LCA Consultant	Ruthe.Fan@sgs.com Chris.Zhao@sgs.com SGS-CSTC Standards Technical Services Co., Ltd Carbon Footprint of Product Certification Centre
Independent Verification Statement	Independent verification of the declaration and data, carried out according to ISO 14025: 2010. ☐ Internal ☒ External Third party verification carried out by: ICMQ S.p.A., via Gaetano De Castilia n ° 10 - 20124 Milan, Italy. Accredited by Accredia.
Comparability Statement	EPDs within same category of product in different programme operators are not suggested to be compared. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible even applying the same PCR.
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 life cycle assessment.

OTHER INFORMATION

Scope of EPD	This EPD is a specific EPD covering only the product manufactured by Huawei Technologies Co., Ltd. under the declared functional unit. It is not an average or generic EPD.

Contents

1. Company Information	1
2. Product Information	1
3. Life Cycle Assessment Information.....	4
3.1 Functional Unit.....	4
3.2 Time boundary.....	4
3.3 System boundary	4
3.4 Impact categories.....	6
3.5 Cut-off	7
3.6 Allocation Principles	8
3.7 Assumption	8
3.8 Data quality	9
3.9 Limitations.....	12
4. Inventory	13
5. Environmental Impact Assessment.....	14
5.1 Environmental Impact Descriptive Parameters	14
5.2 Parameters Describing Resource Use	16
5.3 Waste Production Descriptive Parameters.....	17
6. LCA results and interpretations	17
7. Reference	19

1. Company Information

Owner of the EPD

Huawei Technologies Co., Ltd.

Address: Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C

Description of the company

Founded in 1987, Huawei is a leading global provider of information and communications technology (ICT) infrastructure and smart devices. Huawei has 207,000 employees and operates in over 170 countries and regions, serving more than three billion people around the world. Huawei is committed to bringing digital to every person, home, and organization for a fully connected, intelligent world.

2. Product Information

Product Name: SMART STRING ESS (LUNA2000-5015-2S)

Product Description:

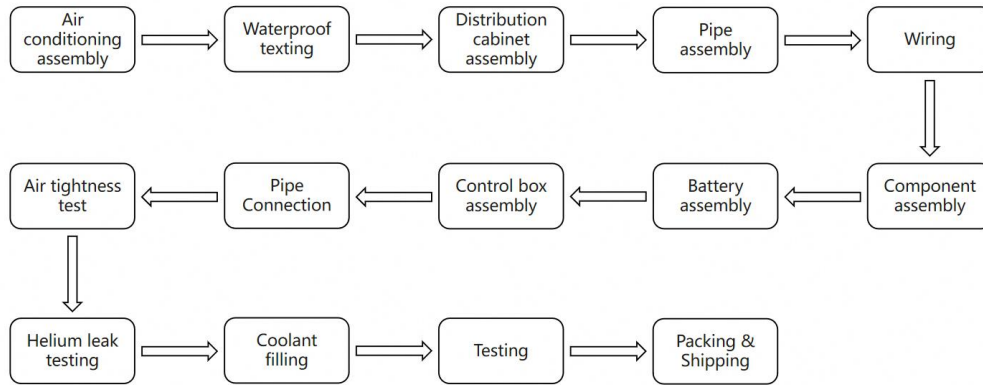
SMART STRING ESS (LUNA2000-5015-2S) is intelligent string-type grid-forming energy-storage system with the cell technology of lithium iron phosphate, manages the charging and discharging of DC energy transmitted from the external power grid via the intelligent energy-storage controller, and supports application scenarios such as peak-shaving and frequency regulation of the power grid. The total energy system storage energy is 5015 kWh.

The declared products are mainly used in commercial energy storage scenarios. Storage of solar power, then connected to the grid, can also be used for frequency modulation. These products are mainly used in large photovoltaic power plants and have the function of storing electricity and regulating the frequency of the grid. The characteristics of the products are shown in following table.

