EUROBAT
ASSOCIATION OF EUROPEAN AUTOMOTIVE AND INDUSTRIAL BATTERIES MANUFACTURERS

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EUROBAT proposal for a notification, verification and validation system of batteries that become waste

Introduction

Batteries are critical to decarbonise our economy and tackle climate change: from electric mobility to energy storage, from grid stabilisation to logistic, batteries will support the decarbonisation of the transport, energy, production and telecommunications sectors.

However, with the growing public interest on this technology, several myths related to batteries gained some attention. A common misconception regarding batteries is that they are not collected or recycled, and that they risk ending up in landfills or anyway not treated properly, with negative consequences for the environment.

With this document, EUROBAT wants to address these concerns and remark that virtually all automotive and industrial batteries available for collection in the EU are actually collected. We will follow this structure:

1. Show how the battery market is a very diverse one, with several technologies and applications
2. Explain how the current collection system of industrial and automotive batteries works in EU and illustrate its success in terms of virtual close loop and high collection levels
3. Propose a set of principles further improve the collection system in terms of tracing and data collection

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1 Battery technologies

Four battery technologies[1] are now available on the market: lead, lithium, nickel and sodium-based batteries, all with their specific characteristics and advantages for a given application.

Lead: lead batteries are the most widely used electrochemical system, used in numerous applications from starting, lighting and ignition (SLI) to stationary energy storage and industrial mobility. Lead-based batteries are recycled in a closed-loop system: all components are recycled, and the lead in batteries is collected and re-used to produce new batteries. Spent lead batteries have a positive value: recyclers, waste collectors and manufacturers have a direct economic interest in taking back and recycling these batteries.

Lithium: Lithium-Ion is currently the dominant battery system for portable and on-road electric vehicles applications, but it is also widely used in stationary storage applications. Li-ion batteries meet the average recycling rate of 50% mandated by the Batteries Directive for this family. There is a substantial effort on-going to bring capacity and automation to the existing Li-ion recycling facilities, so that when large volumes of used (automotive and) storage batteries will reach the end of their life, they will be recycled at marginal cost.

Nickel: Nickel based batteries are used for stationary energy storage, Hybrid Electric Vehicles (HEV) and in industrial mobility applications. Nickel batteries are recycled in a well-developed infrastructure, and due to their high recyclability, nickel is reused in the manufacture of a wide variety of industrial products.

Sodium: sodium based batteries are used in stationary energy storage applications and in industrial mobility applications. The battery is fully recyclable within existing industries for the production of stainless steel and road paving.

While Lithium based batteries have the have the highest growth potential, Lead based batteries are by far the most important market. In a foreseeable future, Lead Acid and Li-ion batteries will remain the most important electrochemical systems to serve that market demand.[2]

[1] EUROBAT conventionally gathers the different battery technologies available on the market in four groups. However, there are considerable differences among different battery in the same group.
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2 Collection of industrial and automotive batteries in the EU

Batteries can be distinguished by their application or by their technology. If we look at applications, the Batteries Directive[3] distinguishes between **portable[4], automotive and industrial batteries**.

The Batteries Directive includes a collection target for portable batteries but not industrial and automotive batteries. However, it obliges battery producers to set up end of life solutions as detailed in Art. 8.3 and 8.4. This obligation, combined with the ban on landfilling and incineration (Art. 14), results in an **implicit 100% collection target for automotive and industrial batteries**. Based on these strict obligations, on the data available, and the reality of the battery business in Europe, we are confident that this target is met.

Automotive batteries

- Automotive batteries are lead-based and have a positive value at the end of their life
- Established and effective collection system in place in the EU
- EUROBAT study proves closed-loop
- Studies report collection rates of 96-99% in the EU
- Problems of data availability

Automotive batteries are used for automotive starter, lighting or ignition power. These are the "traditional" batteries used in every vehicle on the road. The traction battery of electric vehicles does not fall under this category.

Automotive batteries are **lead-based**. These batteries have a **positive value at the end of their life**, and all economic actors have a direct economic interest in recycling them. Recycling lead is relatively simple and cost effective and in most of the applications where lead is used, especially lead-based batteries, it is possible to recover it for use over and over again without any loss in quality.

