Huawei Digital Power Technologies Co., Ltd.

ENVIRONMENTAL PRODUCT DECLARATION

PRODUCT NAME :

Battery Modules of the Stationary Energy Storage System

PLANTS:

HQ of Huawei, Bantian, Longgang District, Sehnzhen, 518129, P.R.C

in compliance with ISO 14025

Program Operator	UL
Publisher	EPDItaly

Declaration Number	4790331578.101.1
Registration Number	MR-EPDITALY0063

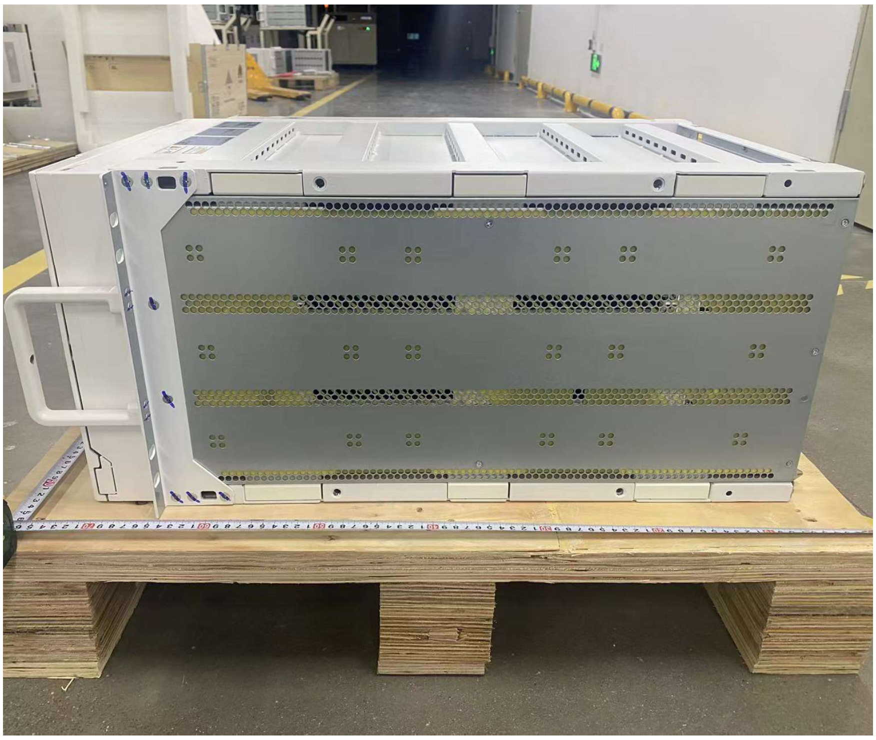
Issue Date	2022/09/19
Valid to	2027/09/19

Registered under the mutual recognition between EPDItaly and UL.
www.epditaly.it

ENVIRONMENTAL PRODUCT DECLARATION

HUAWEI DIGITAL POWER TECHNOLOGIES CO., LTD

BATTERY MODULES OF THE STATIONARY ENERGY STORAGE SYSTEM



Battery Modules of the Stationary Energy Storage System

Environmental protection is one of the main pillars of corporate philosophy in Huawei Digital Power Technologies Co., Ltd. It is an integral part of the business strategy and ranks equally with other company objectives.

Huawei Digital Power practices active environmental protection throughout the company. To efficiently utilize resources, they are constantly searching for ways to reduce raw material use, energy consumption and waste.

The environmental policy obliges all Huawei Digital Power employees worldwide to aim to protect the environment and conserve natural resources.