Table 1 Properties of Energy storage system

Product model	Net weight(kg)	Dimensions(W×H×D)	Number of battery packs	Rated DC Voltage(Vd.c.)
LUNA2000-5015-2S	42000	6058mm×2896mm×2438mm	48	1331.2
Product model	Total energy storage system energy (kWh)	Type of coupling:	Type of cell technology	Type of application
LUNA2000-5015-2S	5015	DC	lithium iron phosphate	Industrial

Figure 1 Flow chart of manufacturing energy storage system



Description of manufacturing process:

The first step is to install the air conditioning unit in the power distribution compartment and seal the holes. Then, the entire container undergoes water spraying and waterproofing treatment. Next, the power distribution cabinet frame and the liquid cooling unit are installed into the corresponding compartments. After that, the liquid cooling pipes are assembled into the reserved positions within the container. Following this, the wiring phase begins, during which power and communication harnesses are installed, ensuring smooth cable routing. The component assembly phase includes the installation of devices in the battery compartment and the configuration of fire extinguisher bottles to ensure all components are complete. Battery assembly primarily involves placing the battery packs into the container and securing them, as well as installing and securing the corresponding cluster control boxes for each battery cluster into the container. After that, the pipes are connected to the battery pack ports. Once the pipes are connected, airtightness tests and helium leak tests are conducted to ensure there are no leaks in the system's liquid cooling pipes. After completing the coolant filling, safety and functional tests are performed to verify the overall performance and safety of the system. Finally, after a final inspection confirms that there are no foreign objects inside the container and that the harnesses and components are properly installed, the container is packaged, weighed, and shipped.

Material Composition

The material composition of per pc and per kWh stored of product is listed below. The component per kWh is obtained by dividing the component per piece by the total energy storage system energy of 5015 kWh.

Table 2 Material composition of the product considered in the analysis.

Electronic components	unit	Per piece	Per kWh
Batthey cell	g	2.80E+07	5.57E+03
PCB	g	2.14E+04	4.26E+00
Cable	g	1.88E+05	3.75E+01
Other electronic components (capacitor, tansformer, etc.)	g	2.43E+05	4.84E+01
Structual components	unit	Per piece	Per kWh
Steel	g	9.78E+06	1.95E+03

Copper	g	1.30E+05	2.58E+01
Aluminium	g	1.46E+06	2.91E+02
Zinc	g	1.80E+00	3.59E-04
PP	g	2.86E+04	5.70E+00
ABS	g	6.14E+02	1.23E-01
Other plastics (PC, PVC, PA, etc.)	g	5.27E+05	1.05E+02
Inorganic Non-metallic Materials (Rubber, Glass, Ceramics, etc.)	g	9.33E+05	1.86E+02
Functional Fluids (Nitrogen, Fire extinguisher agent, etc)	g	2.93E+05	5.85E+01
Packaging	unit	Per piece	Per kWh
Packaging-Paper	g	6.00E+00	1.19E-03
Packaging-Plastic	g	1.24E+00	2.47E-04
Packaging- Montmorillonite	g	1.86E+01	3.70E-03

Table 3 Location of production, application and end-of-life of product

Product	Location of production	Location of application and end-of-life
SMART STRING ESS (LUNA2000-5015-2S)	China	Netherlands

3. Life Cycle Assessment Information

A Life Cycle Assessment (LCA) is a methodology for assessing the environmental impacts associated with the life cycle of a particular product or process. LCA consists of 4 stages (Goal and Scope, Inventory Analysis, Impact Assessment, and review/presentation), which must follow similar procedures to a PCR (Product Category Rules) and helps to evaluate the carbon footprint and natural resources of a product or process. The product and life cycle stages are described in the following sections.

3.1 Functional Unit

The functional unit for the products assessed in this report is per kWh of smart string energy storage system with 10 years RSL. The environmental impacts are reported for 1 kWh stored by a smart string energy storage system. The smart string energy storage system is for industrial use with the cell technology of lithium iron phosphate. The coupling type of the product is DC.

