EPDCHINA

PCR

EPDCN-PCR-202205

Product Category Rules

ENERGY STORAGE BATTERY

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PCR development log（this section is for the PCR that is developed for the first version）

Date	Status	Notes
2022-04-09	Draft	First issue
2022-08-22	Finished	Publish

Revision Log (this section is for the PCR that is updated based on the formal version)

This is an overview of the changes made to this PCR. Typology of changes:

- Editorial (ed): Text or layout edited, with no change in content.
- Technical (te): Existing content has been changed.
- Addendum (ad): New content has been added.

Date	Version No.	Type	Description of change
		/	/

Public feedback and update records of this PCR

Title	**Content**
Name of PCR	PCR for Energy Storage Battery
Public Comment Date	July 01, 2022 – August 15, 2022
Feedback units or individuals	
Feedback and response	
PCR review date	August 15, 2022
PCR review team members	EPD China Technical Committee

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1. INTRODUCTION

1.1 GENERAL INFORMATION

Background of this PCR

This document is a Product Category Rules (PCR) that has been developed within the framework of EPD China, and is a program for type III environmental declarations according to ISO 14025:2006. The name of this PCR is “Energy Storage Battery Product Category Rules”, the latest version of this PCR can be downloaded from www.EPDChina.com.

Standards

This PCR is developed to ensure different LCA practitioners generate consistent results while developing an EPD or carbon footprint (CFP) report.

Table 1 References and standards

Standard ID	Standard name
PEFCR-Batteries	PEFCR - Product Environmental Footprint Category Rules for High Specific Energy Rechargeable Batteries for Mobile Applications
EPD China GPI v1.0	Environmental Management - Life Cycle Assessment Principles and Framework
ISO14040:2006	Environmental management - Life Cycle Assessment Requirements and Guidelines
ISO14044:2006	Environmental Labels and Declarations - General Rules
ISO14020:2006	Environmental Labeling and Declarations - Type III Environmental Declaration Principles and Procedures
ISO 14025:2006	Product Carbon Footprint Standard
ISO 14067:2018	Environmental Management - Life Cycle Assessment Principles and Framework

Version history of this PCR

1.2 ADMINISTRATIVE INFORMATION

Table 2 Administrative information

PCR Name	PCR for Energy Storage Battery
Registration number	EPDCN-PCR-2022-0005
Version Number	v1.0
EPD Operator	EPD China
EPD Operator Information	EPD China Website: www.epdcchina.cn E-mail: epd@1mi1.cn
PCR Drafter	Xiaoqu Han Xi'an Jiaotong University、hanxiaoqu@mail.xjtu.edu.cn Yanxin Li Xi'an Jiaotong University、liyanxinxjtu@163.com
PCR participating units	Shanghai Ecovane Environmental Co., Ltd.
Date of publication:	August 22, 2022
Valid until:	August 22, 2027
PCR Renewal schedule	Once a PCR is developed and published, it will become effective and used to carry out environmental impact assessment statements for products and services, including carbon footprint statements. In order to ensure the cycle stability of the statement, the drafter of the PCR needs to contact the Secretariat to apply for renewal within 3-6 months before the expiration of the PCR.
PCR Standards conformance	General Programme Instructions of EPD China v1.0 EPD China PCR General Template, release date November 30, 2021
PCR language(s)	The PCR will be constructed in Chinese or in English, but the Chinese version shall prevail in the end. For related links, please refer to www.epdchina.cn

1.3 PCR VERIFICATION

Table 3 PCR verification

PCR review panel	The Technical Committee of the EPD China System. A full list of members is available at www.EPDChina.cn. The review panel may be contacted via PCR@1mi1.cn *Members of the Technical Committee were requested to state any potential conflict of interest with the EPD China Secretariat, and if there were conflicts of interest they were excused from the review.
Chair of the PCR review panel	Mr. Wanbin Gong
Review dates	August 20, 2022

2. SCOPE OF THIS PCR

2.1 TECHNICAL SCOPE OF THIS PCR

The product groups and/or services covered by this PCR include the following category of battery products:

Battery products for stationary power plants (e.g. energy storage plants, renewable energy plants, etc.)

This PCR is a general core PCR for energy storage batteries. In the case of other specific energy storage battery product PCRs, it must be used at the same time as the product-specific PCR.

If there is a product beyond the above scope, but there is a reasonable reason to use this PCR, please contact the EPD China Secretariat to explain the function and purpose of the product. It is up to the EPD China Technical Committee to decide whether the product can use this PCR.

2.2 GEOGRAPHICAL SCOPE

This PCR may be used globally.

2.3 EPD VALIDITY

An EPD based on this PCR shall be valid from its registration and publication at www.EPDChina.com and for a five-year period starting from the date of the verification report (“approval date”), or until the EPD has been de-registered from the EPD China.