For more information please visit : https://digitalpower.huawei.com

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

HUAWEI

Huawei Digital Power
Lithium-ion Iron Phosphate Batteries Module

According to ISO 14025

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Environment 333 Pfingsten Rd, Northbrook, IL 60062	www.ul.com www.spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	General Program Instructions v.2.7 2022	
MANUFACTURER NAME AND ADDRESS	Huawei Digital Power Technologies Co., Ltd. HQ of Huawei, Bantian, Longgang District, Shenzhen, 518129, P.R.C	
DECLARATION NUMBER	4790331578.101.1	
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Functional Unit: Per kWh discharged energy over the entire life cycle of the battery module analyzed when the status of the health (SOH) of the battery module reaches the level of 60%.	
REFERENCE PCR AND VERSION NUMBER	The PCR for Energy Storage Battery, EPDCN-PCR-202205 v1.0 from EPD China	
DESCRIPTION OF PRODUCT APPLICATION/USE	The battery module is the building block for large-scale implementation of the battery packs for the energy storage application.	
PRODUCT RSL DESCRIPTION (IF APPL.)	N/A	
MARKETS OF APPLICABILITY	Global	
DATE OF ISSUE	September 19, 2022	
PERIOD OF VALIDITY	5 Years	
EPD TYPE	Product-specific	
RANGE OF DATASET VARIABILITY	[Industry-average only; mean, median, standard deviation]	
EPD SCOPE	Cradle to Grave	
YEAR(S) OF REPORTED PRIMARY DATA	Jan 2021 – June 2021	
LCA SOFTWARE & VERSION NUMBER	SimaPro 9.2	
LCI DATABASE(S) & VERSION NUMBER	Ecoinvent 3.8	
LCIA METHODOLOGY & VERSION NUMBER	EN 15804+A2:2019	

The PCR review was conducted by:	EPD China PCR Review Panel www.epdchina.cn
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Cooper McCollum, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	James Mellentine, Thrive ESG

THIRD-PARTY REVIEW IS NOT PART OF THE ANNUAL REVIEW OF THIS EPD.

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.

1. Product Definition and Information

1.1. Description of Company/Organization

Established in June 2021, Huawei Digital Power Technologies Co., Ltd. (Huawei Digital Power for short) has developed to a leading global provider of digital power products and solutions. Huawei Digital power is committed to integrating digital and power electronics technologies, developing clean power, and establishing energy digitalization to drive energy revolution for a better and greener future. In the clean power generation sector, Huawei digital power creates new power systems that primarily rely on renewable energy.

In the energy digitalization sector, Huawei digital power builds digital twins of the energy world, streamlining energy production and use. In the ICT energy infrastructure, Huawei digital power build green, low-carbon, and intelligent data centers and communications networks. In the green transportation sector, the company redefines consumer driving and safety experiences with electric vehicles, and fast-tracking electrified transportation.

1.2. Product Description

1.2.1 Product Identification

The main product analyzed in this report is the battery module with 18 cells of lithium-ion iron phosphate batteries in serial connections, battery management units, and module packaging. The battery module is the building block for large-scale implementation of the battery packs for the energy storage application (Figure 1).