3.2 Time boundary

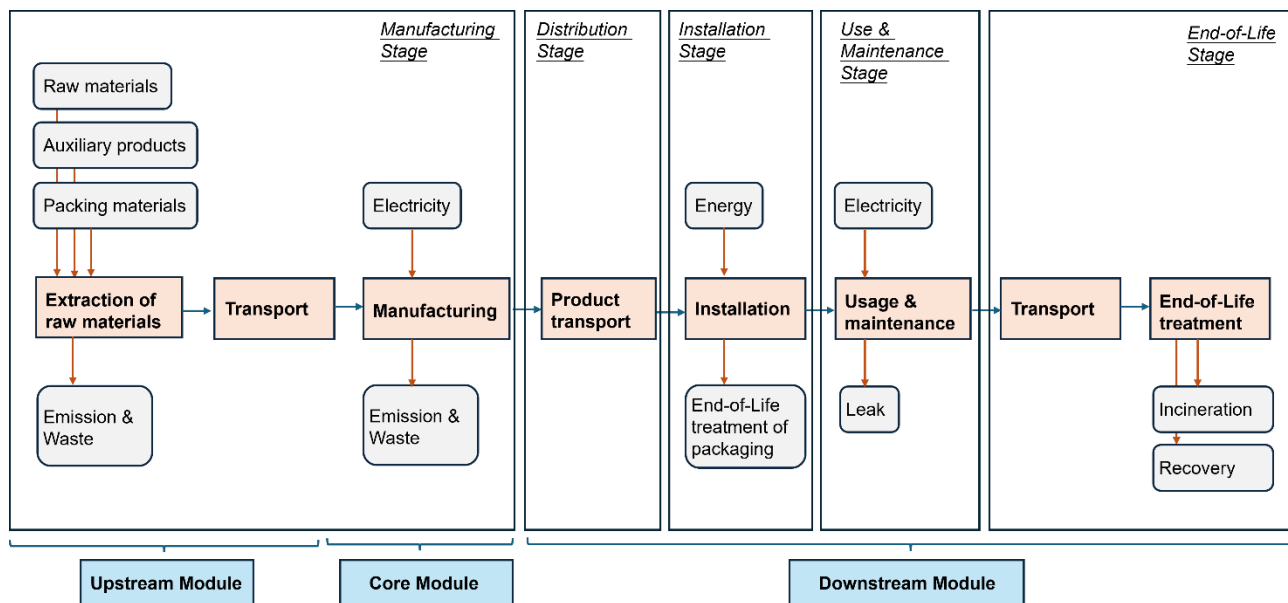
The plant had continuous production during 2025. Time boundary of data for product assessed in the report is 2025-01-01 to 2025-12-31. There is continuous production of the declared product during this period. These latest statistics can provide more representative results with stronger effectiveness for a given period.

3.3 System boundary

According to PCR EPDItaly021 and EN 50693, the product life cycle system boundary assessed in this report include following life cycle stages: manufacturing stage, distribution stage, installation stage, use & maintenance stage, and end-of-life stage.

Table 4 system boundary of product

MANUFACTURING STAGE		DISTRIBUTION STAGE	INSTALLATION STAGE	USE & Maintenance STAGE	END-OF-LIFE STAGE De-installation
UPSTREAM MODULE	CORE MODULE	DOWNSTREAM MODULE			
extraction of raw materials, including waste recycling processes and the production of semi-finished, packaging and ancillary products	manufacturing of the product constituents, including all the stages	IN ACCORDANCE WITH EN 50693			
transportation of raw materials to the manufacturing company	product assembly				
	packaging				
	waste handling processes				



The system boundary of the research begins with the acquisition of raw materials, which will be processed and transported to the production site of Huawei Technologies Co., Ltd. for production, and finally distributed to Netherlands for further use and undergo end-of-life stage.

Life cycle stage	Description
Manufacturing stage (Upstream module)	This stage includes: The processing of all upstream raw materials of the product (including the extraction and processing of natural resources), loss, packaging, and some transportation activities. The process of transporting all upstream raw materials of the product to the production site.
Manufacturing stage (Core module)	It considers the production and assembly of products, including the production of auxiliary materials, water, and electricity consumption as well as waste generation.
Distribution	It considers the transportation of the product from the assembly plant to the installation site.
Installation	It considers the installation of product by 100t crane track working for 1 hour. Packaging material waste is considered in this stage as well.
Use and Maintenance	Use: include energy use due to the operation during the lifetime. Maintenance operations are declared within the cut-off criteria.
End-of-life stage	The end-of-life stage includes: Dismantling: Considering that the product's dismantling does not require any relevant input in terms of materials and energy, a cut-off on the impacts included in this module was applied. Transport to waste processing: The transportation of the product from the point of waste generation to the treatment platform. For recovery and recycling processes, which take place outside the boundaries of the product system, only impacts related to the transport of the waste to the treatment platform are considered. Waste processing for reuse, recovery and/or recycling: Includes collection of waste fractions from the dismantling and waste processing of material flows

	intended for reuse, recycling, and energy recovery. Shredding process requiring electricity is considered within this study. Waste disposal: The environmental impact derived from final waste treatment processes (landfill or incineration) are considered in this module.
--	---