This PCR will not be valid under the following circumstances:

- An updated version is issued on the EPD China website;
- This PCR is not officially available on the EPD China website

The EPD based on this PCR shall be updated and re-verified if the following circumstances occur:

- Any environmental impact index of the product changes by 10% or more due to materials, workmanship or other reasons;
- Errors are found in the EPD declaration information during the annual or periodic review;
- Changes in product information, content claims or additional environmental information declared by the EPD, or
- The owner of the EPD has changed, the model number has been increased or decreased, or the production location has changed

3. TERMS, DEFINITIONS, AND ABBREVIATIONS

3.1 TERMS AND DEFINITIONS

Environmental Product Declaration (EPD)

Environmental Product Declaration provide quantified environmental data using pre-determined parameters and, where relevant, additional environmental information.
[EN 15804:2012]

Life cycle assessment (LCA)

Calculate and evaluate the inputs, outputs and potential environmental impacts of a product throughout its life cycle stages.
[ISO 14044: 2006]

Declared unit

The quantity of the product used as a reference unit in the Environmental Product Declaration.
[EN 15804:2012]

Functional unit

A reference unit based on the quantification of product functionality and performance.
[EN 15804:2012]

Depth of Discharge

The ratio of the output capacity of the battery to its current maximum capacity

BMS，battery management system

Charge and discharge management system for batteries

3.2 ABBREVIATIONS

EPD	Environmental product declaration
DU	Declared unit
FU	Functional unit
PCR	Product category rules
LCA	Life cycle assessment
LCI	Life cycle inventory
LCIA	Life cycle impact assessment
RSL	Reference service life
ESL	Estimated service life

4. PRODUCT CATEGORY RULES AND METHODOLOGY FOR LCA

4.1 GOAL AND SCOPE

1. In order to ensure the consistent quality of the LCA results of the same type of energy storage battery products;
2. Use data for evaluation in larger projects, for example: LCA data of energy storage batteries to assist the overall LCA evaluation of energy storage power stations
3. To serve as basis for Environmental Product Declarations（EPD）using quantitative environmental impacts;
4. To ensure product comparison, the EPD owner shall only compare the product's environmental performance within its own different products produced in different periods. A special carbon emission reduction statement can be issued for carbon footprint (refer to Chapter 5 for carbon emission reduction statement requirements) ;
5. The comparison between different products produced by the different company is not suggested, in an extreme case, if companies want to compare, DISCLAIMER: "It must be noticed that comparison between EPDs using this PCR can be performed only among products with clear technological and functional similarities."

This PCR mainly covers:

Li-ion battery and flow battery

Li-ion batteries mainly include the following two types: nickel cobalt manganese oxide batteries and lithium iron phosphate batteries.
Flow batteries mainly include the following two types: vanadium redow flow batteries and iron chromium flow batteries.

4.2 FUNCTIONAL UNIT（FU）OR DECLARED UNIT（DU）

In order to ensure the comparability of energy storage battery products that can provide the same or similar functions and services within the research scope, the functional units or declared units of energy storage battery products need to be clearly defined in the EPD according to the research objectives and scope. The function of the energy storage battery is to store and release energy. Therefore, the functional unit (FU) of the energy storage battery product defines the environmental impact corresponding to the average unit kWh of energy output by the energy storage battery system in the entire life cycle. Among them, the total energy of the whole life cycle of the battery system is:

Total energy=Average capacity of battery system(BattC) × Depth of discharge（DoD）× Number of electrochemical cycles（Ncc）

The average capacity of the battery system refers to the single average release capacity after considering the battery decay during use, and takes the arithmetic average of the initial capacity and the capacity at the end of the battery life. Among them, the use process needs to consider the efficiency problem.

The total capacity decay can be considered as the algebraic sum of cyclic decay and calendar decay.

$$\Delta C_{loss} = \Delta C_{cycling} + \Delta C_{calendar}$$

The cycle decay is proportional to the number of electrochemical cycles, while the calendar decay is proportional to the square root of the cumulative usage time, both of which need to be fitted experimentally. The battery may be in a dynamic state of charge and discharge. At this time, it is difficult to strictly define the number of cycles. The number of cycles can be referred to by the throughput ampere-hours(Ah).

$$\Delta C_{cycling} = \alpha(Ah), Ah = \int_0^t |I(t)|dt$$

$$\Delta C_{calendar} = \beta t^{0.5}$$

4.3 TECHNICAL SPECIFICATION, LIFESPAN AND REFERENCE SERVICE LIFE（RSL）

The Reference Service Life (RSL) of an energy storage battery product considers the number of complete electrochemical cycles (Ncc) experienced to reach the specified state of health (SOH) of the battery. When the use frequency of the battery is too low, the reference service life of the energy storage battery product is considered as the number of complete electrochemical cycles experienced by the battery to reach the service life.

The state of health of the battery is defined as the ratio of the current capacity of the battery to the initial capacity. A complete electrochemical cycle is defined as a complete cycle of charge-discharge between the preset upper and lower cut-off voltages.

4.4 SYSTEM BOUNDARY AND LIFE CYCLE STAGES

The default system boundaries defined in this PCR are cradle-to-grave, where A1-A3 production stages are mandatory for each EPD to disclose. Cradle to Grave specifically includes all/part of the stages described in 4.4.1 Life Cycle Stages, which are described below.

