Environmental Product Declaration

In accordance with ISO 14025 and EN 50693 for:

Lithium iron phosphate cell

from

Contemporary Amperex Technology Co., Limited

No. 168, Xinke Avenue, Puxing Street, Xinjin District, Chengdu City, Sichuan Province

Programme:	EPDItaly
Programme operator:	EPDItaly
EPD registration number:	EPDItaly0392
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Table of Content

General information

Programme information

Programme:	EPDItaly
Address:	EPDItaly Via Gaetano De Castillia, 10 20124 – Milano Italy
Website:	www.epditaly.it
E-mail:	info@epditaly.it
EPD Owner	Contemporary Amperex Technology Co., Limited 2 Xingang Road, Zhangwan Town, Jiaocheng District Fujian Province (China)
Manufacturer name and address (production site)	No. 168, Xinke Avenue, Puxing Street, Xinjin District, Chengdu City, Sichuan Province
Functional unit	Functional unit is defined as 1 kWh minimum guaranteed energy when the cell is installed, over 20 years RSL with 365 days of operation per year and 1 full charge/discharge cycles per day. The reference flow is defined as 1 kWh lithium iron phosphate cell (net weight 6.027 kg, gross weight 6.268 kg)
CPC code	46410
Independent verification	EXTERNAL, Third party verification carried out by: ICMQ accredited by: ACCREDIA. ICMQ spa - Via Gaetano De Castillia, 10 - 20124 – Milano/Italy
Product category rules (PCR)	Core PCR: EPDItaly007 – PCR for Electronic and Electrical Products and Systems, Rev. 2, 2020/10/21.
Core PCR review was conducted by	ICMQ S.p.A. – Certificazioni e controlli per le costruzioni Moderator: Eng. Vito D'Incognito, Take Care International
Other references	EN 50693:2019 - Product category rules for life cycle assessments of electronic and electrical products and systems. Regulations of the EPDItaly Programme rev. 5.2 published on 2022/02/16
Product RSL description	20 years
LCA study	This EPD study is based on the LCA study described in the LCA report
EPD type	Product specific
EPD scope	Cradle to grave
Year of reported primary data	21 Aug 2021 to 22 Jul 2022
Technical support	Mark lv SGS China Co., Ltd A - 16/F, Century Yuhui Mansion, No. 73 Fucheng Road, Beijing, 100142, China

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 50693, 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 EN 50693 and ISO 14025.

Company information

Owner of the EPD: Contemporary Amperex Technology Co., Limited

Description of the organisation:
Contemporary Amperex Technology Co., Limited (CATL) is a global leader in new energy innovative technologies, committed to providing premier solutions and services for new energy applications worldwide. Adhering to the concept of circular economy, CATL is committed to producing carbon neutral battery products, reducing energy consumption and emissions. CATL implements the quality standard as ISO9001, and environment standards as ISO14001&ISO50001. In the future, CATL will actively fulfil corporate social responsibilities and make outstanding contributions to the cause of global new energy development.

Name and location of production site:
Contemporary Amperex Technology Co., Limited (CATL)
No. 168, Xinke Avenue, Puxing Street, Xinjin District, Chengdu City, Sichuan Province

Product information

Product name: Lithium iron phosphate cell

Product identification: Prismatic cell with 280Ah

Product description: The cell using the LFP chemistry, has 280Ah capacity. It can be assembled in different type of product, such as module, cabinet, container, etc.

Geography: The products are manufactured in China and sold to Europe.