3.4 Impact categories

The methodology chosen to evaluate the potential environmental impacts of the product subject of this study includes all the impact categories required by the EN 50693:2019 as implemented in the SimaPro software. Some indicators have been analyzed in the LCA but are not reported in the EPD, such as Particulate matter, Ionizing, radiation, Ecotoxicity, freshwater, Human toxicity, cancer, Human toxicity, non-cancer and Land use. The categories analyzed are therefore:

Environment Impact Indicator	Unit
Global Warming Potential total (GWP-total)	kg CO ² eq
Global Warming Potential fossil fuels (GWP-fossil)	kg CO ² eq
Global Warming Potential biogenic (GWP-biogenic)	kg CO ² eq
Global Warming Potential land use and land use change (GWP-luluc)	kg CO ² eq
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC11 eq
Acidification potential, Accumulated Exceedance (AP)	mol H ⁺ eq
Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP- freshwater)	kg P eq
Eutrophication potential, fraction of nutrients reaching marine end compartment (EP-marine)	kg N eq
Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	mol N eq
Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg NMVOC eq
Abiotic depletion potential for non-fossil resources (ADP-mineral & metals)	kg Sb eq
Abiotic depletion potential for fossil resources (ADP-fossil)	MJ
Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	m ³ depriv.
Particulate matter	disease inc.
Ionising radiation	kBq U-235 eq
Ecotoxicity, freshwater	CTUe
Human toxicity, cancer	CTUh
Human toxicity, non-cancer	CTUh
Land use	Pt
PERE	MJ (LHV)
PERM	MJ (LHV)

PERT	MJ (LHV)
PENRE	MJ (LHV)
PENRM	MJ (LHV)
PENRT	MJ (LHV)
Use of secondary material	kg
Use of renewable secondary fuels	MJ (LHV)
Use of non-renewable secondary fuels	MJ (LHV)
Net use of fresh water	m3
Hazardous waste disposed	kg
Non-hazardous waste disposed	kg
Radioactive waste disposed	kg
Components for re-use	kg
Materials for recycling	kg
Materials for energy recovery	kg
Exported energy- electricity	MJ
Exported energy - heat	MJ

3.5 Cut-off

All relevant input and output flows of matter and energy included within the system boundaries were considered.

According to the EPDItaly Regulations and PCR EPDItaly021, the following flows and operations were cut-off:

- Materials making up the Storage system itself, whose total mass does not exceed 1% of the total weight of the device.
- Considering that the product's installation does not require any relevant inputs in terms of materials and energy, a cut-off on the impacts included in installation stage module was applied.
- For the use stage, the product has extraordinary maintenance during the RSL. The extraordinary maintenance rates are extremely low according to the past user data analysis that the relevant flows and operations are cut-off.
- For the dismantling phase, the same impacts were considered as for the installation phase. Considering that the product's dismantling is performed manually and does not require any relevant inputs in terms of materials and energy, a cut-off on the impacts included in End-of-life stage module.
- Production, use and disposal of the packaging of raw materials.

3.6 Allocation Principles

The allocation for the energy, water and packaging material consumptions and for the waste was done using mass allocation method based on inventory data.