4.4.1 LIFE CYCLE STAGES

The life cycle of the products is divided into following stages:

•Production stage (A1-A3)
•Distribution stage (A4)
•Construction/Installation stage (A5)
•Use stage (B1-B7)
•End-of-life stage (C1-C4)
•Recovery and Reuse Benefit (D)

The EPD document must indicate the life cycle stages considered by means of a summary table. Any non-declared EPD life cycle stage must be marked with the abbreviation "MND" (Module Not Declared).

Table 4 life cycle stages

Production stage(A1-A3)	A1 Raw materials production
	A2 Raw material transportation
	A3 Product manufacturing
Distribution stage(A4)	A4 Product transportation
Construction/Installation stage(A5)	A5 Installation and construction
Use stage (B1-B7)	B1 Product use
	B2 Product Maintenance
	B3 Product repair
	B4 Product replacement
	B5 Product refurbishment
	B6 Operation energy use
	B7 Operation water use
End-of-life stage (C1-C4)	C1 De-construction
	C2 Waste transportation
	C3 Waste sorting or disposal
	C4 Waste incineration or landfill
Reuse, Refurbishment or Recycling Burdens and Potential Benefits	D Reuse, Refurbish or Recycle

4.4.2 UNIT PROCESS

For each process or life cycle stage, the following life cycle checklists need to be included separately.

1. Raw materials production (A1)

The relevant unit processes that should be included in the supply chain are:

- extraction and processing of raw materials
- Other OEM components include battery management system (BMS) and battery thermal management system (ThMU).
- recycling processes of secondary materials from other product life cycles

Raw material transportation (A2**)**

- Transportation of raw materials (if assembly is performed at multiple locations, transportation between locations should be considered ;)

Product manufacturing（A3）

The relevant units that should be included in the lithium-ion battery are:

- Production of electrode slurry
- Manufacturing of electrode sheets
- Cell assembly and formation
- Integration of modules and battery packs
- Handling of other packaging materials

The relevant units that should be included in the flow battery are:

- Assembly of stacks
- Testing of stacks
- Container integration
- Handling of other packaging materials

2. Distribution stage (A4)

- The type of vehicles, transportation distance, and delivery scenarios shall be defined in the EPD.
- If the above information is not available, you can refer to the following table for vehicle type and transportation distance in transportation scenarios:

Destination	Shipping method	Transport distance
In the province	Truck (Country 3)	1000km
Inter-provincial	Truck (Country 3)	2000km
Transnational	Ship	10000km
Transnational(Asia)	Plane	5000km
Transnational(non-Asian)	Plane	15000km

3. Construction stage (A5)

This stage should include

- Handling of packaging materials;
- Supply of materials, fuel and other infrastructure;
- Equipment installation and adjustment;
- Energy, water and emissions during installation;
- Waste generated during installation;

4. Use stage(B1-B7)

- Energy/water/emissions associated with the use of the product;
- Losses during the use, operation, maintenance stage;
- Materials and fuels used for product's component replacement, and refurbishment, etc.;
- Usage scenarios, energy-saving technologies adopted by fixed power plants and energy-saving effects should be disclosed in the EPD;
- B1: The energy consumption associated with the use of the energy storage system is defined as the effect of the internal resistance of the battery and the losses of the inverter itself.
- $$\text{Energy consumption} = \frac{\text{Total output}}{\text{Battery charge and discharge efficiency} \times \text{Inverter efficiency}} \times (1 - \text{Battery charge and discharge efficiency} \times \text{Inverter efficiency})$$

  When the battery is in standby for a long time, the energy consumption in the B1 stage should include the power loss corresponding to self-discharge, and the corresponding self-discharge rate when the SOC is 50% can be used to calculate the loss. The self-discharge losses of flow batteries are not negligible.

$$Self-discharge\ loss = self-discharge\ rate \times Cumulative\ months\ of\ use$$

- When the battery is used in a fixed power station, the energy consumption in the B1 stage should include the power loss corresponding to the power consumption in the fixed power station.

$$Electricity\ consumption = Power\ station\ operating\ power\ consumption \times operating\ time + Power\ station\ standby\ power\ consumption \times standby\ time$$

- B2: Energy, water, and materials consumed during maintenance of the battery system throughout its service life (such as additional charge and discharge during scheduled maintenance)
- B3: Use of energy, water, and repair materials during battery system repairs (eg, replacement of battery casings, charging and discharging systems)
- B4: Overall replacement of battery products, replacement of modules, other infrastructure.
- $$\text{Number of battery replacements} = \frac{\text{Expected service life}}{\text{Actual service life}}$$

  The actual service life is determined by the number of electrochemical cycles.

  Actual service life=NCC/Average number of charge and discharge per year

- B5: Refurbishment of battery products to a state capable of performing their required functional mission, including consumption of energy, water, and repair materials in the process
- B6: Operation energy use (excluding those already mentioned in B1), if there is no energy consumption, report 0
- B7: Operation water use, if there is no water consumption, reported in 0

5. End-of-life stage **(C1-C4)**

The end-of-life process for batteries should include:

- The disassembly process of the assembly: the casing, cooling system, plastic and other components are separated from the battery;

- Transportation and further metallurgical processing of the separated components: (Li-ion battery: Pyrometallurgical processing followed by hydrometallurgical processing. The main output of the recovery process is the metal melt, which can be further refined with a hydrometallurgical process to further extract valuable metals such as cobalt.)