UN CPC code: 46410

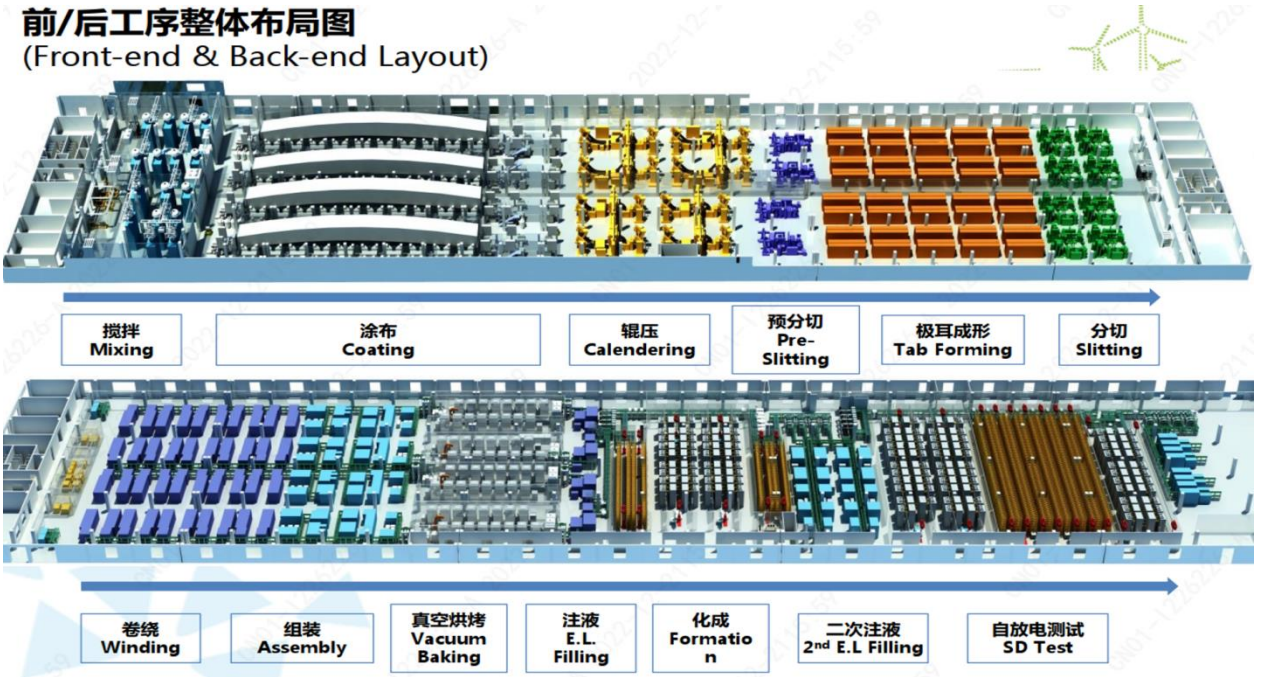
Product description:The cell using the LFP chemistry, has 280Ah capacity. It can be assembled in different type of product, such as module, cabinet, container, etc. The photos below illustrate the representative product, but not all of the product.