3.7 Assumption

The following assumptions were adopted in this study:

Life cycle stage	Assumptions		
Material transportation	The road transport emission factor is selected according to Euro 6 standard which is similar to National 6 standard.		
Production	The electricity mix used during production stage are selected based on the manufacturing scenario in China according to the power capacity from Ecoinvent 3.12, GWP for used electricity mix is 0.649 kg CO₂e./ kWh for Grid electricity. Electricity mix dataset selected is Electricity, low voltage {CN-CSG} market for electricity, low voltage EN15804, U.		
Distribution	For distribution, land transport was considered EURO 6 category vehicle, in absence of primary data on the fleet of vehicles used. A container ship was considered for sea transportation.		
Installation	Label, plastic and paper packaging are assumed to be 100% incinerated at the end of life in this stage. Based on the baseline condition of a 100-ton crane, assuming medium load operation for one hour lifting a 42-ton load, approximately 25 liters of diesel fuel will be consumed.		
Use and Maintenance	In the use phase, the electricity consumed during the service time was calculated according to the formula: $E_{tot}[kWh] = E_{use} + E_{loss}$ $E_{use}[kWh] = P_{use} \times 8760 \times RSL$ $E_{loss}[kWh] = \sum_{i=0}^{RSL} \frac{E_{useful\ i} \times N_{cycles} \times 365}{DC\ RTE_i} \times (1 - DC\ RTE_i)$		
	Material and energy Flow	Unit	Properties
	P _{use}	w	5864

	E _{use}	kWh	513701
	E _{loss}	kWh	1263406
	For the Use phase the following scenario was considered: Low voltage level electricity mix in Netherlands provided by Ecoinvent 3.12. GWP for the energy consumed by the energy storage system electrical auxiliaries during the lifetime is 0.359 kg CO2e./ kWh. Electricity mix dataset selected is Electricity, low voltage {NL} market for electricity, low voltage EN15804, U. Low voltage level photovoltaic electricity in Netherlands provided by Ecoinvent 3.12 GWP for the energy dissipation occurring over the RSL is 0.0989 CO2e./ kWh. Electricity mix dataset selected is Electricity, low voltage {NL} electricity production, photovoltaic, 570kWp open ground installation, multi-Si EN15804, U. The average annual refrigerant leakage is assumed to be 3g/a, the effusion coefficient of fire extinguisher is assumed to be 5%.		
Waste transport	An average distance of 300 km was used to estimate the transport of waste product from installation site to the treatment platform and disposal site.		
Waste processing for reuse, recovery and/or recycling	Waste treatment (shredding as the preparations to recycle) of product is included. For the product end of life (after dismantling), the recycling rate of each material is assumed in accordance with IEC TR 62635:2012, thus the following End-of-life scenarios are moduled for each material:		
	Material or component	Recycling rate	Final disposal rate
	Steel	95%	5% incineration
	Aluminum	95%	5% incineration
	Copper	98%	2% incineration
	Zinc	95%	5% incineration
	PP	90%	10% incineration
	ABS	90%	10% incineration
	Other plastics	90%	10% incineration
	Rubber	0%	100% incineration
	Cable	25%	75% incineration
	PCB	10%	90% incineration
Battery	0%	100% Hydrometallurgy	
Other electronic components	50%	50% incineration	
Disposal	It is assumed that the residues are disposed of incineration.		

3.8 Data quality

All the main flows of matter and energy have been fully quantified and included in the study; the flows excluded from the analysis are identified in the Cut-off rules section.

LCI/LCA database: The secondary data are taken from the ecoinvent 3.12 environmental database.

Process	Representativeness
----------------	---------------------------

	Geographical	Technical	Time
Active electronic component	Good	Fair	Very good
Adapter	Good	Good	Very good
Battery cell	Good	Good	Very good
Bead	Good	Good	Very good
Bridge	Good	Fair	Very good
Cable	Good	Very good	Very good
Capacitor	Good	Very good	Very good
Ceramic	Good	Good	Very good
Connector	Good	Good	Very good
Contacto	Good	Good	Very good
Copper	Good	Very good	Very good
Crystal	Good	Good	Very good
Diode	Good	Good	Very good
Fan	Good	Good	Very good
IC	Good	Good	Very good
Inductor	Good	Good	Very good
Outlet	Good	Fair	Very good
Passive electronic component	Good	Fair	Very good
PCB	Good	Good	Very good
Plug	Good	Fair	Very good
Relay	Good	Fair	Very good
Resistor	Good	Good	Very good
Silicon diode	Good	Good	Very good
Switch	Good	Good	Very good
Transformer	Good	Good	Very good
Transistor	Good	Good	Very good
Steel	Good	Good	Very good
Copper	Good	Good	Very good
Aluminium	Very good	Good	Very good
Zinc	Good	Good	Very good
PA	Good	Good	Very good
PC	Very good	Good	Very good