- Other operations: further shredding may be required before smelting.

All relevant unit processes shall be included, for example:

• transportation of the product to retailer/consumer,

• product use, e.g. use of electricity or water, use activities causing direct emissions, maintenance activities,

• end-of-life treatment of the used product and its packaging, including transportation, and

• generation of electricity and production of fuels, steam, and other energy carriers used in downstream processes.

6. Reuse, Refurbishment or Recycling Burdens and Potential Benefits (D)

D: reuse, recovery, and/or recycling potentials

A separate reporting statement is made in Phase D of the EPD report on the environmental burden and potential benefits of recycling and reusing products beyond

the boundaries of the original product system. EPD users can decide to adopt the following allocation principles:

Default Polluter Pays Principle (PPP) Allocation Principle – Within the framework of EPD China, the default allocation rules for the environmental impacts and benefits of reuse, recovery and/or recycling are based on the Polluter Pays Principle (PPP), i.e. recycle or reuse beneficiary bears the relevant environmental impacts and benefits of recycling or reuse, and the original product manufacturer does not need to bear this part of the impact burden, nor does it participate in the sharing of benefits (the environmental impact caused by the production of the same products avoided by recycling and reuse), and the results of this part are not incorporated into the results of the waste phase of the product, and need to be counted and declared separately.

If the user of the EPD generated based on this PCR wishes to consider the impact and benefits of the D stage in the process of use, it is necessary to supplement the explanation of the proposed allocation calculation formula and the referenced principles (such as the principle of economic value allocation or the principle of cascade utilization allocation) ; In order to avoid double counting and confusion in the value chain process, it is recommended to adopt the default PPP principle.

Processes not considered at the product stage

The following processes are generally not included in the system boundary of the energy storage battery product EPD:

• Manufacture of production equipment, energy storage battery product production plants themselves and other capital goods,

• Personnel business travel,

• personnel commute to and from work,

• Accidental or environmental incidents, and

• Research and development activities.

4.5 CUT-OFF RULES

The default cut-off value for this PCR is 1%. In other words, the included inventory data (excluding inventory data that explicitly exceeds the system boundaries described in Section 4.4) should collectively produce at least 99% of the environmental impact category results. In addition, 99% of the product mass content and 99% of the energy usage during the product life cycle should be stated. However, discarding data should be avoided and all available inventory data should be used.

4.6 ALLOCATION RULES

The following step-wise procedure shall be applied for multifunctional products and multiproduct processes:

4.6.1 GENERAL ALLOCATION RULES

1. The allocation shall be avoided, if possible, by dividing the unit process into two or more sub-processes and collecting the inputs and outputs related to these sub-processes.

2. If allocation cannot be avoided, the inputs and outputs of the system shall be partitioned between its different products or functions in a way that reflects the underlying physical relationships between them; i.e. they should reflect the way in which the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system.

3. Where physical relationships alone cannot be established or used as the basis for allocation (or it is too time-consuming), the inputs shall be divided between the products and the functions to reflect the other relations. For example, the input and output data can be divided among co-products in proportion to the economic value of the products.

4.6.2 ALLOCATION RULES OF CO-PRODUCT

There may have co-products during the production of the energy infrastructures or the operation of energy systems, co-product allocation shall follow the rules below:

1. The various input and output flows shall be allocated across the various co-products by following the physical laws;

2. In case it is not possible to define the physical laws, the allocation shall be based on economic values.

4.6.3 ALLOCATION RULES OF MULTIFUNCTIONAL PRODUCTS

In case the product has multifunction, the environmental impacts shall be allocated to its main purpose and function, while other functions shall be neglected.

4.6.4 ALLOCATION RULE FOR REUSE, RECYCLING, AND RECOVERY PROCESS

Unless otherwise requested in the PCR, the recycling and recovery process shall use the polluter pays principle(PPP) distribution method and the product shall only consider the impact of waste transport to the treatment plant. When the transportation distance is unknown, a reasonable estimate should be carried out in conjunction with a sensitivity analysis.

If the loads and benefits of recycling and recovery processes are quantified, the environmental impacts should be reported separately (refer to Section 4.4).

4.7 DATA QUALITY REQUIREMENTS

An LCA calculation and EPD generally requires two different kinds of data:

•Process data: data related to the inputs and outputs inventory of the considered system (such as materials or energy flows that enter the production system). These data usually come from the company that is performing the LCA calculation.

•Impact data: data related to the environmental impacts of the material or energy flows that enter the production system. These data usually come from databases.

Process data is divided into specific data and general data, which are defined as follows:

•Specific Data – data gathered from the actual manufacturing plant where product-specific processes are carried out, and data from other parts of the life cycle traced to the specific product system under study, e.g. materials or electricity provided by a contracted supplier that is able to provide data for the actually delivered services,

transportation that takes place based on actual fuel consumption, and related emissions, etc.,

• General data, divided into:

  • Selected generic data – data from commonly used data sources (eg commercial and free databases) that meet specified data quality characteristics, including accuracy, completeness and,

  - Proxy Generic Data - Data from commonly used data sources (such as commercial and free databases) that do not all meet all data quality characteristics of Selected Generic Data.