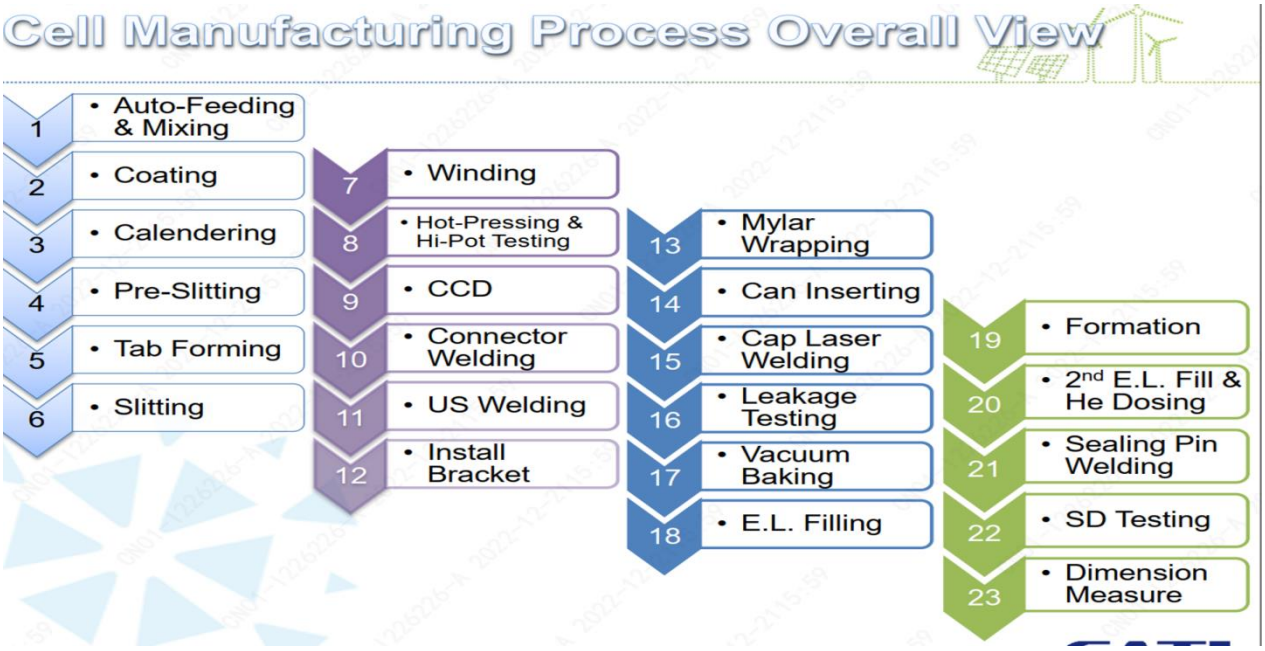


The product can be used for the energy storage system. The major application field include:voltage regulation,frequency regulation,backup power supply,new energy power generation,peak shifting& peak shaving&demand response,micro grid, etc.
The technical parameters are as follows:

Parameter	Value	Unit
Dimension	T71.7*W173.9*H207.2	mm*mm*mm
Weight	5400±300	g
Capacity	280	Ah
Voltage	3.2	V
Minimum guaranteed Energy	896	Wh
RTE	94.5%	%

Manufacturing process:The pictures below show the flow-chart of manufacturing process.





LCA information

Functional unit and reference flow: The functional unit (FU) is the product or system main function(s) quantified, to which the inputs and outputs are related to. For lithium iron phosphate energy storage batteries, the functional unit is defined as **1 kWh minimum guaranteed energy when the cell is installed, over 20 years RSL with 365 days of operation per year and 1 full charge/discharge cycles per day**.

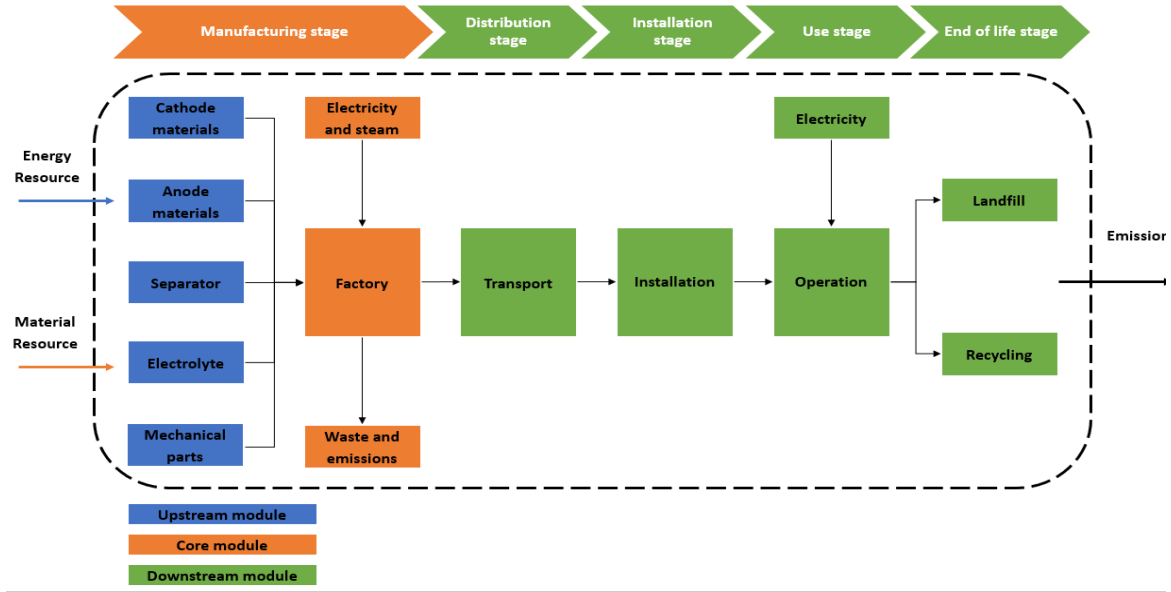
The reference flow describes all the needed flows to fulfil the functional unit, and is defined as **1 kWh lithium iron phosphate cell (net weight 6.027 kg, gross weight 6.268 kg)**.

