Zhejiang Narada Power Source Co., Ltd.

ENVIRONMENTAL PRODUCT DECLARATION

Lithium Battery Energy Storage System
76.8NESP 160/200/250

No. 72 Landscape Avenue, Qingshanhu Street,
Lin'an City, Zhejiang Province, China

In accordance with ISO 14025 and EN 50693:2019

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration Number	NDBT20230530
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GENERAL INFORMATION

EPD OWNER	
Name of the company	Zhejiang Narada Power Source Co., Ltd.
Registered office	Zhejiang Narada Power Source Co., Ltd.
The address of the registered office	No. 72 Landscape Avenue, Qingshanhu Street, Lin'an, Hangzhou, Zhejiang Province, China
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PROGRAM OPERATOR	
EPDItaly	Via Gaetano De Castillia n° 10 - 20124 Milano, Italy www.epditaly.it

INFORMATION ON THE EPD	
Product name (s)	Lithium Battery Energy Storage System 76.8NESP 160/200/250
Site (s)	No. 72 Landscape Avenue, Qingshanhu Street, Lin'an City, Zhejiang Province, China
Short description and technical information of the product (s)	Lithium Battery Energy Storage System: 76.8NESP160, 76.8NESP200 and 76.8NESP250 Module for power grid, with FE80B, FE105A and FE125A Cell respectively.
Field of application of the product (s)	Electronic and electrical products and systems
Product (s) reference standards (if any)	
CPC Code (number) https://unstats.un.org/unsd/classifications/Econ	4641

VERIFICATION INFORMATION	
PCR (title, version, date of publication or update)	• Core PCR: EPDItaly007 – PCR for Electronic and Electrical Products and Systems, Rev. 3. 2023/01/13 • Sub-category PCR: EPDItaly021:2021 — for Energy Storage, Electronic and electrical products and systems – Charging Stations, Rev. 4 2022/06/23
EPDItaly Regulation (version, date of publication or update)	REGULATIONS OF THE EPDItaly PROGRAMME VER. 5.2, ISSUED ON 2022/02/16
Project Report LCA	This EPD study is based on the LCA study described in the LCA report <LCA Report_Zhejiang Narada module_20230727>
Independent Verification Statement	PCR reviewed by ENEL S.p.A.; Life Cycle Engineering. 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 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. 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
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.

CONTENTS

Zhejiang Narada Power Source Co.,Ltd (The abbreviation is Narada) is in the process of seeking their own survival and sustainable development. Narada considers to achieve the goal of enterprise management and improve enterprise market position, and to keep the enterprise in the leading field of competition and the future expansion of the business environment always maintain sustained earnings growth and improvement of ability, ensure longevity enterprise for a long time.

Narada establishes CSR management manual to ensure compliance with laws, regulations and customer requirements and continuous improvement.

1. The CSR policy

People-oriented, green operation, to promote the harmonious and sustainable development of economy, society and environment

2. CSR vision

To build a sustainable social responsibility system and become a first-class enterprise in the global relay field respected by the society and loved by employees

3. The CSR strategy

Develop employee value, promote green environmental protection, pursue win-win ecology and create a better life.

4. CSR practice path

For employees, people-oriented, growth together

For the environment, green environmental protection, clean production

For partners, development together, to achieve win-win

For shareholders, stable operation, create value

For the government, honest and honest, legitimate business

For community, being selfless contribution

GENERAL INFORMATION

Narada focuses on smart energy storage services, covering overall solutions for R&D and production, system integration, and smart operation of energy storage products. Narada adopts international advanced energy storage technology to provide safe and reliable energy storage system products and services for global users. After years of exploration and accumulation, the products have achieved large-scale applications on the User side, Grid side, and New energy generation side.

At the same time, Narada has created two industrial closed loops of "lead battery cycle industrial chain" and "lithium battery cycle industrial chain". The company has carried out sales in 158 countries and regions around the world, and the company's brand "Narada" is famous all over the world. Company development history

1) In 1994, Zhejiang Narada Power Source Co.,Ltd was established.
2) In 2010, Successfully listed on the China Growth Enterprise Market with stock code 300068 .
3) Participated in the development of international and national standards for energy storage batteries since 2014
4) In 2016, Become one of the first national "Internet ＋" smart energy demonstration projects.
5) In 2019, In 2019, the lithium battery containerized energy storage system passed UL9540 certification.
6) In 2021, The Nandu Energy Storage series products have passed the KC&KBIA certification in South Korea

Narada is committed to providing customers with satisfactory products and solutions through continuous innovation and unremitting pursuit of high quality to bring people a more comfortable and convenient life.

