

FOXESS Co., Ltd.



ENVIRONMENTAL PRODUCT DECLARATION

Product Name: ECS2900 series battery storage system
ECS2900-H2/H3/H4/H5/H6/H7

Site Plant: Wenzhou, Zhejiang Province, China

in accordance with ISO 14025:2006 and EN 15804: 2012+A2:2019/AC:2021

Program Operator EPDItaly

Publisher EPDItaly

Declaration Number *FOXESS-EPD03*

Registration Number EPDITALY0592

Issue Date 17 / 06 / 2024

Valid to 17 / 06 / 2029



1. GENERAL INFORMATION

EPD Owner:	FOXESS Co., Ltd. Address: No.939, Jinhai Third Road, New Airport Industry Area, Longwan District, Wenzhou, Zhejiang, P.R. China
Product Name:	ECS2900 series battery storage system ECS2900-H2/H3/H4/H5/H6/H7
Production site:	No.939, Jinhai Third Road, New Airport Industry Area, Longwan District, Wenzhou, Zhejiang, P.R.China
Field of application:	Energy storage, B2B or B2C application
Program Operator:	EPDITALY (www.epditaly.it) Add: via Gaetano De Castillia n° 10 - 20124 Milano, Italy
CPC Code:	464 "Accumulators, primary cells and primary batteries, and parts thereof"
Company Contact:	Zhou Yong Email: zhou-yong@fox-ess.com
External Audit:	This declaration has been developed referring to EPDItaly, following the General Program Instruction; further information and the document itself are available at: www.epditaly.it. Independent verification of the declaration and data, according to EN ISO 14025:2006 and EN 15804+A2:2019/AC:2021. <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL Third party verifier: ICMQ SpA - Via Gaetano De Castillia, 10 - 20124 – Milano/Italy
LCA Consultant:	This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by: TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
Reference PCR and version number:	Core PCR: EPDItaly007 – PCR for Electronic and Electrical Products and Systems, Rev. 3, 2023/01/13. Sub PCR: PCR EPDItaly021 – Energy storage systems, Rev. 4, 2021/03/29.
Other reference documents:	Regulations of the EPDItaly Program rev. 6.0. EN 15804: 2012+A2:2019/AC:2021, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products
Comparability:	EPDs relating to the same category of products but belonging to different programmes 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:	The owner of the declaration will be responsible for the information and supporting evidence. EPDItaly disclaims any liability regarding the manufacturer's information data.
Reference document:	This declaration is based on the EPDItaly regulation, available on the website www.epditaly.com

2. COMPANY INTRODUCTION

FOXESS is a leading enterprise providing research and development, manufacturing, sales and service of inverter and energy storage solutions, which established in September 2019 and located in Wenzhou, China. Product range includes photovoltaic inverters, hybrid inverters, micro inverters, lithium batteries, and electric vehicle chargers.

FOXESS has been accredited by international certification authorities, including ISO9001, ISO14001, ISO45001, ISO50001, and SA8000.

3. SCOPE AND TYPE OF EPD

3.1. Scope of EPD

The system boundary of this study on FOXESS's ECS energy storage system encompasses the entire life cycle of the product, from cradle to grave, including the manufacturing, distribution, installation, use, and end-of-life stage, as defined in the PCR.

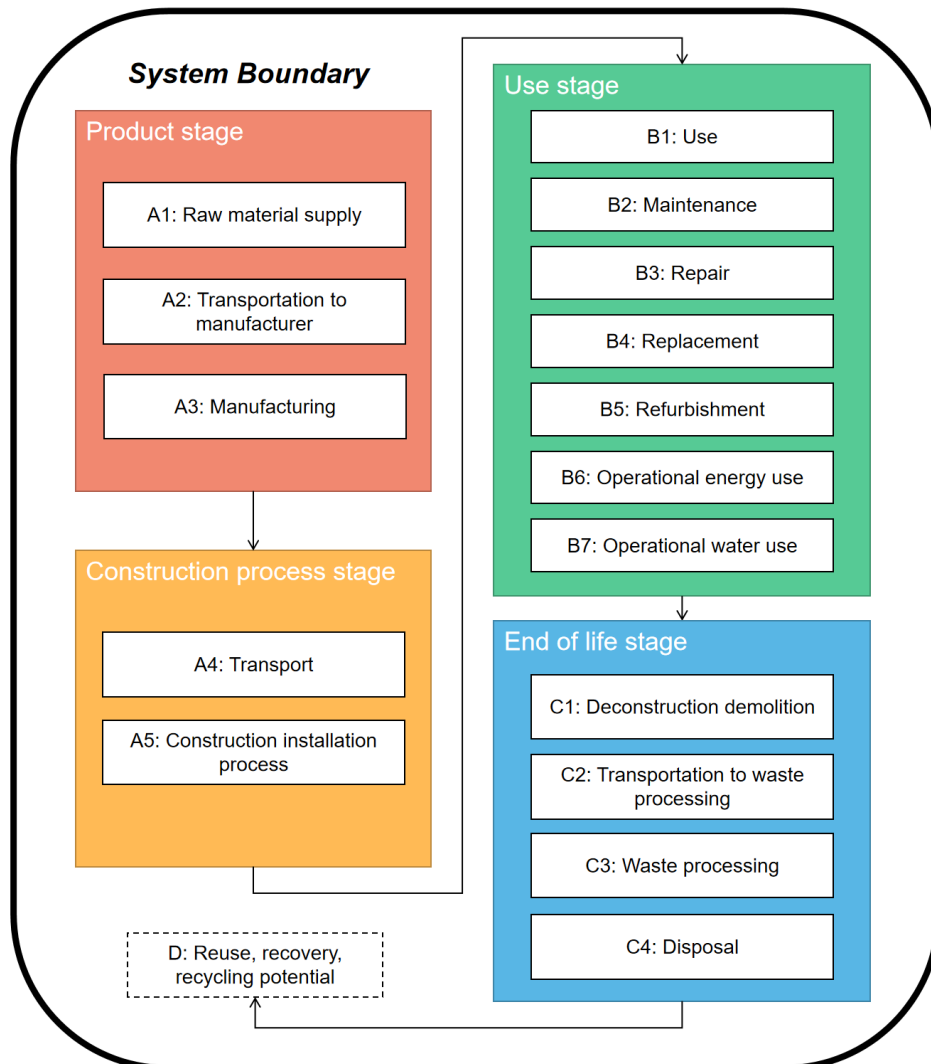


Figure 3-1 System boundary

3.2. Type of EPD

This EPD is a product specific EPD. The declaration covers in total 6 models of ECS2900 battery storage systems, including ECS2900-H2/H3/H4/H5/H6/H7.