Reference service life: 20 years

Time representativeness: The primary data used has been obtained from the CATL plant. The reporting period is selected from 21 Aug 2021 to 22 Jul 2022, being representative of the products and the production process.

Database(s) and LCA software used: SimaPro® software v.9.3 developed by PRé Consultants was used to create the product system model. The ecoinvent® database version 3.8 provided the life cycle background data for product system modelling.

System diagram: This EPD® is from cradle to grave with Upstream module, core module and Downstream module. System diagram is as follow:



The life cycle stages analyzed are described below:

Raw material acquisition stage (Upstream module)

At this stage, the materials and components are manufactured by supplies, and transported to the CATL plant.

The LFP cell product can be divided into 5 parts: Cathode materials, Anode materials, Separator, Electrolyte, Mechanical parts. Because CATL has no financial control or operational control over the supplies manufacturing materials above, Upstream production data for materials (eg. LFP, NCM, Al fiol, Electrolyte) refer to Ecoinvent database and literature.
The mode of transportation of materials is by lorry. However , It's challenging for factories to keep track of the load of lorry. In this case, report assumed that the lorry (EURO 4, 32 t) are in use.

Manufacturing and assembling stage (Core module)

The CATL is responsible for the processing semi-finished products , assembling cells, testing cells performance. In this stage, most of the environmental load comes from outsourcing energy consumption (electricity and steam). Solid waste and hazardous waste in production process are entrusted to a third party, and trucked by EURO 4,20 t lorry. Water pollutants are discharged up to standard after being treated by factories.

Distribution stage (Downstream module)

There are many places where products are sold, it is difficult to determine the distance and mode of transport. According to EN 50693 4.3.2, If no specific data are available, the following generic data shall be applied:

- International transport: 19 000 km by ship plus 1 000 km by lorry (85 % payload);
- Intracontinental transport: 3 500 km by lorry (85 % payload);
- Local transport: 1 000 km by lorry (85 % payload);

This report selects 19 000 km by ship plus 1 000 km by lorry as assumption scenario.

Name	Description	Value	Unit
Transport	Ship	6.268*19000	kg*km
Transport	Lorry, EURO4, 16-32t	6.268*1000	kg*km

Installation stage (Downstream module)

The product does not consume any energy and auxiliary materials during installation. At the same time, the transport and disposal of packaging waste is taken into account. The packaging materials are landfilled. The transport distance of packaging materials to the treatment plant is assumed to be 50km.

Name	Description	Value	Unit
Transport	Lorry, EURO4, 16-32t	0.241*50	kg*km
Landfill	Waste paper	0.190	kg
Landfill	Waste plastics	0.051	kg

Use and Maintenance stage (Downstream module)

The cell does not require maintenance during this stage, but there will be power loss due to charge/discharge cycles. Energy consumed in the use phase shall be considered as a self-consumption and the origin of this energy shall be the same as the primary circuit which feeds the battery. So the location and energy structure of battery use are important factors. This report choose European as basic scenario.