PVC	Good	Good	Very good
PBT	Good	Good	Very good
PET	Very good	Good	Very good
PP	Very good	Good	Very good
PE	Good	Good	Very good
ABS	Good	Good	Very good
EPGC202	Good	Good	Very good
POM+GF (25%)	Good	Good	Very good
Rubber	Good	Good	Very good
Glass	Good	Good	Very good
Silicon	Good	Good	Very good
Nitrile Rubber	Good	Good	Very good
EPE	Good	Good	Very good
Corrugated board	Good	Good	Very good
Paint	Good	Good	Very good
Stone wool	Good	Good	Very good
Nano Silicon dioxide	Good	Good	Very good
XPE	Good	Good	Very good
TPE	Good	Good	Very good
PA66	Good	Good	Very good
PA66+GF30%	Good	Good	Very good
EPDM	Good	Good	Very good
Ceramics	Good	Good	Very good
Nitrogen	Good	Good	Very good
Ethylene glycol	Good	Good	Very good
Printed Paper	Good	Good	Very good
EPS	Good	Good	Very good
Montmorillonite	Good	Good	Very good
Electricity, high voltage in CN-CSG	Very good	Good	Very good
Hazardous waste for incineration	Good	Good	Very good
Treatment of wastewater	Good	Good	Very good
Transportation by lorry	Good	Good	Very good
Transportation by container ship	Good	Good	Very good
Treatment of solid waste	Good	Good	Very good

Electricity, high voltage in Netherlands	Very good	Good	Very good
Treatment of waste steel	Good	Good	Very good
Treatment of waste copper	Good	Good	Very good
Treatment of waste zinc	Good	Good	Very good
Treatment of waste plastic	Good	Good	Very good
Treatment of waste cables	Good	Good	Very good
Treatment of used Li-ion battery	Good	Good	Very good
Treatment of waste aluminium	Good	Good	Very good
Treatment of waste PCB	Good	Good	Very good
Treatment of waste electric and electronic equipment	Good	Good	Very good

Geographic representativeness: primary site-specific data were used for the product assembly processes; for the secondary data, datasets were selected from databases consistent with the geography of the processes.

Technological representativeness: the primary data used represents the specific production technology of the product. For the secondary data taken from the database, reference was made to the most representative technology for the processes.

Time representativeness: the primary data used refers to the year 2025.

Completeness: The LCA model included all known mass and energy flows for production of products. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.

Precision/uncertainty: Data collected for operations were typically averaged for one year, which is expected to reduce the variability of results.

Representativeness analysis: Battery cell in manufacturing stage contributes more than 30% to the core indicate.

Use of Fair data with more than 30% of a core impact: No Fair data contributing 30% to the core indicate used.

Use of poor relevant data: No poor data used.

Use of very poor relevant data: No very poor data used.

3.9 Limitations

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible”. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

4. Inventory

In the development of this EPD, primary data was preferentially utilized wherever accessible. For the secondary data, datasets were selected from the Ecoinvent v3.12 database. The source and version of characterization factors used in this module are EN 15804 +A2 LCIA & LCI indicators.

Data collection was implemented through the creation of a specialized sheet that compiled input and output data. This included mass - related data and energy consumption data, all of which were sourced within the production site from 2025/01/01 to 2025/12/31. Following data collection, the sheet underwent rigorous verification. This involved employing mass balance checks to identify any inconsistencies. Once detected, these inconsistencies were promptly clarified and resolved. All the original data and secondary data used have good transparency, completeness, accuracy and consistency, so the data quality is pretty good.

Regarding the study methodology, SimaPro 10.4 software was employed. It was utilized to construct the model for the product life cycle and to calculate the Life Cycle Assessment (LCA) results.

It should be noted that, in accordance with the principles of confidentiality, the complete LCA report (SGS/2026/LCAR/E/0602) and detailed inventory data have not been fully disclosed in this EPD.

The withheld data primarily relates to specific proprietary processes and certain sensitive material compositions within the production phase. This decision was made to protect the company's intellectual property and trade secrets. However, we are committed to transparency and are willing to provide additional details of the inventory data upon request. Interested parties may contact our company directly to obtain further information

5. Environmental Impact Assessment

For Potential Human exposure efficiency relative to U235 (IRP), this Impact Indicator 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.