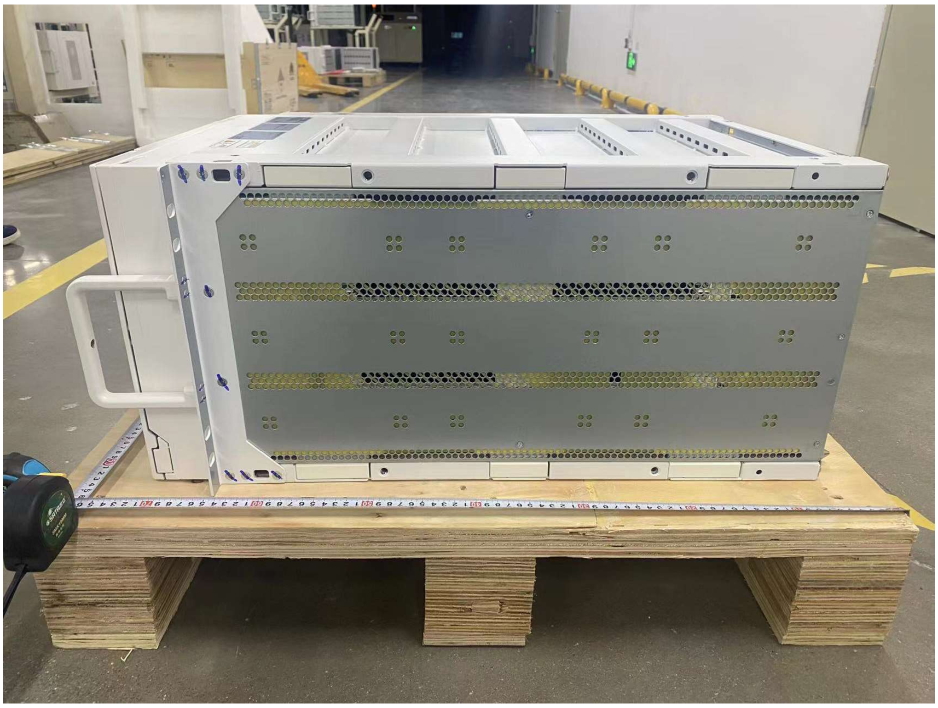


Figure 1. The battery module for the EPD report

1.2.2 Product Specification

The ESM-57280AS1 is a battery module consisting of 18 lithium-ion iron phosphate battery cells in serial connections. The total operating voltage of the battery module is 57.6 V with a 280 Ah capacity and the total storage electricity of the battery module is 16.128 kWh (Table 1). The battery module is also equipped with two battery management units with external packaging for thermal management and structural support.

Table 1. Technical data of the coated separator products under study

Battery module	No. of cells	Voltage (V)	Capacity (Ah)	Total kWh
ESM-57280AS1	18	57.6	280	16.128

1.2.3 Product-Specific EPD

This EPD is a product-specific declaration for the battery module ESM-57280AS1 which consists 18 lithium-ion iron phosphate battery cells in serial connections with 57.6 V total operation voltage and 280 Ah capacity.

1.3. Application

The battery module can be applied to vehicle use, utility scale stationary applications, and backup power.

- The application the home end user market for energy storage.
- Provide energy to different ways of transportation from boat to caravan.
- Solar-powered landscape lighting.
- Other applications include marine electrical systems and propulsion, flashlights, radio-controlled models, portable motor-driven equipment, amateur radio equipment, industrial sensor systems and emergency lighting.

1.4. Declaration of Methodological Framework

A full LCA approach was considered in this project while applying generic data model for most background systems. The LCA used a cradle-to-grave system boundary and no known flows were deliberately excluded from this EPD.

The reference service life of the battery module is the status of the health (SOH) of the battery module reaching the level of 60%.

Additional details on assumptions, cut-offs and allocation procedures can be found in the *section 2: Methodological Framework*.

1.5. Properties of Declared Product as Delivered

About the market of battery module from the Huawei Digital Power, one of the main consumer targets is in the Europe. The following transportation is estimated based on the PCR for the product distribution (Table 2).

Table 2. Product distribution of the ESM-57280AS1

Region	Ratio	Transport	Distance
Europe	100%	Ship	10000 km

1.6. Material Composition

The battery consists of 18 lithium-ion iron phosphate battery cells in serial connections, two battery management units with external packaging for thermal management and structural support. Material composition is presented below.

Table 3. Composition of the battery module

Raw materials	Ratio
Galvanized steel sheet	15.7%
Aluminium alloy	4.5%
Copper	1.3%
Glass fibre reinforced Epoxy	0.3%
Polycarbonate	4.6%
Nylon 66	0.0%
Stainless steel	0.0%
Polypropylene	0.0%
Cable	0.1%
BMU	1.5%
Battery cell	71.9%

2. Methodological Framework

2.1. Declared Unit

The declared unit in the EPD report is defined as the environmental impacts associated with per kWh discharged energy over the entire life cycle of the battery module analyzed when the status of the health (SOH) of the battery module reaches the level of 60%.