As a responsible company to society and environment, Narada applied EPD Italy, conducted LCA study from 2023.1.1 to 2023.3.20, and is willing to disclosure the actual environmental impact to the public and customers for low voltage products.

Declared in this EPD includes the following products and for each product the characteristics and composition were listed from table2-table 5.

Table 1 LCA study related types

Type for LCA Study	Related Types
76.8NESP160	76.8NESP160
76.8NESP200	76.8NESP200
76.8NESP250	76.8NESP250

Table 2 Product characteristics

	Group 1		Group 2		Group 3	
Item	Cell 1	Module 1	Cell 2	Module 2	Cell 3	Module 3
Name	FE80B	76.8NESP160	FE105A	76.8NESP200	FE125A	76.8NESP250
Cell Capacity/Ah	86.00	160.00	105.00	200.00	130.00	250.00
Energy/kwh	0.28	12.30	0.34	15.40	0.42	19.20
Weight/kg	2.12	110.70	2.20	133.50	2.42	141.00
Allowed C-Rate/C	2.00	2.00	2.00	1.00	1.00	1.00
Recommended C-Rate/C	2.00	2.00	1.00	1.00	0.50	0.50

MATERIALS COMPOSITION

Table 3 The 76.8NESP 160 module material composition

Item	Amount	Unit	Amount	Unit
Cell	104.7431	kg/pcs	8.5157	kg/kwh
Steel Sheet	20.3110	kg/pcs	1.6513	kg/kwh
SUS304	0.2100	kg/pcs	0.0171	kg/kwh
Acrylic acid	0.0300	kg/pcs	0.0024	kg/kwh
Epoxy resin	1.1640	kg/pcs	0.0946	kg/kwh
80% Polypropylene & 20% glass fiber	2.8940	kg/pcs	0.2353	kg/kwh
Nylon	0.0056	kg/pcs	0.0005	kg/kwh
A Fan	0.0850	kg/pcs	0.0069	kg/kwh
Polycarbonate	0.0017	kg/pcs	0.0001	kg/kwh
Aluminium alloy	1.0860	kg/pcs	0.0883	kg/kwh
50% Aluminium alloy& 50% copper	0.1000	kg/pcs	0.0081	kg/kwh
Copper + nickel	1.5280	kg/pcs	0.1242	kg/kwh
polyethylene glycol terephthalate	0.0130	kg/pcs	0.0011	kg/kwh
Polyimide	0.0020	kg/pcs	0.0002	kg/kwh
Copper foil + heat shrink tube	0.1270	kg/pcs	0.0103	kg/kwh

Table 4 The 76.8NESP 200 module material composition

Item	Amount	Unit	Amount	Unit
Cell	105.6480	kg/pcs	6.8603	kg/kwh
Steel Sheet	20.3110	kg/pcs	1.3189	kg/kwh
SUS304	0.2100	kg/pcs	0.0136	kg/kwh
Acrylic acid	0.0300	kg/pcs	0.0019	kg/kwh
Epoxy resin	1.1640	kg/pcs	0.0756	kg/kwh
80% Polypropylene & 20% glass fiber	2.8940	kg/pcs	0.1879	kg/kwh
Nylon	0.0056	kg/pcs	0.0004	kg/kwh
A Fan	0.0850	kg/pcs	0.0055	kg/kwh
Polycarbonate	0.0017	kg/pcs	0.0001	kg/kwh
Aluminium alloy	1.0860	kg/pcs	0.0705	kg/kwh
50% Aluminium alloy& 50% copper	0.1000	kg/pcs	0.0065	kg/kwh
Copper + nickel	1.5280	kg/pcs	0.0992	kg/kwh
polyethylene glycol terephthalate	0.0130	kg/pcs	0.0008	kg/kwh
Polyimide	0.0020	kg/pcs	0.0001	kg/kwh
Copper foil + heat shrink tube	0.1270	kg/pcs	0.0082	kg/kwh

Table 5 The 76.8NESP 250 module material composition

Item	Amount	Unit	Amount	Unit
Cell	116.3040	kg/pcs	6.0575	kg/kwh
Steel Sheet	20.3110	kg/pcs	1.0579	kg/kwh
SUS304	0.2100	kg/pcs	0.0109	kg/kwh
Acrylic acid	0.0300	kg/pcs	0.0016	kg/kwh
Epoxy resin	1.1640	kg/pcs	0.0606	kg/kwh
80% Polypropylene & 20% glass fiber	2.8940	kg/pcs	0.1507	kg/kwh
Nylon	0.0056	kg/pcs	0.0003	kg/kwh
A Fan	0.0850	kg/pcs	0.0044	kg/kwh
Polycarbonate	0.0017	kg/pcs	0.0001	kg/kwh
Aluminium alloy	1.0860	kg/pcs	0.0566	kg/kwh
50% Aluminium alloy& 50% copper	0.1000	kg/pcs	0.0052	kg/kwh
Copper + nickel	1.5280	kg/pcs	0.0796	kg/kwh
polyethylene glycol terephthalate	0.0130	kg/pcs	0.0007	kg/kwh
Polyimide	0.0020	kg/pcs	0.0001	kg/kwh
Copper foil + heat shrink tube	0.1270	kg/pcs	0.0066	kg/kwh