While for environmental impact indicator (Abiotic depletion potential for non-fossil resources (ADP-minerals&metals), Abiotic depletion potential for fossil resources (ADP-fossil), Water (user) deprivation potential, deprivation-weighted water consumption (WDP), Potential Comparative Toxic Unit for ecosystems (ETP-fw), Potential Comparative Toxic Unit for humans (HTP-c), Potential Comparative Toxic Unit for humans (HTP-nc), Potential Soil quality index (SQP)), the results of these 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.

5.1 Environmental Impact Descriptive Parameters

5.1.1

Indicator	Unit	Total	Upstream Module	Core Module	Downstream Module			
			Manufacturing Stage		Distribution Stage	Installation stage	Use&Maintenance Stage	End-of-life Stage
Global Warming Potential total (GWP-total)	kg CO ₂ eq	1.64E+02	9.37E+01	8.37E-02	2.25E+00	7.47E-03	6.17E+01	6.10E+00
Global Warming Potential fossil fuels (GWP-fossil)	kg CO ₂ eq	1.62E+02	9.36E+01	8.36E-02	2.25E+00	4.00E-03	6.12E+01	5.31E+00
Global Warming Potential biogenic (GWP-biogenic)	kg CO ₂ eq	1.18E+00	0.00E+00	0.00E+00	0.00E+00	3.47E-03	3.96E-01	7.83E-01
Global Warming Potential land use and land use change (GWP-luluc)	kg CO ₂ eq	1.97E-01	1.20E-01	5.16E-05	1.38E-03	1.07E-06	6.75E-02	7.74E-03
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC11 eq	5.03E-05	4.62E-05	6.41E-10	3.28E-08	2.20E-10	3.96E-06	4.54E-08
Acidification potential, Accumulated Exceedance (AP)	mol H ⁺ eq	2.05E+00	1.68E+00	4.70E-04	3.66E-02	1.63E-05	2.78E-01	5.87E-02
Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	kg P eq	1.05E-01	7.18E-02	1.72E-05	1.13E-04	4.72E-07	3.12E-02	2.30E-03
Eutrophication potential, fraction of nutrients reaching marine end compartment (EP-marine)	kg N eq	2.22E-01	1.45E-01	9.17E-05	1.50E-02	1.59E-05	5.53E-02	6.60E-03
Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	mol N eq	4.76E+00	3.94E+00	9.72E-04	1.66E-01	3.11E-05	5.89E-01	6.12E-02

Formation potential of tropospheric ozone photochemical oxidants (POCP)	kg NMVO C eq	6.54E-01	4.03E-01	2.92E-04	4.46E-02	3.45E-05	1.85E-01	2.08E-02
Abiotic depletion potential for non-fossil resources (ADP- mineral & metals)	kg Sb eq	1.11E-02	9.36E-03	4.46E-07	4.00E-06	2.86E-09	1.63E-03	1.31E-04
Abiotic depletion potential for fossil resources (ADP- fossil)	MJ	2.11E+03	1.20E+03	1.09E+00	2.81E+01	2.19E-01	8.23E+02	6.07E+01
Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	m ³ depriv.	7.82E+01	3.14E+01	5.43E-03	9.65E-02	0.00E+00	4.49E+01	1.80E+00

5.2 Parameters Describing Resource Use

5.2.1

Indicator	Unit	Total	Upstream Module	Core Module	Downstream Module			
			Manufacturing Stage		Distribution Stage	Installation stage	Use&Maintenance Stage	End-of-life Stage
PENRE	MJ (LHV)	2.13E+03	1.22E+03	1.09E+00	2.81E+01	2.19E-01	8.24E+02	6.08E+01
PERE	MJ (LHV)	1.43E+03	1.21E+02	1.53E-01	2.67E-01	7.26E-04	1.29E+03	2.38E+01
PENRM	MJ (LHV)	2.14E+00	2.14E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ (LHV)	1.92E-02	1.92E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ (LHV)	2.13E+03	1.22E+03	1.09E+00	2.81E+01	2.19E-01	8.24E+02	6.08E+01
PERT	MJ (LHV)	1.43E+03	1.21E+02	1.53E-01	2.67E-01	7.26E-04	1.29E+03	2.38E+01
FW	m ³	1.97E+00	7.93E-01	2.66E-04	2.37E-03	0.00E+00	1.10E+00	6.80E-02
MS	kg	1.99E+00	1.26E+00	1.79E-04	1.55E-02	1.97E-05	6.84E-01	2.99E-02
RSF	MJ (LHV)	3.23E-02	1.04E-02	1.56E-06	5.13E-05	1.44E-07	2.06E-02	1.26E-03
NRSF	MJ (LHV)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; **PERE** = Use of renewable primary energy 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 net fresh water; **MS** = Use of secondary material; **RSF** = Use of renewable secondary fuels; **NRSF** = Use of non-renewable secondary fuels