3.3. Geographical scope

The geographical boundary for this LCA study is defined with manufacturing of the systems taking place in mainland China, while use phase and end-of-life treatment stage will be modelled with a case study taken place in Italy. It is noted that the systems can be installed and operated worldwide. Therefore, when interpreting the LCA results, the location where the products is installed and operated shall be considered.

3.4. Time representativeness

All manufacturing data has been collected by FOXESS based on their production inventory in the reference period from June, 2022 to May, 2023. Datasets have been selected according to the actual processes used by the manufacturer. For generic products where no upstream data was available, such as packaging, manufacturing has been modelled according to current industry practices.

3.5. Database and LCA software used

In this study, generic data for materials, energy as well as waste disposal and transportation were taken from the database Ecoinvent 3.9. LCA-software SimaPro 9.5 was used for the modeling and calculation.

4. DETAILED PRODUCT DESCRIPTION

4.1. Description of the Product

An energy storage system stores energy from power source. FOXESS offers a wide range of products for residential, commercial, and utility-scale applications. The products that are under study are ECS2900 series scalable battery storage system, including ECS2900-H2/H3/H4/H5/H6/H7. There is one master battery for each model and additional slave batteries can be installed in series, allowing for a maximum storage capacity of 20.16kWh.

These products have following features:

- Capacity from 2.88kWh to 20.16kWh.
- 90% depth of discharge
- Large temperature tolerance
- Easy installation
- CAN/RS485 communication
- High voltage
- 95% Charge and discharge efficiency

4.2. Technical parameters

Table 4-1 General information of the ECS2900 energy storage systems

Model	ECS2900-H2	ECS2900-H3	ECS2900-H4	ECS2900-H5	ECS2900-H6	ECS2900-H7
Electrical Characteristics						
Battery Type	LiFePO ₄ Prismatic Cell					
Battery Module	1*CM2900 1*CS2900	1*CM2900 2*CS2900	1*CM2900 3*CS2900	1*CM2900 4*CS2900	1*CM2900 5*CS2900	1*CM2900 6*CS2900
Nominal Capacity (Wh)	5760	8640	11520	14400	17280	20160
Nominal Voltage (V)	115.2	172.8	230.4	288	345.6	403.2
Operating Voltage (V)	97.2 - 131.4	145.8 - 197.1	194.4 - 262.8	243 - 328.5	291.6 - 394.2	340.2 - 459.9
Recommend Discharge Current (A)	25					
Max.Charge/Discharge Current (A)	50					
Peak Discharge Current (A)	65A @60sec					
Battery Pack Round-Trip Efficiency	>95%					
Depth of discharge	90%					
Cycle Life	≥6000* ¹					
Communication	CAN, RS485					
Display	CS: LED*1, CM: LED*6					
Scalability	Max. 7 Modules in Series					
Operating Conditions						
Installation Location	Outdoor/ Indoor (Stand)					
Operating Temperature (°C) * ²	Charge: 0 - 55 Discharge: -10 - 55					
Storage Temperature (°C)	-20 - 55					
Cooling method	Natural Convection					
Humidity (%)	5 to 95 (no condensing)					
Altitude (m)	Max. 2,000					
Mechanical Characteristics						
Dimensions (W*H*D) (mm)	570*350*380	570*470*380	570*590*380	570*710*380	570*830*380	570*950*380
Weight (kg)	68.3	100.3	132.3	164.3	196.3	228.3
Certificates						
Safety	IEC 62619					
EMC	EN IEC 61000-6-1/2/3/4					
Transportation	UN38.3					
Ingress Protection	IP65					

*1. 25°C, @90% DOD, 0.5C charging/discharging.

*2. Charge derating will occur between 0°C and +15°C.