4.7.1 GENERAL DATA REQUIREMENTS

The selection of data shall follow the requirements according to EN ISO 14044: 2006.

As a general rule, specific data shall always be used as the first choice. If specific data are not available, generic data shall be used, generic data shall be time-, geographical-, and technological-representative. If generic data are used for LCA calculation, a data quality assessment should be documented.

Particularly, the following specific requirements shall apply:

- Data shall be recent, data used for LCA calculation should be within the time boundary of the products or systems assessment period, for different products and systems, more specific time range shall be identified in specific PCR;
- Manufacturing data shall be state-of-the-art, the inputs and outputs shall represent the physical reality for the reference product or system;
- In case the reference product or system has a different manufacturing site along its life cycle stages, data shall be based on its geographic coverage (e.g. different electricity mix in a different region);

If selected generic data that meets the above data quality requirements are not available, proxy (generic) data can then be used.

Table 5 Optional general database data

Data list type	Geographical range	Specific data item name	Database
Raw materials for battery equipment (metals, chemical raw materials, etc	Mainland China (Preferred)	For example: Steel: steel, low alloy, hot rolled/production bronze/production	1mi1 Platform (2022) Database
	Global Average Data	Steel, low-alloyed{ROW}|Steel Production, converter, low alloyed, alloc cut off Copper{ROW} | Production, Primary, | alloc cut off	Ecoinvent 3 Database
Electricity and other energy data	Mainland China (Preferred)	For example: High Voltage Electricity: Electricity, High Voltage/Market Grouping_2018_Huabei	1mi1 Platform (2022) Database Ecoinvent 3 Database (International)

Note: This table does not mean that the data of other databases that meet the data quality requirements cannot be applied. If you choose other databases, you need to conduct a compliance assessment on the data quality of the database

4.7.2 PRODUCTION STAGE DATA REQUIREMENTS

For data used in the production phase, such as raw material use, energy consumption, waste generation, etc., the data should be based on 1-year average specific data (3-6 months data in extreme cases). If the data for the EPD application is less than 1 year old, it should be updated when the 1 year average data is available.

If the product is in the development stage, has not yet entered the mass production stage, or the production inventory has not reached 1 year, the design EPD can be developed at this stage, and the validity period of the design EPD is 1 year; when the specific data of 1 year can be obtained, the EPD should be renewed within 6 months, otherwise the EPD will be cancelled in EPD China. Design EPDs can only be used for communication on specific occasions, not for comparison.

4.7.3 CONSTRUCTION/INSTALLATION STAGE DATA REQUIREMENTS

If the materials and energy consumption of this stage is not available, reasonable estimation shall be made based on recent research articles or related international or regional standard. The methods for such kind of estimation should be reported, and sensitivity analysis shall be conducted.

4.7.4 USE STAGE DATA REQUIREMENTS

If some of the unit process data is unable to quantify or the system is still in use, a resealable estimation can be made based on research articles or calculations based on the basic data (e.g. past couple years data). If this applies, the related calculation procedures shall be reported in the LCA report, sensitivity analysis shall be conducted to shorten the gap.

4.7.5 ELECTRICITY MIX

For all manufacturing processes, the local or regional/provincial electricity data in the general database is preferentially used, and the national grid hybrid data can be considered if local data is missing. If possible, you can also adjust the electricity mix according to the local electricity mix data, and take into account the loss of electricity transmission and the emission of pollutants in the transmission and distribution process, and build your own electricity supply data model. If you use a specific type of electricity supply model built by yourself, and this combination of models is used for LCA calculations, supporting documentation (eg a specific supply contract for a local factory) should be provided.

If you build a electricity mix model yourself, you must specify and disclose the energy composition information of power in the EPD.

4.7.6 TRANSPORTATION

For all the transportation that takes place along the different life cycle stages, specific data is prior to use, if not, reasonably estimated data are suggested to use, the type of data and estimation method should be documented.

4.7.7 END-OF-LIFE DATA REQUIREMENTS

- Default scenarios for C2 transport to waste processing should be made (e.g. 100 km) if no specific data is available;
- More than one scenario for waste treatment and disposal should be included if there are several relevant common practices, but the most conservative scenario shall always be included.

5. IMPACT CATEGORIES AND IMPACT ASSESSMENT

5.1 ENVIRONMENTAL IMPACTS

The PCR shall provide the environmental impacts categories, characterization factors, and assessment models. Below listed the recommended impacts indicators that shall be included in PCR and reported when developing EPDs. However, to better characterize the environmental performance of a certain group of products, deviations of impacts indicators are allowed. When there is an increase or decrease of categories compare to the default categories list, it should be justified in the PCR and shall be verified during the verification process.

Below demonstrates Environmental impact categories, taken from EN 15804: 2012+A2: 2019.