2.2. System Boundary

The system boundaries identify the life cycle stages, processes, and flows considered in the LCA report. The system boundary considered in this LCA study is from the cradle to the grave, including the use phase by end consumers. The terms defining life cycle stages are included in PCR and the standard of EN15804 is adopted. EN15804 is selected not only because it contains a comprehensive and general description of all life cycle stages of a product, but also because EN15804 is required for the associated EPD.

- Upstream module: includes extraction of raw materials, including waste recycling processes and the production of semi-finished and ancillary products(A1), and transportation of raw materials to the manufacturing company (A2);
- Core module: includes manufacturing of the product constituents, including all the stages, product assembly, products packaging, and waste recycling processes after the production (A3);
- Downstream module: includes distribution stage (A4), installation stage (A5), Use & Maintenance stage (B1-B7), and End-of-life stage (C1-C4); Since it will be years to enter the end-of-life stage for battery, scenarios must be developed for end-of-life treatment. For simplification purpose, assumption is made during the modeling of downstream module. See the following sections for “Estimates and Assumptions”.

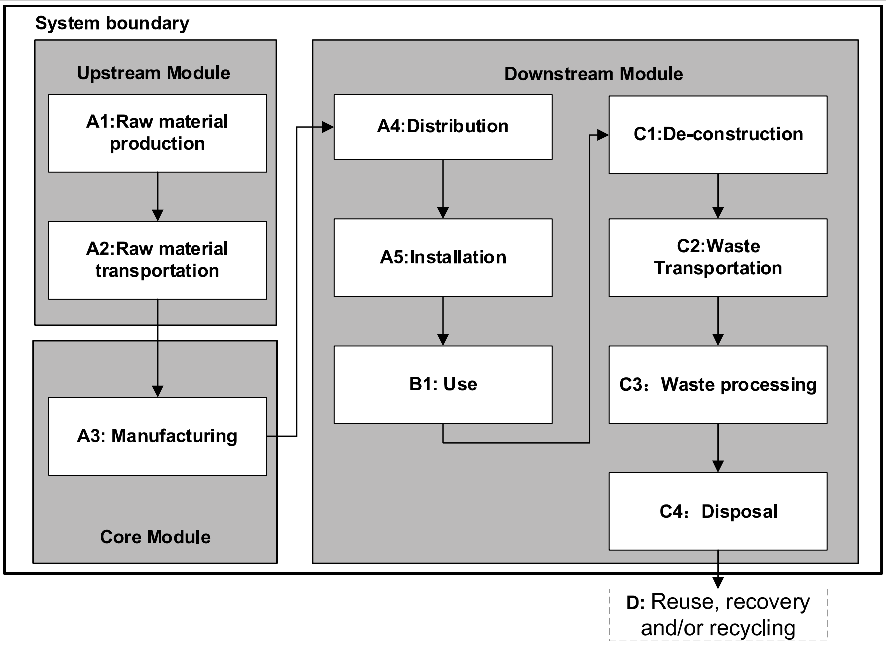


Figure 3. System boundary of the battery module

2.3. Reference Service life and Estimated Building Service Life

The reference service life of the battery module is the status of the health (SOH) of the battery module reaching the level of 60%.

2.4. Allocation

Allocation refers to partitioning of input or output flows of a process or a product system between the product systems under study and one or more other product systems. In this study, there are two types of allocation procedures considered following EN50693 specifications:

Allocation between co-products

No other by-products are produced from the battery module assembly line, hence there is no need to allocate the energy or water consumption with other products.

Allocation for recovery operations

For the allocation of reuse, recycling, and recovery, the polluter pays principle (PPP) is followed in this report. This means that the waste transportation to the treatment site and the waste processing (mainly shredding) is considered in this report, while the benefit, the load from waste treatment for recycling purposes such as de-pollution and crushing, etc., is allocated to the next life cycle of substituted products, but not the primary producers, hence no burden or benefit will be allocated to the primary producer of the transformer products (cut-off approach). Therefore, the reuse, recovery, and/or recycling potentials are reported separately in module (D).

2.5. Cut-off Rules

No specific cut-off is applied, all inputs and outputs to a (unit) process are included in the calculation.

2.6. Data Sources

Steps were taken to ensure that the life cycle inventory data were reliable and representative. The type of data that was used is clearly stated in the Inventory Analysis, be it measured or calculated from primary sources or whether data are from the life cycle inventory databases. In this study, generic data for certain processes were sourced from the databases in SimaPro 9.2.

Specific data of the considered system (such as material or energy flows that enter the production system). These data were calculated and submitted by Huawei Digital Power. Existing LCI data were, at most, less than 10 years old. Newly collected LCI data were current or up to 3 years old. The LCI data related to the geographical locations where the processes occurred and the technology represented the average technologies at the time of data collection.

2.7. Data Quality

In this study, the data quality requirements were summarized in Table 4.

Table 4. Data quality requirement

Quality requirement	Specific requirement	Data quality	Result Good / fair / poor
Time-related coverage (age of data and the minimum length of time over which data should be collected)	Existing LCI data were, at most, 10 years old.	<10 years	good
	Newly collected LCI data were current or up to 3 years old	Huawei Digital Power 2021 production inventory	good
Geographical coverage (the geographical area from which data for unit processes should be collected to satisfy the goal of the study)	Unit process for raw material should be collected directly from manufacturers	All raw material data was collected from the manufacturer in China	good
	Unit process for production should represent the real site	Production data is collected and provided by Huawei Digital Power	good
	Transportation and energy data should represent the region (in China)	Transportation and energy use Ecoinvent data with adaptation to Chinese regional character	good
Completeness	95% percentage of flow is measured or estimated	All of the unit processes within the scope of the life cycle were included	good
Representativeness	Qualitative assessment of the degree to which the data set reflects the true population of interest, i.e. geographical coverage, period, and technology coverage	See geographical coverage, period, and technology coverage requirement above, all meet	good
Consistency	Qualitative assessment of whether the study methodology is applied uniformly to the various	the study methodology is applied uniformly to the various components of	good

Quality requirement	Specific requirement	Data quality	Result Good / fair / poor
	components of the analysis	the analysis	
Reproducibility	Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Yes	good
Sources of the data	The foreground data should be from the primary producer	Yes	good
Uncertainty of the information	Data, models, and assumptions should be verified	All the primary data and assumptions were confirmed with Huawei Digital Power, and models were built following ISO 14040/44	good

2.8. Period under Review

The study used primary data collected from January 2022 to June 2022.

2.9. Comparability and Bench-marking

No comparisons or bench-marking are included in this EPD. LCA results across EPDs can be calculated with different background databases, modeling assumptions, geographic scope and time periods, all of which are valid and acceptable according to the Product Category Rules (PCR) and ISO standards. The user of the EPD should take care when comparing EPDs from different companies. Assumptions, data sources, and assessment tools may all impact the uncertainty of the final results and make comparisons misleading.

2.10. Estimates and Assumptions

The main assumptions of this LCA study are as follows：

- The battery module contains diverse components. The LCA is modelled with more than 98% of the cumulative mass. In this case, the battery pack is weighted at 140kg per piece. The modeled mass is 136 kg. The rest of the mass for the battery module is considered to be steel for the structural support.
- The cathode material (lithium-ion iron phosphate, LFP) is not documented nor supplied by the supplier. Thus, the literature reflecting the most recent understanding of the inventory of the LFP is applied.
- The detailed composition of the battery electrolyte is not provided by the supplier due to commercial confidentiality. Thus, a common combination of lithium hexafluorophosphate and ethylene carbonate is thus applied as the electrolyte.
- The power consumption of de-installation (C1) is assumed to be the same as the installation stage (A5).

- During the end-of-life stage, the transportation of the waste to treatment facilities including recycling, landfill, or incineration center is assumed to be 200 km for simplification purposes.

2.11. Units

SI units are used for all LCA results of Huawei battery module.

3. Technical Information and Scenarios

3.1. Manufacturing Stage

Consisting of 18 lithium-ion iron phosphate battery cells in serial connections, the total operating voltage of the battery module is 57.6V with a 280 Ah capacity. The battery module is also equipped with two battery management units with external packaging for thermal management and structural support. The 18 battery cells are firstly wielded into a serial connection. The two battery management units are mounted onto the battery cells to monitor and regulate the charging/discharging behaviors of the battery cells. The final battery pack is assembled with external steel-based structural support and an aluminum-based thermal conductor.

3.2. Distribution Stage

About the market of battery module from the Huawei Digital Power, one of the main consumer targets is in the Europe. The following transportation is estimated based on the PCR for the product distribution (Table 5).

Table 5. Product distribution of the ESM-57280AS1

Region	Ratio	Transport	Distance
Europe	100%	Ship	10000 km

3.3. Product Installation Stage

As for the installation, the battery module ESM-57280AS1 is further connected into the battery pack. Electricity is the only energy source needed for pack production. A specific energy consumption value of 0.03 kWh/kg is needed for the battery module based on the values.

3.4. Use and Maintenance Stage

The energy associated with the use & maintenance stages stems from the internal resistance, which can be calculated based on the following Equation.

$$Eloss_{use} = \frac{E_{total}}{\eta_{batt}} - E_{total}$$

In this LCA, the battery module is charged with 50% of the energy from the local photovoltaics and 50% of the energy from the grid. In our case, the average European low-voltage electricity mix. η_{batt} is the charging/discharging efficiency (η_{batt} =0.94). E_{total} is the total discharged electricity from the battery over its life cycle. For the maintenance of the battery module, no inputs and outputs are taken into consideration in the maintenance stage in this study. The total energy loss from the 11,184 kWh, in which 5,592 coming from the grid and 5,592 coming from the PV.

3.5. End-of-Life Stage

For the end-of-life stage, the De-construction (C1) of the battery module during the end-of-life stage is assumed to use only electricity, and the electricity consumption is assumed to be the same as the construction stage (A5). 200km transportation distance from the plant site to the waste treatment site (C2) is assumed, and the waste processing (C3) stage is modeled according to the literature regarding hydrometallurgical processing. For the end-of-life disposal process (C4), the IEC/TR 62635 guidelines is referred to for the C4 stage on the recycling rate and disposal rate. Potential recycling benefits are considered separately in Module D. From per kg LFP battery 0.357 kg LiCl product will be extracted.

3.6 electricity mix

In this LCA study, different electricity mix was used based on grid mixes in China. The electricity inventory is based on the year 2018 for Chinese electricity generation (China Energy Statistics Yearbook 2019). China's electricity supply mix is depicted in Figure 4. below. For the core module (A3), the production of the battery module takes place in Guangdong province, China low-voltage electricity mix is used. The emission of the electricity used is 0.914kg/kWh. For the core module, the European low-voltage electricity mix was used for the downstream stage.

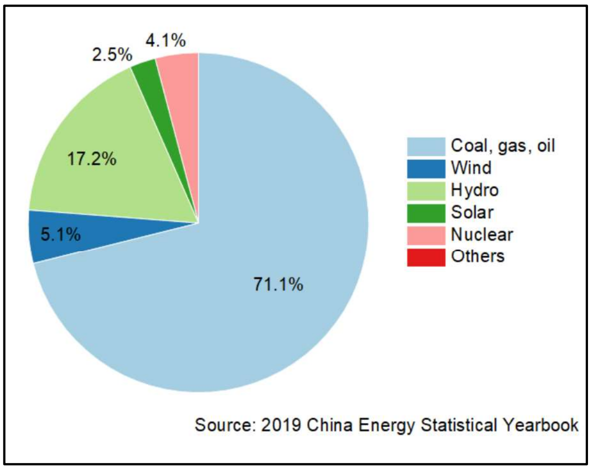


Figure 4. China Electricity Mix

4. Environmental Indicators Derived from LCA

Table 6. Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCT-ION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type: Cradle to grave	x	x	x	x	x	x	MND	MND	MND	MND	MND	MND	x	x	x	x	x