Return points for automotive batteries include car accessory dealerships, automobile workshops and recycling businesses, consumer markets, filling stations, local communities and metal dealerships. Collection points include metal dealerships, freight forwarders and branches of the battery industry. The batteries are picked up from the collection points by specialised companies, authorised by competent authorities to manage hazardous waste, who ensure the safe transport of the end-of-life batteries, and are delivered to secondary smelting plants either directly or via specialised interim storage points. In this way, professionals are engaged from start to finish in ensuring the safe collection, treatment and recycling of used batteries.

[3] Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators
[4] Portable batteries are not in the scope of EUROBAT, and will not be discussed here.

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Considering their economic value and the efficient and cost-effective collection and recycling process that operates within an established infrastructure, it is widely acknowledged that **the collection and recycling of automotive lead-based batteries operates, effectively, in a closed loop**.

Despite the lack of data, EUROBAT already demonstrated in a 2014 study[5] that **99% of automotive lead-based batteries are collected and recycled in the EU**, making one of the most recycled consumer products in the EU.

An updated version of the study will be published in the coming months, extending the scope to consider a larger panel of countries, now covering 92% of the automotive park in the EU (75% in the previous study). This resulted in a slightly lower collection rate of 97,3% mostly due to inaccuracies in Member State data collection. Using the same panel of countries as the previous study, the collection rate calculated now is **99.7%**. Overall, **the study again confirms the closed-loop recycling of lead-based automotive batteries.**

Similar values are quoted in the Evaluation Report on the Batteries Directive[6], which acknowledge a **96-98% collection rate** despite incomplete Eurostat datasets on waste management operations of end-of-life vehicles.

Industrial batteries

- Industrial batteries cover a very broad range of applications and use different battery technologies
- Generally bulk and heavy batteries, used in a professional context in B2B relations
- Established and effective collection system in place in the EU
- The collection rate of industrial batteries is close to 100%
- Problems of data availability

According to the Batteries Directive, industrial batteries are "designed for exclusively industrial or professional uses or used in any type of electric vehicle" (Art 3.6). There is a very broad range of applications among industrial batteries, but with few exceptions (light mobility applications) they are bulky and heavy and used in a professional context in a business to business relation. A non-exhaustive list application of industrial batteries includes:

- Traction battery for different types of electric vehicles:
    - "Large" mobility: cars, vans, trucks, buses

[5] The Availability of Automotive Lead-Base Batteries for Recycling in the EU, https://www.eurobat.org/images/news/publications/ihs_eurobat_report_lead_lores_final_2.pdf

[6] COMMISSION STAFF WORKING DOCUMENT on the evaluation of the Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC SWD(2019)1300 https://ec.europa.eu/environment/waste/batteries/pdf/evaluation_report_batteries_directive.pdf

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  - "Light" mobility: scooters, pedelecs
  - Industrial mobility: forklifts, ground support equipment, material handling, construction/agriculture equipment…
- Backup battery:
  - Storage systems for large renewable installations
  - Grid support systems
  - Storage systems in off-grid and micro-grids solutions
  - Storage systems in residential, commercial and industrial buildings
  - Uninterruptable Power Supply Systems (UPS) for hospitals and buildings
  - Batteries for telecom backup applications
  - Batteries for rail, trams, metros and aircrafts

Industrial batteries reach their end of their useful life and become waste predominantly at industrial and commercial companies which use them. This ensures that, as required by the Batteries Directive, these batteries are handed over to specialised companies, authorised by competent authorities to manage hazardous waste, who ensure the safe transport of the end-of-life batteries and their remittance to fully permitted recyclers. The valuable materials contained within can easily be accessed by recycling professionals who have the expertise and training to deal with their recovery and handling. It also ensures that end-of-life industrial batteries are stored by professionals up until they are collected and economies of scale as these batteries are not dispersed into the wider community, allowing for ease of collection.

Looking more specifically at the technology of the battery, the division of the industrial batteries should be analysed as follows:

- **Lead:** positive value, recyclers, waste collectors and manufacturers have a direct economic interest in taking back and recycling these batteries
- **Nickel-Cadmium:** aggressive commitment from manufacturers who actively support national producers in implementing their national take back and recycling obligation by setting up end of life solutions on their behalf
- **Sodium**: sodium batteries are fully recyclable within existing industries for the production of stainless steel and road paving.
- **Lithium:** This category can be broken down in three sub-categories:
  - *Large mobility batteries* (EV, PHEV and HEV): batteries are already regulated as part of the vehicle and as such the obligation to collect end of life vehicles is already described in the End of Life Vehicles Directive. Involvement of the car owner on servicing electrical powertrain currently is and is expected to stay minimal, and professional actors do participate in the implementation of the take back system.
  - "*Conventional" industrial batteries*: these batteries are used in a professional context in a B2B relation. This means that they are professionally managed at the end of their life.