Table 6 Environmental impact categories

Impact category	LCIA method / model	Indicator	Unit
Climate change - Total[a]	Baseline model of 100 years of the IPCC based on IPCC 2013	Global Warming Potential total (GWP-total)	kg CO_2 eq.
Climate change - fossil		Global Warming Potential total (GWP fossil)	kg CO_2 eq.
Climate change-biogenic		Global Warming Potential total (GWP biogenic)	kg CO_2 eq.
Climate change - land use and change in land use[b]		Global Warming Potential total (GWP luluc)	kg CO_2 eq.

Ozone Depletion	Steady-state ODPs, WMO 2014	Depletion potential of the stratospheric ozone layer (ODP)	kg CFC-11 eq.
Acidification	Accumulated Exceedance, Seppälä et al. 2006, Posch et al., 2008	Acidification potential, Accumulated Exceedance (AP)	mol H^+ eq.
Eutrophication	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe	Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	kg P eq.
Photochemical ozone formation	LOTOS-UROS, Van Zelm et al., 2008, as applied in ReCiPe	Formation potential of tropospheric ozone (POCP)	kg NMVOC eq.
Consumption of abiotic resources - minerals and materials[c d]	CML 2002, Guinée et al., 2002, and van Oers et al. 2002.	Abiotic Depletion for non-fossil resources potential (ADP-minerals & metals)	kg Sb eq.
Consumption of abiotic resources - fossil resources[c]	CML 2002, Guinée et al., 2002, and van Oers et al. 2002.	Abiotic Depletion for non-fossil resources potential (ADP-fossil)	MJ, Calculated with low calorific value
Water consumption	Available WAter REmaining (AWARE) Boulay et al., 2016	Water deprivation potential, deprivation weighted water consumption (WDP)	m^3 eq.

Notes:

a The total global warming potential (GWP-total) is the sum of

— GWP-fossil

— GWP-biogenic

— GWP-luluc

b It is permitted to omit GWP-luluc as separate information if its contribution is < 5 % of GWP-total over the declared modules excluding module D. However, this should not be omitted in the carbon footprint assessment (CFP) reports.

c The abiotic depletion potential is calculated and declared in two different indicators:

— ADP-minerals&metals include all non-renewable, abiotic material resources (i.e. excepting fossil resources);

— ADP-fossil includes all fossil resources and includes uranium.

d ultimate reserve model of the ADP-minerals&metals model

5.2 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS

As mentioned in section 6.1.1, additional impact indicators, characterization factors, as well as the recommended assessment model shall be listed in this section, and the PCR shall provide the requirements on declaring these indicators (shall/recommended/optional).

Table 7 Additional environmental impact categories

Impact category	Recommended LCIA method/model	Indicator	Unit

5.3 USE OF RESOURCES

Besides the environmental impact indicators, indicators describing resource use shall also be provided in PCR. Similar to environmental impact indicators, deviations are allowed for less unnecessary or additional indicators, and this should be verified during the PCR verification process. Below demonstrates the use of resources categories, taken from EN 15804: 2012+A2: 2019.

Table 8 Primary and secondary resource consumption

Parameters	**Unit of measurement**
Use of renewable primary energy excluding renewable primary energy resources used as raw materials PERE	MJ, net calorific value
Use of renewable primary energy resources used as raw materials PERM	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) PERT	MJ, net calorific value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material (PENRE)	MJ, net calorific value
Use of non-renewable primary energy resources used as raw materials PENRM	MJ, net calorific value

Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) PENRT	MJ, net calorific value
Net use of fresh water (FW)	m3
Use of secondary raw materials (SM)	kg
Use of renewable secondary fuels (RSF)	MJ, net calorific value
Use of non-renewable secondary fuels (NRSF)	MJ, net calorific value
Note: In order to identify the input part of renewable/non-renewable primary energy used as an energy carrier and not used as raw materials, the indicator "use of renewable/non-renewable primary energy excluding renewable/non-renewable primary energy resources used as raw materials" is considered and can be calculated as the difference between the total input of primary energy and the input of energy resources used as raw materials.	

5.3.1 WASTE PRODUCTION AND OUTFLOWS

Table 9 Waste production

Impact category	Unit of measurement
Hazardous waste disposal (HWD)	kg
Non-hazardous waste disposed (NHWD)	kg
Radioactive waste disposed (RWD)	kg
Materials for energy recovery (MER)	kg
Material for recycling (MFR)	kg
Components for reuse (CRU)	kg
Exported thermal energy (ETE)	MJ, net calorific value
Exported electricity energy (EEE)	MJ, net calorific value
Notes: Disposal of characteristic hazardous waste should follow the applicable laws of the host country (China).	

5.3.2 ADDITIONAL ENVIRONMENTAL INFORMATION

Besides the environmental impacts, use of resources, and waste productions, a PCR may requires EPD owner to declare other environmentally relevant information not derived from the LCA-based calculations.

such as:

- the release of dangerous substances into indoor air, soil, and water during the use

stage,

- instructions for proper use of the product, e.g. to minimise energy or water consumption or to improve the durability of the product,
- instructions for proper maintenance and service of the product, e.g. to minimise energy or water consumption or to improve the durability of the product,
- information on key parts of the product that determine its durability,
- information on recycling including, e.g. suitable procedures for recycling the entire product or selected parts and the potential environmental benefits gained,
- information on a suitable method of reuse of the product (or parts of the products) and procedures for disposal as waste at the end of its life cycle,
- information regarding disposal of the product, or inherent materials, and any other information considered necessary to minimize the product's end-of-life impacts, and

a more detailed description of an organization's overall environmental work, such as:

- the existence of any type of organized environmental activity, and
- information on where interested parties may find more details about the organization's environmental work.

