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White Paper

An Overview of EU Battery Regulation

Summary

The European Union Battery Regulation (EU) 2023/1542 has entered into force with the objective of regulating the entire lifecycle of batteries to provide better protection for the environment and consumers. Starting from 18 August 2024, compliance assessment will be mandatory and batteries without the CE marking will not be allowed to be sold in the EU market. Battery businesses must comprehend regulatory requirements and remain updated on the progress of various secondary legislations and regulatory standards. In this white paper, we'll delve into key topics such as restricted substances, carbon footprint, recycled materials and waste battery management, performance and durability requirements, safety requirements, battery labelling requirements, battery health monitoring by battery management systems, due diligence checks of battery economic operators and battery passports to help businesses understand the overall framework and timeline of the EU Battery Regulation to carry out the required preparation work. Battery manufacturers should seize this opportunity to progressively establish a safer and more sustainable battery value chain, enhancing their long-term competitiveness and strategic autonomy in the international market.

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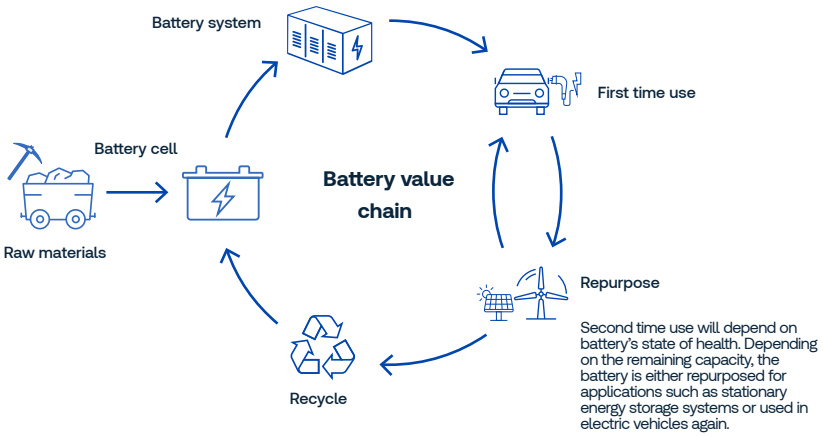
01 Opportunities and risks drive the evolution of quality and challenges

The European Union Battery Regulation (EU) 2023/1542 has entered into force as of August 17, 2023. This Regulation serves as a legal document which will govern the entire lifecycle of batteries covering all stages from production, usage, repurpose and recycling. It aims to bring forward EU's ambitions for a more circular economy and carbon neutrality.

Battery life cycle



For the battery industry, EU Battery Regulation will foster sustainable and environmentally friendly practices in battery production, usage, repurposing and recycling. Meanwhile, it will also present a new challenge for the battery manufacturers. The Battery Regulation will significantly impact the global battery industry landscape. In fact, as early as 2006, the EU introduced the Battery Directive 2006/66/EC, which was subsequently amended to include the detailed requirements for restricted substances, recycling and labelling of batteries. Over time, issues with the EU Battery Directive gradually surfaced. For example, achieving the objectives for collection, recycling and repurposing as stipulated in the Directive has proven difficult. Moreover, the lack of integration for technological innovation and new applications hampers the ability to keep pace with rapid advancements in battery technology. As such, the EU has been considering the implementation of new Battery Regulations since 2020. Moving from the Battery Directive to the Battery Regulation, the aim is to eliminate disparities that may arise when individual EU Member States adapt the Directive into their national laws. Additionally, this Regulation will have uniform legal effect across the EU, taking direct effect without the need for transposition into national laws.

Manufacturer

Refers to any natural or legal person who manufactures and / or designs batteries, has them designed or manufactured and sells them under their own name or trademark or put them into service for their own purposes.

Authorised representative

Refers to any natural or legal person established in the EU who has received written authorisation from the manufacturer to perform specific tasks on behalf of the manufacturer under the obligations stated in Chapters IV and VI.

Importer

Refers to any natural or legal person established within the EU who places batteries from a third country on the EU market.

Dealer

Refers to any natural or legal person in the supply chain other than the manufacturer or importer, who places batteries on the market.

According to Article 44,
it can be regarded as a manufacturer

Producer

Producer

Economic operator

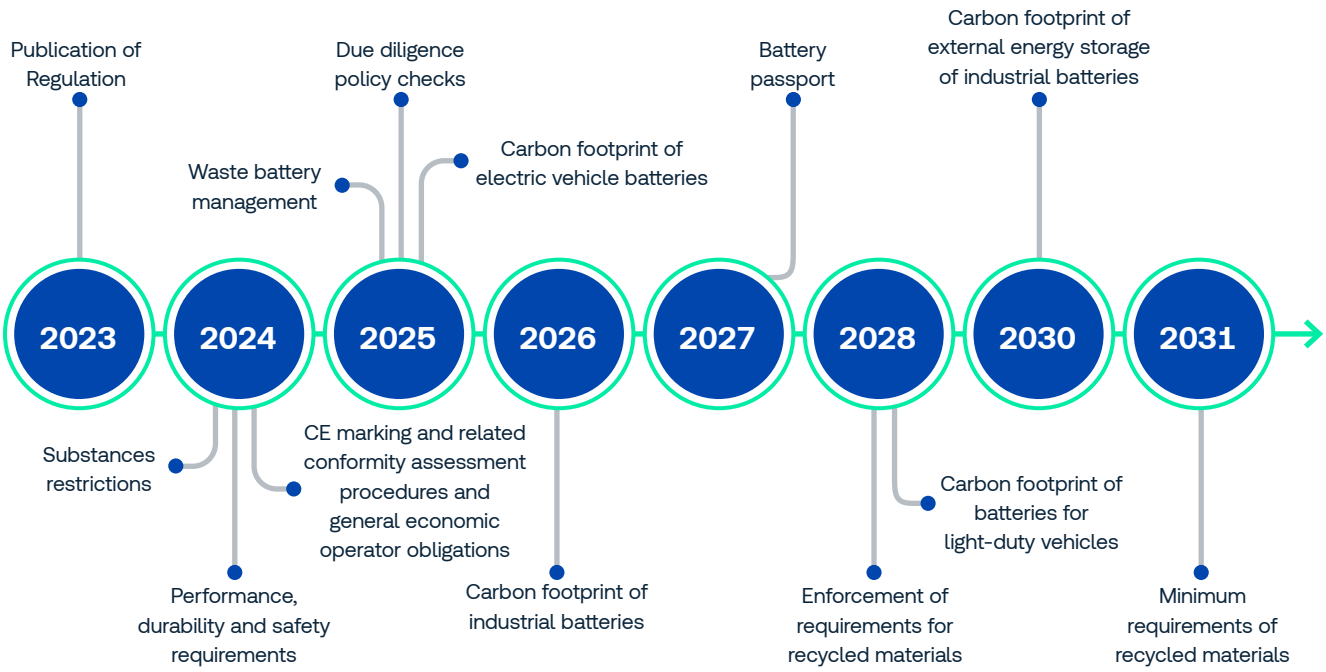
EU Battery Regulation covers electric vehicle batteries, LMT batteries, SLI batteries, industrial batteries, portable batteries, and stationary battery energy storage systems.

Table 1.1 EU Battery Regulation: Battery classification

Battery classification	Battery definition	Battery weight
Electric Vehicle (EV) Battery	Provides electric power for the traction to hybrid or electric vehicles • L category (Regulation (EU) No. 168/2013)or • M, N or O categories (Regulation (EU)2018/858)	> 25kg (L category)
LMT battery	Provides electric power for the traction of wheeled vehicles that can be powered by an electric motor alone or by combination of motor and human power, including type-approved vehicles of category L (EU Battery Regulation 168/2013) such as electric bicycles and electric scooters	≤ 25kg
SLI battery	• Designed to supply electric power for starter, lighting, or ignition • May also be used for auxiliary or backup purposes in vehicles, other means of transport or machinery	-
Industrial battery	• Designed specifically for industrial use or • Intended for industrial uses after being subject to preparing for repurpose or repurposing or • Any battery above 5kg that is not an LMT, EV, SLI battery • Industrial applications include - Industrial activities - Communication infrastructure - Agricultural activities - Energy storage in a private or home environment - Production and distribution of electrical energy - For the traction of other transportation vehicles, including rail, water and air transportation or off-road machinery	> 5kg (If no other category applies)
Stationary battery energy storage systems	• Industrial batteries with internal storage • Specifically designed to store from and deliver electric energy to the grid or store from and deliver electric energy to end users regardless of the location and battery user	-
Portable battery	Not designed for specific industrial use • Encapsulated • Neither an electric vehicle battery, nor a light means of transport battery, nor an SLI battery	≤ 5kg

The EU Battery Regulation contains articles about the restriction of substances, carbon footprint, recycled content, battery performance and durability, removability, safety of stationary battery energy storage systems, labelling and marking, SOH information related to BMS and life expectancy, obligations of economic operators, battery due diligence policies and battery passport while establishing conformity assessment procedures at the same time.

Table 1.2 EU Regulation (EU) 2023/1542 Implementation timeline



02 Requirements of the EU Battery Regulations regarding the restrictions on substances

Article 6 of Chapter II of the Battery Regulation stipulates that the battery must comply with hazardous substance restrictions listed in Annex 17 of the REACH Regulation (Regulation (EC) No. 1907/2006), the ELV (end-of life vehicle) Directive (Directive 200/53/EC) and Annex 1 of the Battery Regulation. Refer to table 2.1. Except for lead in portable batteries, the other conditions have been enforced since February 18, 2024.

Table 2.1 New Battery Regulation on the restriction requirements of hazardous substances

Restriction requirements	Battery type	Implementation date
REACH Annex 17	All batteries	18 February 2024
ELV Directive	Car battery	18 February 2024
Mercury and its compounds ≤ 0.0005% (5 ppm)	All batteries	18 February 2024
Cadmium and its compounds ≤ 0.002% (20 ppm)	Portable battery	18 February 2024
Lead and its compounds ≤ 0.01% (100 ppm)	Portable battery	18 August 2024 18 August 2028 (Zinc-air button battery)

2.1 REACH Annex17 Restriction on substances requirements

REACH (Regulation (EC) No 1907/2006) is a regulation on the registration, evaluation, authorisation and restriction of chemicals imposed by EU. It includes 'restrictions' measures that are used to protect unacceptable risks to human health or the environment posed by chemicals during the process (registration, evaluation, and authorisation). Restrictions are normally used to limit or prohibit the manufacture, market release (including imports) or use of a substance. These restrictions may apply to the substance itself, in mixtures, or substances in products.