The energy loss calculation formula is as follows:

$$E_{loss} = \sum_{i=0}^{RSL} \frac{E_{useful\ i} \times N_{cycles} \times 365 \times (1 - DC\ RTE\ i)}{1000 \times DC\ RTE\ i}$$

Where:

- E_{loss} = the energy dissipation occurring whenever the battery is charged and discharged.
- DC RTEi (DC Round Trip efficiency in the year i) = the battery efficiency during a complete discharge/charge cycle defined as energy discharged divided by energy charged measured on DC power terminal in the charging/discharging cycle at the maximum power that the battery system is able to keep constantly without rest time and at Nominal Operating Temperature.
- $E_{useful\ i}$= the max energy dischargeable from the battery system (DC side) during discharge at the maximum power that the battery system is able to keep constantly during discharging process without rest time and Nominal Operating Temperature. The decreasing E useful is considered during the 20 years.
- N_{cycles} = the number of full charge/discharge cycles per day.
- 365 = the number of days in one year.

Name	Value	Unit
DC RTEi	94.17%	/
N_{cycles}	1	/
RSL	20	year
E_{loss}	395.02	kWh
Energy $_{provided\ total}$	6380.66	kWh

End of life stage (Downstream module)

EoL stage assumes that discard cell is sent for material recovering. The dismantling process refers to Ecoinvnet database. Most valuable fractions (aluminium, copper and plastics) are recycled within the default recycling recovering rate established in EN 50693. The remaining parts, based on mass balance, are sent to sanitary landfill. Based on direct consultation and project assumptions, the transport distances from Installation Location into the treatment facility is 100km. The recycling ratio of LFP is assumed 80%.

Process	Description	Value	Unit
Collection process	Discard cell	6.027	kg
	Transport, lorry, EURO4, 16-32t	6.027*100	kg*km
Recovery system specified by type	Reuse	0	kg
	Recycling	2.549	kg
	Incineration for energy recovery	0	kg
Disposal specified by type	Landfill	3.478	kg
	Incineration	0	kg

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

	MANUFACTURING STAGE		DISTRIBUTION STAGE	INSTALLATION STAGE	USE AND MAINTENANCE STAGE	END-OF-LIFE STAGE
Module	**Upstream module**	**Core module**	**Downstream module**			
Supply chain processes	Extraction of raw materials and the production of semi-finished products and auxiliary items; Electricity production; Transport of raw materials to CATL plant.	Cell assembling; Waste treatment; Emissions to air; Emissions to water; Transport of solid waste.	Cell transport into the operation site, installation and packaging waste management, operating for 20 years (RSL) , deinstallation and transformer EoL, including metal recycling and final disposal of non-recyclable fractions at unsanitary landfill. Transport of waste flows.			
Modules declared	x	x	x	x	x	x
Geography	CN	CN	EU	EU	EU	EU

Information additional

Allocation processes: A number of processes within the system boundary are associated with having multiple inputs and/or outputs. For delivering the functional unit, a procedure for partitioning impacts associated with these processes is required.

In this study, the systems which have been subject to the PCR EPDitaly 007, multi-output and recycling processes. Allocation for multi-input processes is based upon the physical composition of the inputs and outputs. Energy consumption(electricity, water, steam), solid waste and emissions of manufacturing stage are based on annual output 15373 MWh cell from 21 Aug 2021 to 22 Jul 2022 , and allocated to 1 kWh cell.

Regarding to the recycling of ,copper, aluminium and plastics generated during cell manufacturing, as well as wood waste from packaging sent for energy recovering (co-processing) we considered the cut-off approach. According to the PCR EPDitaly 007, 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 should be considered. Therefore, all the impacts of the waste transportation by road were fully attributed to the cell product.

Cut-off rules and considerations: According to EN 50693 4.2.3.3, based on established LCA practice, the cut-off criteria are set to a maximum of 5 % of the overall environmental impact of the analysed product system given by its life cycle impact assessment (LCIA) results.