6. CONTENT OF EPD BASED ON THIS PCR

6.1 PRINCIPLES OF INCLUDING MULTIPLE PRODUCTS IN THE SAME EPD

Similar products from a single or several manufacturing sites covered by the same PCR and manufactured by the same company with the same major steps in the core processes may be included in the same EPD if none of the declared environmental performance indicators differ by more than 10% between any of the included products.

6.2 MANDATORY INFORMATION AND FORMAT OF THE EPD

EPDs based on this PCR shall contain the information described in the following sections. Flexibility is allowed in the formatting and layout provided that the EPD still includes the prescribed information. A generic template for EPDs is available via www.EPDChina.com.

EPDs should be published in English/Chinese but may also be published in additional languages. If the EPD is not available in English/Chinese, it shall contain an executive

summary in English including the main content of the EPD. This summary is part of the EPD and, thus, also subject to the verification process.

6.3 GENERAL INFORMATION

As a general rule, the EPD content:

▪ shall be in line with the requirements and guidelines in ISO 14020 (Environmental labels and declarations - General principles),

▪ shall be verifiable, accurate, relevant and not misleading, and

▪ shall not include rating, judgments, or direct comparison with other products.

An EPD should be made with a reasonable number of pages for the intended audience and use.

6.3.1 PROGRAM INFORMATION

Program operator:	EPD China www.EPDChina.cn
Product category rules (PCR):	Energy Storage Battery
PCR review was conducted by:	
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☑ EPD Process, data and report review ☐ EPD report review only	
Third-party verifier:	Name of the verifierE-mail:
Approved by:	EPD China
Are third-party verifiers involved in the annual review of data and results during the EPD validity period: ☐ Yes ☐ No	

6.3.2 INFORMATION ABOUT THE COMPANY OR MANUFACTURER

The following information should be declared by the manufacturer:

- The location of main manufacturing plant(s) of the final assembly;
- Environmental policy of the manufacturer;
- Relevant environmental certifications e.g. EN ISO 9001, EN ISO 14001, OSHAS

18001.

6.3.3 DESCRIPTION OF THE PRODUCTS OR SYSTEM ANALYZED

- Basic information of the products and their applications
- Constitutive materials and substances
- Manufacturing processes

6.4 LCIA INFORMATION

- Functional/Declared unit
- System boundary
- Excluded processes
- Assumptions and limitations
- Allocations
- Cut-off rules
- Electricity mix
- Environmental Impacts: *See tables in Sections 5.1.1 to 5.1.4.*

6.5 ABOUT CARBON FOOTPRINT DECLARATION

Manufacturers can rely on this PCR to prepare a statement that only discloses the carbon footprint of the product without disclosing other environmental impact indicators (in Section 6.4 h-Environmental Impact). In the process of using this PCR to prepare the LCA report as well as the EPD report, it is necessary to strictly abide by the requirements and regulations of GPI and related functional units, boundaries, and data quality of this PCR (refer to Chapter 3). In addition, for the disclosed products, companies also need to meet the following special requirements for carbon footprints

1. Carbon footprint and carbon sinks: The results of the product carbon footprint statement cannot include the purchase of carbon sinks and other emissions reductions that are not directly related to the production, use and disposal of products (including CCER, carbon allowances, etc.). , companies can disclose the purchase of carbon sinks and etc. in other chapters, for example, in chapter 6.7 Additional Information;
2. Neutrality of carbon footprint results: The carbon footprint statement can only disclose the carbon footprint results of the product, and cannot use guiding words such as zero carbon or low carbon to describe the product, even if the actual carbon footprint of the product is very low, even close to zero or negative ;
3. Sensitivity analysis requirements: important assumptions and uncertain data that

contribute more than 10% to the carbon footprint results (Note: Different from statistical uncertainty, the uncertain data here refers to the hypothesis of the inability to verify and obtain first-hand information or proxy data). It is necessary to carry out sensitivity analysis based on the actual situation to determine the possible reasonable fluctuation range of emission reduction; because the potential fluctuation range (based on reasonable estimates, or the result of 3 standard deviations above and below the average value, i.e. the upper and lower limits of the confidence interval of 99%) for the hypothetical data range that may cause more than 10% change in the carbon footprint results, and conduct necessary verification of the assumptions and alternative data to reduce the impact and error of the carbon footprint results. In the result statement, it is necessary to indicate the interval value of the maximum and minimum carbon footprint caused by the uncertain data (Note: the uncertain data here does not include the background database and methodological uncertainty).