4.3. Materials compositions

Table 4-2 Materials compositions

CLASS NAME	IEC62474 ID	Weight						Percentage					
		H2	H3	H4	H5	H6	H7	H2	H3	H4	H5	H6	H7
Other ferrous alloys, non-stainless steels	M-119	3.03E+00	3.89E+00	4.76E+00	5.62E+00	6.48E+00	7.34E+00	4.29%	3.74%	3.46%	3.28%	3.17%	3.08%
Aluminium and its alloys	M-120	2.02E+01	2.96E+01	3.90E+01	4.84E+01	5.79E+01	6.73E+01	28.54%	28.41%	28.35%	28.31%	28.28%	28.26%
Copper and its alloys	M-121	4.59E+00	6.63E+00	8.67E+00	1.07E+01	1.28E+01	1.48E+01	6.50%	6.37%	6.30%	6.26%	6.23%	6.21%
Magnesium and its alloys	M-122	1.34E-04	1.37E-04	1.40E-04	1.43E-04	1.46E-04	1.49E-04	0.0002%	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%
Nickel and its alloys	M-123	8.17E-03	9.30E-03	1.04E-02	1.16E-02	1.27E-02	1.38E-02	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Zinc and its alloys	M-124	3.19E-04	3.84E-04	4.49E-04	5.14E-04	5.80E-04	6.45E-04	0.0005%	0.0004%	0.0003%	0.0003%	0.0003%	0.0003%
Lead and its alloys (including Pb solders)	M-125	3.98E-03	4.51E-03	5.05E-03	5.58E-03	6.11E-03	6.65E-03	0.0056%	0.0043%	0.0037%	0.0033%	0.0030%	0.0028%
Tin and its alloys (including Pb-free solders)	M-126	8.55E-03	9.91E-03	1.13E-02	1.26E-02	1.40E-02	1.54E-02	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Other non-ferrous metals and alloys	M-149	1.77E-02	1.99E-02	2.20E-02	2.41E-02	2.62E-02	2.84E-02	0.03%	0.02%	0.02%	0.01%	0.01%	0.01%
Gold	M-150	5.50E-04	6.43E-04	7.37E-04	8.30E-04	9.23E-04	1.02E-03	0.0008%	0.0006%	0.0005%	0.0005%	0.0005%	0.0004%
Palladium	M-152	8.72E-05	1.09E-04	1.30E-04	1.52E-04	1.73E-04	1.95E-04	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%
Other precious metals	M-159	2.02E-03	2.38E-03	2.74E-03	3.10E-03	3.46E-03	3.82E-03	0.0029%	0.0023%	0.0020%	0.0018%	0.0017%	0.0016%
Glass	M-161	1.24E-02	1.54E-02	1.84E-02	2.14E-02	2.45E-02	2.75E-02	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%
Other inorganic materials	M-199	2.35E+01	3.52E+01	4.70E+01	5.87E+01	7.04E+01	8.22E+01	33.25%	33.83%	34.13%	34.31%	34.43%	34.52%
PolyVinylChloride (PVC)	M-200	1.19E-03	1.21E-03	1.23E-03	1.25E-03	1.27E-03	1.29E-03	0.0017%	0.0012%	0.0009%	0.0007%	0.0006%	0.0005%
PolyCarbonate (PC)	M-204	2.78E+00	3.93E+00	5.08E+00	6.23E+00	7.38E+00	8.53E+00	3.94%	3.78%	3.69%	3.64%	3.61%	3.58%
PolyEthylene (PE)	M-204	1.19E+00	1.75E+00	2.30E+00	2.85E+00	3.41E+00	3.96E+00	1.69%	1.68%	1.67%	1.67%	1.67%	1.66%
PolyAmide (PA)	M-208	7.42E-02	7.66E-02	7.90E-02	8.14E-02	8.38E-02	8.62E-02	0.11%	0.07%	0.06%	0.05%	0.04%	0.04%
PolyEthyleneTerephthalate (PET)	M-209	1.60E-03	1.63E-03	1.66E-03	1.69E-03	1.72E-03	1.75E-03	0.0023%	0.0016%	0.0012%	0.0010%	0.0008%	0.0007%
Polyphenylenesulfide (PPS)	M-213	1.20E-04	1.27E-04	1.34E-04	1.41E-04	1.49E-04	1.56E-04	0.0002%	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%
Polymethylmethacrylate (PMMA)	M-220	2.08E-04	2.82E-04	3.57E-04	4.32E-04	5.06E-04	5.81E-04	0.0003%	0.0003%	0.0003%	0.0003%	0.0002%	0.0002%
Acrylate, Acrylate resin (PAKC)	M-221	3.18E-06	3.26E-06	3.33E-06	3.40E-06	3.47E-06	3.54E-06	<0.001%	<0.001%	<0.001%	<0.001%	<0.001%	<0.001%
Other unfilled thermoplastics	M-249	1.15E+00	1.73E+00	2.31E+00	2.89E+00	3.46E+00	4.04E+00	1.63%	1.66%	1.68%	1.69%	1.69%	1.70%
PolyAmide (PA) filled	M-258	1.45E-01	2.15E-01	2.86E-01	3.57E-01	4.27E-01	4.98E-01	0.20%	0.21%	0.21%	0.21%	0.21%	0.21%
Epoxy resin (EP)	M-302	5.37E-01	9.12E-01	1.29E+00	1.66E+00	2.04E+00	2.41E+00	0.76%	0.88%	0.94%	0.97%	1.00%	1.01%
Silicone	M-321	4.07E-01	5.81E-01	7.55E-01	9.29E-01	1.10E+00	1.28E+00	0.58%	0.56%	0.55%	0.54%	0.54%	0.54%
Ethylene-Propylene-Diene-Rubber (EPDM)	M-324	7.05E-04	7.25E-04	7.44E-04	7.64E-04	7.83E-04	8.03E-04	0.0010%	0.0007%	0.0005%	0.0004%	0.0004%	0.0003%
Paper	M-341	1.93E-03	1.96E-03	1.98E-03	2.01E-03	2.03E-03	2.06E-03	0.0027%	0.0019%	0.0014%	0.0012%	0.0010%	0.0009%
Other organic materials	M-399	1.30E+01	1.95E+01	2.60E+01	3.25E+01	3.90E+01	4.55E+01	18.43%	18.75%	18.92%	19.02%	19.08%	19.13%

4.4. Description of the production process

All the systems share similar manufacturing processes and life cycle stages. Figure 4-1 is the flowchart illustrating the production process stages of FOXESS ECS energy storage systems. For simplification purposes, only main stages of manufacturing are presented. Generally, production of the system includes assembly of base, LED light panel, air switch, power line, PCBA, module, cable, and top cover, inspection, several tests, packaging and warehousing.

After the preparation works, the production process starts from assembly of base. LED light panel and air switch are installed afterwards. And then, power line, PCBA, module, cable and top cover are assembled successively.

Subsequently, inspection process examines the system, which can quickly and accurately detect various quality issues, such as missing components, position deviation, and soldering defects.

With the finishing of top cover assembling, the systems go into a set of tests including production compliance test, EOL1 test, air-tight test, dynamic condition test, and EOL2 test to ensure the product quality, safety, and durability. Air-tight test is to inflate or exhaust the air in a sealed space to detect the air tightness of the product. Finally, the system is packaged and sent to a warehouse.

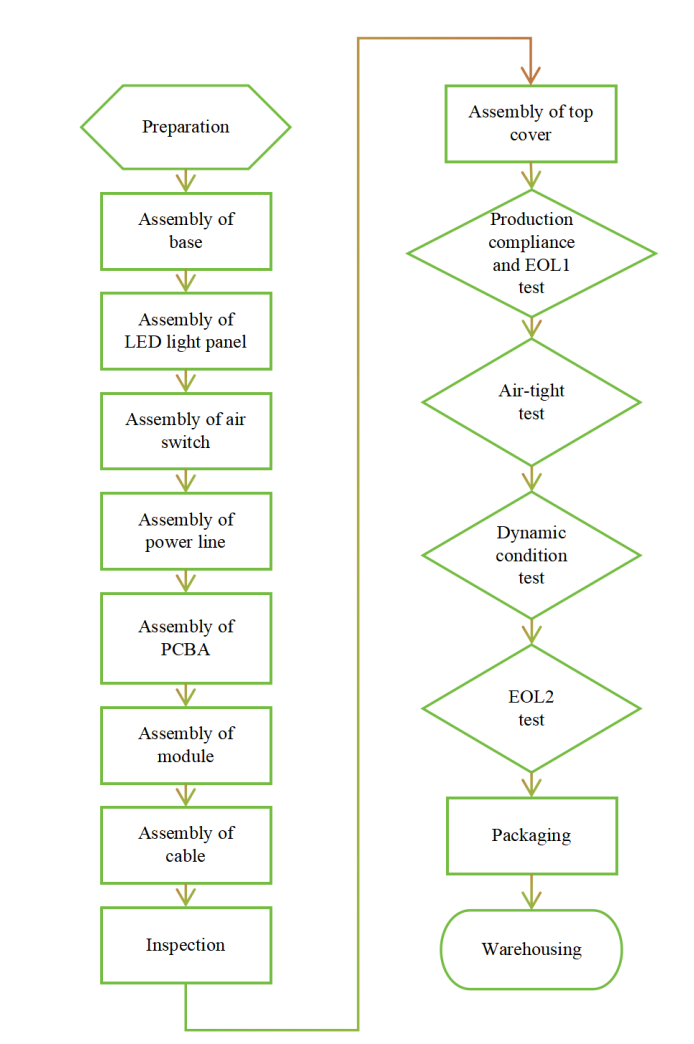


Figure 4-1 Manufacturing process flow diagram of systems

5. LCA RESULTS

The LCA results show the environmental impacts and resource input and output flows calculated according to EN 15804: 2012+A2:2019/AC:2021 reference package based on EF3.1. The results are shown per functional unit (1kWh stored by a single energy storage module). The LCA results have been calculated using the LCA software SimaPro 9.5 and the data from ecoinvent v3.9.

Table 5-1 System boundaries and life cycle stages within this study

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = MODULE NOT DECLARED)																		
	Product Stage			Construction process stage		Use Stage							End of life stage			Resource recovery stage		
	Raw Material	Transport	Manufacturing	Transport	Assembly / Install	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction and demolition	Transport	Waste processing		disposal	
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	
Modules declared	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

5.1. Environmental impacts

Table 5-2 Environmental impacts - ECS2900 Series

ECS2900	Impact category	Unit	Product stage			Construction stage		Use stage							End-of-life stage				3R potential	
			A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	
H2	GWP-total	kg CO2 eq	1.96E+02	2.62E+00	5.41E+00	4.25E+00	8.90E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.33E+01	0.00E+00	0.00E+00	1.14E-01	6.14E-01	7.32E+00	-8.66E+01
	GWP-fossil	kg CO2 eq	1.97E+02	2.62E+00	5.44E+00	4.24E+00	1.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.73E+01	0.00E+00	0.00E+00	1.14E-01	6.13E-01	1.74E+00	-8.66E+01
	GWP-biogenic	kg CO2 eq	-1.45E+00	1.11E-03	-2.92E-02	1.03E-03	1.56E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.90E+00	0.00E+00	0.00E+00	1.13E-04	2.82E-04	5.59E+00	1.65E-01
	GWP-luluc	kg CO2 eq	2.52E-01	1.34E-03	2.15E-03	2.52E-03	2.10E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E-02	0.00E+00	0.00E+00	5.49E-05	1.22E-03	1.35E-04	-1.18E-01
	ODP	kg CFC11 eq	3.17E-06	3.89E-08	1.22E-08	6.47E-08	7.37E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.47E-06	0.00E+00	0.00E+00	2.44E-09	4.19E-09	5.26E-09	-9.49E-07
	AP	mol H+ eq	2.72E+00	8.05E-03	2.78E-02	5.25E-02	2.08E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.32E-01	0.00E+00	0.00E+00	4.61E-04	3.31E-03	1.55E-03	-9.76E-01
	EP-Freshwater	kg P eq	1.31E-02	2.42E-05	1.14E-04	3.19E-05	1.96E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-03	0.00E+00	0.00E+00	8.98E-07	3.07E-05	2.47E-05	-5.98E-03
	EP-Marine	kg N eq	2.72E-01	2.41E-03	5.71E-03	1.45E-02	6.27E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.63E-02	0.00E+00	0.00E+00	1.75E-04	5.52E-04	5.84E-03	-1.07E-01
	EP-Terrestrial	mol N eq	6.08E+00	2.58E-02	6.28E-02	1.59E-01	7.61E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.16E-01	0.00E+00	0.00E+00	1.88E-03	6.55E-03	5.70E-03	-1.27E+00
	POCP	kg NMVOC eq	8.02E-01	1.08E-02	1.86E-02	4.66E-02	3.59E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-01	0.00E+00	0.00E+00	6.75E-04	1.85E-03	2.57E-03	-3.76E-01
	ADP- M&M	kg Sb eq	1.78E-02	8.21E-06	6.69E-06	1.03E-05	8.81E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.96E-04	0.00E+00	0.00E+00	3.60E-07	5.51E-06	4.55E-07	-1.18E-02
	ADP-fossil	MJ	2.22E+03	3.60E+01	5.11E+01	5.62E+01	4.15E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.79E+02	0.00E+00	0.00E+00	1.59E+00	7.64E+00	2.51E+00	-8.38E+02
WDP	m3 depriv.	5.13E+01	1.62E-01	6.16E-01	2.16E-01	1.46E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.72E+01	0.00E+00	0.00E+00	6.57E-03	1.10E-01	1.62E-01	-1.70E+01	

	ODP	kg CFC11 eq	2.84E-06	3.78E-08	1.25E-08	6.10E-08	5.46E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-06	0.00E+00	0.00E+00	2.36E-09	4.06E-09	5.25E-09	-8.71E-07
	AP	mol H+ eq	2.55E+00	7.84E-03	2.85E-02	4.95E-02	1.55E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.26E-01	0.00E+00	0.00E+00	4.47E-04	3.20E-03	1.55E-03	-8.99E-01
	EP-Freshwater	kg P eq	1.13E-02	2.35E-05	1.16E-04	3.00E-05	1.30E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E-03	0.00E+00	0.00E+00	8.69E-07	2.98E-05	2.46E-05	-5.02E-03
	EP-Marine	kg N eq	2.56E-01	2.35E-03	5.84E-03	1.37E-02	4.68E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.54E-02	0.00E+00	0.00E+00	1.69E-04	5.34E-04	5.83E-03	-9.78E-02
	EP-Terrestrial	mol N eq	5.88E+00	2.51E-02	6.43E-02	1.50E-01	5.61E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.06E-01	0.00E+00	0.00E+00	1.82E-03	6.34E-03	5.69E-03	-1.16E+00
	POCP	kg NMVOC eq	7.43E-01	1.05E-02	1.90E-02	4.39E-02	2.73E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.80E-01	0.00E+00	0.00E+00	6.54E-04	1.79E-03	2.56E-03	-3.44E-01
	ADP- M&M	kg Sb eq	1.38E-02	7.98E-06	6.84E-06	9.73E-06	6.55E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-04	0.00E+00	0.00E+00	3.49E-07	5.34E-06	4.54E-07	-8.93E-03
	ADP-fossil	MJ	2.09E+03	3.50E+01	5.23E+01	5.30E+01	3.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.73E+02	0.00E+00	0.00E+00	1.54E+00	7.39E+00	2.50E+00	-7.76E+02
	WDP	m3 depriv.	4.85E+01	1.58E-01	6.30E-01	2.04E-01	1.06E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.65E+01	0.00E+00	0.00E+00	6.36E-03	1.06E-01	1.62E-01	-1.55E+01
H6	GWP-total	kg CO2 eq	1.84E+02	2.54E+00	5.55E+00	3.98E+00	6.71E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.23E+01	0.00E+00	0.00E+00	1.10E-01	5.93E-01	7.31E+00	-8.03E+01	
	GWP-fossil	kg CO2 eq	1.86E+02	2.53E+00	5.58E+00	3.97E+00	7.84E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.64E+01	0.00E+00	0.00E+00	1.10E-01	5.91E-01	1.73E+00	-8.04E+01	
	GWP-biogenic	kg CO2 eq	-1.41E+00	1.07E-03	-2.99E-02	9.63E-04	1.36E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.90E+00	0.00E+00	0.00E+00	1.09E-04	2.72E-04	5.58E+00	1.67E-01	
	GWP-luluc	kg CO2 eq	2.31E-01	1.29E-03	2.21E-03	2.36E-03	1.48E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.97E-03	0.00E+00	0.00E+00	5.30E-05	1.18E-03	1.34E-04	-1.09E-01	
	ODP	kg CFC11 eq	2.80E-06	3.77E-08	1.25E-08	6.06E-08	5.25E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-06	0.00E+00	0.00E+00	2.35E-09	4.04E-09	5.25E-09	-8.63E-07	
	AP	mol H+ eq	2.53E+00	7.81E-03	2.86E-02	4.92E-02	1.49E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.26E-01	0.00E+00	0.00E+00	4.45E-04	3.19E-03	1.55E-03	-8.90E-01	
	EP-Freshwater	kg P eq	1.11E-02	2.35E-05	1.17E-04	2.98E-05	1.23E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-03	0.00E+00	0.00E+00	8.66E-07	2.96E-05	2.46E-05	-4.91E-03	
	EP-Marine	kg N eq	2.54E-01	2.34E-03	5.86E-03	1.36E-02	4.50E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.54E-02	0.00E+00	0.00E+00	1.68E-04	5.32E-04	5.83E-03	-9.68E-02	
	EP-Terrestrial	mol N eq	5.86E+00	2.51E-02	6.44E-02	1.49E-01	5.39E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.06E-01	0.00E+00	0.00E+00	1.81E-03	6.32E-03	5.68E-03	-1.15E+00	
	POCP	kg NMVOC eq	7.36E-01	1.05E-02	1.91E-02	4.36E-02	2.63E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.80E-01	0.00E+00	0.00E+00	6.51E-04	1.78E-03	2.56E-03	-3.41E-01	
	ADP- M&M	kg Sb eq	1.34E-02	7.96E-06	6.86E-06	9.67E-06	6.30E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-04	0.00E+00	0.00E+00	3.48E-07	5.32E-06	4.53E-07	-8.61E-03	
	ADP-fossil	MJ	2.07E+03	3.48E+01	5.24E+01	5.26E+01	2.95E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.73E+02	0.00E+00	0.00E+00	1.53E+00	7.37E+00	2.50E+00	-7.69E+02	
	WDP	m3 depriv.	4.82E+01	1.57E-01	6.32E-01	2.02E-01	1.02E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.66E+01	0.00E+00	0.00E+00	6.34E-03	1.06E-01	1.62E-01	-1.54E+01	
H7	GWP-total	kg CO2 eq	1.84E+02	2.53E+00	5.56E+00	3.96E+00	6.55E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.22E+01	0.00E+00	0.00E+00	1.10E-01	5.91E-01	7.31E+00	-7.99E+01	
	GWP-fossil	kg CO2 eq	1.85E+02	2.53E+00	5.59E+00	3.95E+00	7.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.63E+01	0.00E+00	0.00E+00	1.10E-01	5.90E-01	1.73E+00	-8.00E+01	
	GWP-biogenic	kg CO2 eq	-1.40E+00	1.07E-03	-3.00E-02	9.59E-04	1.35E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.89E+00	0.00E+00	0.00E+00	1.08E-04	2.72E-04	5.58E+00	1.68E-01	
	GWP-luluc	kg CO2 eq	2.30E-01	1.29E-03	2.21E-03	2.35E-03	1.44E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.88E-03	0.00E+00	0.00E+00	5.28E-05	1.18E-03	1.34E-04	-1.08E-01	
	ODP	kg CFC11 eq	2.77E-06	3.76E-08	1.26E-08	6.03E-08	5.10E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-06	0.00E+00	0.00E+00	2.35E-09	4.03E-09	5.25E-09	-8.56E-07	
	AP	mol H+ eq	2.52E+00	7.80E-03	2.86E-02	4.89E-02	1.45E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.25E-01	0.00E+00	0.00E+00	4.44E-04	3.18E-03	1.55E-03	-8.84E-01	
	EP-Freshwater	kg P eq	1.10E-02	2.34E-05	1.17E-04	2.97E-05	1.18E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-03	0.00E+00	0.00E+00	8.64E-07	2.96E-05	2.46E-05	-4.84E-03	

	PENRE	MJ	2.07E+03	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PENRM	MJ	3.73E+01	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PENRT	MJ	2.11E+03	3.51E+01	5.21E+01	5.35E+01	3.25E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.75E+02	0.00E+00	0.00E+00	1.55E+00	7.43E+00	2.50E+00	-7.86E+02	
	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	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	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	FW	m3	1.34E+00	4.95E-03	1.55E-02	6.65E-03	3.24E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E+00	0.00E+00	0.00E+00	2.21E-04	4.10E-03	4.07E-03	-4.24E-01	
	HWD	kg	2.06E-02	2.26E-04	5.27E-05	3.22E-04	1.92E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.20E-03	0.00E+00	0.00E+00	9.85E-06	1.49E-05	1.51E-05	-1.52E-03	
	NHWD	kg	3.33E+01	1.71E+00	4.00E-01	1.87E+00	3.59E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.49E+00	0.00E+00	0.00E+00	7.56E-02	7.08E+00	4.86E+00	-1.43E+01	
	RWD	kg	2.35E-03	7.14E-06	5.57E-05	9.36E-06	1.84E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-03	0.00E+00	0.00E+00	5.03E-07	1.93E-05	1.97E-06	-3.95E-04	
	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	MFR	kg	0.00E+00	0.00E+00	2.34E-01	0.00E+00	6.44E-01	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	4.56E+00	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	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	6.61E-02	0.00E+00	5.64E-01	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	7.29E+00	0.00E+00	
	EEE	MJ	0.00E+00	0.00E+00	4.90E-03	0.00E+00	2.78E-01	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	3.58E+00	0.00E+00	
H5	PERE	MJ	2.30E+02	4.47E-01	7.95E+00	5.86E-01	9.48E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.83E+02	0.00E+00	0.00E+00	2.39E-02	9.91E-01	1.06E-01	-6.13E+01	
	PERM	MJ	8.78E+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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PERT	MJ	2.39E+02	4.47E-01	7.95E+00	5.86E-01	9.48E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.83E+02	0.00E+00	0.00E+00	2.39E-02	9.91E-01	1.06E-01	-6.13E+01	
	PENRE	MJ	2.05E+03	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PENRM	MJ	3.70E+01	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PENRT	MJ	2.09E+03	3.50E+01	5.23E+01	5.30E+01	3.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.73E+02	0.00E+00	0.00E+00	1.54E+00	7.39E+00	2.50E+00	-7.76E+02	
	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	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	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FW	m3	1.33E+00	4.93E-03	1.56E-02	6.58E-03	3.06E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E+00	0.00E+00	0.00E+00	2.19E-04	4.08E-03	4.07E-03	-4.17E-01
	HWD	kg	2.01E-02	2.25E-04	5.29E-05	3.19E-04	1.81E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.13E-03	0.00E+00	0.00E+00	9.80E-06	1.48E-05	1.51E-05	-1.47E-03
	NHWD	kg	3.31E+01	1.71E+00	4.01E-01	1.86E+00	3.38E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E+00	0.00E+00	0.00E+00	7.52E-02	7.02E+00	4.86E+00	-1.42E+01
	RWD	kg	2.31E-03	7.10E-06	5.59E-05	9.27E-06	1.74E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.07E-03	0.00E+00	0.00E+00	5.00E-07	1.92E-05	1.97E-06	-3.82E-04
	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	2.35E-01	0.00E+00	6.15E-01	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	4.50E+00	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	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	6.63E-02	0.00E+00	5.34E-01	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	7.28E+00	0.00E+00	
	EEE	MJ	0.00E+00	0.00E+00	4.92E-03	0.00E+00	2.63E-01	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	3.58E+00	0.00E+00	
H6	PERE	MJ	2.28E+02	4.45E-01	7.97E+00	5.82E-01	9.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E+02	0.00E+00	0.00E+00	2.38E-02	9.87E-01	1.06E-01	-6.06E+01	
	PERM	MJ	8.75E+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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PERT	MJ	2.37E+02	4.45E-01	7.97E+00	5.82E-01	9.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E+02	0.00E+00	0.00E+00	2.38E-02	9.87E-01	1.06E-01	-6.06E+01	
	PENRE	MJ	2.03E+03	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PENRM	MJ	3.68E+01	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PENRT	MJ	2.07E+03	3.48E+01	5.24E+01	5.26E+01	2.95E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.73E+02	0.00E+00	0.00E+00	1.53E+00	7.37E+00	2.50E+00	-7.69E+02	
	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	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	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	FW	m3	1.32E+00	4.91E-03	1.56E-02	6.54E-03	2.94E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E+00	0.00E+00	0.00E+00	2.19E-04	4.06E-03	4.07E-03	-4.13E-01	
	HWD	kg	1.98E-02	2.25E-04	5.30E-05	3.17E-04	1.74E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.10E-03	0.00E+00	0.00E+00	9.77E-06	1.47E-05	1.51E-05	-1.44E-03	
	NHWD	kg	3.29E+01	1.70E+00	4.02E-01	1.84E+00	3.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E+00	0.00E+00	0.00E+00	7.50E-02	6.98E+00	4.86E+00	-1.41E+01	
	RWD	kg	2.28E-03	7.08E-06	5.60E-05	9.20E-06	1.68E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.07E-03	0.00E+00	0.00E+00	4.99E-07	1.91E-05	1.97E-06	-3.74E-04	
	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	MFR	kg	0.00E+00	0.00E+00	2.35E-01	0.00E+00	5.96E-01	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	0.00E+00	4.47E+00	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	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	6.65E-02	0.00E+00	5.14E-01	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	0.00E+00	7.28E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	4.94E-03	0.00E+00	2.53E-01	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	0.00E+00	3.57E+00	0.00E+00	
H7	PERE	MJ	2.27E+02	4.44E-01	7.98E+00	5.80E-01	8.85E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.76E+02	0.00E+00	0.00E+00	2.37E-02	9.84E-01	1.06E-01	-6.02E+01	
	PERM	MJ	8.73E+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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PERT	MJ	2.35E+02	4.44E-01	7.98E+00	5.80E-01	8.85E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.76E+02	0.00E+00	0.00E+00	2.37E-02	9.84E-01	1.06E-01	-6.02E+01	
	PENRE	MJ	2.02E+03	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PENRM	MJ	3.66E+01	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
	PENRT	MJ	2.06E+03	3.48E+01	5.25E+01	5.24E+01	2.87E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.72E+02	0.00E+00	0.00E+00	1.53E+00	7.35E+00	2.50E+00	-7.64E+02	
	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	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	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
FW	m3	1.31E+00	4.90E-03	1.56E-02	6.51E-03	2.85E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E+00	0.00E+00	0.00E+00	2.18E-04	4.05E-03	4.07E-03	-4.09E-01		

HWD	kg	1.95E-02	2.24E-04	5.31E-05	3.15E-04	1.68E-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	0.00E+00	9.74E-06	1.47E-05	1.51E-05	-1.42E-03
NHWD	kg	3.28E+01	1.70E+00	4.03E-01	1.83E+00	3.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E+00	0.00E+00	0.00E+00	7.48E-02	6.95E+00	4.86E+00	-1.40E+01
RWD	kg	2.26E-03	7.07E-06	5.61E-05	9.16E-06	1.63E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.07E-03	0.00E+00	0.00E+00	4.97E-07	1.91E-05	1.97E-06	-3.68E-04
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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	0.00E+00	0.00E+00	2.36E-01	0.00E+00	5.82E-01	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	4.44E+00	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	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	6.66E-02	0.00E+00	5.00E-01	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	7.28E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	4.94E-03	0.00E+00	2.47E-01	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	3.57E+00	0.00E+00

Caption:

1E+01 is equal to 1 x 10¹

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; **PERT:** Total use of renewable primary energy resources; **PENRT:** Total use of non-renewable primary energy resources; **SM:** Use of secondary materials; **RSF:** Use of renewable secondary fuels; **NRSF:** Use of non-renewable secondary fuels; **FW:** Use of net fresh water; **HWD =** Hazardous waste disposed; **NHWD =** Non-hazardous waste disposed; **RWD =** Radioactive waste disposed; **CRU =** Components for re-use; **MFR =** Materials for recycling; **MER =** Materials for energy recovery; **EEE =** Exported electrical energy; **EET =** Exported energy Thermal

6. Calculation rules

6.1. Declared or functional unit

The functional unit has been defined as 1kWh stored by a single energy storage module. And other necessary information is listed below.

- Total battery capacity: listed in Table 4-1, from 5760 to 20160 Wh
- Type of coupling: DC
- Type of cell technology: LiFePO₄ Prismatic Cell
- Type of application: Domestic/residential

The geographical boundary for this LCA study is defined with manufacturing of energy storage system taking place in mainland China, while use phase and end-of-life treatment stage will be modelled with a case study taken place in Italy.

6.2. Reference Service Life

The reference service life of the studied product is 10 years.

6.3. Assumptions

Table 6-1 List of assumptions

Life cycle stages	Items	Assumptions
A1 Raw material supply stage	Material of the electromagnetic relay	Ferrite and copper share 50% of the total weight respectively.
A2 Transportation of raw material	Transportation vehicle type	EURO 5 lorry with 16-32 ton capacity is assumed to be used for those "EURO 5 or EURO 6, arranged by logistics company"
A3 Manufacturing stage	Transportation vehicle type	For the vehicle used for transportation of solid and hazardous wastes, EURO 5 lorry with 16-32 ton capacity is assumed for modelling
A4 Distribution stage	Transportation vehicle type	For the vehicle used for product distribution, EURO 4 lorry with 16-32 ton capacity, and container ship are assumed for land and sea transport. The distance is assumed according to map and the PCR.
A5 Installation stage	Electricity and materials use	No electricity and materials used for installation as it can be done manually
B Use & Maintenance	Replacement	No replacement for the module as the module has RSL>10 years
C1-C4 End-of-life	De-construction	The de-construction of energy storage system is assumed to be done manually, no electricity and materials use in this stage
	Waste transportation	Waste transportation distance from the de-installation plant to the waste treatment facilities is assumed to be 50 km for simplification purposes. The vehicle used is assumed as EURO 4 lorry with 16-32 ton capacity.
	Waste processing	The Ecoinvent waste processing data "waste electric and electronic equipment, treatment of, shredding"
	Disposal	The disposal scenario follows PEF EoL default values in Italy and Europe and IEC/TR 62635 guidelines

6.4. Cut-off rules

For the processes within the system boundary, all available energy and material flow data have been included in the model. The cut-off criteria were set to 2% in this study according to PCR.

Table 6-2 Cut-off flows

Flow name	Process stage	Mass %	Criteria to cut-off
Spacer, tape, buzzer etc.	A1 Raw material	0.52	<2%
Devices external to the systems itself required for installation	A5 Installation stage	N/A	Cut-off due to small impact according to PCR
Any extraordinary maintenance done on the switch	B Use & Maintenance	N/A	Specified in PCR
Total cut-off mass % estimated			<2%

6.5. Data quality

Primary data system (such materials or energy flows that enter the production system) is from FOXESS manufacturing facilities in a reference period from June, 2022 to May, 2023 (annual average). Generic data related to the life cycle impacts of the material or energy flows that enter the production system is sourced from Ecoinvent 3.9 "allocation, cut-off by classification - unit" database.

6.6. Excluded processes

The following steps/stages are not included in the system boundary due to the reason that the elements below are considered irrelevant or not within the boundary to the LCA study:

- Impacts related to the production, transportation and installation of capital goods (buildings, infrastructure, machinery, internal transport packaging) and general operations (staff travel, marketing and communication actions) that cannot be directly allocated to products are excluded from the LCA study.
- Emissions during the installation and operation due to no obvious emission observable.
- Storage phases and sales of products due to no observable impact. Product losses due to abnormal damage such as natural disasters or fire accidents. These losses would mostly be accidental.
- Handling operations at the distribution center and retail outlet due to small contribution and negligible impact.
- Research and development activities.
- Long-term emissions.
- The recycling process of defective products is reused internally for the manufacturing process.

6.7. Allocations

The allocation is made in accordance with the provisions of EN 15804+A2:2019/AC:2021 and Core PCR. Allocation refers to the 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 three types of allocation procedures considered:

Multi-input allocation

For data sets in this study, raw materials as well as packaging materials are based on the BOM from FOXESS, no allocation is used at the stage. As for the manufacturing process, the energy consumption and emission are allocated based on working hours of different product, i.e., the electricity consumption and the emissions are calculated based on the amount of time spent producing each energy storage system.

Multi-output allocation

No other by-products are produced from the production, hence there is no production of by-products that need to be used to allocate the situation.

End-of-life allocation

For end-of-life allocation of background data (energy and materials), the model "allocation cut-off by classification (ISO standard) is used. The underlying philosophy of this approach is that primary (first) production of materials is always allocated to the primary user of a material. If material is recycled, the primary producer does not receive any credit for the provision of any recyclable materials. Consequently, recyclable materials are available burden-free for recycling processes, and secondary (recycled) materials bear only the impacts of the recycling processes.

For end-of-life stage of the energy storage systems, 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 depollution 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 electric products (cut-off approach).

6.8. Electricity mix

The manufacturing stage of the systems takes place in Zhejiang, China. Therefore, the Chinese grid market average electricity mix, and electricity production by PV in Zhejiang are used in this study. The installation and operation of the systems, as well as the end-of-life stage, are assumed taken place in Italy as a case study. Load consumption during the use stage is modelled with DC electricity generated from photovoltaic in Italy, while non-load consumption is modelled using average electricity market mix in Italy.

Table 6-3 Electricity mix used for modelling

Consumption type	Electricity process type
Electricity use in manufacturing stage (from grid)	Grid electricity mix in China (market for electricity, medium voltage, Ecoinvent 3.9)
Electricity use in manufacturing stage (from PV)	Electricity generated by photovoltaic in Zhejiang, China (low voltage, Ecoinvent 3.9)
Electricity use in use stage (standby consumption)	Electricity generated by photovoltaic in Italy (low voltage, Ecoinvent 3.9)
Electricity use in use stage (charge/discharge consumption)	Grid electricity mix in Italy (market for electricity, medium voltage, Ecoinvent 3.9)

6.9. Biogenic carbon in product and packaging

Table 6-4 Biogenic carbon in product and packaging

Biogenic Carbon	Product (kg C eq)	Packaging (kg C eq)
H2	8.18E-05	2.17E-01
H3	5.54E-05	2.13E-01
H4	4.20E-05	2.11E-01
H5	3.41E-05	2.10E-01
H6	2.86E-05	2.09E-01
H7	2.49E-05	2.09E-01

7. LCA calculation scenarios

7.1. Distribution

For the distribution stage, this study takes Italy as the target market. The transportation information is provided by FOXESS. The products are firstly transported from the manufacturing site, Wenzhou plant, to Ningbo Port, with a 500km distance by lorry. Then, it is transported through container ship from Ningbo Port to Naples, Italy. And, the product will be transported 224km and 300km from Naples to Rome, and Rome to customer by lorry. According to the PCR, a 16-32 metric ton EURO 4 lorry is selected to be the transportation vehicle for three sections of land transportation, in the absence of primary data on the category of lorry.

Table 7-1 Product distribution

Sales market	Transportation vehicle	Distance (km)	Start location	End location
Italy	Lorry 16-32 metric ton, EURO4	500km	Wenzhou plant	Ningbo
	Container ship	9259km	Ningbo	Naples.IT
	Lorry 16-32 metric ton, EURO4	224km	Naples.IT	Rome
	Lorry 16-32 metric ton, EURO4	300km	Rome	Customer

7.2. Installation

In the installation stage, the energy use is negligible since the installation process is mainly done manually. According to the product category rules (PCR), end of life of the packaging materials, scrap and general waste generated are considered in this stage.

The waste generated from the product packaging, mainly consist of wood pallets and plywood, papers, and plastics. The treatments of the waste are modelled according to the PEF EoL default values in Italy and Europe. Transportation distance of the waste is assumed to be 50km.

7.3. Use & Maintenance

The electricity consumption during the use stage of the systems includes two different parts, which are the energy required by the battery to operate, and the energy loss due to charge and discharge cycles.

$$E_{tot}[kWh] = E_{use} + E_{loss}$$

According to PCR, the following formula shall be used to calculate the electricity used during the product's service life to keep the battery active:

$$E_{use}[kWh] = \frac{P_{use} \times 8760 \times RSL}{1000}$$

where:

E_{use} (kWh) is the power losses during the operation of system;

P_{use} (W) is the power of the system to keep active during the reference service life, 1W;

RSL is the service life of the product, 10 years;

While the energy loss due to charge and discharge cycles can be calculated by:

$$E_{loss}[kWh] = \sum_{i=0}^{RSL} \frac{E_{useful\ i} \times N_{cycles} \times 365}{DC\ RTE_i} \times (1 - DC\ RTE_i)$$

where E_{loss} (kWh) is the electricity dissipation occurring whenever the battery is charged and discharged, $E_{useful i}$ (kWh) is the max energy dischargeable from the battery system, see Table 4-1; 2.5% capacity fading per year.

N_{cycles} is the number of full charge/discharge cycles per day, 1 time;

$DC RTE_i$ is DC round trip efficiency in the year i , 95%.

The electricity consumption of different energy storage system during use stage is listed in Table 7-2.

Table 7-2 Electricity consumption of systems during use stage

	H2	H3	H4	H5	H6	H7
E_{use}	87.6	87.6	87.6	87.6	87.6	87.6
P_{use}	1	1	1	1	1	1
E_{loss}	9.90E+02	1.48E+03	1.98E+03	2.47E+03	2.97E+03	3.46E+03
$E_{useful0}$	5.76E+00	8.64E+00	1.15E+01	1.44E+01	1.73E+01	2.02E+01
$E_{useful1}$	5.62E+00	8.42E+00	1.12E+01	1.40E+01	1.68E+01	1.97E+01
$E_{useful2}$	5.48E+00	8.21E+00	1.10E+01	1.37E+01	1.64E+01	1.92E+01
$E_{useful3}$	5.34E+00	8.01E+00	1.07E+01	1.33E+01	1.60E+01	1.87E+01
$E_{useful4}$	5.21E+00	7.81E+00	1.04E+01	1.30E+01	1.56E+01	1.82E+01
$E_{useful5}$	5.08E+00	7.61E+00	1.02E+01	1.27E+01	1.52E+01	1.78E+01
$E_{useful6}$	4.95E+00	7.42E+00	9.90E+00	1.24E+01	1.48E+01	1.73E+01
$E_{useful7}$	4.82E+00	7.24E+00	9.65E+00	1.21E+01	1.45E+01	1.69E+01
$E_{useful8}$	4.70E+00	7.06E+00	9.41E+00	1.18E+01	1.41E+01	1.65E+01
$E_{useful9}$	4.59E+00	6.88E+00	9.17E+00	1.15E+01	1.38E+01	1.61E+01
N_{cycles}	1	1	1	1	1	1
$DC RTE_i$	95%	95%	95%	95%	95%	95%
E_{tot}	1.08E+03	1.57E+03	2.07E+03	2.56E+03	3.06E+03	3.55E+03

The FOXESS energy storage systems are designed to be free of maintenance during its service life. Therefore, no inputs and outputs are taken place in the maintenance stage in this study.

7.4. End-of-life

For end-of-life (EoL) stage, assumptions are made due to a lack of data. De-installation stage of the system is assumed to be manually done with no energy use. Transportation distance from the plant site to the waste treatment site is assumed to be 50km according to PCR. For waste processing, the system is shredded and post-processed.

The systems disposal and recycling stage involves removing hazardous valuable materials, metal scraps. The most recyclable materials constitute the metal components, printed circuit board (PCBs), and cables. In this study, both PEF EoL default values in Italy and Europe and IEC/TR 62635 guidelines are referred to.

8. REFERENCES

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