In accordance with the cut-off rule, flows less than 1% of the total inventory were excluded, i.e.:

- construction of company plants and processing machinery (with a life of more than three years);
- staff travel and home-work transfers;
- research and development activities;
- some components of the kit of the products under study, such as: sensors, remote control and other operating tools; trays and other moving parts of the structures moved by the engines;
- the materials necessary for cleaning the machinery;
- Emissions to air

Calculation methodologies: In this study, EN 15804 + A2 method is selected as Impact assessment method. The EN 15804 standard covers Environmental Product Declarations (EPDs) of Construction Products. The 2019 A2 revision of this standard has aligned their methodology with the EF 3.0 method, except for their approach on biogenic carbon. According to the EN 15804, biogenic carbon emissions cause the same amount of Climate Change as fossil carbon, but can be neutralized by removing this carbon from the atmosphere. Temporary and permanent carbon storage is not allowed therefore the 15804 standard provides a set of requirement to prevent its accounting.

Content information

Product components	**Material classes**	**Weight-% (versus the product)**
LFP	M-199	35%~47%
Aluminum	M-120	3%~15%
Graphite	M-399	10%~25%
Copper	M-121	3%~15%
Separator	M-201	0%~5%
PP	M-202	0%~5%
PC	M-204	0%~5%
PET	M-209	0%~5%
Electrolyte	M-449	10%~30%
N-Methylpyrrolidone	M-449	0%~5%
Packaging materials	**Material classes**	**Weight-% (versus the product)**
Wood	M-340	2.69%
Paper	M-341	0.29%
EPO plastics	M-299	0.80%

Note:The exact composition is confidential, it is documented in the background LCA report and has been externally verified.

Environmental performance

Potential environmental impact

			Manufacturing stage		Distribution stage	Installation stage	Use and maintenance stage	End of life stage
Impact category	**unit**	**Total**	**Upsteram**	**Core**	**Downstream**			
GWP-total	kg CO2 eq	2.238E+02	4.373E+01	1.031E+01	2.201E+00	3.589E-01	1.619E+02	5.335E+00
GWP-fossil	kg CO2 eq	2.144E+02	4.383E+01	9.617E+00	2.199E+00	1.254E-02	1.566E+02	2.214E+00
GWP-biogenic	kg CO2 eq	8.530E+00	-1.875E-01	6.465E-01	4.458E-04	3.244E-01	4.824E+00	2.923E+00
GWP-luluc	kg CO2 eq	4.474E-01	7.375E-02	1.390E-03	1.266E-03	7.767E-06	3.702E-01	7.868E-04
ODP	kg CFC11 eq	1.219E-05	3.069E-06	7.277E-07	4.567E-07	1.294E-09	7.881E-06	5.163E-08
AP	mol H+ eq	1.952E+00	9.767E-01	4.020E-02	4.190E-02	6.026E-05	8.902E-01	3.275E-03
EP-freshwater	kg P eq	2.241E-01	6.483E-02	1.229E-03	1.178E-04	1.776E-06	1.577E-01	2.237E-04
EP-marine	kg N eq	2.471E-01	7.289E-02	7.376E-03	1.082E-02	5.752E-04	1.485E-01	6.987E-03
EP-terrestrial	mol N eq	2.378E+00	8.774E-01	6.346E-02	1.198E-01	1.653E-04	1.308E+00	9.269E-03
POCP	kg NMVOC eq	6.752E-01	2.614E-01	1.949E-02	3.156E-02	1.271E-04	3.595E-01	3.203E-03
ADP-minerals&metals	kg Sb eq	1.891E-02	1.745E-02	2.938E-06	5.241E-06	2.488E-08	1.450E-03	5.144E-06
ADP-fossil	MJ	3.997E+03	5.288E+02	1.131E+02	3.036E+01	1.180E-01	3.318E+03	7.004E+00
WDP	m3 depriv.	6.242E+01	2.242E+01	9.497E-01	8.003E-02	3.051E-03	3.885E+01	1.252E-01
Acronyms	AP=Acidification; GWP-total=Global Warming Potential total; GWP-biogenic=Global Warming Potential biogenic; GWP-fossil=Global Warming Potential fossil; GWP-luluc= Global Warming Potentia land use and land use change; EP-freshwater=Eutrophication aquatic freshwater; ODP=Ozone Depletion; POCP=Photochemical ozone formation; ADP-minerals&metals=Depletion of abiotic resources – minerals and metals; ADP-fossil=Depletion of abiotic resources – fossil fuels; WDP=Water use							

