Zucchetti Centro Sistemi SpA

ENVIRONMENTAL PRODUCT DECLARATION

Intelligent Energy Storage

(AZZURRO HV ZBT 5K, AZZURRO HV ZBT ES5, AZZURRO HV ZBT ES10, AZZURRO HV ZBT ES15 and AZZURRO HV ZBT ES20)

No.1, Dongsheng North Road, Chenjiang Street, Zhongkai High-tech Zone, Huizhou City, Guangdong Province, China

In accordance with ISO 14025 and EN 50693

Program Operator	EPDItaly
Publisher	EPDItaly

Declaration Number	EPDItaly-ZCS-004
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1 General information

1.1 Programme information

Programme:	EPDItaly
Address	Via Gaetano De Castillia n° 10 - 20124 Milano, Italy
Website	www.epditaly.it
E-mail	info@epditaly.it
EPD Owner	Zucchetti Centro Sistemi SpA Via Lungarno 305 52029 Terranuova Bracciolini (AR) Italy zcs@pec.it
Manufacturer address	No.1, Dongsheng North Road, Chenjiang Street, Zhongkai High-tech Zone, Huizhou City, Guangdong Province, China
Product code	AZZURRO HV ZBT 5K AZZURRO HV ZBT ES5 AZZURRO HV ZBT ES10 AZZURRO HV ZBT ES15 AZZURRO HV ZBT ES20
Functional unit	Functional unit is defined as 1 kWh stored by Intelligent Energy Storage (AZZURRO HV ZBT 5K, AZZURRO HV ZBT ES5, AZZURRO HV ZBT ES10, AZZURRO HV ZBT ES15 and AZZURRO HV ZBT ES20)
CPC code	46410 “Primary cells and primary batteries”
Independent verification	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.
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.
Product category rules (PCR)	Core PCR: EPDItaly007 - PCR for Electronic and Electrical Products and Systems, (rev.3), January 2023

	Sub-category PCR: EPDItaly021 “Electronic and electrical products and systems - Energy Storage”, (Rev. 4), 23/06/2022
Other references	EN 50693:2019 - Product category rules for life cycle assessments of electronic and electrical products and systems Regulations of the EPDItaly Programme rev. 6.0 published on 2023/10/30
Product RSL description	10 years
LCA study	This EPD study is based on the LCA study described in the LCA report
EPD type	Product specific
EPD scope	Cradle to grave
Year of reported primary data	1 June 2023 to 31 March 2024, since the product is in production from 1 June 2023 in No.1, Dongsheng North Road, Chenjiang Street, Zhongkai High-tech Zone, Huizhou City, Guangdong Province, China.
Technical support	Emily Zhao SGS China Co., Ltd A - 16/F, Century Yuhui Mansion, No. 73 Fucheng Road, Beijing, 100142, China

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

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 50693, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterization factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 50693 and ISO 14025.

1.2 Company information

Owner of the EPD: Zucchetti Centro Sistemi SpA

Description of the organisation:

Zucchetti Centro Sistemi (ZCS) was founded in 1985 from the entrepreneurial spirit of Cav. Lav. Fabrizio Bernini, today shareholder and CEO of the company. The entrepreneur's excellent ability to anticipate changes in the market over the years has allowed ZCS to transform itself from a small family business specialised in software into an international multi-business management company. In 2000, the company became part of the Zucchetti Spa group. The ZCS headquarters are located in Valdarno, in the heart of Tuscany and occupy three buildings (Building of Ideas, Building of Technology and Building of Innovation). It also has branches in Emilia (Parma), Sardinia (Sassari, Nuoro and Cagliari), Umbria (Perugia), as well as subsidiaries in the Tyrrhenian area of Tuscany, in Piedmont and Lombardy. Today, ZCS consists of five Business Units (software, automation, healthcare, robotics and energy renewable) that meet the need to diversify and extend the know-how acquired in the design of management software to different and complementary areas, with the aim of providing technological excellence in the fields of IT, digitalisation and mechatronics.

As a technological pioneer, ZCS understands the potential of digital technologies and introduces them into its own products, solutions and internal processes. The ZCS brands speak the language of the future, they are aimed at different markets, and are linked by common digital factors such as the use of the Cloud, IoT (Internet of Things), Big Data and Artificial Intelligence. The added value lies in the ability to integrate digital innovations into machines, electronic devices and robots, transforming them into “intelligent” objects capable of interacting with humans and providing useful data and information to improve and simplify the everyday life of customers. Innovation is therefore culture: the courage to design and create products that did not exist until now, but that may represent a solution for tomorrow, while respecting the health and safety of people and the environment. Ideas and projects that are functional to all company divisions are developed independently inside the “Laboratory of Ideas (Idealab).” The real driving force behind the Research & Development Department, the lab was set up in 2005 and consists of 40 highly qualified researchers, mechanical and electronic engineers, IT experts and designers. Ideas are transformed into real innovations, combining know-how and creativity for the different market sectors, dedicated to health and safety, traceability, tracking and control, speed and mobility, environmental sustainability and energy saving.

Production site:

No.1, Dongsheng North Road, Chenjiang Street, Zhongkai High-tech Zone, Huizhou City, Guangdong Province, China

1.3 Product information

Product name: Intelligent Energy Storage (AZZURRO HV ZBT 5K, AZZURRO HV ZBT ES5, AZZURRO HV ZBT ES10, AZZURRO HV ZBT ES15 and AZZURRO HV ZBT ES20)

Product identification: the type of cell technology is lithium iron phosphate battery

Product description:

The AZZURRO HV ZBT 5K battery input and output voltages are high DC voltage. The system adopts modular design and stacked installation method. The capacity can be flexibly configured based on actual requirements. The rated energy is 5.12kWh. The BTS 5K battery module is not recommended to be used alone, it needs to be used with battery distribution unit (hereinafter referred to as BDU) or ESI series inverter.

The AZZURRO HV ZBT ES5 is an intelligent battery system composed of a AZZURRO HV ZBT 5K battery module and a AZZURRO BDU ZBT5K (battery distribution unit), If it is AZZURRO HV ZBT ES10, then it is composed of 2 battery modules and 1 battery distribution unit, AZZURRO HV ZBT ES15 is composed of 3 battery modules and 1 battery distribution unit, and AZZURRO HV ZBT ES20 is composed of 4 battery modules and 1 battery distribution unit. Its modular and stacked design enables a flexible configuration based on the user's specific requirements.

AZZURRO ZZT-ZBT5K-ES5 ~ ES20 series intelligent battery system is mainly composed of battery module and battery distribution unit. AZZURRO ZZT-ZBT5K-ES5 ~ ES20 is a battery system with an operating voltage range between 45.6~56.16V. AZZURRO ZZT-ZBT5K-ES5 ~ ES20 series intelligent battery system is mainly composed of battery module and battery distribution unit. The input and output voltages are high DC voltage. The system adopts modular design and stacked installation method. The capacity can be flexibly configured based on actual requirements. The capacity ranges are 5kWh ~ 40kWh.

Intended use:

The application of battery system is residential and industrial. AZZURRO ZZT-ZBT5K-ES5 ~ ES20 is an energy storage unit that is designed to be used in residential on-grid applications with the capability for short-term backup.It

is utilized in household energy storage applications and works together with a high-voltage to realize the goal of energy storage for the home.

Notes regarding intended use:

AZZURRO ZZT-ZBT5K-ES5 ~ ES20 is not suitable for supporting life-sustaining medical devices. This product is intended for use only in accordance with the information provided in the enclosed documentation and with the locally applicable standards and regulations.

Technical data:

Table 1: Key technological data of Intelligent Energy Storage (AZZURRO HV ZBT 5K, AZZURRO HV ZBT ES5, AZZURRO HV ZBT ES10, AZZURRO HV ZBT ES15 and AZZURRO HV ZBT ES20)

Parameter	AZZURRO HV ZBT 5K	AZZURRO HV ZBT ES5	AZZURRO HV ZBT ES10	AZZURRO HV ZBT ES15	AZZURRO HV ZBT ES20	Unit
Dimension	708*420*170	708*680*170	708*1100*170	708*1520*170	708*1940*170	mm*mm*mm
Weight of product	50	59	110	161	212	kg
Capacity	100	100	200	300	400	Ah
Nominal Voltage	51.2	51.2	51.2	51.2	51.2	V
Minimum guaranteed Energy	5.12	5.12	10.24	15.36	20.48	kWh

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

UN CPC code: 46410 “Primary cells and primary batteries”

Manufacturing process: The pictures below show the flow-chart of manufacturing process of AZZURRO HV ZBT 5K and AZZURRO BDU ZBT5K (battery distribution unit).

The flow-chart of manufacturing process of AZZURRO HV ZBT 5K.

1	Cell loading	13	FPC post weld inspection	25	Module inbound binding	37	Box cover fixing
2	Cell OCV testing	14	Install the upper cover assembly	26	Fixed module/insulation cotton 1	38	ATE Test 1
3	Cell classification	15	Lock bolt	27	Waterproof block processing	39	ATE Test 2
4	Lower bracket loading laser coding	16	Laser welding of aluminum bars	28	Waterproof block installation	40	Capacity testing
5	Lower bracket loading	17	Dust removal and inspection after module welding	29	Lock busbar aluminum bar	41	leak test
6	Discharge core into the lower bracket	18	Communication testing	30	Lock plug harness	42	Install accessory package
7	Module polarity detection	19	Terminal box processing one	31	DC internal resistance test	43	Clear BMS charging and discharging

							records
8	Module pole cleaning	20	Terminal Box Processing II	32	DCDC module installation/box binding	44	Visual inspection
9	FPC testing	21	Terminal box processing three	33	Installing terminal boxes/labeling	45	Scan code binding and mark the outer box
10	Install electrode plates/FPC on the upper bracket	22	Install insulation cotton 2/positioning board	34	Lock DCDC module screws	46	Packaging into boxes
11	Fix FPC/lock screws	23	Handle fixed box	35	Voltage withstand test	47	Placing pallets and stacking
12	Welding FPC	24	Box labeling	36	Box cover processing		

The flow-chart of manufacturing process of AZZURRO BDU ZBT5K (battery distribution unit).

1	Box placement and button switch installation	6	Install and tie the wiring harness	10-1	Installing the rear cover	13	Attachment processing
1-1	Install D4B board end male and female connectors	7	Install internal plum blossom limit nails/labels	10-2	Aging test	14	Visual inspection
1-2	Install RJ45 board end connectors	7-1	Gluing/Installing Protective Covers	10-3	T2 test	15	Packing of complete machine and accessories
2	DC switch processing	8	Insulation withstand voltage test - output communication port	11	Install accessory package	16	Stacking storage
3	Assembling transparent panels/PCBA	8-1	Insulation withstand voltage test - output port	12-0	Copying software from a USB drive		
4	Install DC switch components	9	T1 test	12-1	USB software check		
5	Fixed fuse base bracket/waterproof cover	10-0	QC appearance inspection	12	Air tightness test		

2 Content information

Table 2: Content information of Intelligent Energy Storage (AZZURRO HV ZBT 5K, AZZURRO HV ZBT ES5, AZZURRO HV ZBT ES10, AZZURRO HV ZBT ES15 and AZZURRO HV ZBT ES20)

Product components	**Material classes**	**Share [in %]**				
		AZZURRO HV ZBT 5K	AZZURRO HV ZBT ES5	AZZURRO HV ZBT ES10	AZZURRO HV ZBT ES15	AZZURRO HV ZBT ES20
Other ferrous alloys, non-stainless steels	M-199	23.11	31.88	27.95	26.45	25.66
Stainless steel	M-100	1.66	1.62	1.64	1.65	1.65
Aluminium and its alloys	M-120	3.14	3.91	3.56	3.43	3.36
Other elastomers	M-339	0.05	0.07	0.06	0.06	0.05
PC	M-204	2.45	3.28	2.91	2.77	2.69
Other unfilled thermoplastics	M-249	0.34	1.00	0.71	0.59	0.53
PolyAmide (PA)	M-208	0.03	0.03	0.03	0.03	0.03
PC-ABS	M-231	0.06	0.05	0.05	0.05	0.06
Silicone	M-321	0.06	0.09	0.08	0.07	0.07
Solder	M-126	0.10	0.11	0.11	0.10	0.10
Others	M-449	69.00	57.95	62.90	64.79	65.78
Packaging components	**Material classes**	**Share [in %]**				
		AZZURRO HV ZBT 5K	AZZURRO HV ZBT ES5	AZZURRO HV ZBT ES10	AZZURRO HV ZBT ES15	AZZURRO HV ZBT ES20
Packaging film	M-210	2.92	2.74	2.81	2.84	2.86
PE foam	M-210	3.88	7.82	6.26	5.58	5.21
Corrugated box	M-341	41.04	35.73	37.83	38.74	39.25
PS foam	M-203	0.46	0.30	0.37	0.39	0.41
Wood	M-340	51.01	51.98	51.60	51.43	51.34
Packaging straps	M-209	0.68	0.68	0.68	0.68	0.68
Paper	M-341	0.00	0.62	0.37	0.27	0.21
Others	M-449	0.00	0.13	0.08	0.06	0.04

3 LCA information

3.1 Overview

Functional unit: The functional unit (FU) is the product or system main function(s) quantified, to which the inputs and outputs are related to. According to PCR EPDItaly021, **the functional unit is defined as 1 kWh stored by Intelligent Energy Storage** (AZZURRO HV ZBT 5K, AZZURRO HV ZBT ES5, AZZURRO HV ZBT ES10, AZZURRO HV ZBT ES15 and AZZURRO HV ZBT ES20).

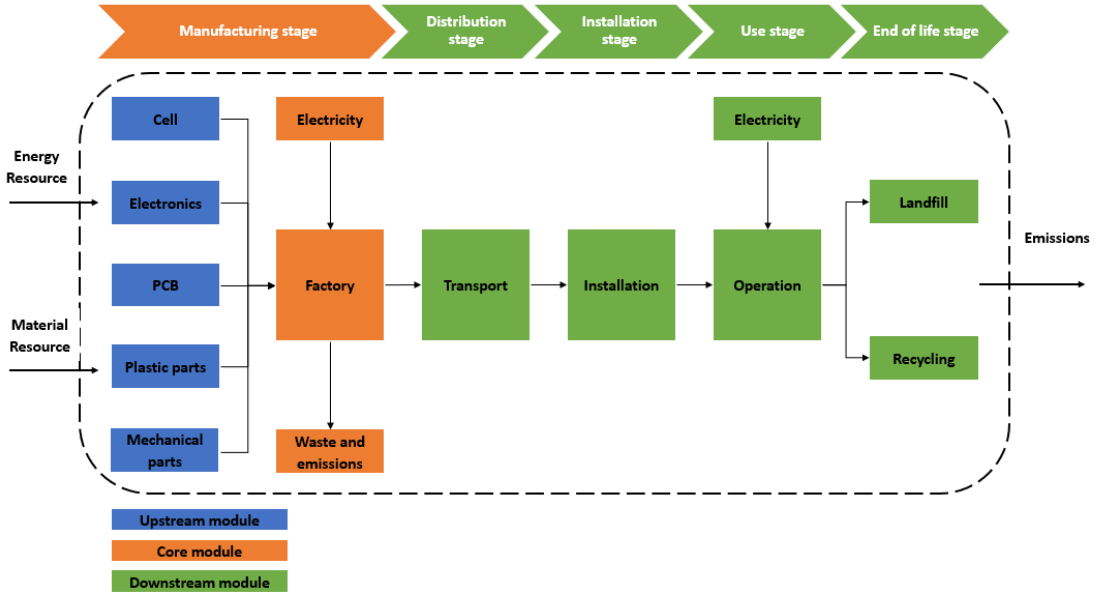
Reference flow: The reference flow describes all the needed flows to fulfil the functional unit.
The reference flow of AZZURRO HV ZBT 5K is 0.195 units product (Net weight:9.58 kg, gross weight:11.44 kg).
The reference flow of AZZURRO HV ZBT ES5 is 0.195 units product (Net weight:11.81 kg, gross weight:14.63 kg).
The reference flow of AZZURRO HV ZBT ES10 is 0.098 units product (Net weight:10.69 kg, gross weight:13.04 kg).
The reference flow of AZZURRO HV ZBT ES15 is 0.065 units product (Net weight:10.32 kg, gross weight:12.51 kg).
The reference flow of AZZURRO HV ZBT ES20 is 0.049 units product (Net weight:10.14 kg, gross weight:12.24 kg).

Reference service life: 10 years

Time representativeness: The primary data used has been obtained from the production unit in China (Huizhou City, Guangdong Province) from 1 June 2023 to 31 March 2024, being representative of the products and the production process.

Database(s) and LCA software used: SimaPro® software v.9.5 developed by PRé Consultants was used to create the product system model. The ecoinvent database version 3.9.1 provided the life cycle background data for product system modelling.

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



Declared life cycle stages:

Table 3: The declared life cycle stages of Intelligent Energy Storage (AZZURRO HV ZBT 5K, AZZURRO HV ZBT ES5, AZZURRO HV ZBT ES10, AZZURRO HV ZBT ES15 and AZZURRO HV ZBT ES20)

Module	**Upstream module**	**Core module**	**Downstream module**			
Stage	**Manufacturing**		**Distribution**	**Installation**	**Use and maintenance**	**End-of-life**
Supply chain processes	Extraction of raw materials and the production of semi-finished products and auxiliary items; Transport of raw materials to production unit.	Printed circuit board assembly and Intelligent Energy Storage assembling; Emissions to air; Treatment of hazardous waste; Transport of solid waste.	Intelligent Energy Storage transport to the operation site; Installation and packaging waste management; The energy required by the battery to operate and the energy loss due to charge/discharge cycles during 10 years (RSL); EoL, including collecting, transport of waste, material/energy recycling and disposal of non-recyclable fractions at sanitary landfill.			
Modules declared	x	x	x	x	x	x
Geography	CN	CN	Italy	Italy	Italy	Italy

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

Allocation processes: Allocation is required when more than one input is needed to produce a product and the products are co-produced with other products. The decision hierarchy applied for allocation of co-products was according to EN 50693. In this study, the consumption of materials from BOM and there is no need for materials allocation. There is no need for electricity consumption allocation. The electricity consumption of the production equipment is calculated by the theoretical formula: power × man-hour. The solid waste and emissions to air in manufacturing stage were estimated based on output from 1 June 2023 to 31 March 2024, and allocated to one unit product.

Cut-off rules and considerations: According to EN 50693 4.2.3.3, based on established LCA practice, the cut-off criteria are set to a maximum of 5% of the overall environmental impact of the analyzed product system given by its life cycle impact assessment (LCIA) results. In accordance with the cut-off rule, flows less than 1% of the total inventory were excluded, i.e.:

- construction of company plants and processing machinery (with a life of more than three years);
- staff travel and home-work transfers;
- research and development activities;
- long-term emissions (occurring beyond 100 years);

- some components of the kit of the products under study, such as: sensors, remote control and other operating tools; trays and other moving parts of the structures moved by the engines;
- the materials necessary for cleaning the production equipment/machinery;
- power consumption of auxiliary equipment.

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

Principles: According to EN 50693, the principles of "Polluter pays" and "Modularity" were followed in this study:
Polluter pays: Processes of waste processing shall be assigned to the product system that generates the waste until the end-of-waste state is reached;
Modularity: Where processes influence the product's environmental performance during its life cycle, they shall be assigned to the information module of the life cycle stage where they occur; all environmental aspects and impacts are declared in the life cycle stage where they appear.

3.2 Raw material acquisition stage (Upstream module)

At this stage, the materials and components are manufactured by supplies, and transported to the production unit in China (Huizhou City, Guangdong Province).
The Intelligent Energy Storage can be divided into 5 parts: LFP cell, PCB, electronics, plastic parts and mechanical parts. Because the production unit has no financial control or operational control over the supplies manufacturing materials above, Upstream production data for materials refer to Ecoinvent database.
The mode of transportation of materials is by lorry and assumed was EURO 4, 7.5-16 t.

3.3 Manufacturing and assembling stage (Core module)

The production unit is responsible for Printed circuit board assembly, Intelligent Energy Storage assembling, testing Intelligent Energy Storage and packaging. The electricity consumed in production unit comes from grid during 1 June 2023 to 31 March 2024. Waste is divided into ordinary solid waste and hazardous waste. Solid waste for recycling and hazardous waste for incineration in production process are entrusted to a third party, and trucked by EURO 4, 7.5-16t lorry. Air pollutants are discharged up to standard after being treated by factories, and pollutants were obtained from factory monitoring.

3.4 Distribution stage (Downstream module)

The distance between the production unit in China and the port of departure is 72.2 km by lorry. The distance between the port of departure and the port of arrival is 14704.88 km. The logistics of the product from the port of arrival to the installation site is difficult to determine, 500 km by lorry was adopted according to PCR EPDItaly021.

Table 4: The transport way and its distances of Intelligent Energy Storage (AZZURRO HV ZBT 5K, AZZURRO HV ZBT ES5, AZZURRO HV ZBT ES10, AZZURRO HV ZBT ES15 and AZZURRO HV ZBT ES20)

Name	Description	Value	Unit
Transport	Ship	14704.88	km
Transport	Lorry, EURO4, 16-32t	72.2+500=572.2	km

3.5 Installation stage (Downstream module)

Installing the AZZURRO HV ZBT 5K and AZZURRO HV ZBT ES5 require a yarding to work for 3 minutes, AZZURRO HV ZBT ES10 requires 6 mins, AZZURRO HV ZBT ES15 requires 9 mins, AZZURRO HV ZBT ES20 requires 12 mins. And the transport and End-of-life of packaging waste is taken into account in this stage. The transport distance of packaging materials from installation site to the treatment plant is assumed to be 50 km. The End-of-life scenario of packaging materials was used according to EN 50693.

3.6 Use and Maintenance stage (Downstream module)

The Intelligent Energy Storage does not require maintenance during use and maintenance stage. The energy required by the battery to operate and the energy loss due to charge/discharge cycles during its entire reference service life was considered. The following formula be used to calculate the electricity consumed during the product's service life:

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

Where:

- E_{tot} is the total energy consumed by the battery
- E_{use} is energy required by the battery to operate.
- E_{loss} is the energy loss due to charge/discharge cycles.

The energy required by the battery to operate calculation formula is as follows:

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

Where:

- E_{use} is energy required by the battery to operate.
- P_{use} is the power absorbed by the storage equipment auxiliaries services, expressed in W.
- RSL is the service life of the product, assumed to be 10 years.
- 8760 is the number of hours in a year.
- 1000 is the conversion factor that allows the energy consumed in kWh over the product's service life to be expressed.

The energy loss calculation formula is as follows:

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

Where:

- E_{loss} is the energy dissipation occurring whenever the battery is charged and discharged.
- DC RTEi (DC Round Trip efficiency in the year i) is the battery efficiency during a complete discharge/charge cycle defined as energy discharged divided by energy charged measured on DC power terminal in the charging/discharging cycle at the maximum power that the battery system can keep constantly without rest time and at Nominal Operating Temperature.
- E_{useful} is the max energy dischargeable from the battery system (DC side) during discharge at the maximum power that the battery system can keep constantly during discharging process without rest time and Nominal Operating Temperature.
- N_{cycles} is the number of full charge/discharge cycles per day; in the reference scenario, 1 entire charge/discharge.
- cycle per day shall be considered.
- 365 is the number of days in one year.

Table 5: The parameter used in Use and Maintenance stage of one unit of Intelligent Energy Storage (AZZURRO HV ZBT 5K, AZZURRO HV ZBT ES5, AZZURRO HV ZBT ES10, AZZURRO HV ZBT ES15 and AZZURRO HV ZBT ES20)

Parameter	AZZURRO HV ZBT 5K	AZZURRO HV ZBT ES5	AZZURRO HV ZBT ES10	AZZURRO HV ZBT ES15	AZZURRO HV ZBT ES20	Unit
DC RTE	97.68	97.68	97.68	97.68	97.68	%
$\sum_{i=0}^{RSL} E_{useful\ i}$	46.336	46.336	92.672	139.008	185.344	KWh
P_{use}	1	1	2	3	4	W
E_{loss}	401.693	401.693	803.385	1205.078	1606.770	kWh
E_{use}	87.600	87.600	175.200	262.800	350.400	kWh
E_{tot}	489.293	489.293	978.585	1467.878	1957.170	kWh

3.7 End of life stage (Downstream module)

The material recovery rate of LFP cell was assumed as 100%. The material recovery rate, energy recovery rete and disposal rete of PCB, electronics, plastic parts and mechanical parts is in line with EN 50693 Annex G. The disposal way of materials was assumed as 100% sanitary landfill. The transport distances from Installation site to the disassembly facility was assumed as 50 km.

4 Environmental impacts

4.1 Potential environmental impact

Table 6-1: The environmental impact of 1 kWh energy stored by AZZURRO HV ZBT 5K

Impact category	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
GWP-total	kg CO_2 eq	1.169E+02	8.058E+01	1.711E+00	3.004E+00	1.687E+01	7.346E+00	7.415E+00
GWP-fossil	kg CO_2 eq	1.154E+02	9.647E+01	1.718E+00	3.001E+00	8.160E-01	7.295E+00	6.074E+00
GWP-biogenic	kg CO_2 eq	1.360E+00	-1.605E+01	-8.613E-03	8.879E-04	1.605E+01	3.578E-02	1.332E+00
GWP-luluc	kg CO_2 eq	1.876E-01	1.613E-01	1.077E-03	1.941E-03	2.341E-04	1.461E-02	8.422E-03
ODP	kg CFC11 eq	1.118E-05	1.053E-05	4.882E-09	5.175E-08	1.298E-08	5.131E-07	7.090E-08
AP	mol H+ eq	2.064E+00	1.881E+00	9.766E-03	5.603E-02	4.417E-03	4.616E-02	6.652E-02
EP-freshwater	kg P eq	1.062E-02	9.851E-03	3.590E-05	1.686E-05	5.806E-06	4.682E-04	2.381E-04
EP-marine	kg N eq	1.911E-01	1.568E-01	1.765E-03	1.463E-02	3.215E-03	7.357E-03	7.270E-03
EP-terrestrial	mol N eq	4.749E+00	4.388E+00	1.949E-02	1.614E-01	1.984E-02	8.506E-02	7.474E-02
POCP	kg NMVOC eq	5.804E-01	4.668E-01	5.430E-03	4.541E-02	6.770E-03	3.065E-02	2.537E-02
ADP-minerals&metals	kg Sb eq	1.449E-02	1.402E-02	9.858E-06	5.616E-06	1.307E-06	2.969E-04	1.507E-04
ADP-fossil	MJ	1.440E+03	1.217E+03	1.949E+01	3.842E+01	1.060E+01	8.726E+01	6.703E+01
WDP	m^3 depriv.	3.934E+01	2.902E+01	2.128E-01	1.214E-01	3.676E-02	7.016E+00	2.934E+00

Acronyms: GWP-total=Global Warming Potential total; GWP-biogenic=Global Warming Potential biogenic; GWP-fossil=Global Warming Potential fossil; GWP-luluc=Global Warming Potential land use and land use change; ODP=Ozone Depletion; AP=Acidification; E=Eutrophication; POCP=Photochemical ozone formation; ADPE=Depletion of abiotic resources-minerals and metals; ADPF=Depletion of abiotic resources-fossil fuels; WDP=Water resource deprivation.

Table 6-2: The environmental impact of 1 kWh energy stored by AZZURRO HV ZBT ES5

Impact category	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
GWP-total	kg CO_2 eq	1.335E+02	9.442E+01	1.800E+00	3.842E+00	1.834E+01	7.346E+00	7.786E+00
GWP-fossil	kg CO_2 eq	1.318E+02	1.117E+02	1.808E+00	3.839E+00	8.454E-01	7.295E+00	6.242E+00
GWP-biogenic	kg CO_2 eq	1.563E+00	-1.750E+01	-9.006E-03	1.136E-03	1.750E+01	3.578E-02	1.535E+00
GWP-luluc	kg CO_2 eq	2.119E-01	1.848E-01	1.129E-03	2.483E-03	2.506E-04	1.461E-02	8.669E-03
ODP	kg CFC11 eq	1.948E-05	1.881E-05	5.601E-09	6.619E-08	1.334E-08	5.131E-07	7.235E-08
AP	mol H+ eq	2.213E+00	2.013E+00	1.023E-02	7.167E-02	4.563E-03	4.616E-02	6.730E-02
EP-freshwater	kg P eq	1.179E-02	1.101E-02	3.774E-05	2.157E-05	6.174E-06	4.682E-04	2.453E-04
EP-marine	kg N eq	2.142E-01	1.747E-01	1.850E-03	1.872E-02	3.908E-03	7.357E-03	7.721E-03
EP-terrestrial	mol N eq	4.992E+00	4.583E+00	2.042E-02	2.065E-01	2.023E-02	8.506E-02	7.655E-02
POCP	kg NMVOC eq	6.643E-01	5.366E-01	5.788E-03	5.809E-02	7.121E-03	3.065E-02	2.598E-02
ADP-minerals&metals	kg Sb eq	1.598E-02	1.551E-02	1.033E-05	7.183E-06	1.368E-06	2.969E-04	1.518E-04
ADP-fossil	MJ	1.645E+03	1.409E+03	2.043E+01	4.914E+01	1.090E+01	8.726E+01	6.893E+01
WDP	m^3 depriv.	4.225E+01	3.185E+01	2.237E-01	1.553E-01	4.324E-02	7.016E+00	2.963E+00

Acronyms: GWP-total=Global Warming Potential total; GWP-biogenic=Global Warming Potential biogenic; GWP-fossil=Global Warming Potential fossil; GWP-luluc=Global Warming Potential land use and land use change; ODP=Ozone Depletion; AP=Acidification; E=Eutrophication; POCP=Photochemical ozone formation; ADPE=Depletion of abiotic resources-minerals and metals; ADPF=Depletion of abiotic resources-fossil fuels; WDP=Water resource deprivation.

Table 6-3: The environmental impact of 1 kWh energy stored by AZZURRO HV ZBT ES10

Impact category	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
GWP-total	kg CO_2 eq	1.252E+02	8.750E+01	1.755E+00	3.423E+00	1.760E+01	7.346E+00	7.600E+00
GWP-fossil	kg CO_2 eq	1.236E+02	1.041E+02	1.763E+00	3.420E+00	8.307E-01	7.295E+00	6.158E+00
GWP-biogenic	kg CO_2 eq	1.462E+00	-1.677E+01	-8.809E-03	1.012E-03	1.677E+01	3.578E-02	1.434E+00
GWP-luluc	kg CO_2 eq	1.998E-01	1.730E-01	1.103E-03	2.212E-03	2.423E-04	1.461E-02	8.545E-03
ODP	kg CFC11 eq	1.533E-05	1.467E-05	5.241E-09	5.897E-08	1.316E-08	5.131E-07	7.162E-08
AP	mol H+ eq	2.138E+00	1.947E+00	9.999E-03	6.385E-02	4.490E-03	4.616E-02	6.691E-02
EP-freshwater	kg P eq	1.120E-02	1.043E-02	3.682E-05	1.922E-05	5.990E-06	4.682E-04	2.417E-04
EP-marine	kg N eq	2.026E-01	1.657E-01	1.807E-03	1.668E-02	3.561E-03	7.357E-03	7.496E-03
EP-terrestrial	mol N eq	4.870E+00	4.486E+00	1.995E-02	1.840E-01	2.004E-02	8.506E-02	7.565E-02
POCP	kg NMVOC eq	6.223E-01	5.017E-01	5.609E-03	5.175E-02	6.945E-03	3.065E-02	2.568E-02
ADP-minerals&metals	kg Sb eq	1.523E-02	1.477E-02	1.009E-05	6.399E-06	1.338E-06	2.969E-04	1.512E-04
ADP-fossil	MJ	1.543E+03	1.313E+03	1.996E+01	4.378E+01	1.075E+01	8.726E+01	6.798E+01
WDP	m^3 depriv.	4.079E+01	3.043E+01	2.183E-01	1.384E-01	4.000E-02	7.016E+00	2.949E+00

Acronyms: GWP-total=Global Warming Potential total; GWP-biogenic=Global Warming Potential biogenic; GWP-fossil=Global Warming Potential fossil; GWP-luluc=Global Warming Potential land use and land use change; ODP=Ozone Depletion; AP=Acidification; E=Eutrophication; POCP=Photochemical ozone formation; ADPE=Depletion of abiotic resources-minerals and metals; ADPF=Depletion of abiotic resources-fossil fuels; WDP=Water resource deprivation.

Table 6-4: The environmental impact of 1 kWh energy stored by AZZURRO HV ZBT ES15

Impact category	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
GWP-total	kg CO_2 eq	1.225E+02	8.519E+01	1.740E+00	3.283E+00	1.736E+01	7.346E+00	7.539E+00
GWP-fossil	kg CO_2 eq	1.208E+02	1.016E+02	1.748E+00	3.280E+00	8.258E-01	7.295E+00	6.130E+00
GWP-biogenic	kg CO_2 eq	1.428E+00	-1.653E+01	-8.744E-03	9.705E-04	1.653E+01	3.578E-02	1.400E+00
GWP-luluc	kg CO_2 eq	1.957E-01	1.691E-01	1.095E-03	2.122E-03	2.396E-04	1.461E-02	8.504E-03
ODP	kg CFC11 eq	1.395E-05	1.329E-05	5.121E-09	5.656E-08	1.310E-08	5.131E-07	7.138E-08
AP	mol H+ eq	2.114E+00	1.925E+00	9.922E-03	6.124E-02	4.465E-03	4.616E-02	6.678E-02
EP-freshwater	kg P eq	1.101E-02	1.024E-02	3.651E-05	1.843E-05	5.929E-06	4.682E-04	2.405E-04
EP-marine	kg N eq	1.988E-01	1.628E-01	1.793E-03	1.600E-02	3.446E-03	7.357E-03	7.421E-03
EP-terrestrial	mol N eq	4.830E+00	4.453E+00	1.980E-02	1.764E-01	1.997E-02	8.506E-02	7.534E-02
POCP	kg NMVOC eq	6.084E-01	4.901E-01	5.550E-03	4.964E-02	6.887E-03	3.065E-02	2.558E-02
ADP-minerals&metals	kg Sb eq	1.498E-02	1.452E-02	1.001E-05	6.138E-06	1.328E-06	2.969E-04	1.511E-04
ADP-fossil	MJ	1.508E+03	1.281E+03	1.980E+01	4.199E+01	1.070E+01	8.726E+01	6.766E+01
WDP	m^3 depriv.	4.031E+01	2.996E+01	2.165E-01	1.327E-01	3.892E-02	7.016E+00	2.944E+00

Acronyms: GWP-total=Global Warming Potential total; GWP-biogenic=Global Warming Potential biogenic; GWP-fossil=Global Warming Potential fossil; GWP-luluc=Global Warming Potential land use and land use change; ODP=Ozone Depletion; AP=Acidification; E=Eutrophication; POCP=Photochemical ozone formation; ADPE=Depletion of abiotic resources-minerals and metals; ADPF=Depletion of abiotic resources-fossil fuels; WDP=Water resource deprivation.

Table 6-5: The environmental impact of 1 kWh energy stored by AZZURRO HV ZBT ES20

Impact category	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
GWP-total	kg CO_2 eq	1.211E+02	8.404E+01	1.733E+00	3.213E+00	1.724E+01	7.346E+00	7.508E+00
GWP-fossil	kg CO_2 eq	1.195E+02	1.003E+02	1.741E+00	3.210E+00	8.233E-01	7.295E+00	6.116E+00
GWP-biogenic	kg CO_2 eq	1.411E+00	-1.641E+01	-8.711E-03	9.498E-04	1.641E+01	3.578E-02	1.383E+00
GWP-luluc	kg CO_2 eq	1.937E-01	1.672E-01	1.090E-03	2.077E-03	2.382E-04	1.461E-02	8.484E-03
ODP	kg CFC11 eq	1.326E-05	1.260E-05	5.061E-09	5.536E-08	1.307E-08	5.131E-07	7.126E-08
AP	mol H+ eq	2.101E+00	1.914E+00	9.883E-03	5.994E-02	4.453E-03	4.616E-02	6.671E-02
EP-freshwater	kg P eq	1.091E-02	1.014E-02	3.636E-05	1.804E-05	5.898E-06	4.682E-04	2.399E-04
EP-marine	kg N eq	1.969E-01	1.613E-01	1.786E-03	1.566E-02	3.388E-03	7.357E-03	7.383E-03
EP-terrestrial	mol N eq	4.809E+00	4.437E+00	1.972E-02	1.727E-01	1.994E-02	8.506E-02	7.519E-02
POCP	kg NMVOC eq	6.014E-01	4.842E-01	5.520E-03	4.858E-02	6.858E-03	3.065E-02	2.553E-02
ADP-minerals&metals	kg Sb eq	1.486E-02	1.440E-02	9.976E-06	6.007E-06	1.323E-06	2.969E-04	1.510E-04
ADP-fossil	MJ	1.491E+03	1.265E+03	1.972E+01	4.110E+01	1.068E+01	8.726E+01	6.750E+01
WDP	m^3 depriv.	4.007E+01	2.972E+01	2.155E-01	1.299E-01	3.838E-02	7.016E+00	2.941E+00

Acronyms: GWP-total=Global Warming Potential total; GWP-biogenic=Global Warming Potential biogenic; GWP-fossil=Global Warming Potential fossil; GWP-luluc=Global Warming Potential land use and land use change; ODP=Ozone Depletion; AP=Acidification; E=Eutrophication; POCP=Photochemical ozone formation; ADPE=Depletion of abiotic resources-minerals and metals; ADPF=Depletion of abiotic resources-fossil fuels; WDP=Water resource deprivation.

4.2 Use of resources

Table 7-1: The use of resources of 1 kWh energy stored by AZZURRO HV ZBT 5K

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
PERE	MJ, lower calorific value	5.388E+02	1.243E+02	4.152E+00	4.133E-01	1.093E-01	3.843E+02	2.560E+01
PERM	MJ, lower calorific value	3.397E+01	3.397E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PERT	MJ, lower calorific value	5.728E+02	1.583E+02	4.152E+00	4.133E-01	1.093E-01	3.843E+02	2.560E+01
PENRE	MJ, lower calorific value	1.425E+03	1.202E+03	1.949E+01	3.842E+01	1.060E+01	8.726E+01	6.703E+01
PENRM	MJ, lower calorific value	1.507E+01	1.507E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PENRT	MJ, lower calorific value	1.440E+03	1.217E+03	1.949E+01	3.842E+01	1.060E+01	8.726E+01	6.703E+01
FW	cubic metres	1.195E+00	8.601E-01	5.149E-03	4.176E-03	1.266E-03	2.446E-01	8.008E-02
MS	kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RSF	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NRSF	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Acronyms: PENRE=Use of non-renewable primary energy excluding nonrenewable primary energy resources used as raw material; PERE=Use of renewable primary energy excluding renewable primary energy resources used as raw material; PENRM=Use of non-renewable primary energy resources used as raw material; PERM=Use of renewable primary energy resources used as raw material; PENRT=Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials); PERT=Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials); FW=Net use of fresh water; MS=Use of secondary materials; RSF= Use of renewable secondary fuels ; NRSF=Use of non-renewable secondary fuels

Table 7-2: The use of resources of 1 kWh energy stored by AZZURRO HV ZBT ES5

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
PERE	MJ, lower calorific value	5.617E+02	1.466E+02	4.347E+00	5.287E-01	1.201E-01	3.843E+02	2.580E+01
PERM	MJ, lower calorific value	4.966E+01	4.966E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PERT	MJ, lower calorific value	6.113E+02	1.963E+02	4.347E+00	5.287E-01	1.201E-01	3.843E+02	2.580E+01
PENRE	MJ, lower calorific value	1.615E+03	1.378E+03	2.043E+01	4.914E+01	1.091E+01	8.726E+01	6.893E+01
PENRM	MJ, lower calorific value	3.082E+01	3.082E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PENRT	MJ, lower calorific value	1.645E+03	1.409E+03	2.043E+01	4.914E+01	1.091E+01	8.726E+01	6.893E+01
FW	cubic metres	1.292E+00	9.540E-01	5.414E-03	5.341E-03	1.439E-03	2.446E-01	8.108E-02
MS	kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RSF	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NRSF	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Acronyms: PENRE=Use of non-renewable primary energy excluding nonrenewable primary energy resources used as raw material; PERE=Use of renewable primary energy excluding renewable primary energy resources used as raw material; PENRM=Use of non-renewable primary energy resources used as raw material; PERM=Use of renewable primary energy resources used as raw material; PENRT=Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials); PERT=Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials); FW=Net use of fresh water; MS=Use of secondary materials; RSF= Use of renewable secondary fuels ; NRSF=Use of non-renewable secondary fuels

Table 7-3: The use of resources of 1 kWh energy stored by AZZURRO HV ZBT ES10

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
PERE	MJ, lower calorific value	5.503E+02	1.355E+02	4.250E+00	4.710E-01	1.147E-01	3.843E+02	2.570E+01
PERM	MJ, lower calorific value	4.181E+01	4.181E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PERT	MJ, lower calorific value	5.921E+02	1.773E+02	4.250E+00	4.710E-01	1.147E-01	3.843E+02	2.570E+01
PENRE	MJ, lower calorific value	1.520E+03	1.290E+03	1.996E+01	4.378E+01	1.075E+01	8.726E+01	6.798E+01
PENRM	MJ, lower calorific value	2.294E+01	2.294E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PENRT	MJ, lower calorific value	1.543E+03	1.313E+03	1.996E+01	4.378E+01	1.075E+01	8.726E+01	6.798E+01
FW	cubic metres	1.244E+00	9.071E-01	5.282E-03	4.758E-03	1.353E-03	2.446E-01	8.058E-02
MS	kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RSF	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NRSF	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Acronyms: PENRE=Use of non-renewable primary energy excluding nonrenewable primary energy resources used as raw material; PERE=Use of renewable primary energy excluding renewable primary energy resources used as raw material; PENRM=Use of non-renewable primary energy resources used as raw material; PERM=Use of renewable primary energy resources used as raw material; PENRT=Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials); PERT=Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials); FW=Net use of fresh water; MS=Use of secondary materials; RSF= Use of renewable secondary fuels ; NRSF=Use of non-renewable secondary fuels

Table 7-4: The use of resources of 1 kWh energy stored by AZZURRO HV ZBT ES15

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
PERE	MJ, lower calorific value	5.464E+02	1.317E+02	4.217E+00	4.518E-01	1.129E-01	3.843E+02	2.566E+01
PERM	MJ, lower calorific value	3.920E+01	3.920E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PERT	MJ, lower calorific value	5.856E+02	1.709E+02	4.217E+00	4.518E-01	1.129E-01	3.843E+02	2.566E+01
PENRE	MJ, lower calorific value	1.488E+03	1.261E+03	1.980E+01	4.199E+01	1.070E+01	8.726E+01	6.766E+01
PENRM	MJ, lower calorific value	2.032E+01	2.032E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PENRT	MJ, lower calorific value	1.508E+03	1.281E+03	1.980E+01	4.199E+01	1.070E+01	8.726E+01	6.766E+01
FW	cubic metres	1.228E+00	8.914E-01	5.238E-03	4.564E-03	1.324E-03	2.446E-01	8.041E-02
MS	kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RSF	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NRSF	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Acronyms: PENRE=Use of non-renewable primary energy excluding nonrenewable primary energy resources used as raw material; PERE=Use of renewable primary energy excluding renewable primary energy resources used as raw material; PENRM=Use of non-renewable primary energy resources used as raw material; PERM=Use of renewable primary energy resources used as raw material; PENRT=Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials); PERT=Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials); FW=Net use of fresh water; MS=Use of secondary materials; RSF= Use of renewable secondary fuels ; NRSF=Use of non-renewable secondary fuels

Table 7-5: The use of resources of 1 kWh energy stored by AZZURRO HV ZBT ES20

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
PERE	MJ, lower calorific value	5.445E+02	1.299E+02	4.201E+00	4.422E-01	1.120E-01	3.843E+02	2.565E+01
PERM	MJ, lower calorific value	3.789E+01	3.789E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PERT	MJ, lower calorific value	5.824E+02	1.678E+02	4.201E+00	4.422E-01	1.120E-01	3.843E+02	2.565E+01
PENRE	MJ, lower calorific value	1.472E+03	1.246E+03	1.972E+01	4.110E+01	1.068E+01	8.726E+01	6.750E+01
PENRM	MJ, lower calorific value	1.900E+01	1.900E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PENRT	MJ, lower calorific value	1.491E+03	1.265E+03	1.972E+01	4.110E+01	1.068E+01	8.726E+01	6.750E+01
FW	cubic metres	1.219E+00	8.836E-01	5.216E-03	4.467E-03	1.309E-03	2.446E-01	8.033E-02
MS	kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RSF	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NRSF	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Acronyms: PENRE=Use of non-renewable primary energy excluding nonrenewable primary energy resources used as raw material; PERE=Use of renewable primary energy excluding renewable primary energy resources used as raw material; PENRM=Use of non-renewable primary energy resources used as raw material; PERM=Use of renewable primary energy resources used as raw material; PENRT=Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials); PERT=Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials); FW=Net use of fresh water; MS=Use of secondary materials; RSF= Use of renewable secondary fuels ; NRSF=Use of non-renewable secondary fuels

4.3 Waste production and output flows

Table 8-1: The waste production and output flows of 1 kWh energy stored by AZZURRO HV ZBT 5K

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
HWD	kg	3.200E-03	0.000E+00	3.200E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NHWD	kg	1.982E+00	0.000E+00	0.000E+00	0.000E+00	9.288E-01	0.000E+00	1.053E+00
RWD	kg	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MFR	kg	8.390E+00	0.000E+00	2.351E-03	0.000E+00	0.000E+00	0.000E+00	8.388E+00
MER	kg	1.071E+00	0.000E+00	0.000E+00	0.000E+00	9.288E-01	0.000E+00	1.427E-01
CRU	kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ETE	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EEE	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Acronyms: 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 electric energy; ETE = Exported thermal energy

Table 8-2: The waste production and output flows of 1 kWh energy stored by AZZURRO HV ZBT ES5

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
HWD	kg	4.211E-03	0.000E+00	4.211E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NHWD	kg	2.914E+00	0.000E+00	0.000E+00	0.000E+00	1.145E+00	0.000E+00	1.769E+00
RWD	kg	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MFR	kg	9.772E+00	0.000E+00	2.882E-03	0.000E+00	0.000E+00	0.000E+00	9.769E+00
MER	kg	1.412E+00	0.000E+00	0.000E+00	0.000E+00	1.145E+00	0.000E+00	2.672E-01
CRU	kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ETE	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EEE	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Acronyms: 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 electric energy; ETE = Exported thermal energy

Table 8-3: The waste production and output flows of 1 kWh energy stored by AZZURRO HV ZBT ES10

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
HWD	kg	3.706E-03	0.000E+00	3.706E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NHWD	kg	2.448E+00	0.000E+00	0.000E+00	0.000E+00	1.037E+00	0.000E+00	1.411E+00
RWD	kg	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MFR	kg	9.081E+00	0.000E+00	2.616E-03	0.000E+00	0.000E+00	0.000E+00	9.078E+00
MER	kg	1.242E+00	0.000E+00	0.000E+00	0.000E+00	1.037E+00	0.000E+00	2.050E-01
CRU	kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ETE	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EEE	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Acronyms: 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 electric energy; ETE = Exported thermal energy

Table 8-4: The waste production and output flows of 1 kWh energy stored by AZZURRO HV ZBT ES15

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
HWD	kg	3.537E-03	0.000E+00	3.537E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NHWD	kg	2.293E+00	0.000E+00	0.000E+00	0.000E+00	1.001E+00	0.000E+00	1.292E+00
RWD	kg	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MFR	kg	8.851E+00	0.000E+00	2.528E-03	0.000E+00	0.000E+00	0.000E+00	8.848E+00
MER	kg	1.185E+00	0.000E+00	0.000E+00	0.000E+00	1.001E+00	0.000E+00	1.842E-01
CRU	kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ETE	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EEE	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Acronyms: 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 electric energy; ETE = Exported thermal energy

Table 8-5: The waste production and output flows of 1 kWh energy stored by AZZURRO HV ZBT ES20

Parameter	Unit	Total	Upstream	Core	Downstream			
			Manufacturing stage		Distribution	Installation	Use and maintenance	End of life
HWD	kg	3.453E-03	0.000E+00	3.453E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NHWD	kg	2.215E+00	0.000E+00	0.000E+00	0.000E+00	9.828E-01	0.000E+00	1.232E+00
RWD	kg	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MFR	kg	8.735E+00	0.000E+00	2.483E-03	0.000E+00	0.000E+00	0.000E+00	8.733E+00
MER	kg	1.157E+00	0.000E+00	0.000E+00	0.000E+00	9.828E-01	0.000E+00	1.738E-01
CRU	kg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ETE	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EEE	MJ	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Acronyms: 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 electric energy; ETE = Exported thermal energy

5 Reference

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