DECLARED UNIT (FUNCTIONAL UNIT)

The declared unit is specified in kWh stored by a single energy storage module. The functional unit is per kWh of 76.8 NESP Lithium Battery Energy Storage System (76.8NESP160/200/250 Module) with a RSL of 10 years.

As for the type of cell technology, the three Lithium Battery Energy Storage System are Lithium Iron Phosphate for industrial use.

SYSTEM BOUNDARIES

The life cycle of 76.8 NESP Lithium Battery Energy Storage System (76.8NESP160/200/250 Module), is a “from cradle to grave” analysis and covers the following main life cycle stages.

The following table shows the stages of the product life cycle and the information stages according to EN 50693 and PCR021 for the evaluation of electronic and electrical products and systems.

Table 6 System boundaries

<table>
<tr><th colspan="2">MANUFACTURING STAGE</th><th>DISTRIBUTION STAGE</th><th>INSTALLATION STAGE</th><th>USE & Maintenance STAGE</th><th>END-OF-LIFE STAGE

De-installation</th></tr>
<tr><th>UPSTREAM MODULE</th><th>CORE MODULE</th><th colspan="4">DOWNSTREAM MODULE</th></tr>
<tr><td>extraction of raw materials, including waste recycling processes and the production of semi-finished and ancillary products</td><td>manufacturing of the product constituents, including all the stages</td><td colspan="4" rowspan="4">IN ACCORDANCE WITH EN 50693</td></tr>
<tr><td>transportation of raw materials to the manufacturing company</td><td>product assembly</td></tr>
<tr><td></td><td>packaging</td></tr>
<tr><td></td><td>waste handling processes</td></tr>
</table>

The stages of the product life cycle and the information considered for the evaluation of the cluster are:

- Manufacturing upstream includes raw materials, and production activities of HONGFA suppliers, including transport of semi-finished items and subassemblies to HONGFA. This includes also the packaging production.
- Manufacturing core includes local consumptions due tomanufacturing of the products , the relevant assembling and waste due to manufacturing
- The distribution stage includes the impacts related to the distribution of the product from manufacture to the logistic center of the receiver
- The installation stage includes the impact related to the transportation of packaging waste to recycling place.
- The use stages include the impact related to energy consumption during the service life of the product.
- End of life includes the transportation and operations for the disposal of the product at the end of its service life.