4. Carbon footprint and carbon emission reduction: The product carbon footprint statement cannot replace the product's emission reduction statement. If the company implements energy-saving emission reduction measures (such as ecological design, green supply chain, circular economy, etc.), so that the product achieves emission reduction effect, then the product carbon emission reduction statement can be additionally developed on the basis of the product carbon footprint statement. For specific requirements, please refer to 5.6. About carbon emission reduction statement;

6.6 SUPPLEMENTARY DECLARATION ON PRODUCT CARBON REDUCTION

In the carbon footprint or EPD statement, if the manufacturer makes a product emission reduction statement in order to meet the disclosure needs of the relevant parties, it needs to make a special carbon reduction statement. After obtaining the carbon footprint of the benchmark product, calculate the carbon footprint of the product after emission reduction, the difference between the two is the emission reduction amount, and the calculation of emission reduction amount needs to refer to the following basis to carry out the carbon emission reduction statement:

1. Object of declaration: The object of emission reduction declaration must be the same type of products or services that meet the same function;
2. Evaluation criteria: The evaluation of benchmark products and emission reduction products needs to comply with the same PCR rules, and the emission reductions are calculated on the basis of the same evaluation background database (R1, R1 =

carbon footprint of the benchmark product minus the carbon footprint of the new product)); if the background database for the same product type has changed, the emission reduction effect due to the background database upgrade needs to be listed separately (R2, R2 = the carbon footprint of the new product based on the new database minus the carbon footprint of the new product based on the original database), and the final emission reduction effect is equal to the direct emission reduction R1 plus the indirect emission reduction R2 of the database upgrade (R=R1+R2);

3. Evaluation basis: For the optimization and improvement measures such as the energy usage rate, material type, production process change, etc. of the emission-reduction products, it is necessary to submit clear evidence to prove the relevance of the changes;
4. Basis cannot be seen as emission reduction: if it has nothing to do with the company's implementation of cleaner production, ecological design, green supply chain and economic structure model optimization (such as circular economy, service economy, etc.) The behavior of purchasing carbon sinks and other external carbon emission reduction activities to offset the company's own carbon emissions by its own cannot be used as the basis for carbon emission reduction;
5. Evaluation of system carbon emission reduction: Enterprises can calculate the carbon emission reduction at the system level outside the organization due to the improvement of products in the organization. To do so, it is necessary to optimize the functions of the system outside the organization (such as the optimization of the engine product contributes to the emission reduction at the system-level of transportation, etc.) to conduct a carbon footprint standard assessment and then use the same rules as above to evaluate the system-level emission reduction effect due to optimized products;
6. Sensitivity analysis requirements: For important assumptions and uncertain data that contribute more than 10% to the carbon footprint results, sensitivity analysis needs to be carried out in combination with the actual situation to determine the possible reasonable floating range of emission reductions; For the hypothetical data that may cause a change of more than 10% or more in the carbon footprint results due to the potential floating interval (based on a reasonable estimate, or the result of taking 3 standard deviations above and below the mean, that is, the upper and lower limits of the 99% confidence interval), it is necessary to carry out necessary verification on the hypothetical and alternative data in order to judge the cumulative difference of the emission reduction caused by this, and the difference must not exceed the emission reduction value, otherwise the emission reduction statement will be invalid. If the difference is less than the emission reduction value, the interval value of the maximum and minimum emission reduction caused by the

uncertain data needs to be indicated in the emission reduction result; (Note: The uncertain data here does not include the background database and methodological uncertainty)

The drafter is requested to supplement the information and content of the above marked yellow as appropriate in accordance with the above requirements and in combination with the characteristics of specific industries or products.

6.7 ADDITIONAL INFORMATION

The EPD should declare relevant important environmental information during the life cycle stages of battery, if such information is not mentioned in above mentioned sectors.

7. REFERENCES

[1] CEN (2013) EN 15804:2012+A1:2013, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.

[2] CEN (2019) EN 15804:2012+A2:2019, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.

[3] EPD China (2021) General Programme Instructions for the EPD China. Version 4.0, dated 2021-03-29. www.EPDChina.com.

[4] ISO (2000) ISO 14020:2000, Environmental labels and declarations – General principles.

[5] ISO (2004) ISO 8601:2004 Data elements and interchange formats – Information interchange – Representation of dates and times.

[6] ISO (2006a) ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

[7] ISO (2006b) ISO 14040:2006, Environmental management – Life cycle assessment – Principles and framework.

[8] ISO (2006c) ISO 14044: 2006, Environmental management – Life cycle assessment – Requirements and guidelines.

[9] ISO (2013) ISO/TS 14067:2013, Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification and communication.

[10] ISO (2014) ISO 14046:2014, Environmental management – Water footprint – Principles, requirements and guidelines.

[11] ISO (2015a) ISO 14001:2015, Environmental management systems – Requirements with guidance for use.

[12] ISO (2015b) ISO 9001:2015, Quality management systems – Requirements.

[13] ISO (2016a) ISO 21067-1:2016, Packaging – Vocabulary – Part 1: General terms.

[14] ISO (2016b) ISO 14021:2016, Environmental labels and declarations - Self-declared environmental claim (Type II environmental labelling).

[15] ISO (2017) ISO 21930:2017, Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.

[16] ISO (2018) ISO 14024:2018, Environmental labels and declaration – Type I environmental labelling – Principles and procedures.