4.1. Life Cycle Impact Assessment Results

Based on the model of ESM-57280AS1, the EN 15804 result is calculated and listed in Table 7. The LCIA results by different life cycle stages in line with EN15804 are presented.

Table 7. Environmental impacts of the ESM-57280AS1

Environmental Impacts	Unit	A1	A2	A3	A4	A5	B1	C1	C2	C3	C4	D
GWP, t	kg CO2 eq	1.57E-02	1.07E-05	1.57E-04	9.32E-05	2.19E-05	3.21E-02	2.19E-05	2.72E-05	8.78E-04	3.40E-04	-1.01E-03
GWP, f	kg CO2 eq	1.62E-02	1.09E-05	1.60E-04	9.48E-05	2.24E-05	3.28E-02	2.24E-05	2.77E-05	8.94E-04	3.40E-04	-1.02E-03
GWP, b	kg CO2 eq	-3.39E-04	-1.56E-08	-1.31E-06	-1.84E-07	-1.83E-07	-2.66E-04	-1.83E-07	-3.90E-08	-1.90E-06	5.50E-06	5.98E-06
GWP, luluc	kg CO2 eq	1.25E-05	2.48E-09	3.60E-09	1.62E-08	5.04E-10	2.57E-06	5.04E-10	4.91E-09	7.79E-08	3.94E-08	-9.42E-08
ODP	kg CFC-11 eq	1.56E-09	2.31E-12	1.08E-12	1.67E-11	1.52E-13	5.40E-10	1.52E-13	6.07E-12	8.89E-11	2.14E-11	-1.56E-10
AP	mole H+ eq	1.14E-04	4.71E-08	8.10E-07	1.89E-06	1.13E-07	1.68E-04	1.13E-07	1.24E-07	5.51E-06	6.20E-07	-6.24E-06
EP-freshwater	kg P eq	2.51E-05	5.97E-10	2.20E-08	4.06E-09	3.08E-09	5.10E-06	3.08E-09	1.28E-09	1.90E-07	9.40E-08	-4.41E-07
POCP	kg NMVOC eq	9.89E-05	5.28E-08	4.42E-07	1.32E-06	6.18E-08	9.35E-05	6.18E-08	1.44E-07	2.70E-06	5.36E-07	-3.40E-06
ADPE	kg Sb eq	1.79E-06	3.72E-11	1.01E-10	2.08E-11	1.41E-11	9.99E-08	1.41E-11	7.18E-11	3.30E-09	3.54E-10	-6.33E-09
ADPF	MJ	1.60E-02	1.07E-05	1.58E-04	9.34E-05	2.21E-05	3.23E-02	2.21E-05	2.73E-05	8.80E-04	3.35E-04	-9.07E-03
WDP	m3 water eq	7.31E-03	8.28E-07	5.55E-06	5.70E-06	7.77E-07	3.20E-03	7.77E-07	2.16E-06	7.38E-04	2.10E-05	-6.85E-04

4.2. Life Cycle Inventory Results

The life cycle inventory analysis results of the resources and waste is depicted in table below.

Table 8. Resource use and output of the ESM-57280AS1

Environmental Impacts	Unit	A1	A2	A3	A4	A5	B1	C1	C2	C3	C4	D
PENRE	MJ	1.83E-01	1.55E-04	2.08E-03	1.27E-03	2.92E-04	4.26E-01	2.92E-04	3.99E-04	1.17E-02	1.64E-03	-9.46E-03
PERE	MJ	1.91E-02	2.06E-06	1.98E-04	2.92E-05	2.78E-05	1.65E-01	2.78E-05	4.96E-06	1.08E-03	7.29E-05	-8.17E-04
PENRM	MJ	1.47E-01	1.63E-04	1.38E-03	1.27E-03	1.94E-04	2.87E-01	1.94E-04	4.21E-04	8.38E-03	1.21E-03	0.00E+00
PERM	MJ	9.11E-03	7.37E-07	1.62E-05	3.11E-06	2.27E-06	3.96E-03	2.27E-06	1.76E-06	3.25E-04	2.42E-05	0.00E+00
PENRT	MJ	3.31E-01	3.18E-04	3.47E-03	2.54E-03	4.85E-04	7.13E-01	4.85E-04	8.21E-04	2.00E-02	2.85E-03	-9.46E-03
PERT	MJ	2.82E-02	2.80E-06	2.15E-04	3.23E-05	3.00E-05	1.69E-01	3.00E-05	6.72E-06	1.41E-03	9.72E-05	-8.17E-04
FW	m3	1.15E-02	9.08E-07	7.49E-06	6.02E-06	1.05E-06	2.73E-02	1.05E-06	2.04E-06	3.33E-04	2.91E-05	-1.07E-03
SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HWD	kg	3.05E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E-04	0.00E+00
NHWD	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-05	0.00E+00
RWD	kg	1.02E-07	4.09E-10	4.82E-10	3.00E-09	6.75E-11	1.06E-07	6.75E-11	1.07E-09	4.42E-09	8.20E-10	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MRF	kg	3.36E-04	0.00E+00	0.00E+00	0.00E+00	8.79E-05	0.00E+00	0.00E+00	0.00E+00	6.09E-04	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

5. LCA Interpretation

The study of life cycle assessment following ISO 14040/14044 standard is conducted on the battery module from the Huawei Digital Power. The system boundary of this LCA is cradle to grave. EN 15804+A2:2019 method was used for life cycle impact assessment in this report.

The life cycle inventory (LCI) includes data collection from a variety of publicly available sources, by taking into consideration the technological representativeness, and the temporal and geographical scales. In the case of data missing, Ecoinvent and regional database and some other relevant databases were referred to. Sensitivity analysis was conducted to check the influences of some uncertain data on the LCA result and test the robustness of the study.

The contribution analysis of the products on various impact categories reveals that the raw materials stage (A1) is the main contributor to environmental impact followed by the B1 stage. The contribution from these two stages are reaching 99%. Other stages are mostly negligible.

Sensitivity analysis shows that uncertainty in the different formulations of the electrolyte, different waste transport distance, and different EoL scenarios trigger some but relatively low fluctuations of the final LCA results. It is still however recommended to continuously update the model and analysis to get up-to-date results, in case the assumption of process parameters will be changed in the future, or better data would be provided. The cathode materials, on the other hand, exert significant influences over the final impact results. Therefore, further analysis and data collection are needed for the next step.

6. Additional Environmental Information

6.1. Environment and Health During Manufacturing

Production at battery module adheres to the according national guidelines and regulations during all manufacturing steps, and in all facilities. Certification of the environmental management system is in accordance with ISO 14001.

6.2. Further Information

The additional information of the battery module can be found on the website:

https://digitalpower.huawei.com/

7. References

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

PCR for Energy Storage Battery, EPDCN-PCR-2022-0003 v1.0

ISO 14040 (2006): Environmental Management - Life Cycle Assessment - Principles and Framework

ISO 14044 (2006): Environmental Management - Life Cycle Assessment - Requirements and Guidelines

Jiawei Quan, Siqi Zhao, Duanmei Song, Tianya Wang, Wenzhi He, Guangming Li, Comparative life cycle assessment of LFP and NCM batteries including the secondary use and different recycling technologies, Science of the total Environment, Vol 819, 153105.

SimaPro - LCA Computer Software http://www.pre-sustainability.com/