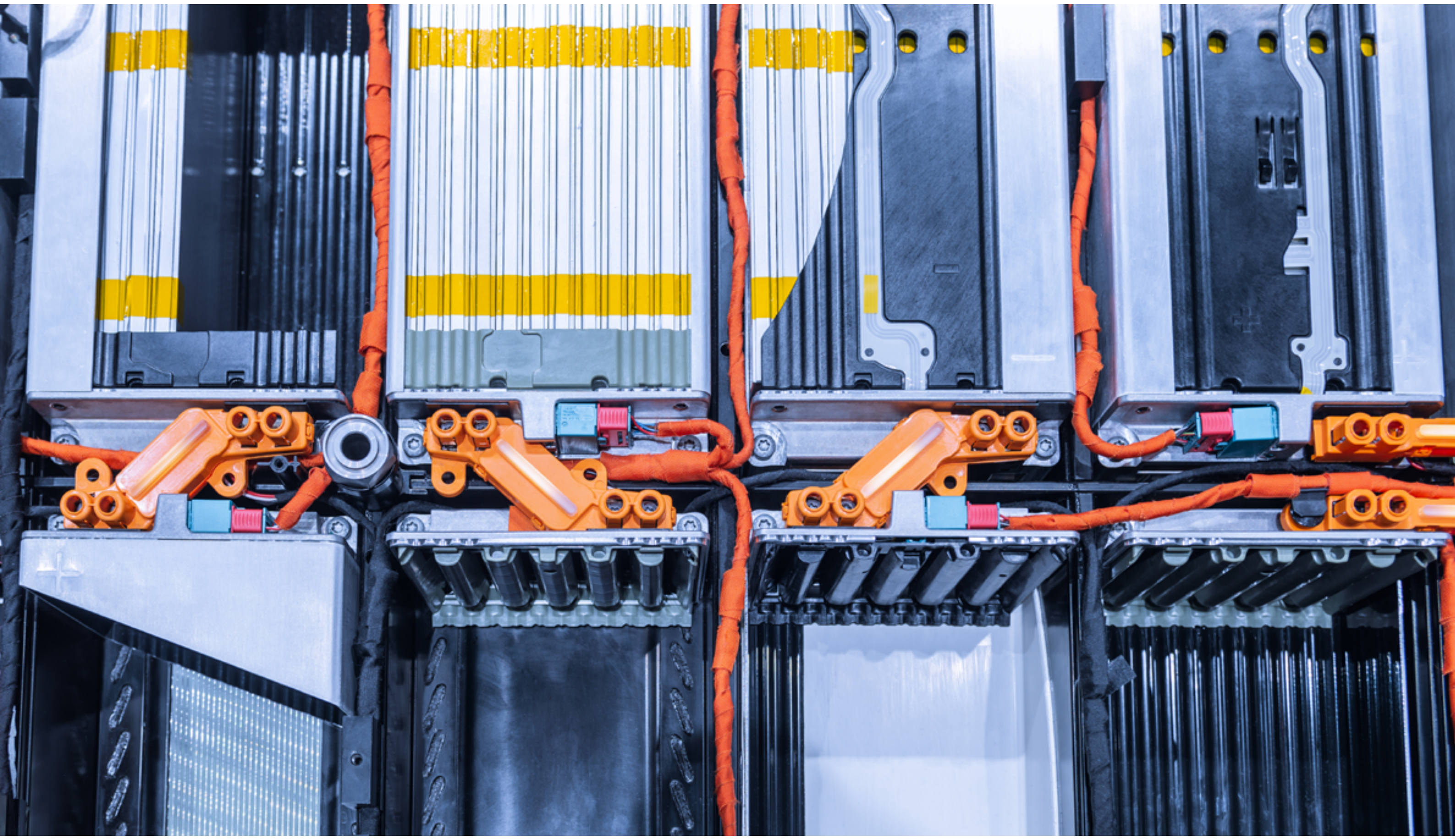
THE POSITIVE SIDE OF BATTERIES

THE ROLE OF STANDARDS IN SUPPORTING SUSTAINABILITY REQUIREMENTS FOR BATTERIES



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CONTENTS

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EXECUTIVE SUMMARY

Electromobility has a great potential to become a key solution for an environmentally friendly and decarbonised transport sector. Moving away from dirty fossil fuels and introducing proper sustainability criteria for batteries are essential to making it happen.

In terms of energy use, mineral resources and CO_2 emissions, production is the most critical stage in a battery's life. A longer lifetime can therefore reduce the environmental footprint of batteries, notably by extending their first life and by fostering a second repurposed life. These crucial aspects need to be addressed through ambitious European policies and a coherent regulatory framework, supported by effective standards.

The Circular Economy Action Plan proposes a new regulatory framework for batteries. The proposal will build on the Batteries Directive and include new items, such as recycled content, measures to enhance collection and recycling rates, as well as sustainability requirements that will improve the carbon footprint and sourcing of raw materials, and facilitate reuse, repurposing and recycling. Standards will have an important role in supporting this new regulatory framework.