However, the scope of "restriction" is limited and is normally targeted at specific use of a substance that pose unacceptable risks while not impacting other uses. The restricted substances and their corresponding restrictions under the REACH Regulation are listed in Annex XVII., which currently contains 78 entries (actual valid entries are 73). Some examples of the restricted substances list are shown on Table 2.2

Table 2.2 REACH Regulation 17 Restricted substances examples

Entry	Name of substance	Common uses
20	Organotin compounds	Stabiliser of polyvinyl chloride (PVC), catalyst for silicone resin or polyester polymer
45	Octabromodiphenyl ether	Flame retardant
51	Phthalate	Plasticiser for plastics (such as PVC)
68	PFASs (C9-C14 PFCAs)	Processing aids for fluorinated polymers (such as PTFE, PVDF)

2.2 ELV Directive: Restricted substance requirements

According to Article 4, Point 2(a), of the EU ELV Directive 2000/53/EC, vehicle materials and components placed on the EU market must not contain lead, mercury, cadmium or hexavalent chromium, unless there is a clear exemption in cases where no suitable alternatives are available. The exemption conditions are listed in Annex 2 of the Regulation and generally require that the lead, mercury, and hexavalent chromium content in homogeneous materials does not exceed 0.1%, and cadmium does not exceed 0.01%.

Please note that the reference weight (the limits are defined as percentage by mass (weight)) for substance limits in the Battery Regulation, the REACH Regulation and the ELV Directive differ. In Annex I of the Battery Regulation, the content of the three metals is limited based on the total weight of the battery, whereas in the ELV Directive it is based on the weight of homogeneous materials. Meanwhile in Annex 17 of the REACH Regulation, the limits of each substance are defined in conjunction with the definition of regulations, product types, and specific restrictions.

2.3 Other regulatory chemical requirements (not explicitly mentioned in the EU Battery Regulation)

2.3.1 POPs Regulation on prohibited substance requirements

Regarding the hazardous substances in batteries, in addition to the abovementioned regulations/directives, there is also a need to comply with the requirements of the EU POPs Regulation (EU) 2019/1021 on prohibited substances. POPs Regulation is implemented by the Stockholm Convention of Persistent Organic Pollutants treaty, aimed at eliminating or restricting the production and use of persistent organic pollutants (POPs) to protect human health and the environment from their harm effects." Similar to Annex 17 of the REACH Regulation, the restriction requirements can be applied to the substance itself, the substance in mixtures or substances in products. Restricted activities include the production of the substance and market release (include import) or usage. The prohibitions and exemptions for POPs are listed in Annex 1 or Annex 2, and some examples are shown in Table 3.

Table 2.3 POPs regulation: Examples of prohibited substances

Name of substance	Common uses
Polybrominated polyphenylene ether (tetra-, penta-, hexa-, hepta- and decaBDE)	Flame retardant
Short-chain chlorinated paraffins	Flame retardant, plasticiser
PFASs (PFOS, PFOA, PFHxS)	Polymerisation additives for fluorinated polymers (such as PTFE, PVDF)

2.3.2 REACH Regulation Candidate list of related substances

In accordance with Article 57 of the REACH Regulation, substances that are identified as substances of very high concern (SVHC) will be included in the authorised candidate list. The list is usually updated twice a year and it currently contains 241 substances. If the battery contains these substances, such as N-methyl pyrrolidone (NMP), the company may subject to regulatory obligations pertaining to information communication and notification.

concentration above 0.1% (by weight), the supplier of the product will need to provide the recipient and consumer with the relevant safety information of the product and submit the product with its relevant SVHC identification information, the concentration level of the SVHC and other data to the SCIP database and to notify SCIP immediately. In addition, based on the concentration level, if the quantity of SVHC of the product exceeds 1 ton per annum, the manufacturer or importer will need to inform ECHA with the relevant information, unless exempted.

The above provides a brief overview of the chemical regulatory requirements for placing batteries on the EU market. Companies must understand their obligations and ensure compliance. Additional requirements from other Regulations / Directives might also be applicable depending on the product specifications (e. g. RoHS Directive (Directive 2011/65/EU)). Market participants bear the ultimate responsibility for their products, therefore it is crucial for them to fully comprehend the entire scope of legislative requirements.

With the rapid development of the new energy vehicle and energy storage industries, battery technology has become increasingly competitive across various markets. However, alongside the pursuit of technological advancements, it is vital to enhance material quality to minimise the introduction of hazardous substances. For example, the plastic and metal components in lithium power batteries may contain high levels of lead. Additionally, PVDF and PTFE, which are commonly used as binders in electrode active materials, may result in the presence of PFOA during production through emulsion polymerisation. The solvents used may also introduce NMP into the battery. Therefore, battery manufacturers will need to conduct stringent screening for hazardous substances in their batteries, based on the composition of battery materials, to ensure compliance with regulatory requirements throughout the production process. Implementing clean production technologies and reducing or substituting raw materials are essential to minimise the risk of violating harmful substance restrictions from the outset.

03 Requirements of carbon footprint of products

Article 7 of EU Battery Regulation stipulates that for electric vehicle batteries, rechargeable industrial batteries with a capacity greater than 2 kWh and LMT batteries, a carbon footprint declaration shall be drawn up for each battery model per manufacturing plant. This article mainly covers 2 topics - the regulatory requirements for the carbon footprint calculation of the battery and the basic requirements for carbon footprint reporting.

3.1 Carbon footprint requirements

The battery carbon footprint calculation and reporting will be conducted by the battery manufacturer based on the methodology specified in the Battery Regulation and the delegated acts mentioned therein, as well as the principles of the PEF method which will be verified by the notified bodies accordingly. The notified body will verify the reliability of the carbon footprint data as claimed by the manufacturer and if the manufacturer has correctly used the calculation methodology as specified in the EU Battery Regulation, and associated provisions. The EU Commission members will provide a template for the carbon footprint labelling in the relevant documents at a later stage.

The carbon footprint statement will at least contain the following:

1. Manufacturer information;
2. Battery model;
3. Actual address of manufacturing plant;
4. The results of the battery's carbon footprint calculations are expressed in kilograms of carbon dioxide equivalent per kilowatt-hour ($kgCO_2e/kWh$). Here, kWh refers to the total electrical energy provided by the battery during its expected service life;
5. The carbon footprint of the battery differentiated based on their life cycle which consists of these 4 stages: raw material acquisition and pre-processing, main product production, distribution, end of life and recycling;
6. Identification number of the EU Declaration of Conformity for batteries;
7. Link to the website that contains the carbon footprint value of the product.

Table 3.1 Battery carbon footprint declaration, performance and maximum threshold implementation date

Battery categories	Carbon footprint declaration	Carbon footprint performance class requirements	Maximum life cycle carbon footprint threshold
Electric vehicle battery	2025-02-18*	2026-08-18**	2028-02-18**
Industrial energy storage battery (without external energy storage)	2026-02-18**	2027-08-18**	2029-02-18**
Light vehicle battery	2028-08-18**	2030-02-18**	2031-08-18**
Industrial energy storage battery (with external energy storage)	2030-08-18**	2032-02-18**	2033-08-18**

Remarks: * indicates 12 months after the delegated act or the implementing act respectively enters into force, whichever is the latest; ** indicates either 18 months after delegated act or the implementing act respectively enters into force, whichever is the latest.

The table above shows the carbon footprint declaration, performance class requirements and maximum life cycle carbon footprint threshold implementation date of various types of batteries. Among the list of battery types, industrial energy storage batteries (with external energy storage) refer to batteries that specifically store energy in external equipment such as flow batteries and hydrogen fuel cells which are different from the currently most common used lithium-ion batteries that store energy inside the battery. With the large number of electric vehicles in the European market, electric vehicle batteries will be the first to require a carbon footprint declaration.

The EU Commission will establish a standard methodology for carbon footprint calculation and verification, as well as templates for carbon footprint declarations. Documentation about the rules for carbon footprint calculation for electric vehicle batteries can now be found on the EC website. Basis is the upcoming delegated act for EV-CFB, already available in a draft version. Additional rules for other battery types will be released in future on the basis of recommendations from JRC.

Hence, for the same type of battery is used in the different fields, it needs to be calculated based on the standards and delegated acts of the relevant fields. The carbon footprint value of the model must be indicated on the product label.

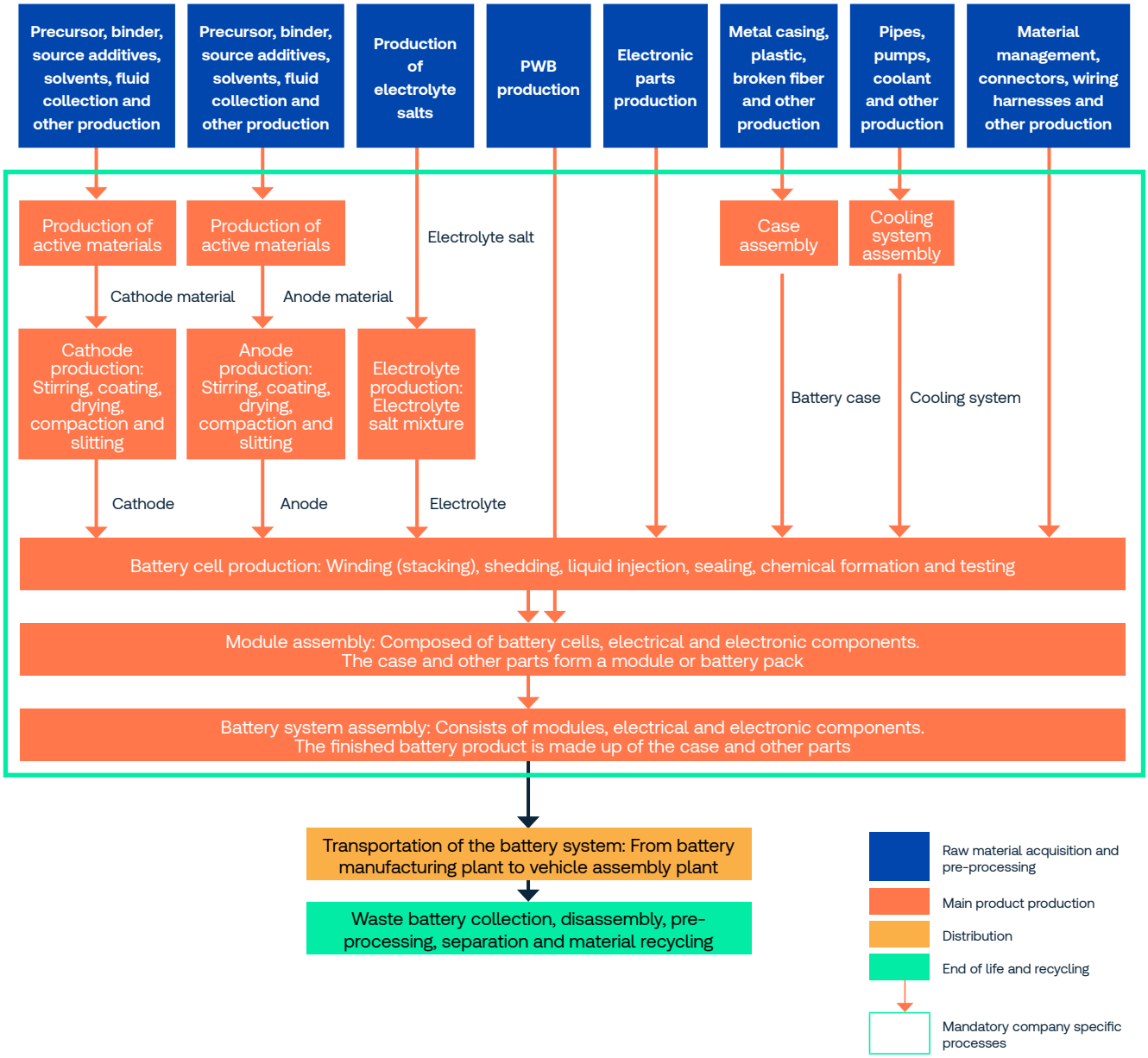
Electric vehicle batteries, industrial batteries with a capacity greater than 2kWh, and light vehicle batteries will need to have their carbon footprint performance level labelled on the products. The EU Commission will be collecting battery carbon footprint distribution values on the EU market for the first three years to determine the maximum battery carbon footprint threshold. The carbon footprint performance level will be reclassified based on the maximum carbon footprint threshold. Therefore, battery manufacturers will need to ensure that the calculation of the carbon footprint values are realistic and accurate and based on actual manufacturing levels.

The Commission will need to evaluate the feasibility of a carbon footprint declaration for portable batteries and industrial batteries with a capacity of less than 2kWh before December 31, 2030. There is no need to re-evaluate the carbon footprint of batteries that already exist in the EU market or those that have been put into use, used or manufactured for a second time.

3.2 Basic requirements for carbon footprint calculation

Product carbon footprint calculation and verification methodology should follow the product environmental footprint method (PEF) which is based on life cycle assessment and its related product environmental footprint category rules (PEFCRs). The calculation of the product carbon footprint should be based on the list of raw materials (BOM), energy and auxiliary materials. Especially for electronic components such as battery management components, safety components, and cathode materials which should be accurately identified and calculated because they could be the main source of the battery carbon footprint.

Figure 3.2 EV battery carbon footprint system boundary and data collection requirements



Note: Refer to CFB-EV power batteries carbon footprint calculation rules

Other types of batteries, such as CTP designs, anode-free batteries, etc., may have different system boundary process flows. Each box represents the process while each arrow represents the activity data, such as kg solvent and kg additive. The different colours (blue, orange, yellow, and green) represent the different stages of the life cycle. The orange arrows and borders that indicate the process and activity data must be associated to the company. PWB refers to printing circuit boards.

Table 3.2 Stages of the battery carbon footprint life cycle

Life cycle stage	Includes process
Raw material aquisition and pre-processing	Includes mining, transportation and pre-processing of active materials, batteries and battery parts such as active substances, diaphragms, electrolytes, production of casings and electrical or electronic components
Main product production	Production of battery cells, the assembly process of battery cells and parts of the finished battery product
Distribution	Ship to the sales location
End of life and recycling	Collection, disassembly and recycling

Table 3.2 shows the life cycle stages of the battery's carbon footprint. The four stages must be included withing the system boundary. Preceding text lists down the system boundary of the battery's carbon footprint. The following processes must be excluded from the system boundary:

1. The production equipment used for battery assembly and recycling because studies have shown that the impact from the production equipment on the carbon footprint of the battery is negligible;
2. The production of packaging materials;
3. The OEM parts assembly process of the battery system as these processes are conducted via mechanical assembly and moreover, conducted inside the OEM equipment or on the vehicle assembly line. There is little impact from the energy and material consumption process;
4. The auxiliary inputs to manufacturing plants that are not directly related to the battery production process, including heating and lighting of associated office rooms, secondary services, sales processes, administrative and research departments;
5. The battery usage phase must be excluded in the calculation of the battery's carbon footprint, because it does not directly impact the battery manufacturer.

3.3 Functional unit and reference flow

The functional unit refers to the total energy provided by the battery system during the entire service life, and the unit is kWh. The total energy is obtained by multiplying the energy capacity with full equivalent charge-discharge cycles per year and the years of operation. The reference flow is the weight of the battery per functional unit used to achieve a specific function, and the unit of measurement is kg/kWh. kWh refers to the total energy released by the battery throughout its service life. When calculating battery carbon footprint, all input and output information collected by the battery manufacturer must be taken into consideration with the reference flow.

When considering whether backup batteries can serve as a sustainable power source, the primary focus is on the battery's power output capacity throughout its entire lifecycle. The functional unit for this type of battery is measured in KWmin. Consequently, the reference flow of the backup battery is determined by the weight of the battery per functional unit per year during its service life, expressed in kg/KWmin. When calculating the backup battery carbon footprint, all input and output information collected by the battery manufacturer must be taken into consideration with the reference flow.

The carbon footprint calculation methodology will need to clearly indicate that for other specific types of batteries, such as those used in plug-in hybrid vehicles, uses different functional units.

3.4 Company-specific data and secondary data

Due to the complexity of battery manufacturing process and the large number of parts and components, manufacturing operators mainly have to use company-specific data for the most important processes (c.f. Figure 3.2).

Specifically for any activity data related to the anode, cathode, electrolyte, diaphragm and battery casing, it is compulsory to make reference to the data of the specific battery model produced by the manufacturing plant. Similarly, the default activity data cannot be used. The activity data of the specific battery must be used in conjunction with the official EC LCDN secondary data of the related product.

Since the battery carbon footprint declaration is linked to the specific model of the battery produced at a specified production location, the use of activity data of other production plants that produce the same battery model is prohibited when calculating the carbon footprint.

If there is a change in the list of raw materials and energy mixture during the production of a specific type of battery and the carbon footprint of that battery increases by more than 10% compared to the carbon footprint calculated, this shall be considered a change to the battery's technical characteristics relevant for the requirements of Regulation (EU) 2023/1542 and thus for the new battery model a new carbon footprint shall be calculated and a new carbon footprint declaration shall be drawn up.

04 Management of waste batteries and use of recycled content

4.1 Collection of waste portable and LMT batteries

Basic definition

- Portable battery: sealed, weighs less than 5kg, not designed for industrial use, any type of battery in non-electric vehicles or automobile;
- LMT battery (light means of transport battery): Any sealed battery that weighs less than or equal to 25kg and is designed to provide electric power for traction of wheeled vehicles but does not include electric vehicle batteries.

Basic requirements

1. Set up a waste battery recycling and collection system;
2. Work with distributors, end-of-life vehicle disposal agencies, public authorities or third parties in waste management, voluntary collection points, waste electrical and electronic equipment treatment facilities to set up free waste battery collection points;
3. Provide necessary arrangements for the collection and transportation of waste batteries, such as equipment suitable for collection and transportation;
4. Collect waste portable batteries, including those from waste electrical and electronic equipment, free of charge from designated points. Ensure collection frequency is proportionate to the area, volume, and hazardous nature of the batteries to maintain safety and regulatory compliance;
5. Ensure that the waste batteries are collected from the waste battery collection points (waste electrical and electronic equipment must be removed from the waste batteries) and are subsequently processed by waste management operators in approved facilities.

Waste battery collection targets rates:

- Portable battery:

Attain 45% in 2023;
Attain 63% in 2027;
Attain 73% in 2030.

- LMT battery:

Attain 51% in 2028;
Attain 61% in 2031.

The European Commission is empowered to amend the defined methodology, as outlined in Annex XI of the EU Battery Regulation, used to calculate and verify the recycling rate of LMT and portable batteries before 18 August 2027, in view of market developments.

4.2 Collection of waste batteries-SLI batteries, industrial batteries, electric vehicle batteries

Current regulations outline no fixed collection targets for SLI batteries (batteries used for car start-up, lighting, and ignition), industrial batteries (batteries designed for industrial use), and electric vehicle batteries. However, the regulations have stated clearly that the parties are responsible for waste batteries collection. Manufacturers of SLI batteries, industrial batteries, and electric vehicle batteries are required to collect batteries purchased by the end users for free and to collect the different types of batteries separately. Battery manufacturers can either collect the waste batteries themselves or collaborate with organisations to establish collection points for the collection of waste batteries.

Currently, the four categories of collection points recognised by the European Union are as follows:

1. Distributors of SLI batteries, industrial batteries and electric vehicle batteries;
2. Operators that re-manufacture or reuse SLI batteries, industrial batteries, and electric vehicle batteries;
3. Waste electrical and electronic equipment as well as scrap car processing facilities, operators that handle waste SLI batteries, waste industrial batteries and waste electric vehicle batteries generated during the operation process;
4. Public authorities or third-party handling waste management.

In addition, the Regulation has also put forth the requirements for the manufacturers and organisations of SLI batteries, industrial batteries and electric vehicle batteries;

1. Provide appropriate collection facilities for the recycling and collection systems;
2. The collection frequency, together with the quantity and hazardous nature of the waste batteries typically collected through these retrieval and collection systems, should be proportional to the storage capacity of the collection sorting facilities;
3. The collected waste SLI batteries, waste industrial batteries and waste electric vehicle batteries are to be transported to approved facilities for recycling;
4. The Commission has the right to enforce a law that stipulates that the waste LMT batteries, waste industrial batteries, or waste electric vehicle batteries must meet the detailed technical and verification requirements to confirm they are no longer waste products.

4.3 Battery recycling management requirements

Table 4.3.1 Battery recycling efficiency

Time	Lead-acid battery	Lithium-based battery	Nickel-cadmium battery	Other battery
Not later than 2025	75%	65%	80%	50%
Not later than 2030	80%	70%	-	-

Table 4.3.2 Minimum level for material recycling

Time	Lithium	Cobalt, copper, lead, nickel
Not later than 2027	50%	90%
Not later than 2031	80%	95%

The EU Commission will determine the methodology for calculation and verification of the efficiency of battery recycling and standard for material recycling before 18 February 2025.

4.4 Proportion of recycled content

Material recycling

EV batteries, SLI batteries, and industrial batteries with a capacity greater than 2kWh (except for those with external energy storage only) will start from 2028 and LMT batteries will start from 2033. The technical documents attached to "every year, every model of battery, and every factory" consist of:

1. The percentage share of cobalt, lithium, and nickel recycled from battery manufacturing waste or post-consumer waste present in the active materials;
2. Percentage share of lead recycled from battery waste.

In addition, the above-mentioned percentage share must meet the minimum levels set by the EU before 2031 and 2036 respectively. The details are in the table below.

Table 4.4.1 Recycled content requirements

Time	Cobalt (Co)	Lead (Pb)	Lithium (Li)	Nickel (Ni)
2031 (eight years after the Regulation enters into force)	16%	85%	6%	6%
2036 (13 years after the Regulation enters into force)	26%	85%	12%	15

Within 36 months after bill takes comes into force, the Commission will formulate and adopt:

1. Detailed calculation and verification methodology of the recycled content;
2. Enforcement of the bill of the recycled content declaration format and technical documents.

05 Requirements of performance and durability

If safety forms the basis for the existence of batteries, then the merits of batteries depend on their performance and durability. The EU requires batteries sold on the market to be durable and high-performing. Therefore, it is essential for the Regulation to establish the performance and durability parameters for commonly used portable batteries, rechargeable industrial batteries, LMT batteries, and electric vehicle batteries.

Regarding electric vehicle batteries, the United Nations Economic Commission for Europe Informal Working Group on Electric Vehicles and Environment has formulated the durability requirements for vehicles. These requirements will be implemented in the EU, and in the future, the type approval of motor vehicles, engines, systems, components, and separate technical units will be regulated. The utilisation of technical skills for such vehicles depends on their emissions and battery durability (Euro 7).

On the other hand, in the field of energy storage batteries, the current measurement methodology for testing battery performance and durability is deemed to be inaccurate and not representative enough to set the minimum requirements. When minimum requirements related to the performance and durability of these batteries are introduced, it is necessary to provide uniform standards or general specifications at the same time.

For portable batteries, the EU Commission will evaluate the feasibility of implementing measures to phase out ordinary non-rechargeable portable batteries. This evaluation will be based on their life cycle and alternatives for end users. At the very least, this can reduce the environmental impact of batteries.

The EU Commission will pass a Delegated Act in accordance with article 89 to mandate the minimum values of electrochemical performance and durability parameters of commonly used portable batteries (except button batteries). The table below shows the list of the performance and durability parameters as per regulations and the current standards as a point of reference.

Table 5.1 Primary battery regulatory requirements

Regulatory requirements	Reference standard
Minimum average discharge time	IEC 60086-1/2
Discharge performance after storage	IEC 60086-1
Leakage prevention	IEC 60086-1

Table 5.2 Rechargeable battery regulatory requirements

Regulatory requirements	Reference standard
Specified capacity	IEC 61960-3, IEC 61951-1/2
Charge (capacity) retention	IEC 61960-3, IEC 61951-1/2
Charge (capacity) recovery	IEC 61960-3
Life cycle	IEC 61960-3, IEC 61951-1/2
Leakage prevention	IEC 61951-1/2

For rechargeable industrial batteries, LMT batteries and electric vehicle batteries with a capacity greater than 2 kWh, the minimum requirements for its electrochemical performance and durability will also be specified. The table below shows the list of relevant requirements and existing reference standards.

Table 5.3 Parameters related to electrochemical performance and durability

Regulatory requirements	LMT battery	EV battery	Industrial battery
Fixed capacity (Ah) and Capacity fade (%)	ISO 18243	prEN 18060	IEC 62620
Power (W) and Power fade (%)	ISO 18243	prEN 18060	-
Internal resistance (Ω) and Increase in internal resistance (%)	ISO 18243	prEN 18060	IEC 62620
If applicable, energy cycle efficiency and its attenuation (%)	-	prEN 18060	-
Expected life time, including cycles and calendar life in years	ISO 18243	prEN 18060	IEC 62620

Table 5.4 Provides an explanation the results of the measurement parameters as listed in A

Regulatory requirements	LMT battery	EV battery	Industrial battery
Charge / discharge current	ISO 18243	prEN 18060	-
Ratio between nominal battery power (W) and battery energy (Wh).	ISO 18243	prEN 18060	-
Depth of discharge in the cycle-life test.	ISO 18243	prEN 18060	IEC 62620
Power at 80% and 20% at state of charge.	-	prEN 18060	-
Any calculation is done based on the measured parameters	-	-	-

One of the highlights of the new EU Battery Regulation is the battery passport which provides users and relevant stakeholders information on battery performance and durability. This includes insights into the battery's State of Health (SOH), ensuring that stakeholders are informed about the battery's current condition and long-term viability.

The main highlight of the batteries is that the Battery Regulation require its performance and durability to be stated. In addition, understanding the residual performance and durability of individual batteries is critical for the secondary use of batteries or for users to be able to identify their residual value. Therefore, the performance and durability data will be passed on to end users through the battery passport, which is also an important factor in ensuring sustainable and circular use of battery.

EU Battery Regulation stipulates the State of Certified Energy (SOCE) for electric vehicle batteries, which represents the remaining capacity as a percentage. Economic operators believe that below this value, the battery capacity is insufficient for continued use in electric vehicles. SOCE serves as the reference data for the State of Health (SOH) of electric vehicle batteries and can replace the remaining capacity as a key metric.

The remaining capacity is the dynamic counterpart of the rated capacity, and it determines the capacity fade. Currently, it is only compulsory to report for startionary battery energy storage systems and LMT batteries on the battery passport. In the future, all battery categories will be required to state their remaining capacity. The measurement of both fixed capacity and remaining capacity must be defined according to standards, such as the C-rate (battery charging and discharging rate), the shelving time between charging and discharging, and the operating temperature.

For both LMT and industrial batteries, pre-standards are currently under development to set clear benchmarks for performance and durability. Concurrently, the European Commission is formulating delegated acts to outline technical thresholds, establish durability standards, and specify reporting requirements. It is crucial for manufacturers and stakeholders to remain informed and adaptable to these changing standards to ensure compliance and maintain a competitive edge in the market.

The remaining capacity is the dynamic counterpart of the rated capacity, and it determines the capacity fade. Currently, it is only compulsory to report for stationary battery energy storage systems and LMT batteries on the battery passport. In the future, all battery categories will be required to state their remaining capacity. The measurement of both fixed capacity and remaining capacity must be defined according to standards, such as the C-rate (battery charging and discharging rate), the shelving time between charging and discharging, and the operating temperature.

The charging-discharging cycle count alone doesn't accurately reflect battery lifespan due to varying usage patterns, especially with fast charging. Expected lifetime includes both cycling aging and calendar aging, which vary depending on the application.

It will be easier for end users to understand the battery life in calendar year rather than the expected number of charge-discharge cycles used. The commercial warranty period provides a life expectancy guarantee. Besides providing guarantee to the minimum remaining capacity within a certain period or use or SOCE, it needs the battery life to be specified in calendar years. This value may be different from the commercial warranty period as provided above. Moreover, the actual battery lifespan may exceed the warranty period.

The durability of the battery will be impacted by how the battery is used under different environmental conditions. Particularly, temperature, which has a significant impact on the aging process of the battery. Battery regulatory economic operators provide static data on the temperature range, specifying the lower and upper limits in degree Celsius. They also provide information on the duration of exposure to extreme temperatures and the time taken to charge the battery under these extreme temperature conditions.

Moreover, the battery performance and durability are impacted by negative events, particularly on the number of times during deep discharge. The deep discharge of the battery may cause irreversible damage to the battery due to the deterioration of the active material. Deep discharge events are usually obtained by detecting whether the voltage drops below the operating limit. In the current battery system consisting of BMS, the BMS will monitor the voltage level, to prevent deep discharging and material deterioration during operation. Ideally, the number of deep discharge events should remain at zero. If a deep discharge does occur, battery operation must be halted immediately, followed by a thorough inspection. Additionally, it is important to record any overcharging incidents and other adverse events. This will improve the workplace safety during the disassembly of the battery packs and modules.

The performance and durability requirements are the first set of regulatory requirements enforced starting 18 August 2024, alongside the restricted substances requirements stipulated in the current Battery Directive. It is necessary for battery enterprises to develop verification plans for performance and durability earlier, with a focus on accelerated life testing solutions.

Battery durability is crucial in meeting other requirements of the new Battery Regulation, especially concerning the carbon footprint value. Improving battery life can lead to a reduction in battery's carbon footprint. Additionally, incorporating recycled content is not only a mandate of the new Battery Regulation, but may also bring about a positive impact on battery's performance and durability. Therefore, battery companies need to conduct more in-depth research in this area.

Implementing the new Battery Regulation involves adhering to rigorous performance and durability standards, which can be time-consuming and labor-intensive. However, battery companies that proactively prepare and conduct comprehensive testing to verify their batteries' performance and durability to ensure compliance with the EU's delegated act can confidently navigate the approval process.

06 Safety requirements of stationary battery energy storage systems

As previous contents mentioned, the EU Battery Regulation has officially entered into force from August 17, 2023. The purpose of this Regulation is to prevent and reduce the adverse effects of batteries on the environment, and to ensure sustainability and safety of all batteries.

Safety forms the basis for the existence of products. Article 5 of the regulations stipulates that batteries must meet the requirements of sustainability, safety, labelling and information, and batteries must not cause damage to human health, personal safety, property or the environment. For all batteries, safety is a prerequisite and compulsory requirement to be allowed in the market or put into use.

For the safety of electric vehicle batteries and ignition, lighting and ignition batteries (SLI batteries), according to European Regulation (EU) 2018/858, the EU type certification for M, N and O vehicles continues to be valid. The Parliament and Council require that any repaired or replaced batteries must continue to meet the necessary safety requirements. If there is any change in the safety details, further inspections or tests must be conducted to verify that they are still able to meet the requirements based on the current EU type of certification.

Reliable batteries form the basis for the operation and safety of many products, appliances, and services. As such, the design and manufacture of batteries should ensure that they do not pose a risk to human health or personal safety, property or the environment. This is especially important for stationary battery energy storage systems, which are currently not covered by other EU laws. Therefore, the new EU Battery Regulation contains a list of parameters that shall be used as a reference for the safety testing of these batteries.

For stationary battery energy storage systems, Article 12 of the Regulation requires that stationary battery energy storage systems are safe during their normal operation and use.

6.1 Evaluation Methodology

Firstly, manufacturers need to conduct hazard analysis and risk assessment of fixed battery energy storage systems (Hazards analysis and risk assessment). The safety risks analysis will cover the entire life cycle of the battery system and system levels (batteries, modules, battery packs, battery systems). For identified hazards, the manufacturer needs to explain what risk reduction measures have been taken and provide evidence to prove the effectiveness of these measures by testing.

Secondly, Annex V of the regulations listed 11 safety parameters, which mainly correspond to the safety risks that exist in batteries. If the battery passes these tests, it is proven that the battery is safe in these aspects.

For the safety risks that are not covered in Annex V, manufacturers will need to submit evidence to show that the corresponding risks have been successfully reduced (such as tests), and such tests should adopt the use of the latest test methodology.

The manufacturer will need to provide the technical documentation required by Annex VIII of the regulations before 18 August 2024, covering the abovementioned requirements.

Although the delegated act and harmonised standards corresponding to the current safety testing have not been released, there are other standards such as EN IEC 62619:2022, EN IEC 63056:2020 and other international standards that are widely accepted and recognised by the market with regards to the safety of battery energy storage systems. These standards basically cover the safety parameters in Annex V of the Regulation hence it is still feasible to evaluate the safety requirements of regulations for stationary battery energy storage systems at this stage.

TÜV SÜD has developed a safety testing program, PPP 51098A, specifically for stationary energy storage systems in accordance with battery regulatory requirements and existing international standards. This program can provide the relevant testing and certification services for battery manufacturers.

The table below shows relationship between the safety parameters in Annex V and the existing international standards:

Annex V Safety parameters	Corresponding standards	Test object
1. Thermal shock and cycling	UL 1973:2022	Battery system
2. External short circuit protection	EN IEC 62619:2022, EN IEC 63056:2020	Battery cells, modules and battery systems
3. Overcharge protection	EN IEC 62619:2022	Battery cells and battery systems
4. Over-discharge protection	EN IEC 62619:2022, EN IEC 63056:2020	Battery cells and battery systems
5. Over-temperature protection	EN IEC 62619:2022	Battery systems
6. Thermal propagation protection	EN IEC 62619:2022 UL 9540A:2019	Battery systems Battery cells (Contains combustible and toxic gas component detection)
7. Mechanical damage by external forces	EN IEC 62619:2022, EN IEC 63056:2020	Battery cells and battery systems
8. Internal short circuit	EN IEC 62619:2022	Battery cells
9. Thermal abuse	EN IEC 62619:2022	Battery cells
10. Fire test	UL 1973:2022	Battery cells and battery systems
11. Emission of gases	The requirements for gas emissions must also be taken into consideration during the tests.	-

6.2 The 11 safety parameters in Annex V

1. Thermal shock and cycling
The objective of this test is to evaluate changes in the integrity of the battery arising from expansion and contraction of cell components upon exposure to extreme and sudden changes in temperature, and potential consequences of such changes. During a thermal shock, the battery shall be exposed to two temperature limits and held at each temperature limit for a specified period.

2. External short circuit protection
This test shall evaluate the safety performance of a battery when applying an external short circuit. The test can evaluate the activation of the overcurrent protection device or the ability of cells to withstand the current without reaching a hazardous situation (e.g. thermal runaway, explosion, fire). The main risk factors are heat generation at cell level and electrical arcing, which can damage circuitry or lead to reduced isolation resistance.

3. Overcharge protection
This test shall evaluate the safety performance of a battery in overcharge situations. The main safety risks during overcharge are the decomposition of the electrolyte, cathode and anode breakdown, exothermic decomposition of the solid electrolyte interphase (SEI) layer, separator degradation, and lithium plating, which can lead to self-heating of the battery and thermal runaway. The factors affecting the outcome of the test shall, as a minimum, include, the charging rate and the finally reached state of charge (SOC). The protection can be ensured either by voltage control (interruption after reaching the limit charging voltage) or current control (interruption after exceeding maximum charging current).

4. Over-discharge protection
This test shall evaluate the safety performance of a battery in over-discharge situations. Safety risks during over-discharge include polarity reversal leading to oxidation of the anode current collector (Copper) and to plating on the cathode side. Even minor over-discharge can cause dendrite formation and ultimately short-circuiting.

5. Over-temperature protection
This test shall evaluate the effect of temperature control failure or failure of other features for protection against internal overheating during operation.

6. Thermal propagation protection
This test shall evaluate the safety performance of a battery in thermal propagation situations. A thermal runaway in one cell can cause a cascading reaction throughout the entire battery which can be composed of numerous cells. It can lead to severe consequences including a significant gas release. The test shall consider the tests that are under development for transport applications by ISO and the UN Global Technical Regulation.

7. Mechanical damage by external forces
These tests shall simulate one or more situations in which a battery is accidentally exposed to mechanical stresses and remains operational for the purpose for which it was designed. The criteria to simulate these situations should reflect real life uses.

8. Internal short circuit
This test shall evaluate the safety performance of a battery in internal short-circuit situations. The occurrence of internal short circuits, one of the main concerns for battery manufacturers, potentially leads to venting, thermal runaway, and sparking which can ignite the electrolyte vapours escaping from the cell. The generation of such internal short circuits can be triggered by manufacturing imperfections, the presence of impurities in the cells or dendritic growth of lithium is the cause of most in-field safety incidents. Multiple internal short circuit scenarios are possible (e.g. electrical contact of cathode/anode, aluminium current collector/copper current collector, aluminium current collector/anode) each with a different contact resistance.

9. Thermal abuse
During this test, the battery shall be exposed to elevated temperatures (in IEC 62619 the temperature is 85 °C) which can trigger exothermal decomposition reactions and lead to a thermal runaway in the cell.

10. Fire test
The risk of explosion shall be assessed by exposing the battery to fire.

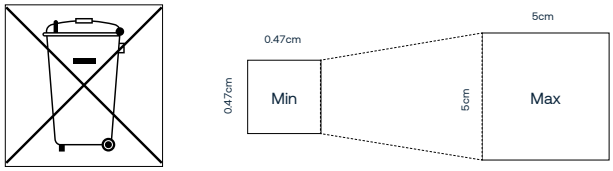
11. Emission of gases
Batteries can contain significant amounts of potentially hazardous materials, for example highly flammable electrolytes, corrosive and toxic components. If exposed to certain conditions, the integrity of the battery could be compromised, resulting in the release of hazardous gases. Therefore, it is important to identify emissions of gases from substances released from the battery during tests: the risk of toxic gases emitted from non-aqueous electrolytes shall be properly considered for all safety parameters listed in points 1 to 10.

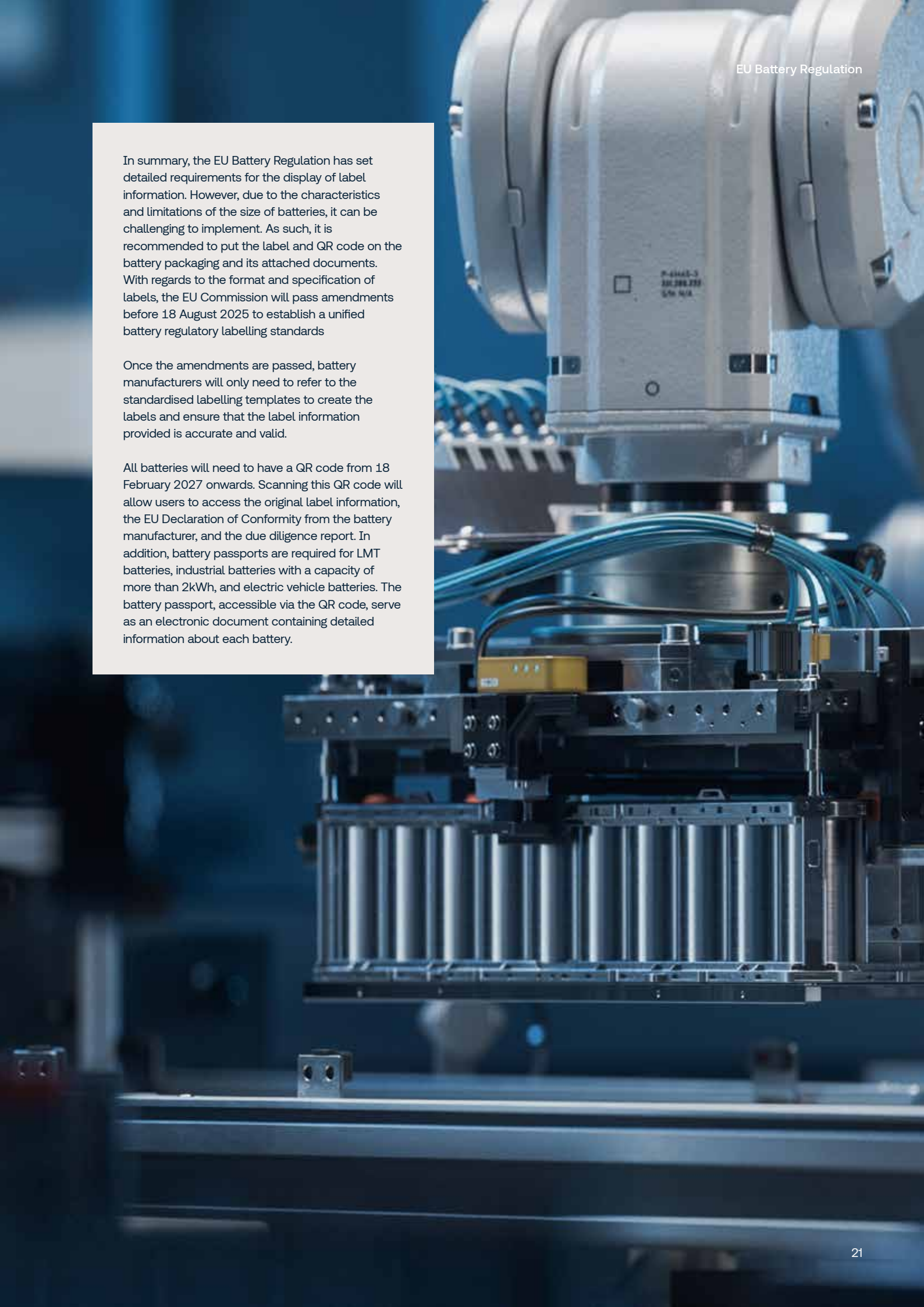
The safety requirements of the Battery Regulation has taken effect on August 18, 2024. This inaugural implementation of regulatory standards supplements the existing restricted substance directives in the current battery directive. Battery companies must ensure that their products comply with these new safety standards to avoid rejection by the EU market after the specified date.

07 Battery labelling requirements

The new EU Battery Regulation includes detailed requirements regarding battery labelling information. In fact, there are already regulations on battery labelling requirements in the older version of Batteries Directive 2006/66/EC, but it is not as detailed as the new EU Battery Regulation. The Directive 2006/66/EC is valid with a transitional period of 2 years (until 18.08.2025).

The labelling requirements of the new EU Battery Regulation has entered into force from 18 February 2024. The detailed requirements and effective dates are as follows:

Effective requirements	Battery types	Effective date
Art. 13 (1): Batteries shall bear a label containing the general information on batteries set out in Part A of Annex VI.	All batteries	08/18/2026*
Art. 13 (2): Batteries shall bear a label containing information on their capacity	Rechargeable portable batteries, LMT batteries and SLI batteries	08/18/2026*
Art. 13 (3): Batteries shall bear a label containing information on their minimum average duration when used in specific applications and a label indicating 'non-rechargeable'.	Non-rechargeable portable batteries	08/18/2026*
Art.13 (4): Batteries shall be marked with the symbol for separate collection of batteries ('separate collection symbol') as shown in Part B of Annex VI (The requirements of the Battery Directive 2006/66/EC Article 21 (1) apply until the effective date of this Article.) 	All batteries	08/18/2025
Art. 13 (5): Batteries containing more than 0.002 % cadmium or more than 0.004 % lead, shall be marked with the chemical symbol for the metal concerned: Cd or Pb. The relevant chemical symbol indicating the heavy metal content shall be printed beneath the separate collection symbol and shall cover an area of at least one-quarter the size of that symbol.	All batteries	02/18/2024
Art. 13 (6): Batteries shall be marked with a QR code as described in Part C of Annex VI. The QR code shall provide access to the following: a) for LMT batteries, industrial batteries with a capacity greater than 2kWh and electric vehicles batteries, the battery passport in accordance with Article 77 b) for other batteries, the applicable information referred to in paragraphs 1 to 5 of this Article, the declaration of conformity referred to in Article 18, the report referred to in Article 52(3) and the information regarding the prevention and management of waste batteries laid down in Article 74(1), points (a) to (f) c) for SLI batteries, the amount of cobalt, lead, lithium or nickel recovered from waste and present in active materials in the battery, calculated in accordance with Article 8. This information shall be complete, up-to-date and accurate	All batteries	02/18/2027
Art. 13 (7): The labels and the QR code referred to in paragraphs 1 to 6 shall be printed or engraved visibly, legibly and indelibly on the battery. Where this is not possible or not war-ranted on account of the nature and size of the battery, the labels and the QR code shall be affixed to the packaging and to the documents accompanying the battery.	All batteries	02/18/2024
Art. 38 (6): Manufacturers shall ensure that batteries which they place on the market bear a model identification and batch or serial number, or product number or another element allowing their identification. Where the size or nature of the battery does not allow it, the required information shall be provided on the packaging or in a document accompanying the battery.	All batteries	08/18/2024
Art. 38 (7): Manufacturers shall indicate on the battery their name, registered trade name or registered trade mark, their postal address, indicating a single contact point, and, if available, web and email address. Where that is not possible, the required information shall be provided on the packaging or in a document accompanying the battery. The contact details shall be indicated in a language or languages which can be easily understood by end-users and market surveillance authorities, as determined by the Member State in which the battery is to be placed on the market or put into service, and shall be clear, understandable and legible.	All batteries	08/18/2024
Art. 41 (3): Importers shall indicate on the battery their name, registered trade name or registered trade mark, their postal address, indicating a single contact point, and, if available, web and email address. Where that is not possible, the required information shall be provided on the packaging or in a document accompanying the battery. The contact details shall be in a language or languages which can be easily understood by end-users, as determined by the Member State in which the battery is to be made available on the market, and shall be clear, understandable and legible.	All batteries	08/18/2024



In summary, the EU Battery Regulation has set detailed requirements for the display of label information. However, due to the characteristics and limitations of the size of batteries, it can be challenging to implement. As such, it is recommended to put the label and QR code on the battery packaging and its attached documents. With regards to the format and specification of labels, the EU Commission will pass amendments before 18 August 2025 to establish a unified battery regulatory labelling standards

Once the amendments are passed, battery manufacturers will only need to refer to the standardised labelling templates to create the labels and ensure that the label information provided is accurate and valid.

All batteries will need to have a QR code from 18 February 2027 onwards. Scanning this QR code will allow users to access the original label information, the EU Declaration of Conformity from the battery manufacturer, and the due diligence report. In addition, battery passports are required for LMT batteries, industrial batteries with a capacity of more than 2kWh, and electric vehicle batteries. The battery passport, accessible via the QR code, serve as an electronic document containing detailed information about each battery.

08 Compliance assessment

The conformity assessment procedure is conducted by a designated notified body before the sale of the battery and shall prove that it fulfils the legal requirements. As part of the conformity assessment, the economic operator in-charge shall draft relevant technical documents that complies with the obligations of manufacturers and importers which will form the basis for the conformity assessment procedure.

Only authorised notified bodies can perform conformity assessment procedures. As such, the notified body is authorised to evaluate the technical documents and quality system, and conduct inspections, calculations, measurements and tests. When the conformity assessment procedure has proven that the battery meets the relevant regulatory requirements, the economic operator in-charge will draft the EU Declaration of Conformity and affixes the CE mark.

The following provisions in the Battery Regulation require the corresponding conformity assessments:
- Article 6: Restrictions on substances
- Article 7: Carbon footprint
- Article 8: Recycled content
- Article 9: Performance and durability requirements for portable batteries of general use
- Article 10: Performance and durability requirements for rechargeable industrial batteries, LMT batteries and electric vehicle batteries
- Article 12: Safety of stationary battery energy storage systems
- Article 13: Labelling and marking of batteries
- Article 14: Information on the state of health and expected lifetime of batteries

If the evaluation shows non-conformity, the responsible economic operator must address and rectify them. If rectification is not possible, each Member State will implement appropriate measures to restrict or prohibit the sale of these batteries in the market or ensure their removal or recall from the market.

The test report results should show conformity with the EU Battery Regulation. These test reports are part of the conformity assessment procedure and need to be included in the technical documentation. The following section provides an introduction of the conformity assessment and its related content:

8.1 Procedures for conformity assessment

Article 17 of the Battery Regulation stipulates the conformity assessment of batteries with the requirements laid down in Articles 6, 9, 10, 12, 13 and 14 shall be carried out in accordance with one of the following procedures:

a) for batteries manufactured in series:
- 'Module A – Internal production control', set out in Part A of Annex VIII, or
- 'Module D1 – Quality assurance of the production process', set out in Part B of Annex VIII;

b) or batteries not manufactured in series:
- 'Module A – Internal production control', set out in Part A of Annex VIII, or
- 'Module G – Conformity based on unit verification', set out in Part C of Annex VIII

Conformity assessment of batteries with requirements laid down in Articles 7 and 8 shall be carried out in accordance with one of the following procedures:
1) 'Module D1 – Quality assurance of the production process' set out in Part B of Annex VIII for batteries manufactured in series;
2) 'Module G – Conformity based on unit verification' set out in Part C of Annex VIII for batteries not manufactured in series.

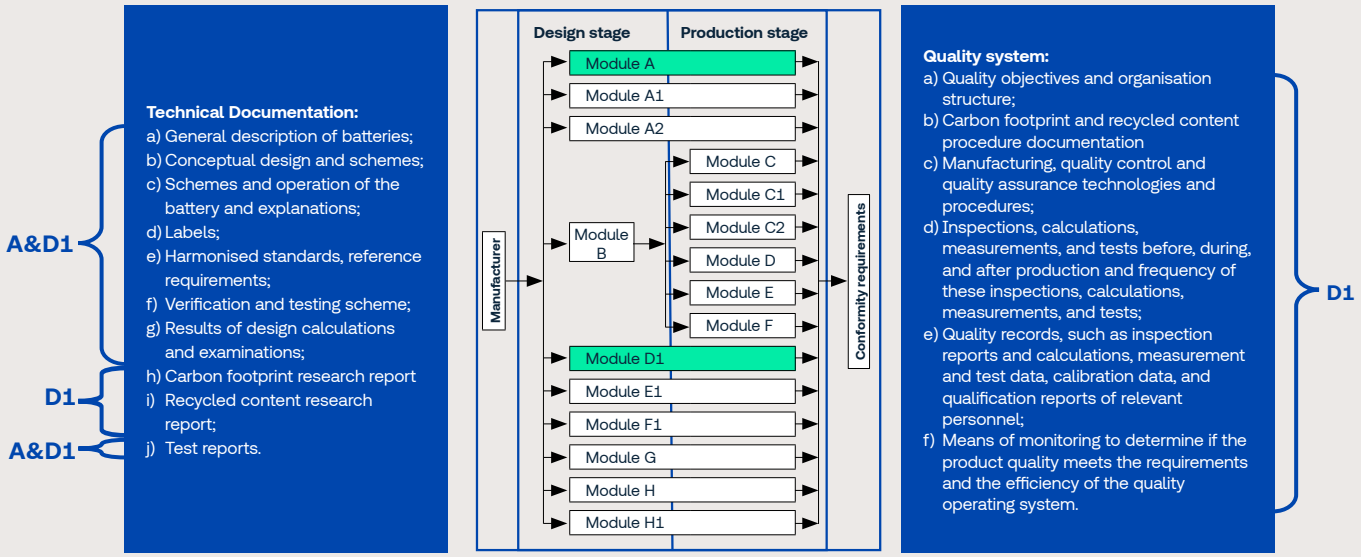
According to the above requirements, for battery products that are manufactured in series, there are two options to choose from:
1) Conduct conformity assessment in accordance with "Module A-Internal Production Control" in Articles 6, 9, 10, 12, 13 and 14; Conduct conformity assessment in accordance with "Module D1-Quality Assurance of the Production Process" in Articles 7 and 8, or
2) Conduct conformity assessment in accordance with Module D1-Quality assurance of the production process" in Articles 6, 7, 8, 9, 10, 12, 13, 14

8.2 How can battery manufacturers manage and ensure compliance

Since Article 7 on Carbon footprint and Article 8 on Recycled content must be evaluated in accordance with Module D1, manufacturers need to prepare accordingly to meet Module D1 requirements. Particularly for quality system requirements, manufacturers should establish a comprehensive quality system to consistently ensure adherence to the regulatory provisions. These requirements can be based on the manufacturer's existing quality system (such as ISO 9001 or other suitable systems) and integrate into the content as required by regulations.

With the increase in battery exports to Europe, especially energy storage and electric vehicle batteries, it is inevitable for battery products in the EU market to undergo a more stringent supervision. To mitigate the risk of non-compliance due to a lack of understanding of the Regulation, battery manufacturers can have Articles 6, 9, 10, 12, 13, and 14 evaluated alongside Articles 7 and 8 by a notified body, in accordance with Module D1.

Figure 8.1 Conformity assessment requirements of the different modules



An introduction of Module A, Module D1, Module G

Module A – INTERNAL PRODUCTION CONTROL

1. Description of the module
2. Technical documentation
3. Manufacturing
4. CE marking and EU Declaration of Conformity
5. Manufacturer's authorised representative

Module D1 – QUALITY ASSURANCE OF THE PRODUCTION PROCESS

1. Description of the module
2. Technical documentation
3. Availability of technical documentation
4. Manufacturing
5. Quality system
6. Surveillance under the responsibility of the notified body
7. CE marking and EU declaration of conformity
8. Availability of technical documentation
9. Information obligations of the notified body
10. Manufacturer's authorised representative

Module G – Compliance based on modular verification

1. Description of the module
2. Technical documentation
3. Manufacturing
4. Verification
5. CE marking and EU Declaration of Conformity
6. Manufacturer's authorised representative

Figure 8.1 shows the conformity assessment requirements of the different modules, with the focus on Module A and Module D1:

Module A is the internal production control whereby the manufacturer ensures that battery products comply with the requirements outlined in Articles 6, 9, 10, 12, 13 and 14 applicable to them. As for Article 7 on Carbon footprint requirements and Article 8 on Recycled content requirements, relying solely on manufacturer's internal production control is insufficient, it must also be reviewed by a notified body under Module D1. This necessity arises because it is not possible to ensure compliance with carbon footprint and recycled content requirements with internal production control (Module A) alone. It cannot be guaranteed even with "supervised product testing" (module A1). The reliability and completeness of the carbon footprint and recycled content data sources, records, monitoring, calculations and updates can only be ensured through quality system control. Furthermore, since the compliance of these two requirements is integral to the "European Green Agreement" and the "Battery Strategic Action Plan", given their significance, supervision and control over these aspects must be tightened.

Module D1 must be audited, evaluated, and certified by an EU-recognised notified body to assess whether the manufacturer can ensure ongoing compliance with the requirements outlined in Articles 6, 7, 8, 9, 10, 12, 13, and 14. The audit includes the review of technical documents and the quality system. Upon completion of the audit, the notified body shall inform the manufacturer of its decision and the statement shall contain the inspection conclusion and a reasonable evaluation decision. Notified bodies should conduct regular audit (usually once a year) to ensure that the manufacturer continues to maintain and utilise the quality system effectively and they must provide an audit report to the manufacturer. Additionally, the notified body may conduct unexpected visits to the manufacturer. For the same application, the manufacturer is permitted to apply for a review with only one notified body.

09 Supply chain due diligence

Starting from August 18, 2025, battery economic operators with a net turnover exceeding 40 million euros will be required to conduct due diligence in compliance with the EU Battery Regulation. With the surge in demand for battery raw materials, the EU requires battery economic operators, manufacturers, importers and distributors to focus on product quality and performance while ensuring the environmental and social responsibility of their supply chains. This new Regulation aims to improve the transparency of raw material procurement and minimise environmental and social risks.

This section will deep dive into the supply chain due diligence of the EU Battery Regulation and provide relevant insights to companies to help them cope with the due diligence challenges.

9.1 Basic due diligence information

• **Raw materials:**
(a) cobalt;
(b) natural graphite;
(c) lithium;
(d) nickel;
(e) chemical compounds based on the raw materials listed in points (a) to (d), which are necessary for the manufacturing of the active materials of batteries.

• **Investigate the risks involving economic operators**
1) Environmental risks

- Water
- Soil
- Air
- Hazardous Substances
- Biodiversity
- Noise and vibration
- Plant Safety
- Waste and residues

2) Social risks

- Child Labour
- Community life, including that of indigenous peoples
- Discrimination
- Forced Labour
- Occupational health and safety
- Trade Union Freedom

• **Basis of due diligence**
(a) the International Bill of Human Rights, including the International Covenant on Civil and Political Rights and the International Covenant on Economic, Social and Cultural Rights;
(b) the UN Guiding Principles on Business and Human Rights;
(c) the OECD Guidelines for Multinational Enterprises;
(d) the ILO Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy;
(e) the OECD Due Diligence Guidance for Responsible Business Conduct;
(f) the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High- Risk Areas.

9.2 Due diligence obligations

Each economic operator should:
1. adopt, and clearly communicate to suppliers and the public, a company battery due diligence policy;
2. incorporate in its battery due diligence policy standards that are consistent with the standards set out in the internationally recognised due diligence instrument;
3. structure its internal management system and maintain records of that system for a minimum of 10 years;
4. assign responsibility to its top management level to oversee its battery due diligence policy;
5. establish and operate a system of controls and transparency regarding the supply chain including a chain of custody or traceability system, identifying upstream actors in the supply chain;
6. incorporate its battery due diligence policy, including risk management measures into contracts and agreements with suppliers;
7. establish a grievance mechanism, including an early-warning risk-awareness system and a remediation mechanism, such mechanisms shall be based on the UN Guiding Principles on Business and Human Rights.

9.3 Third-party verification

All due diligence obligations carried out by economic operators must undergo verification by a third-party notified body certified by the EU. This verification includes due diligence policies, activities, processes and systems, collection of relevant information from stakeholders, etc., and the verification result must be publicly disclosed in the reports. If the economic operator places the products on the EU market without obtaining verification from a notified body, they will face corresponding consequences, which may include sales restriction and product recalls.

10 Battery Passport

The Battery passport is part of the **set of digital product passes (DPP)**, that are mandated by the Ecodesign for Sustainable Products Regulation (ESPR). The ESPR entered into force on 18 July 2024, is the cornerstone of the Commission's approach to more environmentally sustainable and circular products.

Further delegated acts for product specific requirements are necessary. The battery passport needs to be **interoperable with other product passports** based on the ESPR regulation, e.g. if the battery is implemented into a product that needs a product passport. The intention of the battery passport is to provide

- **Transparency**
- **Tracking and tracing of batteries**
- **Exchange of information** regarding
  - Carbon intensity and sustainability
  - Material, origin, renewable content, composition
  - Repair, repurposing and dismantling possibilities
  - Recycling and recovery processes, including information for the handling

Recycling and recovery processes, including information for the handling applicability	• The economic operator placing the following battery types on the market is responsible for compliance with the provisions of the battery passport (Preamble 125):
	  • Electric vehicle batteries (Art. 77.1).
	  • LMT batteries (Art. 77.1).
	  • Industrial batteries with a capacity greater than 2kWh (Art. 77.1).
	• **From 18 February 2027** onwards if the criteria for applicability are met (Art. 77.1).
	• Batteries subjected to preparation for re-use, preparation for re-purposing, repurposing or remanufacturing, shall have a new battery passport; the new battery passport must **be linked with the old battery passport**; the responsibility transfers to the economic operator, who has placed the repurposed / remanufactured battery on the market (Art. 77.7)
	• The battery passport shall be **deleted only after the recycling of the battery** (Art. 77.8), i.e. separation of the battery into its materials

Access	• The information in the battery passport shall comprise (Art. 77.2):
	  • **Information accessible to the general public in accordance with point 1 of Annex XIII**: I.e. general information about the manufacturer and the battery, carbon footprint as well as recycled content information, responsible sourcing as indicated in the report on battery due diligence policy, electrotechnical parameter, ...
	  • **Information accessible only to notified bodies, market surveillance authorities and the Commission in accordance with points 2 and 3 of Annex XIII**: Results of test reports proving compliance with the applicable requirements.
	  • **Information accessible only to any natural or legal person with a legitimate interest in accessing and processing that information in accordance with points 2 and 4 of Annex XIII**: I.e. detailed information about the active chemistries, the structure and parts of the battery, dismantling information, information on the state of health, battery status, ...
	• Groups of people with access rights will be defined in an implementing act by 18 August 2026 according to the need-to-know principle (Art. 77.9).
	• Access to public part of battery passport should **already be possible for prospective buyers** as soon as the product is offered (i.e. placed on the market) (eco-design regulation draft section 67)

Structure of the battery passport	• The battery passport must be interoperable with other ESPR product passports in relation to
	  • Technical aspects
	  • Semantic aspects
	  • Organisation aspects of end-to-end communication and data transfer

Requirements for the battery passport	• The battery passport shall be accessible through a QR code (Art. 77.3). • According to Art. 77.4 the information provided in the battery passport shall be accurate, complete and up to date (dynamic data regarding performance and durability updated at least daily (Preamble 46)). • Data must be in an interoperable format, transferable through an open interoperable data exchange network without vendor lock-in, machine-readable, structured and searchable (Art. 77.5). • Access to the information shall be provided free of charge (Art. 78.b); the responsible economic operator needs to take care of the data storage (Art 78.c), they cannot outsource it to a pay-by-data supplier (Art 78.d) • The battery passport must stay available also after the economic operator ceases to exist (Art 78.e) → according to current draft of ecodesign regulation, a back-up of the digital product passport must be available via an independent third party (section 38) • The battery passport shall be of a high level of security, privacy and fraud shall be avoided. Data authentication, reliability and integrity shall be ensured (Art. 78.g-h).
Requirements for content in the battery passport	• Unique identification of the battery in line with ISO/IEC 15459 series (Art 77.3) • All information shall be based on open standards (Art. 77.5) • Content must be reliable (data authentication must be ensured) (Art. 78.g) • The Commission is empowered to adopt delegated acts to amend the information to be included in the battery passport in view of technical and scientific progress (Art. 77.2).

	Publicly accessible		**Accessible to persons with legitimate interest**	**Accessible to notified bodies, market surveillance and commission**

Content of the battery passport	• Manufacturer identification (ref Art 38.7)
	• Battery category
	• Battery identification (ref Art 38.6)
	• Place of manufacture
	• Date of manufacture (month and year)
	• Weight
	• Capacity
	• Chemistry
	• Hazardous substances present in the battery
	• Usable extinguishing agent
	• Critical raw materials (>0.1% by weight)
	
	Information of label
		• Minimum, nominal, maximum voltages with temperature ranges
		• Original power capability, limits and temperature dependencies
		• Expected lifetime in cycles and reference test
		• Capacity threshold for exhaustion for EV
		• Temperature range when not operational
		• Commercial warranty period
		• Initial and 50% round trip energy efficiency
		• Internal battery cell and pack resistance
		• C-rate of cycle life test
		• Marking acc Art 13.3 and 13.4
		• CE declaration acc Art 18
		• Information regarding the management of waste batteries acc Art 74.1
			• Detailed composition, include materials of cathode, anode and electrolyte
			• Part numbers for components and contact details of source for spare parts
			• Dismantling information include
			  • Explosion diagrams of battery pack down to cell level
			  • Disassembly sequence
			  • Type and number of fastening techniques to be unlocked
			  • Tools required
			  • Warnings if risk of damaging parts exist
			  • Amount of cells used and layout
			
			Also accessible for commission
				• Results of test reports proving compliance with requirements
				
				Notified Bodies will need access to all passport information in the course of the CE conformity process.

	• Carbon Footprint (ref Art 7.1 and 7.2) • Information on responsible sourcing • Recycled content information (ref Art 8.1) • Share or renewable content		• Safety mesasures • Values for performance and durability acc Art 10.1 (placing on market and changes in status) • State of health acc Art 14 • Status of battery (original, repurposed, re-used, remanufactured, waste) • Usage date (number of cycles, accidents, operated temperature...) **Individual battery info**	

From 18 February 2027, EU Battery Regulation (EU) 2023/1542 stipulates that LMT batteries, industrial batteries with a capacity greater than 2 kWh and each electric vehicle battery placed on the market or put into service shall have a 'battery passport and scanning the QR code will allow you to have access to the battery's label information, EU Declaration of Conformity, due diligence report, etc. This is an electronic document containing detailed information about each battery. The access rights of the battery passport are classified into several categories: information accessible to the public (such as manufacturer information, carbon footprint information, etc.), information accessible by the licensed business entity and the European Commission (detailed composition of the battery, etc.), information accessible by notified bodies, market regulators, and the European Commission (test report results proving compliance with this regulation), and information accessible by people with specific legitimate interests (such as batteries being put on the market and changes in status).

Currently, the Battery Passport Alliance is conducting supporting research. During the research development process, the alliance will finetune the content requirements of the battery passport, determine and formulate the necessary data infrastructure technical standards and evaluate the existing technical standards, establish software and physical demonstrators, and evaluate the value of the battery passport relevant to the enterprise, society and the environment qualitatively and quantitatively.

Figure 10.1 Overview of the Battery Passport Alliance job description

Working Teams		Sub-topics
Working Team1	Project coordination and stakeholder participation	a) Alliance coordination b) Quality and content consistency management c) EU consistency and global compatibility d) External communication and dissemination of results e) Expansion of scope and ensuring long-lasting results
Working Team2	Content standards	a) Carbon footprint b) Provide supply chain investigation c) Cyclicity and resource efficiency d) Efficiency and durability e) Roles and responsibilities f) Approval
Working Team3	Technical standards	a) Battery life cycle data acquisition reference model b) Background analysis of EU and global data space c) Processing and logic access based on reference model
Working Team4	Demonstration	a) Data infrastructure b) Data storage and processing c) Combine with Catena-X, EES, Gaia-X d) Demonstration
Working Team5	Value assessment	a) Model benefits of a single use case b) Overall efficiency of battery passport model

Figure 10.2 Battery Passport Alliance three-year work plan and major milestones

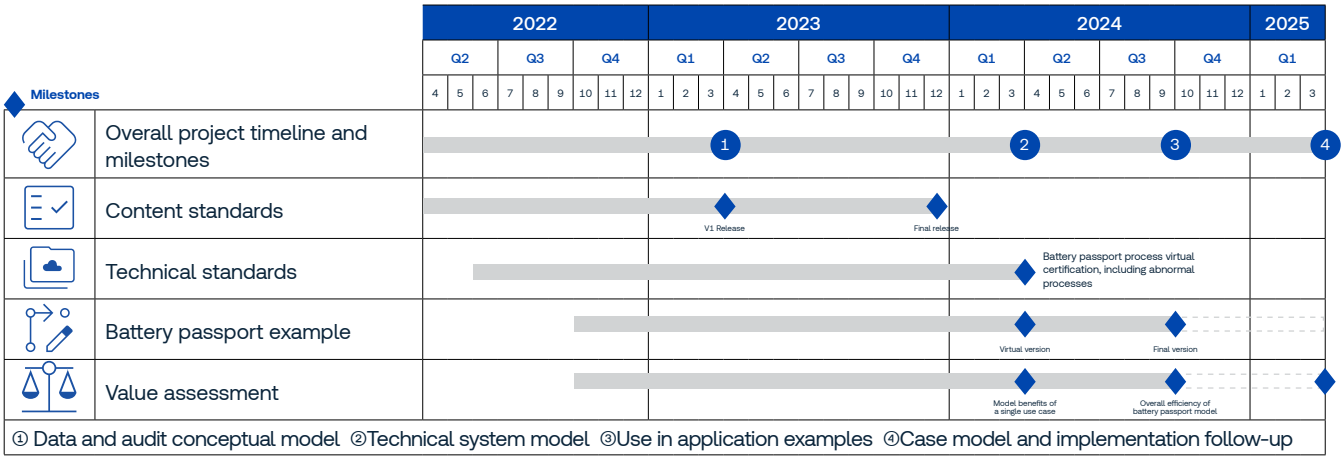


Figure 10.1 and 10.2 Source: https://thebatterypass.eu/assets/images/content-guidance/pdf/2023_Battery_Passport_Content_Guidance.pdf

At this stage, the European Committee for Standardisation (CEN), the European Electrotechnical Standardisation Committee (CENELEC) and the European Telecommunications Standards Institute (ETSI) are required to draft a list of eight European harmonised standards to support the setup of a digital electronic passport system.

The eight aspects include: unique identifiers, data carriers, relationship between physical products and digital representations, including search mechanisms, access rights management, and interactivity. (Technology, semantics, organisation), including data exchange protocols and formats and data processing (introduction, , rectification , upgrade), data authentication, reliability, integrity, data security and privacy. The harmonised standards corresponding to these eight aspects will be announced before 31 December 2025.

Although the battery passport project is targeted at the European battery market, it is now progressively being launched globally while making preliminary adjustments according to local policies. Through the battery value chain participants (Includes international participants active in the EU market) and suggestions and results from European institution', the project will lay the foundation for the rapid development of battery passports and provide support for a smooth implementation for market expansion.

11 CE marking

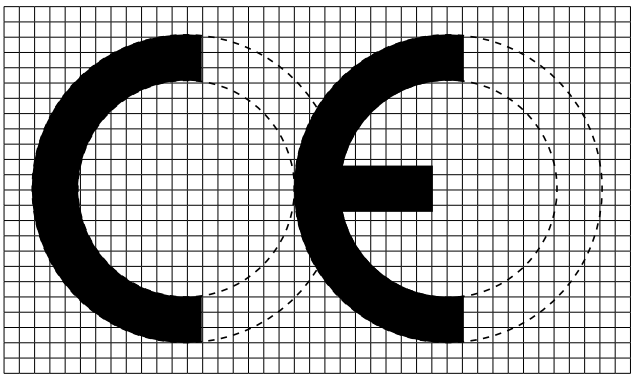
Many products in the EU market will require CE marking. With the CE marking on the products, the manufacturer will bear the responsibility for the product declaration that it has met the basic requirements of the EU regulations and has conducted a conformity assessment of the relevant procedures. As such, products with CE marking are known to have met the safety, health and environmental requirements of the EU regulations and can be circulated in the EU market.

From 18 August 2024, products sold within the EU market needs to be affixed with CE marking. Some battery products are subjected to multiple EU regulations at the same time, before the labelling of the CE marking, you will need to ensure that your batteries meet the relevant requirements. You can check the scope of CE products from the following website:
https://single-market-economy.ec.europa.eu/single-market/ce-marking/manufacturers_en

CE marking must be clearly visible and indelible. If it cannot be affixed due to the properties of the battery, it should adhere to the CE marking and affix to on the battery packaging and its accompanying documents. CE marking should contain the initials "CE" in caps, both letters should have the same vertical dimension and should not be smaller than 5mm (unless specified differently in the relevant product requirements).

If an appointed notified body needs to be involved, the CE marking must be accompanied by the identification number of the appointed notified body (for example, CE0123 represents the authorised notified body of TÜV SÜD Product Service GmbH). The identification number should be affixed according to the instructions of the notified body.

CE marking should be affixed before the battery is put on the market or put into use.



If you wish to reduce or enlarge the CE marking on your product, you should abide by the proportions of the two letters. As long as the initials remain visible, the CE marking can take different forms (for example colour, solid or hollow). If the CE marking is reduced or expanded, the proportions of the two letters must abide by the scale proportions in the diagram. For detailed information of the CE marking, please refer to the Regulation (EC) No 765/2008.

In order to ensure the fairness of market supervisory control, the members of the public institutions of member states will collaborate with the European Commission on the supervisory control for CE marking.

There is no period of validity for the CE marking. However, the EU Declaration of Conformity (DoC) that is required for the CE marking must be updated. In case any of the elements of the DoC change, for example, modification of the legislation, in the product, or in the contact details of the manufacturer or authorised representative. the version of the Declaration must be updated. EU DoC is a mandatory document in which the manufacturer or its authorised representative in the European Economic Area (EEA) states that the product meets all the necessary requirements of the EU regulations applicable to a particular product. Disregarding the involvement of the appointed agency, manufacturers must draft and sign this EU Declaration of Conformity. After the EU DoC is signed, the manufacturer is responsible if the product conforms to the relevant EU laws. The EU DoC must be signed by an individual working for the manufacturer or its authorised representative and the responsibilities of the employee must also be indicated.

For battery products, the statement should consist of the following information (see EU Battery Regulation (EU) 2023/1542, Annex IX):

1. Battery model (product, category, and batch or serial number):
2. Name and address of the manufacturer and, where applicable, its authorised representative;
3. This Declaration of Conformity is issued under the sole responsibility of the manufacturer;
4. Object of the declaration (description of the battery and identification allowing traceability, and which may, where appropriate, include an image of the battery);
5. The object of the declaration is in conformity with the relevant Union harmonisation legislation: ... (reference to the other Union acts applied);
6. References to the relevant harmonised standards or the common specifications used or references to the other technical specifications in relation to which conformity is declared;
7. The notified body ... (name, address, number) ... performed ... (description of intervention) ... and issued the certificate(s): ... (details, including its date, and, where appropriate, information on the duration of and conditions for its validity);
8. Additional information: name of company that signed the statement, the place and date on which the statement was issued, the name, function and signature of the signatory;

For battery products produced outside the EU, the importer must ensure that the product is accompanied by the DoC and must keep a copy of it for 10 years after the product has been placed on the market. Furthermore, the EU Declaration of Conformity must be translated into one or more languages as required by the EU country where the product is sold.

Therefore, manufacturers play an important role in ensuring the safety of battery products entering the European Economic Area (EEA). A manufacturer refers to any individual or legal person who designs and produces batteries and puts them in the market under their own name or trademark.

1. Manufacturers are responsible for conducting conformity assessments of products and needs to fulfil a string of obligations, including traceability requirements."
2. With regards to the products placement in the EU market, their responsibilities are the same regardless of whether the manufacturer is located outside the EU or within a Member State.
3. If the product presents risks or does not comply with regulations, the manufacturer must then need to work closely with the government authorities responsible for market surveillance.
4. The manufacturer must retain the technical documentation and the EU Declaration of Conformity for 10 years after the product has been placed on the market, or within the period specified by the relevant EU regulations.

Authorised representatives are any natural or legal person established within the EU who accept a written mandate from the manufacturer to represent the manufacturer in fulfilling certain specific tasks Manufacturers established outside the EU are not obliged to appoint an authorised representative. The minimum responsibilities of the authorised representative include:

1. The EU Declaration of Conformity, technical documents, and due diligence reports must be retained for 10 years after the battery is put on the market or put into use.
2. Upon reasonable request, provide all information and documentation required to demonstrate the conformity of the battery to the competent national authority. This information and documents must be provided in electronic format and, when required, in hardcopy.
3. When requested by governmental authority, the authorised representative shall work with the national authority to undertake any action to eliminate any hazard posed by the battery product.

In addition, importers and distributors play an important role to ensure that only approved CE marking affixed on products are allowed to be placed on the market This not only help to strengthen EU's requirements in terms of health, safety, and environmental protection but also ensure fair competition where all participants adhere to the same rules.

If the product is manufactured in a third-party country and the manufacturer does not have representative in the European Economic Area, the importer must ensure that the product placed on the market complies with the relevant requirements and will not pose a risk to the public in Europe. Importers will need to verify if the manufacturers outside EU have taken the necessary measures and should provide the relevant documents as required.

Therefore, importers need to have a comprehensive understanding of the EU harmonised legislation and are obligated to provide support to government authorities when issues arise. Importers need to obtain written assurance from the manufacturers that they can obtain the necessary documents such as EU Declaration of Conformity and technical documentation and are able to provide these documents to government authorities when requested. Importers should also ensure that the manufacturer remains contactable all times.

Distributors play an important role in ensuring that only compliant products enter the market and they should handle the products with caution so as to ensure that their handling will not adversely impact the products which could lead to non-compliance. Distributors will also need to have basic knowledge, including recognising products which are affixed with CE marking and certification documents and should also be able to identify products which do not fulfil the compliance requirements.

Distributors must be able to prove to government authorities that they have taken the necessary precautionary measures and have obtained confirmation from the manufacturer or importer. Additionally, distributors must assist the government authorities in retrieving the required documentation.

If the importers or distributors sell the products under their own name, they will assume the responsibilities of the manufacturer. In such cases, they must obtain detailed information about the product design and production processes, as they will be legally accountable when affixing the CE marking.

For information regarding CE marking, products with CE marking, EU harmonisation legislation governing CE marking and related procedures, please refer to:
https://ec.europa.eu/growth/single-market/ce-marking_en

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