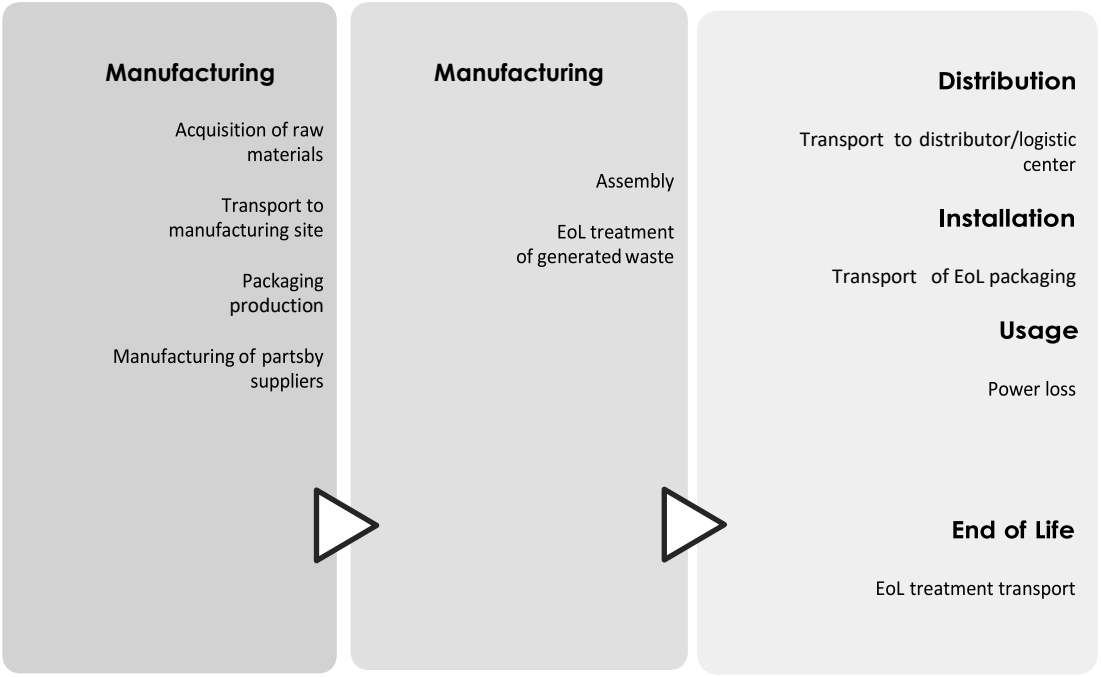

Figure 1 System boundary

TEMPORAL AND GEOGRAPHICAL BOUNDARIES

The Narada component suppliers are sourced: China. All primary data collected from Narada factory are from January to March 2023, which is a representative production period. Because during that period, there is continuous production of the three products. And with stronger effectiveness for a given period of time, the latest statistics can provide more representative results. Secondary data are also representative for this year, as provided by Ecoinvent v3.8.

The selected Ecoinvent processes in the LCA model have a global representativeness, due to the unclear origin of each component. In this way, the conservative approach is adopted.

BOUNDARIES IN THE LIFE CYCLE

As indicated in the PCR EPDItaly021, capital goods, such as buildings, machinery, tools and infrastructure, the packaging for internal transport which cannot be allocated directly to the production of the reference product, may be excluded from the system boundary.

DATA QUALITY

In this EPD, both primary and secondary data are used. Site specific foreground data have been provided by Narada. Main data sources are the bill of materials or weighting photos available on the enterprise resource planning. For all processes for which primary are not available, generic data originating from the Ecoinvent v3.8 database, allocation cut-off by classification, are used. The Ecoinvent database is available in the SimaPro 9.0.0.48 software used for the calculations.

ENVIRONMENTAL IMPACT INDICATORS

The information obtained from the inventory analysis is aggregated according to the effects related to the various environmental issues. According to PCR, EPDItaly021 and EN 50693 the environmental impact indicators must be determined using the characterization factors and impact assessment methods specified in EN 15804 + A2 Method V1.02.

PCR EPDItaly021 and the EN 50693 standard establish four indicators for climate impact(GWP-GHG): GWP (total) which includes all greenhouse gases; GWP (fossil fuels); GWP(biogenic carbon) which includes the emissions and absorption of biogenic carbon dioxide and biogenic carbon stored in the product; GWP (land use).

ALLOCATION RULES

The energy demand for product line for products is allocated by yield based on total production amount from 2021.1.1 till 2021.12.31.

In the system studied, there is no co-product which is defined as "Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems." [Source: ISO 14044:2006]. Therefore, there is no co-product allocation.

LIMITATIONS AND SIMPLIFICATIONS

The data of energy consumption and pollutants emission in the raw material acquisition stage are from the Ecoinvent 3.8 database published by the European Ecoinvent Center.

The emission factor of China electricity is from the Ecoinvent 3.8 database.

The emission factor of the U.S. electricity is also from the Ecoinvent 3.8 database. The emission factor of China electricity is from the Ecoinvent 3.8 database. This dataset has been extrapolated from year 2015 to the year of the calculation (2020). China state grid launched the green electricity program in late of 2021, however, the green electiricty selling information is not public available when creating this LCA report. Thus we use the Ecoinvent data base data for China electricity [Electricity, low voltage {CN}| market group for | Cut-off, S] is deemed conservative as this value is higher than the reality.

The uncertainty has been adjusted accordingly. This dataset describes the electricity available on the low voltage level in China and the U.S. This is done by showing the distribution of 1kWh electricity at low voltage.

INVENTORY ANALYSIS

The Ecoinvent v3.8 by classification system processes are used to model the background system of the processes.

Due to the large amounts of components in the module, raw material inputs are modelled with data from Ecoinvent representing a global market coverage. These datasets are assumed to be representative.

MANUFACTURING STAGE

Cell is the most frequently used material, followed by steel.

The packaging (Plywood, PET etc.) are also included in the analysis in the manufacturing stage-core. Narada receives packaging components from outside suppliers and packages the module before shipping them.

The transport distances and weight from raw materials suppliers to the manufacturing are assumed as below:

- 76.8NESP160 Module: Transport, freight, lorry: 7.3796 tkm/pcs;
- 76.8NESP200 Module: Transport, freight, lorry: 7.3796 tkm/pcs;
- 76.8NESP150 Module: Transport, freight, lorry: 7.3796 tkm/pcs;

"Transport, freight, lorry, unspecified {GLO}| market for | Cut-off, S;" is used

The manufacturing of the module is located in Narada factory of Hangzhou city, Zhejiang provice, China. In the factory, the different components and subassemblies are assembled to abroad.

For the manufacturing phase, the general China low voltage electricity mix from Ecoinvent v3.8 is used.

DISTRIBUTION

The transport distances from Narada plant to the place of use are shown as below: However, the data source is from https://sea-distances.orf/

Table 7 Transportation activity data

76.8NESP 160 Module				
Way of transportation	Amount	Unit	Amount	Unit
By truck	79.0753	t km/pcs	6.4289	t km/kwh
By ship	3129.2893	t km/pcs	254.4138	t km/kwh

76.8NESP 200 Module				
Way of transportation	Amount	Unit	Amount	Unit
By truck	79.5278	t km/pcs	5.1348	t km/kwh
By ship	3147.1953	t km/pcs	204.3633	t km/kwh
76.8NESP 160 Module				
Way of transportation	Amount	Unit	Amount	Unit
By truck	84.8558	t km/pcs	4.1185	t km/kwh
By ship	3358.0431	t km/pcs	174.8981	t km/kwh

USE

Use and maintenance are modelled according to the PCR EPDItaly021.

During the use phase, the modules dissipates some electricity due to Euse and Eloss. The total energy consumed by the battery is the result of two parameters: the former describes the energy required by the battery to operate, while the latter considers the energy loss due to charge/discharge cycles.

They arecalculated according to the own internal resistance of the Switch and the following PCR rules:

- RSL of 10 years;
- 8760 is the number of hours in a year;
- 365 is the number of days in one year;
- Nominal Operation Temperature equal to 25°C ±5°C shall be assumed.

The formula for the calculation of the electricity consumed is shown in sub-PCR EPDItaly021 and it is described as follows, where Euse and Eloss are the power consumed by the module at a given value of current:

$$E_{use}\,[kWh] = \frac{P_{use} * 8760 * RSL}{1000} \qquad E_{loss}\,[kWh] = \sum_{i=0}^{RSL} \frac{E_{useful\,i} * N_{cycles} * 365}{DC\ RTEi} * (1 - DC\ RTEi)$$

Equation 1 E_{use} and E_{loss}

Table 8 Data list of 76.8NESP Module

Item	Amount	Unit
Puse (A Fan)	3.36	w
hours in a year	8760.00	hours
RSL	10.00	years
conversion factor	1000.00	/
Euse	294.34	Kwh
Item	Amount	Unit
DC RTEi	94.00	%
Euseful-76.8NESP160	12.30	Kwh

Euseful-76.8NESP200	15.40	Kwh
Euseful-76.8NESP250	19.20	Kwh
Nominal Operating Temperature	25.00	℃
N cycles	1.00	Time
Days	365.00	Days
conversion factor	1000.00	/
Eloss-76.8NESP160	2.44	Kwh/10 year
Eloss-76.8NESP200	3.06	Kwh/10 year
Eloss-76.8NESP250	3.81	Kwh/10 year

Since no maintenance happens during the use phase, the environmental impacts linked this procedure have been omitted from the analysis.

END OF LIFE

The end-of-life stage is modelled according to PCR EPDItaly021 and WEEE Directive(2012/19/EU). Thepercentages for end-of-life treatments of switches are taken from WEEE Directive(2012/19/EU).

ENVIRONMENTAL INDICATORS

The following tables show the environmental impact indicators of the life cycle of a single module, as indicated by PCR EPDItaly007, sub-PCR EPDItaly021 and EN 50693:2019.

The indicators are divided into the contribution of the processes to the different modules (upstream, core and downstream) and stages (manufacturing, distribution, use and end-of-life).

Table 9 Environmental impacts of per kWh 76.8NESP160 Lithium Battery Energy Storage System Module