5.3 Waste Production Descriptive Parameters

5.3.1

Indicator	Unit	Total	Upstream Module	Core Module	Downstream Module			
			Manufacturing Stage		Distribution Stage	Installation stage	Use&Maintenance Stage	End-of-life Stage
HWD	kg	2.60E+02	2.20E+02	2.59E-02	1.64E-01	2.02E-04	3.59E+01	3.22E+00
NHWD	kg	5.65E+02	3.77E+02	7.84E-02	1.05E+00	1.37E-02	1.69E+02	1.79E+01
RWD	kg	3.20E-03	1.45E-03	1.91E-06	3.43E-06	1.18E-08	1.64E-03	1.13E-04
MER	kg	2.33E-04	1.65E-04	3.81E-08	7.17E-07	1.62E-09	6.05E-05	6.87E-06
MFR	kg	2.36E+00	1.37E-01	1.39E-04	2.69E-02	2.87E-06	1.18E+00	1.01E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	MJ	5.59E-01	3.90E-01	6.24E-05	1.29E-03	4.08E-06	1.41E-01	2.68E-02
EEE	MJ	1.17E+00	5.89E-01	4.03E-05	1.61E-03	1.20E-05	5.28E-01	4.81E-02

HWD = Hazardous waste disposed; **NHWD** = Non-hazardous waste disposed; **RWD** = Radioactive waste disposed; **MER** = Materials for energy recovery; **MFR** = Materials for recycling; **CRU** = Components for reuse; **ETE** = Exported thermal energy; **EEE** = Exported electricity energy;

6. LCA results and interpretations

The results of the underlying LCA are provided in this section as for environmental impacts, resource use and waste categories. All parameters required by the sub-PCR EPD Italy021 are included and reported in the Section 5.

The main general conclusions of the LCA are:

The upstream module is the stage with the highest contribution in the lifecycle environmental burden. Use & maintenance module and distribution results with a minor contribution. The installation and production stage does not result in any significant environmental impact.

In upstream module, as the core component of the energy storage system, the battery cell has been the main contributor to all environmental categories, the impact depending on its content.

For use & maintenance module, the electricity consumed and dissipated during the 20 years' service life is considered as the hotspot of the life cycle of the product. Thus, the overall environmental impacts of the product are highly dependent on operating power and DC round trip efficiency.

The distribution of the product contributes to a significant environmental impact in GWP, the shipment from Yantian port to Rotterdam port is considered as the main contributing process.

In end-of-life stage, the treatment of used li-ion battery was considered contributes the highest lifecycle environmental burden in this waste processing stage with the hydrometallurgical treatment.

7. Reference

- ISO 14040:2006 Environmental management — Life cycle assessment — Requirements and guidelines
- ISO 14044:2006 Environmental management — Life cycle assessment — Principles and framework
- EN50693:2019 Product category rules for life cycle assessments of electronic and electrical products and systems
- EPD Italy 007 Rev. 3.2 – 10/12/2025: “Electronic and electrical product and systems”
- EPD Italy 021 Rev. 5 – 03/10/2024: “Electronic and Electrical Products and Systems - Energy Storage”
- SGS/2026/LCAR/E/0602LCA Report-25/09/2026
- Regulations of the EPDItaly Programme - Revision 7.1- 05/09/2025
- Ecoinvent Database. <http://www.Ecoinvent.org>
- ISO 14025:2026 : Environmental statements and programmes for products — Environmental product declarations (EPDs)
- IEC TR 62635:2012 Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment