ENVIRONMENTAL PRODUCT DECLARATION

BC 2 UPS BATTERY CABINET

BC 2 UPS Battery Cabinet product for datacenter back up power

ZincFive

At ZincFive, our commitment to sustainability is rooted in a deep respect for the planet—and a belief that better chemistry can drive a better future.

We harness **The Power of Good Chemistry®** to develop technologies that are not only high performing, but also **good for people and the planet**. From the materials we choose to the supply chains we build, we are intentional about reducing environmental impact, eliminating harmful substances, and designing for long-term sustainability.

We believe innovation and responsibility go hand in hand. That's why we're relentless in our pursuit of solutions that power progresswithout compromising the world we leave behind.

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

Environmental Product Declaration

ZincFive

BC 2 UPS Battery Cabinet
Uninterruptible Power Supply (UPS) Battery Cabinet

According to ISO 14025, EN 15804+A2

EPD Program and Program Operator Name, Address, Logo, and Website	UL Solutions 333 Pfingsten Rd, Northbrook IL, 60062 www.ul.com www.spot.ul.com
General Program Instructions and Version Number	Program Operator Rules v 2.7 2022
Manufacturer Name and Address	ZincFive Headquarters 20170 SW 112th Ave Tualatin, Oregon 97062
Declaration Number	4791836375.101.1
Declared Product & Functional Unit or Declared Unit	Uninterruptible Power Supply Battery Cabinet; One (1) BC 2 UPS Battery Cabinet that ensures 266 kW of power for five (5) minutes for a reference lifetime of ten (10) years when integrated into a UPS
Reference PCR and Version Number	PEP Ecopassport Program PCR “Product Category Rules for Electrical, Electronic and HVAC-R Products” (PEP Association, 2021), and PEP Ecopassport Program PSR “Specific Rules for Electrical switchgear and control gear soultions” (PEP Association, 2023)
Description of Product Application/Use	Uninterruptible power supply battery cabinet to provide power
Product RSL Description (if Appl.)	10 years
Markets of Applicability	North America
Date of Issue	November 13, 2025
Period of Validity	5 years
EPD Type	Product-specific
EPD Scope	Cradle-to-grave
Year(s) of Reported Primary Data	2024
LCA Software & Version Number	LCA FE v 10.9 (formerly GaBi Software)
LCI Database(s) & Version Number	Managed LCA Content 2025.1 (formerly GaBi Database)
LCIA Methodology & Version Number	IPCC AR6 + CML 2001 Aug 2016 + TRACI 2.2

The PCR review was conducted by:	PEP Ecopassport PCR Review Panel contact@pep-ecopassport.org
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Mina Vlasic, UL Solutions Mina Vlasic
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Sphera Solutions
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Omar Mayorga, UL Solutions Mayorga.

Limitations

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible”. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

1. Product Definition and Information

1.1. Description of Company

Established in 2016 and headquartered in Tualatin, Oregon, ZincFive is the leading developer of nickel-zinc (NiZn) battery solutions for mission-critical applications. ZincFive's battery cabinet systems are utilized across many industries, including mission critical infrastructure for data centers, intelligent transportation, industrial engine starting, and information technology, providing immediate power solutions (IPS) for backup power in the event of electrical grid outages or perturbations. ZincFive is an integrated manufacturer of its power system products, fabricating both the power systems, such as the BC 2 UPS Battery Cabinet, and the NiZn batteries that are the core of the products. Through our patented NiZn electrochemistry, the BC 2 UPS Battery Cabinets provide high power density and run-time performance while ensuring safety and reliability in operation. ZincFive harnesses The Power of Good Chemistry™ to champion sustainability and innovation, and was recognized by *TIME* Magazine as one of America's Top GreenTech Companies in 2024, and again in 2025 among the top GreenTech companies both in America and the world.

1.2. Product Description

Product Identification

The BC 2 UPS Battery Cabinet is an immediate power solution (IPS) used as a part of an uninterruptible power supply (UPS) to provide backup power for short periods of time (e.g., five minutes) in the event of electrical service interruptions . When in operation, the BC 2 UPS Battery Cabinet allows long duration backup power systems such as diesel generators to start up, stabilize, and deliver clean backup power with no interruption of service. The BC 2 UPS Battery Cabinet accommodates 36 to 39 high-rate monobloc NiZn batteries, Model type HSF, (each with an 80 Ah rating) and provides 252 - 273 kW of power for five minutes. The BC 2 UPS Battery Cabinets are typically integrated into a full UPS system – for example, a 1 MW UPS system includes four thirty-eight (38) battery BC 2 UPS Battery Cabinets with the UPS system electronic switchgear, wiring, and control systems. The BC 2 UPS Battery Cabinet is an attractive alternative to traditional valve regulated lead-acid (VLRA) or lithium ion (Li-ion) battery energy storage systems used in UPS applications, offering the benefits below.

- **High power density:** The BC 2 utilizes a flexible and modular monobloc design, which contributes to its high current output compared with VLRA or Li-Ion systems.
- **Inherent Safety:** The monobloc batteries' patented chemistry uses a non-flammable alkaline electrolyte and does not experience thermal runaway in third-party safety testing.
- **Reliability**: Each ZincFive BC 2 UPS Battery Cabinet is equipped with a battery management system (BMS), which continuously monitors battery health and performance to prevent runtime interruptions. The battery cabinet additionally remains operational even when cells become weak or depleted, ensuring uninterrupted performance and minimal downtime.

Product Specification

This report covers four different BC 2 Cabinet configurations as follows:

- 36 Battery BC 2 UPS Battery Cabinet: ZF-36A6BS022KB1UF000
- 37 Battery BC 2 UPS Battery Cabinet: ZF-37A6BS022KB1UF000
- 38 Battery BC 2 UPS Battery Cabinet: ZF-38A6BS022KB1UF000 (standard configuration)
- 39 Battery BC 2 UPS Battery Cabinet: ZF-39A6BS022KB1UF000

Figure 1: BC 2 UPS Battery Cabinet in data center setting

Table 1: Battery Cabinet Power Ratings and Weights

	BC 2 UPS BATTERY CABINET MODELS			
Model Number	ZF-36A6BS022KB1 UF000	ZF-37A6BS022KB1 UF000	ZF-38A6BS022KB1 UF000	ZF-39A6BS022KB1 UF000
System power rating (kW at 5 min backup time)	252	259	266	273
# of HSF batteries	36	37	38	39
Total Weight (no packaging) - kg	843.3	858.5	873.8	889.0
Total Weight (packaged) - kg	903.8	919.1	934.3	949.5
Dimensions (m) (W x L x H)	0.5 x 0.9 x 2.1			

Flow Diagram

Figure 2 displays the flow diagram of the cradle-to-grave study of the BC 2 UPS Battery Cabinet.

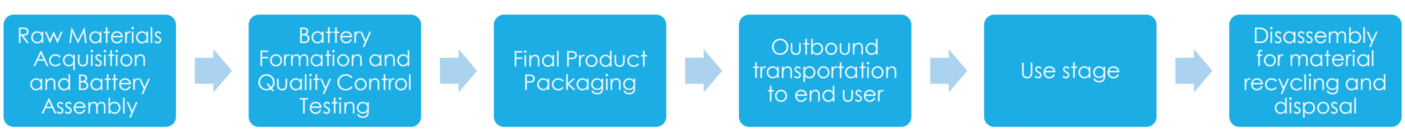

Figure 2: System boundary of ZincFive's BC 2 UPS Battery Cabinet

Product Specification

BC 2 UPS battery cabinets must meet the following product specifications:

Model	ZincFive BC 2 ZF-38A6SU022KB1-LF000
Electrical	
Nominal Voltage	494 Vdc
Charge Voltage Range	537 - 555 Vdc (36s), 552 - 570 Vdc (37s), 567 - 585 Vdc (38s), 582 - 600 Vdc (39s). See the Installation & Operation Manual for more detail.
Minimum and Maximum Charge Current	20 A minimum; 160 A maximum
Standard Charging Current	80 A
Charge Time	Ranges from 2 hours to 5 hours for 0-100% SOC, dependent on charge current
Low Voltage Cutoff	360 Vdc - 390 Vdc - 10 Vdc per battery
Battery Option	Z5 13-80 HSF
Nominal Capacity C/2 at 25°C	>80 Ah
Nominal Energy Storage at C/2	36 kWh (36s), 37 kWh (37s), 38 kWh (38s), 39 kWh (39s)
Maximum Discharge Current	800 A
Application	High-Rate discharge Less than 5 minute runtime
Battery Chemistry	Wet, Alkali filled
Single String Battery Configuration	36, 37, 38, 39 battery modules per battery string
System BMS Functions	
Monitoring	BMS manages charge functions and monitors full suite of parameters during discharge and standby including battery voltage, temperature, and current.
Power Supply	100 - 240 VAC 50/60 Hz standard. Additional 100 - 240 VAC and 600 VDC redundant supply options available
Data Communications	Ethernet, Modbus TCP/RTU, USB, Local Server, and Cloud options
Safety and Environmental	
Safety	Batteries exhibit no thermal runaway as per UL 9540A
Breaker Protection	Circuit breaker is accessible with door closed and (manual or upon fault) disconnects batteries from inverter. Various kA rated breakers available
Operating Temperature Range [1]	20°C to 35°C
Storage Temperature Range	-20°C to 50°C
Storage Period	6 months at 25°C before batteries need charge
Humidity Range	0-90%, Non-Condensing
Cooling	Forced Ventilation Standard
Certifications	
Cabinet	UL 9540, UL 1973, UL 1778, CAN/CSA C22.2 No. 107.3, IEC 62040-1, IEC 62040-2, CE, UKCA, RoHS
Battery	UL 9540A, UL 1973, UL 1989, CAN/CSA C22.2 No. 60950-1, EU 2023/1542
Seismic	IBC 2021, ICC AC156 – SDS 2.29

1.3. Application

The BC 2 UPS Battery Cabinet is designed for mission-critical industries and is used specifically in data centers that are designed with UPS backup power. The purpose of a UPS system is to provide backup power supply in the event of a data center electrical outage.

The BC 2 UPS Battery Cabinet with thirty-eight (38) NiZn batteries provides nominally five (5) minutes of high-power runtime, ensuring that critical operations continue without interruption, while the grid-tied system resets and/or the long-term backup power generator is started.

1.4. Declaration of Methodological Framework

This EPD is "cradle-to-grave" covering the production stages (modules A1-A3), construction stages (modules A4 – A5), use stages (modules B1 – B7), and end-of-life (modules C1 – C4). Benefits and loads beyond the system boudnary (module D) is also reported separately. Further details are described in ZincFive's background report (ZincFive, 2025).

Capital goods and infrastructure flows are excluded from this analysis due to the minimal extent to which they affect the LCIA results. For the manufacturing of BC 2 UPS battery cabinets, capital goods and infrastructure are expected to last for more than 20 years with periodic replacement of key componenents as needed. All other impacts associated with the use stage of the building and while the product is being produced and all human labour and commute have also been excluded.

No other known flows are deliberately excluded from this EPD.

The substitution approach has been applied in the case of any incoming post-consumer/post-industrial reycled content and outgoing material or energy recovery. This approach is based on the perspective that material that is recycled into secondary material at the End-of-Life ("EoL") stage is technically able to substitute an equivalent amount of virgin material. Hence, a credit is given to account for this substitutability. To avoid double-counting the benefits of recycled content, waste materials collected for recycling in EoL are first used to satisfy the scrap demand of the manufacturing phase before being sent to recycling and crediting in EoL. This 'net scrap' approach rewards both end of life recycling as well as the use of recycled content.

1.5. Technical Requirements

The products in the range of this EPD are designed in conformity with the requirements of the following standards and regulations:

- RoHS Directive 2011/65/EU and its amendment directives, including Commision Delegated Directive 2015/863
- EU REACH Regulation 1907/2006 article 33 (SVHC) (Jan 2022 - 223 Substances)
- EU Battery Regulation 2023/1542 (July 2023)
- Waste Framework Directive 2008/98/EC (SCIP) (223 Substances)
- EU REACH Regulation 1907/2006 article 67 (Restriction) (Jan 2021)
- EU POP Regulation 2019/1021 (Aug 2020)
- WEEE Directive 2012/19/EU

1.6. Properties of Declared Product as Delivered

BC 2 UPS battery cabinets are delivered and installed in a variety of battery sizes (36 to 39 batteries) specific to the project's needs. This EPD is representative of the battery range produced by Zinc Five.

Results published in this EPD is focused on the standard configuration: 38 batteries. The final product unit weight with packaging is 934.3 kg and without packaging is 873.8 kg.

1.7. Material Composition

BC 2 UPS battery cabinets are comprised of HSF-type NiZn batteries in a cabinet enclosure, with a battery management system (BMS) attached.

Table 2: Material Composition of the BC 2 UPS Battery Cabinet

	Weight (kg)	Percentage (%)	Notes
Plastics			
Polystyrene	0.1	<0.1%	Packaging material
Polyethylene	0.1	<0.1%	Packaging material
Metals			
Steel	250.9	26.9%	Cabinet and packaging materials
Copper	36.4	3.90%	Wiring and busbars
Aluminum	1.59	0.17%	Heatsink
Other			
Batteries	578.8	62.0%	38 x HSF-type NiZn batteries
Wood	54.4	5.82%	Packaging material
Electronics	6.56	0.70%	BMS + switchgear
Cardboard	5.40	0.58%	Packaging material
Total	934.3	100%	

1.8. Manufacturing

ZincFive manufactures the HSF NiZn batteries used in its BC 2 UPS Battery Cabinets at a contract manufacturer in Changsha, China, according to designs developed and engineered by ZincFive. The battery manufacturing process flow is described in Figure 3 below.

The battery assembly process uses roll-to-roll and stamping techniques to fabricate positive and negative electrodes from proprietary nickel and zinc-based materials on specialized substrates, incorporating metal additives and tabs as needed. Scrap generated during production is sorted and sent to recycling suppliers. Once the positive and negative electrodes are fabricated and formed, the positive and negative plates are stacked along with the separator materials to create dry prismatic cells. The assembly process is completed by electrolyte filling and sealing. The fully assembled battery is then connected to electrical switchgear for battery formation, which is an automated procedure of charge-discharge cycles to condition the battery for optimal electrical performance. At this point, a final quality control (QC) test is performed with all passing batteries moving to finished goods and any failing batteries collected for recycling by an external supplier. Once the battery is assembled, the BC 2 battery cabinets are shipped from Changsha, China to Tualatin, Oregon, USA for battery cabinet assembly.

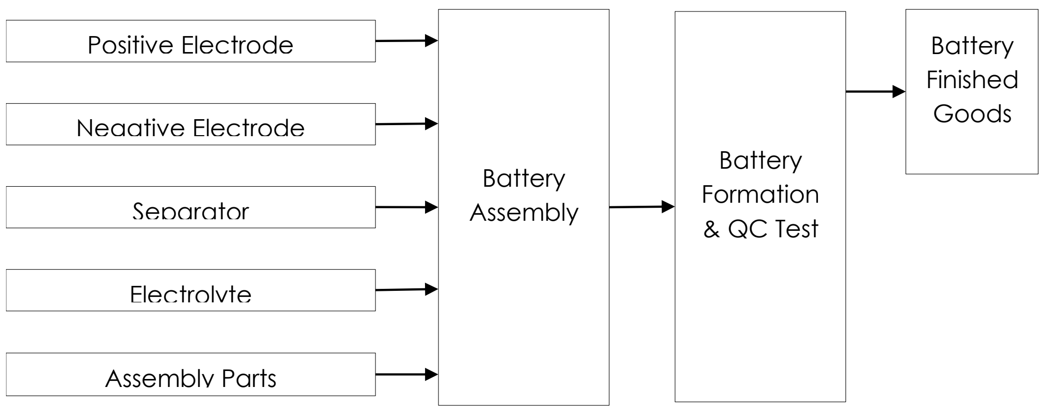

Figure 3: HSF-Type Battery Manufacturing Flow

The battery cabinet assembly process begins with incoming inspection and quality assurance tests for all HSF battery parts. Batteries that pass this step are released to production where they are manually installed into the shelves of the cabinet. They are then connected in series with copper busbars and wiring, including a Battery Management System (BMS), to complete the assembly process.

The fully assembled cabinet is then tested for quality and performance, including charge/discharge cycling to ensure the proper function of the product.

1.9. Packaging

After final quality control testing, the BC 2 UPS Battery Cabinet is packaged by bolting the cabinet to a pallet, then applying protective plastic film, cardboard, and stretch wrap to protect the product during transit. An additional wooden skeleton frame is attached to the base pallet for additional protection and security during transport.

1.10. Transportation

The BC 2 UPS Battery Cabinet is distributed from Tualatin, Oregon, USA to customers directly. The LCA includes transporation by truck of the packaged BC 2 Cabinet to customers within Loudon County, Virginia. Loudon County, Virginia was determined to be where most of ZincFive's customers are located and where data centers are concentrated within the United States.

1.11. Product Installation

The BC 2 UPS Battery Cabinet is manually installed at a customer site with either 36, 37, 38 or 39 HSF-type batteries. Installation at the customer site is largely a manual process with electricity consumed to test the proper functioning of the product upon commissioning into service. The electrical input of the conditioning step at this stage is 36 MJ (10 kWh).

Packaging waste (e.g., plastics, containerboard, and pallet) generated during the installation stage is considered in this module according to the EPA material management (EPA Materials Management, 2025).

1.12. Use

The BC 2 UPS Battery Cabinet is used as part of the backup power systems within a data center to ensure 100% uptime of this mission critical infrastructure. The main factor related to the use stage is the electrical energy consumption of the system over the ten-year reference service life (RSL).

Energy Consumption (module B6): The electrical energy consumed by the declared unit over its lifetime is modeled at 14,958 MJ (4,155 kwh) and comprises the following:

a) Electricity used by the BMS with an average 28 Watt of power operating at 100% of the time.

b) Electricity consumed by the system due to the operation of cooling fans corresponding with power cycling of the system. The cooling fans operate at 35 Watts for approximately 8 hours per year.

c) Losses of stored electrical energy due to cycling of the system's batteries for maintenance and backup power activation. Maintenance cycling of the system's batteries occurs twenty-four times per year (or two per month) with a ten percent (10%) depth of discharge (DoD). While backup power activation frequency varies by user, the frequency associated with the BC 2 UPS Battery Cabinet warranty was used in the LCA model, with the assumption of two 100% DoD events per year. In cycling the batteries, the roundtrip efficiency of the batteries was assumed to be 97%.

1.13. Reference Service Life

The reference service life (RSL) is 10 years.

1.14. Reuse, Recycling, and Energy Recovery

The EoL phase begins with battery deinstallation from the system and subsequent system deinstallation from its installed location, both of which are manual operations performed at the customer site. The deinstalled batteries are shipped to specialized battery recyclers while the empty cabinet is shipped to a scrap metal recycler for further dismantling.

The scrap metal recycler will manually dismantle the major cabinet parts resulting in steel, aluminum, and copper components that are put back into metal refining processes. The scrap metal recycler will also send the BMS system to a waste electrical and electronic equipment processor for recovery and disposal. Table 3 shows the end-of-life metal scrap flows from the system's cabinet components (i.e., sans batteries) as well as the assumptions on EoL recovery and disposal rates.

Table 3: EoL treatment fractions for cabinet components

FLOWS	RECYCLING	LANDFILL	INCINERATION
Steel	100%	0%	0%
Copper	100%	0%	0%
Aluminum	100%	0%	0%
Electronics	100%	0%	0%

The batteries are recycled via pyrometallurgy processing to a nickel/copper/steel concentrate, zinc metal, and waste slag. The nickel concentrate and zinc metal are reintroduced into separate refining operations to produce new starting materials while the waste slag is sent to a landfill for disposal. The recovery rates of nickel, copper, steel, and zinc conform to the PEP PCR (PEP Association, 2023). The credits associated with each recovered component are aligned with the purity of the processed materials or the value of such materials versus pure materials traded on major exchanges such as the London Metals Exchange. Table 4 shows the end-of-life flows and recovery rates for the HSF batteries from the reference product using pyrometallurgy treatment.

Table 4: EoL treatment fractions for HSF-type battery

FLOWS	RECYCLING	LANDFILL	INCINERATION
Zinc	60%	40%	0%
Steel	80%	20%	0%
Copper	60%	40%	0%
Nickel	80%	20%	0%
Stainless steel	80%	20%	0%
Plastics	0%	60%	40%
Slags and ashes	0%	100%	0%

The pyrometallurgy process also results in the incineration of the plastic components of the batteries. The model assumes thermal and electrical credits associated with this operation per the allowed rates defined in the PEP PCR (PEP Association, 2023).

For the battery parts, the LCA employed the maximum rates defined in the PEP PCR (PEP Association, 2023). However, based upon discussions with recycling suppliers, ZincFive believes that the actual recovery rates of metals are higher than defined by the PEP PCR. However, the maximum allowable recovery rates defined in the PEP PCR are applied in the LCA model.

Benefits and loads from reuse, recovery, and recycling potential are reported in module D.

1.15. Disposal

The disposal of the BC 2 UPS battery cabinet can be categorized into two streams: cabinet and the HSF-type batteries. The cabinets are 100% recycled based on information provided by ZincFive's metal scrap recycler. The HSF-batteries are disposed according to the waste disposal channels as defined by the PEP PCR (PEP Association, 2023).

2. Life Cycle Assessment Background Information

2.1. Functional or Declared Unit

The BC 2 UPS Battery Cabinet with 38 NiZn batteries (Model HSF) is the basis of the functional unit under the PEP PCR (PEP Association, 2023). The functional unit and declared unit descriptions are provided as follows:

Functional Unit: To provide 266 kW of power for five (5) minutes for a reference lifetime of ten (10) years for use in UPS applications.

Declared Unit: One (1) BC 2 UPS Battery Cabinet that ensures 266 kW of power for five (5) minutes for a reference lifetime of ten (10) years when integrated into a UPS.

2.2. System Boundary

This EPD is "cradle-to-grave", covering the production stages (modules A1-A3), construction stages (modules A4 – A5), use stages (modules B1 – B7), and end-of-life (modules C1 – C4). Benefits and loads beyond the system boundary (module D) is also reported separately.

Capital goods and infrastructure flows are excluded from this analysis due to the minimal extent to which they affect the LCIA results. For the manufacturing of BC 2 UPS battery cabinets, capital goods and infrastructure are expected to last for ~20 years with periodic replacement of key componenents as needed. All other impacts associated with the the building's use stage, product production, all human labour, and commute have also been excluded.

No other known flows are deliberately excluded from this EPD.

The substitution approach has been applied in the case of any incoming post-consumer/post-industrial reycled content and outgoing material or energy recovery. This approach is based on the perspective that material which is recycled into secondary material at end of life is technically able to substitute an equivalent amount of virgin material. Hence, a credit is given to account for this substitutability. To avoid double-counting the benefits of recycled content, waste materials collected for recycling in EoL are first used to satisfy the scrap demand of the manufacturing phase before being sent to recycling and crediting in EoL. This 'net scrap' approach rewards both end of life recycling as well as the use of recycled content.

2.3. Estimates and Assumptions

This study is based on primary data collected from ZincFive. This includes the primary data collected from battery manufacturing based in China and battery assembly based in the United States. Primary data was also collected from suppliers for specific processes and recycling partners on energy use and recovery rates.

For distribution to the end-user customer, a distance of 4577km (2844 miles) was assumed to represent transport from ZincFive's assembly centre in Tualatin, Oregon, USA to Loudon County, Virginia, USA. Based on industry knowledge, Loudon County, Virginia, USA was determined to be where most data centers are developed within the United States.

Background datasets that are based on regional averages are used to represent the production of raw and auxiliary materials by upstream suppliers. When multiple datasets were available, a conservative approach was adopted and the dataset with the higher environmental impact was used. Where datasets were not available, regional proxies or technological proxies with the closest relevance were used.

2.4. Cut-off Criteria

The cut-off criteria for including or excluding materials, energy and emissions data of the study are as follows:

- **Mass** – According to ISO guidelines, if a flow is less than 1% of the cumulative mass of the model it may be excluded, providing its environmental relevance is not a concern. For the purpose of this LCA, all known mass flows are reported, and no known flows were deliberately excluded.
- **Energy** – According to ISO guidelines, if a flow is less than 1% of the cumulative energy of the model it may be excluded, providing its environmental relevance is not a concern. For the purpose of this LCA, all known energy flows are reported, and no known flows were deliberately excluded.
- **Environmental relevance** – If a flow meets the above criteria for exclusion, yet is thought to potentially have a significant environmental impact, it was included. Material flows which leave the system (emissions) and whose environmental impact is greater than 1% of the whole impact of an impact category that has been considered in the assessment must be covered. This judgment was made based on experience and documented as necessary.

As specified in Section 2.3 of the PEP PCR (PEP Association, 2021), the cut-off criteria also fulfills:

- >95% of the mass of the defined reference product; LCA study captures 98% of the material flows of the declared product, including and excluding packaging.
- >95% of the total use of primary energy during the lifecycle of the reference product

If a flow meets the above criteria for exclusion, yet is thought to potentially have a significant environmental impact, it was included. Material flows which leave the system (emissions) and whose environmental impact is greater than 1% of the whole impact of an impact category that has been considered in the assessment must be covered. This judgment was made based on experience and documented as necessary.

Packaging of incoming raw materials (e.g. pallets, totes, super-sacks) are excluded as they represent less than 1% of the product mass and are not environmentally relevant. Capital goods and infrastructure required to produce and install the product (e.g. batch mixers, spraying equipment) are presumed to produce millions of units over the course of their life, so the impact of a single functional unit attributed to this equipment is negligible; therefore, capital goods and infrastructure were excluded from this study. No known flows are deliberately excluded from this EPD.

2.5. Data Sources

The LCA model was created using LCA for Experts (LCA FE) software v10.9 system for life cycle engineering, developed by Sphera. Background life cycle inventory for raw materials and processes were obtained from the Sphera Managed LCA Content (MLC) 2025.1 database (CUP 2025.1) (Sphera Solutions Inc., 2025). Primary manufacturing data were provided by Zinc Five.

2.6. Data Quality

Inventory data quality was judged by its precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied), and representativeness (geographical, temporal, and technological).

To cover these requirements and to ensure reliable results, first-hand industry data in combination with consistent background LCA information from the MLC 2025.1 database were used. The LCI datasets from the MLC 2025.1 database are widely distributed and used with the LCA FE v10.9 software. The datasets have been used in LCA models worldwide, in industrial and scientific applications as well as in many critically reviewed and published studies. In the process of providing these datasets, they are cross-checked with other databases and values from industry and science.

Precision and Completeness

Precision: As most of the relevant foreground data are measured data or calculated based on primary information sources from the owner of the technology, precision is considered to be moderately high. All background data are sourced from MLC databases with documented precision.

Completeness: Each foreground process was checked for mass balance and completeness of the emission inventory. No data was knowingly omitted. Completeness of foreground unit process data is high. All background data are sourced from MLC databases with documented completeness.

Consistency and Reproducibility

- **Consistency:** To ensure data consistency, all primary data were collected with the same level of detail, while all background data were sourced from the MLC databases.
- **Reproducibility:** Reproducibility is supported as much as possible through the disclosure of input-output data, dataset choices, and modeling approaches in this report. Based on this information, any third party should be able to approximate the results of this study using the same data and modeling approaches.

Representativeness

Temporal: All primary data were collected from June through December 2024. All secondary data come from the MLC 2025.1 and are representative of the years 2012-2024. As the study intended to compare the product systems for the reference year 2022, temporal representativenessis considered to be high.

Geographical: All primary and secondary data were collected specific to the countries or regions under study. Where country-specific or region-specific data were unavailable, proxy data was used. Geographical representativeness is considered to be high.

Technological: All primary and secondary data were modeled to be specific to the technologies or technology mixes under study. Where technology-specific datasets were unavailable, proxy data were used. Technological representativeness is considered to be moderately high.

2.7. Period under Review

This EPD intends to represent product in 2024.

2.8. Allocation

There are no co-products produced in the reference flow and, therefore, there are no allocation rules applied in the LCA Study.

Allocation of background data (energy and materials) taken from the Sphera MLC 2025.1 database is documented online at https://lcadatabase.sphera.com/.

Substitution approach is adopted in the case of any post-consumer and post-industrial reyccled content, and material and energy recovery. All benefits and loads from reyccled material and energy recovery are reported under module D.

3. Life Cycle Assessment Scenarios

The following tables show additional information for the declared modules: inbound transportation (A4), installation (A5), Use (B1), and End of Life (C4). The following tables report results per functional unit for the BC 2 UPS battery cabinet, 38 batteries.

Table 5. Transport to the building site (A4)

NAME	VALUE	UNIT
Fuel type	Diesel	
Liters of fuel	1.51	l/100km
Vehicle type	Heavy/bulk truck	
Transport distance	4577	km
Capacity utilization (including empty runs, mass based)	100	%
Weight of products transported	937.9	kg
Volume of products transported	0.045	m^3

Table 6. Installation into the building (A5)

NAME	VALUE	UNIT
Ancillary materials	-	kg
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	-	m^3
Other resources	-	kg
Electricity consumption	10	kWh
Other energy carriers	-	MJ
Product loss per functional unit	-	kg
Waste materials at the construction site before waste processing, generated by product installation	60.5	kg
Output materials resulting from on-site waste processing (specified by route; e.g. for recycling, energy recovery and/or disposal)	-	kg
Biogenic carbon contained in packaging	96.7	kg CO_2
Direct emissions to ambient air, soil and water	-	kg
VOC content	-	µg/m^3

Table 7. Reference Service Life

NAME	VALUE	UNIT
RSL	10	years

Table 8. Operational energy use (B6) and Operational water use (B7)

NAME	VALUE	UNIT
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	-	m^3
Ancillary materials	-	kg
Energy input, specified by activity, type and amount	4206	kWh
Equipment power output	266	kW
Characteristic performance (e.g. energy efficiency, variation of performance with capacity utilization)	5	mins
Direct emissions to ambient air, soil and water	-	kg

Table 9. End of life (C1-C4)

<table>
<tr><th>NAME</th><th></th><th>VALUE</th><th>UNIT</th></tr>
<tr><td colspan="2">Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation)</td><td colspan="2">Cabinet materials are 100% recycled, HSF batteries are sent to recycler (landfill, material recovery)</td></tr>
<tr><td>Collection process (specified by type)</td><td>Collected separately</td><td>874</td><td>kg</td></tr>
<tr><td rowspan="4">Recovery (specified by type)</td><td>Reuse</td><td></td><td>kg</td></tr>
<tr><td>Recycling</td><td>525*</td><td>kg</td></tr>
<tr><td>Landfill</td><td>314</td><td>kg</td></tr>
<tr><td>Incineration with energy recovery</td><td>35</td><td>kg</td></tr>
<tr><td>Disposal (specified by type)</td><td>Product or material for final deposition</td><td></td><td>kg</td></tr>
<tr><td colspan="2">Removals of biogenic carbon (excluding packaging)</td><td>-</td><td>kg CO_2</td></tr>
</table>

*mass reported in recycling is representative of total mass of material going into recycling. This includes the mass of some material that is evaporated via recycling (pyrometallurgical) process.

Table 10. Reuse, recovery and/or recycling potentials (D), relevant scenario information

NAME	VALUE	UNIT
Net energy benefit from energy recovery from waste treatment declared as exported energy in C3 (R>0.6)	-	MJ
Net energy benefit from thermal energy due to treatment of waste declared as exported energy in C4 (R<0.6)	442	MJ
Net energy benefit from material flow declared in C3 for energy recovery	-	MJ
Process and conversion efficiencies	15 - 27%	
Further assumptions for scenario development (e.g. further processing technologies, assumptions on correction factors);	-	

4. Life Cycle Assessment Results

Table 11. Description of the system boundary modules

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

4.1. Life Cycle Impact Assessment Results

Results are reported per functional unit. To improve readability, modules with zero (0) values have been omitted (modules B1, B2, B3, B4, B7, and C1).

Table 12. North American Impact Assessment Results

TRACI v2.2	A1-A3	A4	A5	B6	C2	C3	C4	D
GWP 100 [kg CO_2 eq]	6.78E+03	3.52E+02	2.92E+01	2.02E+03	2.89E+02	4.19E+02	9.10E+01	-2.22E+03
ODP [kg CFC-11 eq]	7.49E-08	9.95E-11	2.53E-11	1.76E-08	7.89E-11	4.14E-09	3.54E-11	-2.16E-08
EP, freshwater [kg P eq.]	7.57E-03	2.87E-04	4.14E-04	3.01E-04	1.97E-04	2.76E-04	4.83E-04	-2.08E-03
EP, marine [kg N eq]	1.17E+01	1.54E+00	1.01E-02	1.01E+00	1.77E+00	3.30E-01	1.62E-02	-3.46E+00
AP [kg SO_2 eq]	1.79E+02	1.65E+00	1.62E-02	2.41E+00	2.01E+00	6.76E-01	4.46E-02	-1.18E+02
POCP [kg O_3 eq]	4.06E+02	3.80E+01	3.56E-01	3.61E+01	5.25E+01	1.15E+01	5.49E-01	-1.24E+02
ADP_{fossil} [MJ, LHV]	8.39E+04	4.48E+03	8.10E+01	2.41E+04	3.62E+03	4.98E+03	8.72E+01	-2.73E+04

4.2. Life Cycle Inventory Results

Table 13. Resource Use

PARAMETER	A1-A3	A4	A5	B6	C2	C3	C4	D
RPR_E [MJ, LHV]	2.17E+04	1.88E+02	8.07E+02	9.63E+03	1.32E+02	2.11E+03	1.91E+01	-5.96E+03
RPR_M [MJ, LHV]	1.25E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPR_T [MJ, LHV]	2.29E+04	1.88E+02	8.07E+02	9.63E+03	1.32E+02	2.11E+03	1.91E+01	-5.96E+03
$NRPR_E$ [MJ, LHV]	8.55E+04	4.53E+03	1.05E+02	3.32E+04	3.65E+03	8.19E+03	9.28E+01	-3.12E+04
$NRPR_M$ [MJ, LHV]	3.45E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
$NRPR_T$ [MJ, LHV]	8.90E+04	4.53E+03	1.05E+02	3.32E+04	3.65E+03	8.19E+03	9.28E+01	-3.12E+04
SM [kg]	1.18E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF [MJ, LHV]	-	-	-	-	-	-	-	-
NRSF [MJ, LHV]	-	-	-	-	-	-	-	-
RE [MJ, LHV]	-	-	-	-	-	-	-	-
FW [m^3]	6.31E+01	2.03E-01	5.81E-02	1.27E+01	1.44E-01	2.77E+00	2.10E-01	-1.88E+01

Table 14. Output Flows and Waste Categories

PARAMETER	A1-A3	A4	A5	B6	C2	C3	C4	D
HWD [kg]	-	-	-	-	-	-	-	-
NHWD [kg]	2.73E+02	0.00E+00	4.11E+01	0.00E+00	0.00E+00	0.00E+00	1.90E+02	0.00E+00
HLRW [kg] or [m^3]	3.53E-03	1.85E-05	7.57E-06	3.90E-03	1.48E-05	1.35E-03	1.87E-06	-1.64E-03
ILLRW [kg] or [m^3]	3.03E+00	1.55E-02	5.54E-03	3.26E+00	1.24E-02	1.13E+00	1.98E-03	-1.40E+00
CRU [kg]	-	-	-	-	-	-	-	-
MFR [kg]	4.42E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E+02	0.00E+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
EE [MJ, LHV]	-	-	-	-	-	-	-	-

Table 15. Carbon Emissions and Removals

PARAMETER	A1-A3	A4	A5	B6	C2	C3	C4	D
BCRP [kg CO_2]	1.35E+01	0.00E+00	0.00E+00	0.00E+00	1.55E+01	8.83E+00	4.00E-01	-1.02E+01
BCEP [kg CO_2]	-	-	-	-	-	-	-	-
BCRK [kg CO_2]	1.34E+02	0.00E+00	0.00E+00	0.00E+00	1.42E-01	4.34E-02	2.42E-03	-7.59E+00
BCEK [kg CO_2]	3.73E+01	0.00E+00	0.00E+00	0.00E+00	2.54E-09	4.46E-08	6.04E-10	-2.23E-04
BCEW [kg CO_2]	-	-	-	-	-	-	-	-
CCE [kg CO_2]	-	-	-	-	-	-	-	-
CCR [kg CO_2]	-	-	-	-	-	-	-	-
CWNR [kg CO_2]	-	-	-	-	-	-	-	-

5. LCA Interpretation

Figure 4 represents the results for the environmental profile of one (1) BC 2 battery cabinet to ensure 266 kW of power for five (5) minutes for a reference lifetime of ten (10) years when integrated into a UPS. Extraction, processing, and premanufacturing of the raw materials (A1), have the largest contribution on the environmental footprint of the battery cabinet. Within raw materials, the metals such as nickel, zinc, and copper based materials represent the bulk of the impact across the impact categories.

Following A1, the use phase (B6) has a significant contribution across the impact categories (1 – 20%) due to the electricty usage.

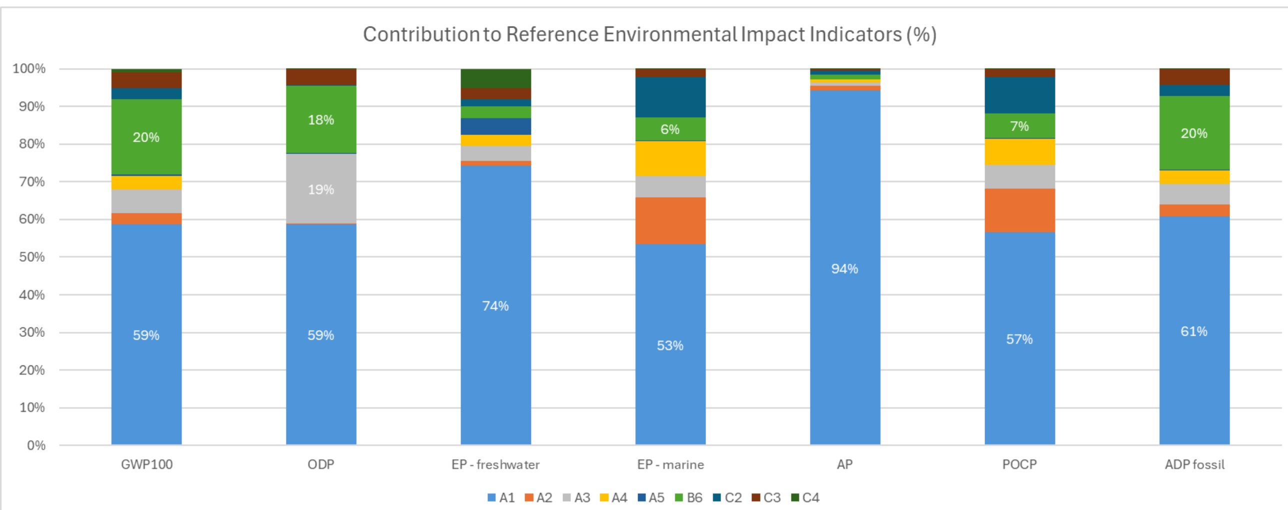

Figure 4: Contributions to the environmental impact categories for BC 2 for 38 HSF batteries

6. Additional Environmental Information

6.1. Environment and Health During Manufacturing

ZincFive manufactures its battery products and systems in accordance with all applicable environmental and safety regulations. ZincFive is actively developing its ISO management systems to the ISO 9001, 14001, and 45001 standards.

6.2. Environment and Health During Installation

ZincFive has developed Standard Operating Procedures ("SOPs") to ensure worker safety during the installation of the BC 2 UPS Battery Cabinet, the main risk of which is managing high operating voltages. All installers, including third parties, are provided ZincFive's SOPs and are trained on the proper procedures for installing the product.

6.3. Extraordinary Effects

Fire

N/A

Water

N/A

Mechanical Destruction

N/A

6.4. Delayed Emissions

N/A

6.5. Environmental Activities and Certifications

ZincFive is in the process of completing ISO 14001 certification at both its United States and China manufacturing facilities.

6.6. Further Information

A PEP Ecopassport can also be requested for the BC 2 Battery Cabinet.

More information of ZincFive can be found on: https://zincfive.com/company/sustainability-corporate-responsibility/

Contact Information: esg-info-request@zincfive.com

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