In order to minimise the environmental footprint of batteries and extend their lifetime, the European Commission and the Standardisation Organisations must:

- Define standards that assess the **performance and durability** of batteries. New European Standards should define the metrics used to characterise batteries and their performance as well as tests to evaluate them. In addition, standards should also provide test profiles which are suitable for all battery applications, including electric vehicle batteries;
- Define technical specifications to facilitate **repair, reuse and recycling** of electric vehicle batteries. Standards must describe which data is to be disclosed openly, and in which format. In addition, a set of basic design standards are needed for battery modules and packs, to make the recycling process less complex and time-consuming. No such standards currently exist.

In order to properly address these aspects, new standards need to be developed, and the existing ones must be revised.

INTRODUCTION

Batteries will be an essential product on the EU's pathway to decarbonisation. In fact, because of the increasing demand for storage batteries and electric vehicles, the global lithium-ion market is set to grow by up to 30% each year. Between 2013 and 2016, 15 gigawatt hours (GWhs) of battery production capacity were already added[1]. In the coming years, an additional 50 GWh will be added annually reaching 700 GWh of capacity by 2025.

Together with pollution and material extraction issues, battery production brings about additional concerns over the carbon footprint of the whole battery production chain. In the case of an electric vehicle battery, the production phase accounts for around 70% of its global warming potential. Although batteries will be the backbone of the transition to renewable energy and clean electromobility[2], because of their material composition and energy-intensive manufacturing they need to be viewed as highly valued and strategic products from an EU environmental policy point of view.

Policymakers have already started to address the sustainability level of batteries. In 2018, the Commission adopted a Strategic Action Plan for Batteries[3], which has the ambition to make Europe a global leader in producing and using sustainable batteries that are safe, efficient and follow the highest environmental and social standards in the context of the circular economy. The Action Plan foresees the setting of sustainability requirements for all batteries placed on the EU market, thus boosting the production of high-performance battery cells and battery packs with the smallest environmental footprint.

This vision was given a more concrete shape by the EU Ecodesign preparatory study, which started at the end of 2018. Despite the final decision not to continue with an Ecodesign Regulation for batteries, the preparatory study demonstrated that ecodesign principles and an appropriate set of requirements are key to a sustainable battery market, and would help decarbonise the energy and transport sector.

Another key piece of legislation that is currently under revision is the Batteries Directive (2006/66/EC)[4], which introduced requirements for placing batteries on the market, as well as their collection, treatment and recycling.

However, the definitions and categorisation of batteries applied in the Directive are outdated, which results in there currently being no collection scheme for EV batteries (among other types). Moreover, since the recycling targets are weight-based, there is little incentive to improve the quality of recycling processes to recover critical raw materials and lithium. The labelling requirements for batteries (e.g. by chemistry types) also need to be improved and harmonised. Finally, the second use of batteries is not fully addressed in the Directive, and the responsibilities in the supply chain are not clear.

As one of the pillars of the European Green Deal, in 2020 the European Commission adopted a Circular Economy Action Plan[5], foreseeing the proposal of a new regulatory framework for batteries. The proposal will build on the Batteries Directive and include new items, such as recycled content, measures to enhance collection and recycling rates, as well as sustainability requirements that will improve the carbon footprint, sourcing of raw materials, and facilitate reuse, repurposing and recycling.

Many of the chemistries used for batteries (Lithium and non-Lithium-based) contain elements such as Cobalt, Nickel or rare earths such as Yttrium, some of which are included in the European Union's classification of Critical Raw Materials[6] and for which manufacturers need to ensure a responsible and ethical sourcing.

The production phase of batteries is the most environmentally impactful and energy intensive of their lifecycle: 100 to 200 kWh of energy are needed to produce a battery with a capacity of 1 kWh[7]. This amounts to an estimated 70 to 110 kg of CO_2-equivalent emitted when manufacturing only 1 kWh of battery. With this in mind, it becomes evident that energy and material efficiency at the manufacturing stage, as well as reuse and recycling, should be top priorities for this product.

A longer lifetime can reduce the environmental impact of batteries: if we increase battery durability, as well as facilitate reuse, the carbon footprint and energy waste per functional unit decreases. Requirements to increase battery lifespan, to allow second-life batteries and recycling, as well as to improve consumer information will greatly contribute to the sustainability of batteries.

Standards play a central role in supporting regulatory requirements by providing definitions, technical and quality specifications for every phase of the value chain of a product, and by creating a level-playing field. However, the current standards are inadequate, conflicting or altogether non-existent on key issues that could significantly contribute to the sustainability of the battery value chain[8]. It is therefore crucial that existing standards are updated, and new ones are developed where lacking.

1 European Commission, Preparatory Study on Ecodesign and Energy Labelling of Batteries under FWC ENER/C3/2015-619-Lot 1, April 2019

2 Analyses of full life cycle CO_2 consistently show that on average battery electric vehicles emit less CO_2 over their lifetime than diesel or petrol cars. See Transport & Environment report "How clean are electric cars?" (April 2020)

3 Strategic Action Plan on Batteries, Europe on the move, COM(2018) 293 final, 2018

4 Directive 2006/66/EC of the European Parliament and of the Council on batteries and accumulators and waste batteries and accumulators, September 2006

5 European Commission, A New Circular Economy Action Plan - For a cleaner and more competitive Europe (COM(2020) 98 final), March 2020

6 Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)

7 Preparatory study on Ecodesign and Energy Labelling of Batteries under FWC ENER/C3/2015-619-Lot 1. Task 4, p.54

8 The European Commission acknowledged a lack of standardisation in its report on the implementation of the Strategic Action Plan for Batteries (2019), where it is stated that minimum performance requirements have to be "supported by science-based harmonised standards, which will be used by industry to document compliance with the regulatory requirements laid down in EU legislation"

Scope of the report

The present report mainly focuses on electric vehicle Lithium-ion batteries and their possible second-life applications (as residential energy storage), that fall in the category of traction and industrial batteries. We have based our analysis on the input given by the Ecodesign preparatory study for batteries contracted by the European Commission in 2018[9], which also focused on three main categories of application:

- High-capacity and low-capacity electric cars, and plug-in hybrid electric cars;
- Electric trucks and plug-in hybrid electric trucks;
- Residential energy storage system (ESS) and grid supporting ESS.

Recently, Lithium chemistries have become a reference technology for electrochemical storage in traction and industrial batteries. However, we recommend that the same standardisation work is performed for other types of commonly used or emerging chemistries.

The report takes stock of the following standards, all of which are important for battery sustainability, as also highlighted by the Ecodesign preparatory study[10].

Table 1. Standards for performance testing of traction batteries	
IEC 62660-1:2018	Secondary Li-ion cells for the propulsion of electrical road vehicles – Performance testing
ISO 12405-4:2018	Electrically propelled road vehicles -Test specification for lithium-ion traction battery packs and systems - Part 4: Performance testing
DOE-INL/EXT-15-34184 (2015)	U.S. DOE Battery Test Manual for Electric Vehicles
DOE-INL/EXT-07-12536 (2008)	Battery test manual for plug-in hybrid electric vehicles
SAE J1798:2008	Recommended Practice for Performance Rating of Electric Vehicle Battery Modules
ISO/DIS 18243: 2017	Electrically propelled mopeds and motorcycles - Test specification and safety requirements for lithium-ion battery system

Table 2. Standards for performance testing for other applications	
IEC 62620: 2014	Secondary lithium cells and batteries for use in industrial applications
IEC 61427-2: 2015	Secondary cells and batteries for renewable energy storage Part 2 On grid applications
IEC 62984-3-2:2017	High Temperature Secondary Batteries – Part 3: Sodium-based batteries – Section 2: Performance requirements and tests
ANSI/CAN/UL 1974:2018	Standard for evaluation for repurposing batteries

Table 3. Standards for safety and environmental issues	
IEC 62619:2017	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications
Nordic Swan Ecolabel (2018)	About Nordic Swan Ecolabelled Rechargeable batteries and portable chargers
IEC 60086-6 (2017)	Primary batteries: Guidance on environmental aspects
IEC/TS 62933-4 (2017)	Electrical Energy Storage (EES) Systems - Guidance on environmental issues
IEC 63218 (under development)	Secondary Li-ion, Ni-Cd, and Ni-MH cells and batteries for portable applications - Guidance on environmental aspects
ISO 14040:2006	Environmental management – Life cycle assessment – principles and framework
ISO 14044:2006	Environmental management – Life cycle assessment – requirements and guidelines
prEN 50693 (under development)	Method for quantitative eco design via life cycle assessment and environmental declarations through product category rules for EEE

9 European Commission, Ecodesign preparatory Study for Batteries

10 Preparatory study on Ecodesign and Energy Labelling of Batteries under FWC ENER/C3/2015-619-Lot 1. Task 1, Annex Analysis of available relevant performance standards & methods

Extending battery lifespan:

STANDARDISATION NEEDS

Battery lifespan is one of the most environmentally critical elements on which policy requirements and standardisation should focus. Increasing battery durability (both in first and second life applications) will naturally reduce the product's carbon and Critical Raw Materials footprint per functional unit (FU). Consequently, an extended battery lifespan would also increase the overall environmental performance of electric vehicles.

BATTERY DICTIONARY

Battery **lifespan** is the length of time during which a battery will be usable, before its performance decreases too much. This decrease of performance includes two different yet concurrent effects: a lower performance when the battery is used and cycled (evaluated with the **cycle-life** metric), and the decrease of performance when a battery ages even without being used (represented with the **calendar ageing** metric).

BATTERY DICTIONARY

Battery capacity is the total energy that can be stored in the battery when it is charged with a specific current value.

The **number of cycles** is the number of times the battery is fully discharged and recharged.

The **capacity fade** is the percentage of the battery's initial capacity which is lost due to ageing.

The **internal resistance** is the resistance of the elements of the battery. Ideally this resistance would be 0, but the electrodes and electrolytes of the battery are not perfect conductors. The internal resistance increases as the battery ages.

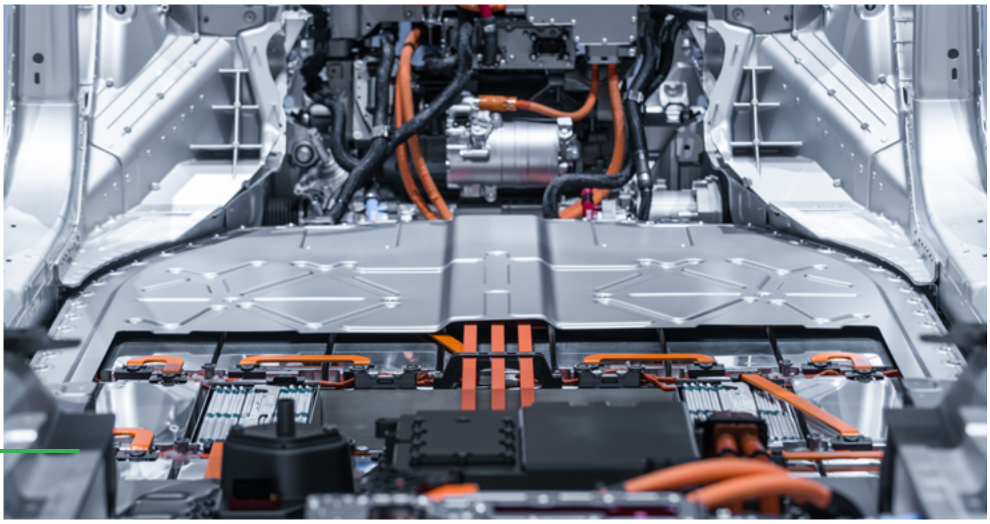
The **round-trip efficiency** of a battery is the ratio of the energy stored in the battery that can be retrieved. This efficiency decreases as the battery ages.

In order to increase battery lifespan, the following requirements should be set:

- **Requirements for performance after a certain number of cycles**, in terms of maximum capacity fade, internal resistance increase and round-trip efficiency. This requirement pertains only to cycle-life: it considers the decrease of performance when the battery is used;
- **Requirements for minimum guarantee period for batteries**. This requirement relates both to cycle-life and to calendar ageing. Today, the market already proposes extended guarantees on battery lifespan (market average of 8 years for 80% capacity fade). However, these are still far from matching the vehicle's expected lifespan (for example, an EV that could last over 20 years would very likely need to replace the batteries twice).

The following types of standards are needed to support such requirements:

- **Characterisation tests** that provide definitions for the metrics in a uniform way, as well as ways to test these metrics;
- **Ageing tests** to test the behaviour of the battery as it is operated throughout its lifetime, depending on the application that it is intended for.



Characterisation tests

Characterisation tests describe the metrics and how they can be tested. Almost all the relevant metrics, such as battery capacity, power, internal resistance or energy efficiency, are already defined in existing standards, but without a uniform way to test them.

In each standard and for each application, a different method is used to measure those aspects, and several methods can even be given for the same metric if it concerns a different application. For example, the capacity can be based on a one-hour discharge period in the standard ISO 12405-4:2018 (traction batteries), but on an eight-hour discharge period in the standard IEC 62984-3-2:2017 (other applications). The units for battery capacity are mostly expressed in ampere hour (Ah), but sometimes in kilowatt hour (kWh), especially in the context of automotive applications.

It should also be stressed that two important metrics are lacking in the current standards: **End of life** (EoL) and **State of Health** (SoH).

End of Life (EoL)

The EoL criterion is currently based on the specific test described by the standard. The EoL starts either when the battery capacity reaches a certain percentage of its initial value (as in standards IEC 62660-1:2010, ISO/DIS 18243 and IEC 62620), or when the test cannot be performed anymore by the battery (in standards ISO 12405-4:2018, DOE-INL/EXT-1534184(2015) and DOE-INL/EXT-07-12536(2008)). In the absence of a uniform definition for the EoL, one possible way to harmonise it would be to implement a more elaborate definition of SoH, as described in the section below.

State of Health (SoH)

SoH is an important parameter that represents the general well-being of the battery. Unfortunately, no clear definition currently exists for such a parameter. Since battery degradation is a combination of capacity fade, power fade, efficiency reduction, rise in negative incidents and others, any combination of these parameters can be considered a description of the SoH.

Currently, the SoH is used differently depending on the manufacturer and the application. Capacity fade is commonly used by the industry, as it is directly related to the vehicle autonomy (for example, some manufacturers offer to replace the batteries if they reach less than 80% of their initial SoH, in this case defined as the initial capacity). However, it is not sufficient to use capacity fade as the only end-of-life condition, since a consumer can continue to use a vehicle, for instance, even with a lower battery autonomy.

A more adequate way to define SoH would be to consider the internal resistance of the battery. The latter influences internal currents and can provoke overheating and even curtailments in the functioning of the vehicle, immobilising it and provoking significant user discomfort. Even so, internal resistance cannot be the only end-of-life criterion either, since capacity and power fade may still render a vehicle useless for the intended applications regardless of the internal resistance.

It is clear that a more elaborated and harmonised way to define SoH is needed. In addition, a calculation method should be clarified for the definition of capacity fade, since it can be evaluated against the nominal capacity or to the capacity related to the power needed.

CONCLUSION

For sustainability requirements for batteries to be met, there is a need to harmonise the characterisation tests. It is necessary to clearly define the metrics and develop tests that measure them in a uniform way. In addition, clear and complete definitions for End of Life and for State of Health should be provided in new standards.

Ageing tests

Standards must establish tests that emulate the behaviour of the battery as it is operated during its lifetime. These tests are necessary to measure the decrease of battery performance as it is being used (cycle-life) and as it ages (calendar ageing).

Currently, cycle-life in standards is tested depending on the application. The battery repeatedly follows a specific test profile, which is a simplification of real-life battery profiles that depend on the application. For example, such tests can be performed on samples of batteries in pre-production to estimate future internal resistance, capacity fade, and round-trip efficiency after a certain number of cycles using a test profile fit for the intended application.

It is important that all the applications highlighted by the Ecodesign preparatory study have available cycle-life tests described in relevant standards:

- For high and low capacity cars, and for plug-in hybrid electric cars, the standards ISO 12405-4:2018 and IEC 62660-1 describe such tests;
- For electric and plug-in hybrid electric trucks, no standards are available;
- For residential energy storage system (ESS) and grid supporting ESS, the standard IEC 61427 is a good basis, but has a few shortcomings: no clear end-of-life criteria are defined, the power level is strict (scaling of battery systems and power level is not possible), and one cycle takes 24 hours, therefore the test lasts several years.

In addition to cycle-life, calendar life is another important ageing parameter for the battery, affecting its performance even when it is not used.

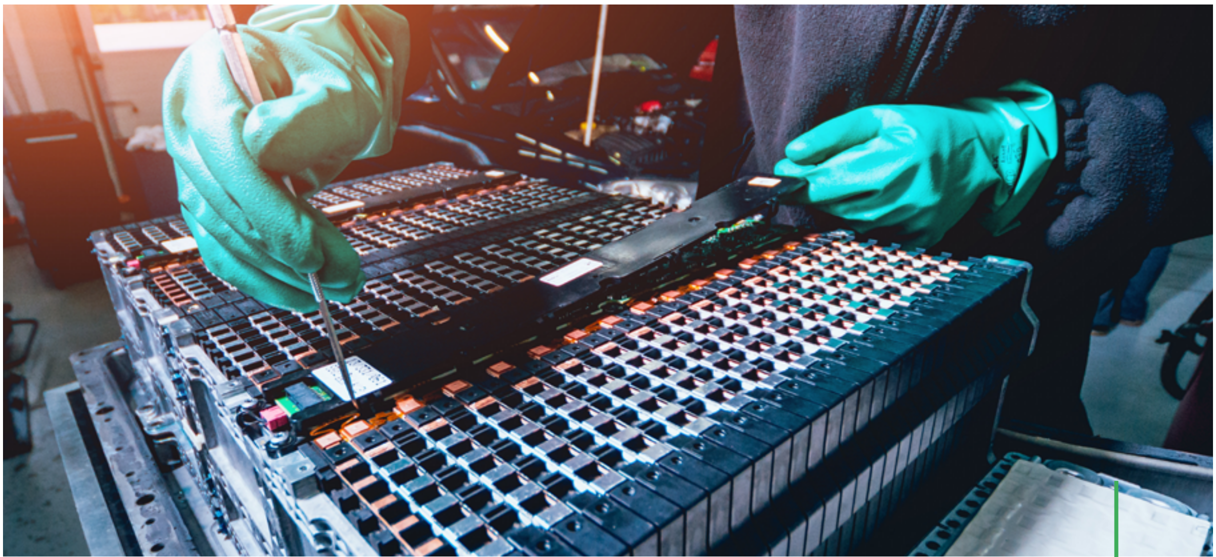
The calendar life metric is currently lacking in both European and international standards. In fact, only one standard developed in the United States describes a test for this metric (standard DOE-INL/EXT-15-34184 (2015)). This kind of test should not, however, be underestimated, as it allows to identify better thresholds for the minimum guarantee requirements on batteries.

In European battery development projects, ageing tests are often performed with test conditions that are a combination of calendar life testing and cycle-life tests with a set of simple profiles. These conditions allow to understand the ageing behaviour and go beyond a single use case. Unfortunately, such generic approach is missing in the current test standards [11].

CONCLUSION

Cycle-life tests for high and low capacity electric cars and plug-in hybrid electric cars must be harmonised. Cycle-life tests for electric and plug-in hybrid electric trucks, as well as residential ESS must be developed in new standards. The dimension of calendar ageing must be defined in new standards, including ways to test it.

11 White Paper on Test methods for improved battery cell understanding, 2018. Spicy, eCaiman, FiveVB



DESIGN REQUIREMENTS

for second life, recycling and consumer information

In addition to performance, battery design requirements and provision of information are crucial for two reasons:

1. They facilitate the reuse of batteries, which reduces their overall footprint as it increases the value of the battery over its lifetime with regards to the material, energy and carbon footprint of its manufacturing;
2. They improve the recycling rates, and allow to recover the critical raw materials used in batteries.

The objective of these requirements is to improve material efficiency by facilitating second-life use of batteries, and by improving the recycling of used batteries. To achieve this, it is important that data facilitating reuse and recycling is complete and easily accessible, and that tests for second-life batteries are uniform and coherent with tests for new batteries.

Open data on BMS

As highlighted in the Ecodesign preparatory study, access to information stored in the battery management systems (BMS) will be necessary to facilitate reuse and recycling. The BMS is an electronic system that monitors the state of the battery and prevents it from operating at unsafe levels, for example at too high a voltage. A BMS with open data enables a quicker determination of the SoH of a used battery and has enough reference information to facilitate repair, reuse and recycling.

For the open data on BMS to be a requirement, the following specifications need to be developed:

- Test protocols should be defined in a standard to ensure that the metrics disclosed in the BMS are always tested in a uniform way;
- The format in which the data is stored should also be standardised, to facilitate exploitation;
- Battery information and parameters to be disclosed must also be defined in a standard. We suggest the following information to be disclosed as a minimum, based on discussions with second-life batteries producers and on the UL 1974 standard:
  - Battery specification (chemistry, weight, size);
  - Current and original pack capacity;
  - Current and original internal resistance of the cells;
  - State of charge;
  - Cell voltages;
  - Total lifetime energy input and output;
  - Minimum and maximum temperature reached by the cells during their lifetime;
  - Original and current isolation resistance, and their limits;
  - Discharge and charge limits reached during lifetime;
  - Pack errors that occurred during first life;
  - Battery's intended calendar life;

BETTER STANDARDS TO DEVELOP THE SECOND-HAND VEHICLES MARKET

Another way open BMS data and standardisation of SoH metrics can extend the lifetime of batteries is through the enhancement of the second-hand cars market. Electric motors are much more robust (an average EV motor is composed of 200 parts, compared with 1,200 for internal combustion engines) and have great potential to see their lifetime extended in the second-hand market. The battery will be the critical aspect in the buyer's decision to purchase a used electric vehicle; transparency on battery SoH is therefore key for the consumer.

In several European countries there exist entities responsible for providing transparency to consumers wishing to buy second-hand vehicles, such as Car Pass in Belgium[12]. Accessible and standardised BMS data, as well as standardised metrics such as internal resistance, capacity fade or even residual cycle-life, will enable these parties to cut the verification procedure costs by reducing the need for or even possibly avoiding characterisation tests.

If characterisation tests were still necessary, they should also be standardised and performed in a short period of time by, for example, technical control centres and garages. In any case, buyers should be provided with easily interpretable information such as the percentage of capacity fade or a residual lifespan for the battery of the vehicle they intend to purchase.

12 https://www.car-pass.be/en

- A regulation should oblige manufacturers to make safety documents available (e.g. reports from IEC 62619 and UN 38.3 tests). This would facilitate reuse and transportation at the end of life and might even be used in future standards;
- Furthermore, a standardised diagnostic connector must be included with the BMS in order to quickly identify and report any faults in the battery's safety systems (e.g. to report overheat or overvoltage protection systems).

A similar approach is suggested in the study "Follow-up feasibility study on sustainable batteries",[13] which provides three levels of information: a public part covering information on carbon footprint and battery type, a second part available to third party accredited professionals including performance and BMS-related data as well as information on repair and dismantling, and a third part on compliance available for market surveillance authorities only.

While the information level approach is correct, it remains to be verified whether information provided under this scheme would be enough to ensure a maximum repairability of a battery without "locking in" to the original manufacturer. For example, at least part of the second level information should be made available to all accredited repair professionals, and not only to exclusive dealerships. Owners or at least non-authorised dealers should be, as a very minimum, allowed to perform minor and recurrent repairs (such as replacing fuses or connectors).

Opening up BMS historical data will take a long time. If we assume that the standardisation process starts as soon as possible, the standards and policies will enter into force only three years from now. To this, we need to add two more years before the new batteries and BMS are included in cars, and five more years for their batteries to be reused. This amounts to a 10-year long gap. During this time, a transitional method should be put in place or, at the very least, it should be studied whether it is possible to do it in another way.

Reuse of batteries

Certification of EV batteries for second use, intended mostly for buildings as energy storage, is currently subject to extensive safety tests.

The current reference standard for safety testing of stationary batteries is the IEC 62619, which sets safety requirements for battery design, as well as tests and criteria to evaluate resistance of batteries to external damage, such as mechanic shock or external short-circuits. Although it is not necessary for these tests to be performed by a certified authority as they can be part of the manufacturer's self-evaluation, they can prove to be costly for a specific battery model (industry reported that costs can exceed 50,000 €)[14].

13 European Commission, Final report for task 3, Development of models for rechargeable battery chemistries and technologies beyond lithium-ion, in compliance with the existing product environmental footprint category rules – Study, 2020

14 Similar testing requirements are set for battery transportation by the UN 38.3 testing protocol, which requires tests related to battery transportation (e.g. altitude or vibration tests)

Today, companies repurposing batteries for a second life must perform the same set of tests as for new batteries. A standard which facilitates the characterisation and classification of used batteries based on the open data found in their BMS would alleviate the costs of such tests. In the USA, this is done with the UL 1974 standard, which can be used to evaluate batteries for repurposing based on BMS measurements. Similar standards are yet to be developed in Europe.

The UL 1974 standard covers the sorting and grading process of battery packs, modules and cells, and electrochemical capacitors originally used and configured for other purposes, such as EV propulsion, and that are intended for a repurposed use. In this case, the cells, modules and auxiliary equipment of the battery must meet the requirements of the future application as presented in standards. Also, the battery should not be used longer than the calendar expiration date, which is to be provided by the manufacturer. It is worth mentioning that in the threshold set by the minimum warranty period, the calendar expiration date cannot be set too early to avoid reusing the battery. The history of the battery parameters must be tracked, with emphasis on previous misuse and on BMS information on the battery's state of health.

The UL 1974 standard prescribes a routine test analysis comprising:

- Incoming open circuit voltage (OCV) measurement;
- Incoming high voltage isolation check;
- Capacity check;
- Internal resistance check;
- Check of BMS controls and protection components;
- Discharge/charge cycle test;
- Self-discharge.

Again, access to the information included in the BMS is essential to facilitate the reuse of batteries, in particular by:

- Improving the sorting of batteries in order to only recover those with a sufficient SoH and prepare them for reuse;
- Making it possible to reuse batteries without (re)testing them, if a standard is developed in parallel which allows the use of the BMS open data to certify the batteries for a second use.

Without standards for open data BMS or reuse of batteries, and as long as the SoH criteria are not standardised, a company reusing batteries needs to perform characterisation tests to determine the SoH based on its own criteria. These tests require a special machinery (testing banks) and complex algorithms to estimate the remaining life with sufficient precision. Besides being time consuming, these tests are also costly in energy, since batteries with often important capacities need to be cycled (charged and discharged) several times.

With open data BMS, the sorting process would be greatly facilitated, since the BMS would provide enough information to determine the SoH as well as the internal resistance, charging/discharging history, high temperature events and more, without testing the battery, thus reducing costs dramatically and allowing for greater streamlining of the processes.

Recyclability

Standardised battery module sizes and pack sizes can be useful for recycling procedures. Size standardisation is currently only at cell level (ISO/PAS 19295: 2016; DIN 91252:2016). Due to the lack of standardisation, there is variation in the materials used, the design, the location of the battery, and the shape of the battery pack. This makes the recycling of batteries complex and time consuming.

Complete standardisation at module and pack level is both unrealistic and a burden to innovation, given that it restricts design options. A trade-off would be to establish a minimum set of standards for basic components, such as for example lifting parts. This would allow standard lifting tools to be used for disassembly[15].

Explicit information and guidance on battery recycling is still lacking in current standards. Moreover, standards that define battery marking including the principal active material (such as IEC 62620) will soon need to be revised to anticipate new active materials such as silicon-based anodes.

CONCLUSION

Standards must be developed to allow the open data requirement on BMS (format, test protocols, SoH, diagnostic connector). In parallel, standards providing a method to test batteries for second use (such as the UL 1974) are also needed. Finally, standards applicable in first life of batteries should be developed in coherence with those governing the second life, in order to facilitate reuse.

15 European Environment Agency, Electric vehicles from life cycle and circular economy perspectives. TERM 2018: Transport and Environment Reporting Mechanism (TERM) report. p.52

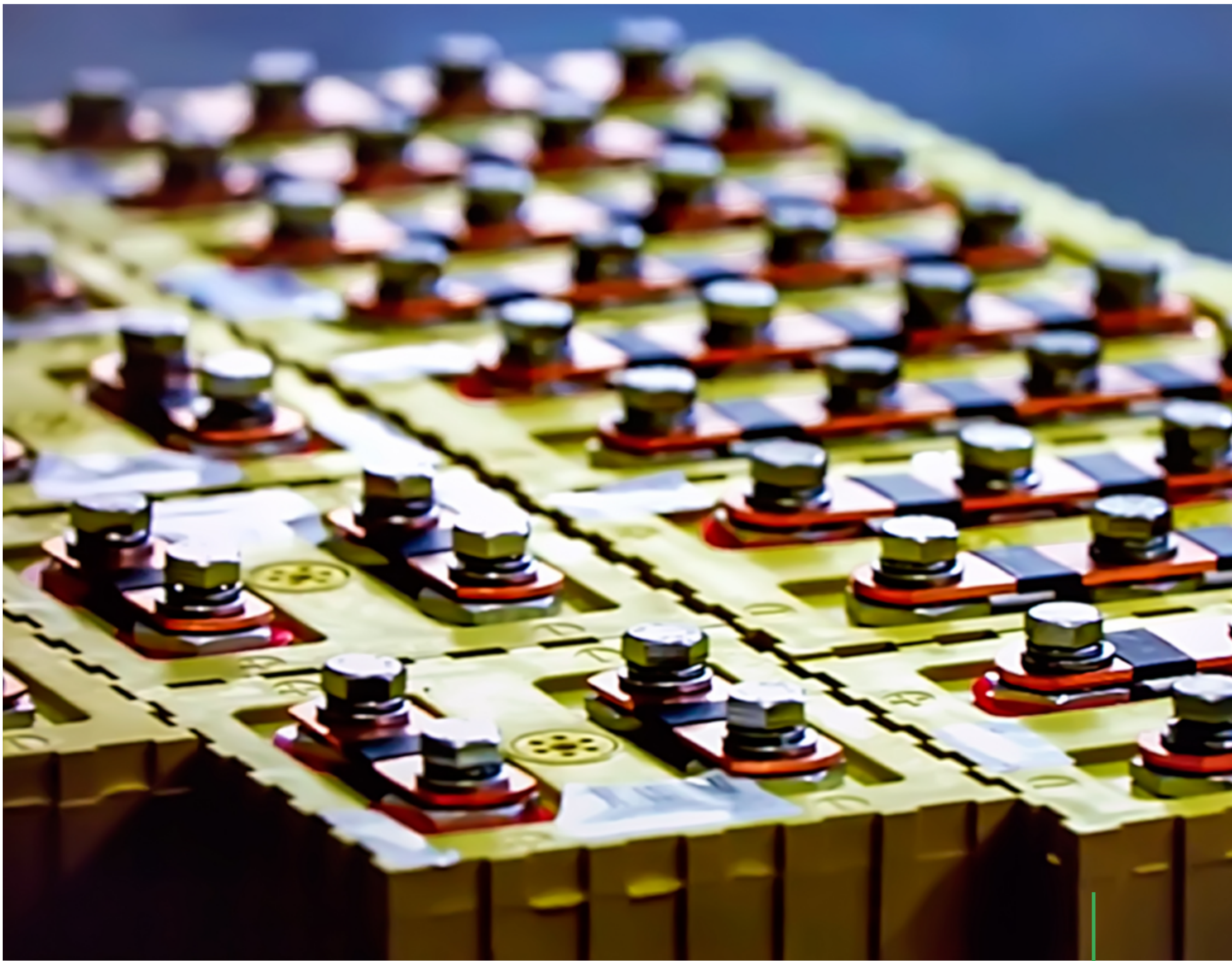
CONCLUSIONS

The EU has declared a clear ambition to become a technological and industrial leader in the field of sustainable batteries to accompany a transition to a zero-emission electromobility. For this to happen, however, initiatives at policy and standardisation level will be vital.

From a policy point of view, although the Ecodesign preparatory study is a step in the right direction, further action is necessary to limit the environmental impact of batteries. The future regulatory framework for batteries announced in the European Green Deal and its Circular Economy Action Plan should aim not only at formulating sustainability requirements for aspects such as durability or CO_2 footprint, but also at facilitating reuse and recycling.

Such requirements will need to be supported by standards necessary to harmonise the characterisation process, provide information on recyclability and environmental footprint, define the reuse and repurposing of batteries, as well as to have a clear way of defining State of Health and End-of-Life. European standardisation should support and reflect the ambitious EU policy for a sustainable European battery value chain and set an example for the international market.

As this publication demonstrates, the battery sector has a great potential to become more sustainable and greatly contribute to the EU's decarbonisation goals, and standards can help make this happen. However, a number of elements have yet to be put in place in order for this ambition to become a reality.



ECOS

ECOS is the only environmental organisation worldwide specialised in standardisation.

We are an international network of members sharing a vision of a clean and healthy environment where people live in respect of the planet and its natural resources, preserving them for future generations. ECOS aims to influence the development of ambitious standardisation, legislation and political strategies to promote the transition to a clean and circular economy that respects planetary boundaries.

ECOS promotes and defends environmental interests in the development of standards at European and international level, as well as in the development of technical environmental product policies. Thanks to nearly 20 years of experience and a strong network of members and experts, our role in these processes is highly valued and widely recognised.

The green line to standards

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