Use of resources

			Manufacturing stage		Distribution stage	Installation stage	Use and maintenance stage	End of life stage
Parameter	**unit**	**Total**	**Upsteram**	**Core**	**Downstream**			
PENRE	MJ, lower calorific value	3.987E+03	5.201E+02	1.131E+02	3.036E+01	1.180E-01	3.316E+03	7.005E+00
PERE	MJ, lower calorific value	7.577E+02	5.874E+01	3.258E+01	2.813E-01	4.880E-03	6.656E+02	5.526E-01
PENRM	MJ, lower calorific value	8.761E+00	8.761E+00	0	0	0	0	0
PERM	MJ, lower calorific value	3.266E+00	3.266E+00	0	0	0	0	0
PENRT	MJ, lower calorific value	3.995E+03	5.289E+02	1.131E+02	3.036E+01	1.180E-01	3.316E+03	7.005E+00
PERT	MJ, lower calorific value	7.610E+02	6.200E+01	3.258E+01	2.813E-01	4.880E-03	6.656E+02	5.526E-01
FW	cubic metres	3.445E+00	5.829E-01	2.632E-02	2.668E-03	8.272E-05	2.829E+00	4.366E-03
MS	kg	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0
Acronyms	PENRE=Use of non-renewable primary energy excluding nonrenewable primary energy resources used as raw material; PERE=Use of renewable primary energy excluding renewable primary energy resources used as raw material; PENRM=Use of non-renewable primary energy resources used as raw material; PERM=Use of renewable primary energy resources used as raw material; PENRT=Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials); PERT=Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials); FW=Net use of fresh water; MS=Use of secondary materials; RSF= Use of renewable secondary fuels ; NRSF=Use of non-renewable secondary fuels							

Waste production and output flows

Waste production

			Manufacturing stage		Distribution stage	Installation stage	Use and maintenance stage	End of life stage
Parameter	**unit**	**Total**	**Upsteram**	**Core**	**Downstream**			
HWD	kg	0.013	0	0.013	0	0	0	0
NHWD	kg	4.507	0	0.788	0	0.241	0	3.478
RWD	kg	0	0	0	0	0	0	0
Acronyms	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed;							

Output flows

			Manufacturing stage		Distribution stage	Installation stage	Use and maintenance stage	End of life stage
Parameter	**unit**	**Total**	**Upsteram**	**Core**	**Downstream**			
MER	kg	0	0	0	0	0	0	0
MFR	kg	2.549	0	0	0	0	0	2.549
CRU	kg	0	0	0	0	0	0	0
ETE	MJ	0	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0	0
Acronyms	CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electric energy; ETE = Exported thermal energy							

References

- ISO 14044:2006: Environmental management − Life cycle assessment − Requirements and guidelines
- ISO 14040:2006: Environmental management − Life cycle assessment − Principles and framework
- ISO 14025:2006: Environmental labels and declarations − Type III environmental declarations − Principles and procedures
- EN 15804:2012+A2:2019/AC:2021: Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
- EN 50693:2019: Product category rules for life cycle assessments of electronic and electrical products and systems
- PCR EPDItaly 007: Electronic and Electrical Products and Systems, (rev.2), October 2020
- Xie, J., Gao, F., Gong, X., Wang, Z., Liu, Y., Sun, B. (2018). Life Cycle Assessment of LFP Cathode Material Production for Power Lithium-Ion Batteries. In: Han, Y. (eds) Advances in Energy and Environmental Materials. CMC 2017. Springer Proceedings in Energy. Springer, Singapore. https://doi.org/10.1007/978-981-13-0158-2_54
- ISO 14040:2006/Amd 1:2020: Environmental management − Life cycle assessment − Principles and framework − Amendment 1
- ISO 14044:2006/Amd 2:2020: Environmental management − Life cycle assessment − Requirements and guidelines − Amendment 2
- ISO 14044:2006/Amd 1:2017: Environmental management − Life cycle assessment − Requirements and guidelines − Amendment 1