Item	Unit	Total	MANUFACTURING STAGE		DISTRIBUTION	INSTALLATION	USE STAGE	END-OF-LIFE
			UPSTREAM MODULE	CORE MODULE	DOWNSTREAM MODULE			
Climate change	kg CO2 eq	3.72E+01	2.62E+01	1.61E-01	9.03E-01	8.00E-02	5.64E+00	4.21E+00
Ozone depletion	kg CFC11 eq	2.91E-06	2.36E-06	1.60E-08	1.86E-07	1.94E-09	3.16E-07	3.12E-08
Photochemical ozone formation	kg NMVOC eq	1.50E-01	1.22E-01	6.77E-04	1.68E-02	6.94E-05	8.45E-03	2.22E-03
Acidification	mol H+ eq	4.11E-01	3.66E-01	7.27E-04	2.30E-02	6.09E-05	1.89E-02	2.32E-03
Eutrophication, freshwater	kg P eq	2.99E-02	2.55E-02	3.05E-05	4.08E-05	1.36E-06	4.24E-03	1.20E-04
Water use	m3 depriv.	3.38E-01	2.97E-01	3.07E-03	4.15E-05	0.00E+00	3.43E-02	3.54E-03
Resource use, fossils	MJ	4.51E+02	3.39E+02	2.85E+00	1.21E+01	1.26E-01	9.37E+01	3.96E+00
Resource use, minerals and metals	kg Sb eq	1.75E-03	1.71E-03	3.44E-07	1.58E-06	2.63E-08	3.57E-05	2.70E-06
Climate change - Fossil	kg CO2 eq	3.70E+01	2.60E+01	1.62E-01	9.03E-01	8.00E-02	5.60E+00	4.21E+00
Climate change - Biogenic	kg CO2 eq	2.06E-01	1.77E-01	-1.05E-03	-1.75E-04	6.28E-06	2.95E-02	4.75E-04
Climate change - Land use and LU change	kg CO2 eq	3.39E-02	2.98E-02	9.30E-05	5.60E-04	2.89E-06	2.54E-03	9.22E-04
Use of resources of per kWh 76.8NESP160 Lithium Battery Energy Storage System Module								

Item	Unit	Total	MANUFACTURING STAGE		DISTRIBUTION	INSTALLATION	USE STAGE	END-OF-LIFE
			UPSTREAM MODULE	CORE MODULE	DOWNSTREAM MODULE			
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	MJ, net calorific value	4.37E+02	3.28E+02	1.12E+01	1.26E-01	0.00E+00	9.37E+01	3.96E+00
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	MJ, net calorific value	2.26E+01	2.86E+01	-1.65E+01	2.13E-03	0.00E+00	1.03E+01	2.74E-01
Use of non-renewable primary energy resources used as raw material (PENRM)	MJ, net calorific value	1.44E+01	1.06E+01	3.78E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable primary energy resources used as raw material (PERM)	MJ, net calorific value	1.68E+01	0.00E+00	1.68E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	MJ, net calorific value	4.51E+02	3.39E+02	1.50E+01	1.26E-01	0.00E+00	9.37E+01	3.96E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	MJ, net calorific value	3.94E+01	2.86E+01	2.54E-01	2.13E-03	0.00E+00	1.03E+01	2.74E-01
Net use of fresh water (FW)	m^3	1.22E+01	1.09E+01	7.49E-02	3.89E-02	1.11E-03	1.11E+00	1.01E-01
Use of secondary raw materials (MS)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels (RSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels (NRSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Item	Unit	Total	MANUFACTURING STAGE		DISTRIBUTION	INSTALLATION	USE STAGE	END-OF-LIFE
			UPSTREAM MODULE	CORE MODULE	DOWNSTREAM MODULE			
Generation of waste of per kWh 76.8NESP160 Lithium Battery Energy Storage System Module								
HWD = Hazardous waste disposed,	HWD (kg)	4.53E-01	1.31E-01	7.68E-04	8.90E-04	0.00E+00	4.38E-02	2.76E-01
NHWD = Non-hazardous waste disposed,	NHWD (kg)	1.70E+01	1.63E+01	2.58E-01	8.30E-03	0.00E+00	2.66E-01	1.85E-01
RWD = Radioactive waste disposed,	RWD (kg)	1.46E-03	8.83E-04	8.70E-05	8.21E-07	0.00E+00	4.69E-04	1.60E-05
MER= Materials for energy recovery,	MER (kg)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR =Material for recycling,	MFR (kg)	1.05E+00	0.00E+00	0.00E+00	0.00E+00	1.05E+00	0.00E+00	0.00E+00
CRU =Components for reuse,	CRU (kg)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE =Exported thermal energy,	ETE (MJ)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE= Exported electricity energy.	EEE (MJ)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 10 Environmental impacts of per kWh 76.8NESP200 Lithium Battery Energy Storage System Module

Item	Unit	Total	MANUFACTURING STAGE		DISTRIBUTION	INSTALLATION	USE STAGE	END-OF-LIFE
			UPSTREAM MODULE	CORE MODULE	DOWNSTREAM MODULE			
Climate change	kg CO2 eq	3.28E+01	2.39E+01	1.36E-01	7.25E-01	6.39E-02	4.60E+00	3.38E+00
Ozone depletion	kg CFC11 eq	2.66E-06	2.22E-06	1.28E-08	1.50E-07	1.55E-09	2.58E-07	2.51E-08
Photochemical ozone formation	kg NMVOC eq	1.31E-01	1.08E-01	5.66E-04	1.35E-02	5.55E-05	6.90E-03	1.78E-03
Acidification	mol H+ eq	3.53E-01	3.16E-01	6.23E-04	1.85E-02	4.87E-05	1.54E-02	1.87E-03
Eutrophication, freshwater	kg P eq	2.46E-02	2.10E-02	2.60E-05	3.28E-05	1.08E-06	3.46E-03	9.62E-05
Water use	m3 depriv.	3.04E-01	2.70E-01	2.49E-03	3.32E-05	0.00E+00	2.80E-02	2.85E-03
Resource use, fossils	MJ	3.97E+02	3.06E+02	2.35E+00	9.76E+00	1.01E-01	7.65E+01	3.18E+00
Resource use, minerals and metals	kg Sb eq	1.42E-03	1.39E-03	3.00E-07	1.27E-06	2.10E-08	2.91E-05	2.17E-06
Climate change - Fossil	kg CO2 eq	3.26E+01	2.37E+01	1.37E-01	7.25E-01	6.39E-02	4.57E+00	3.38E+00
Climate change - Biogenic	kg CO2 eq	1.73E-01	1.50E-01	-8.81E-04	-1.41E-04	5.02E-06	2.41E-02	3.82E-04
Climate change - Land use and LU change	kg CO2 eq	2.91E-02	2.58E-02	7.62E-05	4.50E-04	2.30E-06	2.07E-03	7.42E-04
Use of resources of per kWh 76.8NESP200 Lithium Battery Energy Storage System Module								

Item	Unit	Total	MANUFACTURING STAGE		DISTRIBUTION	INSTALLATION	USE STAGE	END-OF-LIFE
			UPSTREAM MODULE	CORE MODULE	DOWNSTREAM MODULE			
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	MJ, net calorific value	3.83E+02	2.97E+02	6.07E+00	1.01E-01	0.00E+00	7.65E+01	3.19E+00
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	MJ, net calorific value	7.18E+00	2.52E+01	-2.66E+01	1.70E-03	0.00E+00	8.40E+00	2.20E-01
Use of non-renewable primary energy resources used as raw material (PENRM)	MJ, net calorific value	1.45E+01	8.44E+00	6.04E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable primary energy resources used as raw material (PERM)	MJ, net calorific value	2.68E+01	0.00E+00	2.68E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	MJ, net calorific value	3.97E+02	3.06E+02	1.21E+01	1.01E-01	0.00E+00	7.65E+01	3.19E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	MJ, net calorific value	3.40E+01	2.52E+01	2.11E-01	1.70E-03	0.00E+00	8.40E+00	2.20E-01
Net use of fresh water (FW)	m^3	1.11E+01	1.00E+01	6.11E-02	3.13E-02	8.83E-04	9.05E-01	8.08E-02
Use of secondary raw materials (MS)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels (RSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels (NRSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Item	Unit	Total	MANUFACTURING STAGE		DISTRIBUTION	INSTALLATION	USE STAGE	END-OF-LIFE
			UPSTREAM MODULE	CORE MODULE	DOWNSTREAM MODULE			
Generation of waste of per kWh 76.8NESP200 Lithium Battery Energy Storage System Module								
HWD = Hazardous waste disposed,	HWD (kg)	3.74E-01	1.15E-01	6.24E-04	7.11E-04	0.00E+00	3.57E-02	2.22E-01
NHWD = Non-hazardous waste disposed,	NHWD (kg)	1.66E+01	1.60E+01	2.07E-01	6.63E-03	0.00E+00	2.17E-01	1.49E-01
RWD = Radioactive waste disposed,	RWD (kg)	1.28E-03	8.10E-04	6.99E-05	6.56E-07	0.00E+00	3.83E-04	1.29E-05
MER= Materials for energy recovery,	MER (kg)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR =Material for recycling,	MFR (kg)	1.37E-01	0.00E+00	0.00E+00	0.00E+00	1.37E-01	0.00E+00	0.00E+00
CRU =Components for reuse,	CRU (kg)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE =Exported thermal energy,	ETE (MJ)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE= Exported electricity energy.	EEE (MJ)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 11 Environmental impacts of per kWh 76.8NESP250 Lithium Battery Energy Storage System Module

Item	Unit	Total	MANUFACTURING STAGE		DISTRIBUTION	INSTALLATION	USE STAGE	END-OF-LIFE
			UPSTREAM MODULE	CORE MODULE	DOWNSTREAM MODULE			
Climate change	kg CO2 eq	2.67E+01	2.14E+01	1.17E-01	6.21E-01	5.13E-02	3.79E+00	7.13E-01
Ozone depletion	kg CFC11 eq	2.37E-06	2.00E-06	1.04E-08	1.28E-07	1.24E-09	2.13E-07	1.77E-08
Photochemical ozone formation	kg NMVOC eq	1.15E-01	9.66E-02	4.79E-04	1.15E-02	4.45E-05	5.68E-03	8.36E-04
Acidification	mol H+ eq	3.11E-01	2.81E-01	5.42E-04	1.58E-02	3.90E-05	1.27E-02	1.04E-03
Eutrophication, freshwater	kg P eq	2.11E-02	1.82E-02	2.24E-05	2.81E-05	8.69E-07	2.85E-03	6.01E-05
Water use	m3 depriv.	2.67E-01	2.41E-01	2.08E-03	2.66E-05	0.00E+00	2.31E-02	1.18E-03
Resource use, fossils	MJ	3.50E+02	2.74E+02	1.96E+00	8.35E+00	8.09E-02	6.30E+01	2.32E+00
Resource use, minerals and metals	kg Sb eq	1.20E-03	1.17E-03	2.64E-07	1.09E-06	1.69E-08	2.40E-05	1.76E-06
Climate change - Fossil	kg CO2 eq	2.65E+01	2.13E+01	1.18E-01	6.20E-01	5.13E-02	3.77E+00	7.13E-01
Climate change - Biogenic	kg CO2 eq	1.44E-01	1.25E-01	-7.52E-04	-1.20E-04	4.02E-06	1.98E-02	2.05E-04
Climate change - Land use and LU change	kg CO2 eq	2.53E-02	2.25E-02	6.30E-05	3.85E-04	1.85E-06	1.71E-03	6.23E-04
Use of resources of per kWh 76.8NESP250 Lithium Battery Energy Storage System Module								

Item	Unit	Total	MANUFACTURING STAGE		DISTRIBUTION	INSTALLATION	USE STAGE	END-OF-LIFE
			UPSTREAM MODULE	CORE MODULE	DOWNSTREAM MODULE			
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	MJ, net calorific value	3.39E+02	2.68E+02	5.46E+00	8.09E-02	0.00E+00	6.30E+01	2.32E+00
Use of renewable primary energy excluding renewable primary energy resources used as raw material (PERE)	MJ, net calorific value	8.00E+00	2.22E+01	-2.13E+01	1.36E-03	0.00E+00	6.91E+00	1.81E-01
Use of non-renewable primary energy resources used as raw material (PENRM)	MJ, net calorific value	1.16E+01	6.77E+00	4.85E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable primary energy resources used as raw material (PERM)	MJ, net calorific value	2.15E+01	0.00E+00	2.15E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PENRT)	MJ, net calorific value	3.50E+02	2.74E+02	1.03E+01	8.09E-02	0.00E+00	6.30E+01	2.32E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (PERT)	MJ, net calorific value	2.95E+01	2.22E+01	1.81E-01	1.36E-03	0.00E+00	6.91E+00	1.81E-01
Net use of fresh water (FW)	m^3	9.79E+00	8.94E+00	5.02E-02	2.68E-02	7.08E-04	7.45E-01	3.04E-02
Use of secondary raw materials (MS)	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels (RSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Item	Unit	Total	MANUFACTURING STAGE		DISTRIBUTION	INSTALLATION	USE STAGE	END-OF-LIFE
			UPSTREAM MODULE	CORE MODULE	DOWNSTREAM MODULE			
Use of non-renewable secondary fuels (NRSF)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generation of waste of per kWh 76.8NESP250 Lithium Battery Energy Storage System Module								
HWD = Hazardous waste disposed,	HWD (kg)	1.70E-01	1.01E-01	5.27E-04	5.70E-04	0.00E+00	2.94E-02	3.89E-02
NHWD = Non-hazardous waste disposed,	NHWD (kg)	1.50E+01	1.45E+01	1.78E-01	5.32E-03	0.00E+00	1.79E-01	8.72E-02
RWD = Radioactive waste disposed,	RWD (kg)	1.11E-03	7.26E-04	5.98E-05	5.26E-07	0.00E+00	3.15E-04	1.03E-05
MER= Materials for energy recovery,	MER (kg)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR =Material for recycling,	MFR (kg)	1.10E-01	0.00E+00	0.00E+00	0.00E+00	1.10E-01	0.00E+00	0.00E+00
CRU =Components for reuse,	CRU (kg)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE =Exported thermal energy,	ETE (MJ)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE= Exported electricity energy.	EEE (MJ)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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