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- *Light mobility batteries* (eBikes, scooters…): these batteries are placed on the market in mobility appliances through distribution outlets. They are used, maintained and discarded by the general public. On most aspects, their life and end of life is akin to that of portable batteries (it is only their "traction" function which makes them industrial). For this reason, these batteries should be managed (and classified) in a different way.

Despite the lack of data, it is generally assumed that the collection rate of industrial batteries is close to 100%, as recognised also by the European Commission Service[7]. There are several elements to confirm this: the B2B character of these batteries, the fact that they are bulky and heavy and for some technologies the positive value of the spent battery. There is actually no evidence to support the assumption that not all waste industrial batteries are collected and recycled.

Nevertheless, the Evaluation Report on the Batteries Directive[8] claims that 56 000 tonnes (11 %) of industrial batteries placed on the market are not collected every year, but this calculation is flawed by some fundamental mistakes.

First of all, the report directly compares batteries placed on the market in 2015 and batteries collected in 2015. This obviously generates misleading conclusions: industrial batteries have a useful life of up to 20 years, therefore batteries placed on the market in 2015 will be collected and recycled up until 2035. Similarly, batteries collected in 2015 were mostly produced before 2005.

Of course, the number of industrial batteries placed on the market is not constant, it increases over the years in line with the growing importance of batteries in several applications.

Secondly, the report does not model the "exports in appliance" flow, which means that the export of new batteries in appliances across Member States borders or towards non-EU countries has been not taken into consideration. This is highly problematic since these batteries are not available for collection in the country where they have been initially reported as placed on the market or not available for collection in the EU at all.

Therefore, the overall analysis on collection targets included in the Evaluation report does not reflect reality and should therefore not be used to take any conclusion on the effectiveness of the system.

[7] Frequently Asked Questions on Directive 2006/66/EU on Batteries and Accumulators
https://ec.europa.eu/environment/waste/batteries/pdf/faq.pdf
[8] COMMISSION STAFF WORKING DOCUMENT on the evaluation of the Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC SWD(2019)1300
https://ec.europa.eu/environment/waste/batteries/pdf/evaluation_report_batteries_directive.pdf

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3 EUROBAT proposal on a notification and validation system

- EU collection rates of automotive and industrial batteries are reasonably close to 100%, but there are data availability issues
- A notification, verification and validation system of batteries that become waste could solve this issue. It should:
  - Capture the volume of batteries available for collection
  - Avoid statistical models, count real volume of batteries
  - Create a database where generators of spent batteries notify when batteries become waste:
    - industrial and commercial companies for industrial batteries
    - service point or dismantling center for automotive batteries
  - The system would not apply to consumers

From our short analysis, we can conclude that there are no serious problems with the collection of automotive and industrial batteries, and that there is actually no evidence to support the assumption that not all waste automotive and industrial batteries are collected.

However, it must be recognised that data on battery collection is somehow difficult to gather, due to several reasons – among these, improper filing, unclear definitions or methodologies, differences among member states. To address these problems, a new notification, verification and validation system to report the change of battery status should be implemented, taking into account two key points: it should capture the volume of batteries available for collection and it should not be based on a statistical model.

- **What to measure: batteries available for collection**.
  A first point to address is what to measure. Not all automotive and industrial batteries produced in Europe are available for collection: some are exported outside of the EU, as primary or second-hand products, while other are still in operation. Any collection target should of course be based only on batteries available for collection.

- **How to calculate collection rate: statistical model are inaccurate tools**
  The number of "batteries available for collection" should not be calculated based on a statistical model, but properly based as those batteries that actually reach the end of their life. Statistical models have a very high degree of uncertainty and imprecisions, and they would not really address the issue at stake: the lack of reliable data.
  This is of particular concern in the case of industrial batteries: defining industrial batteries available for collection by using statistical models that refer to the batteries placed on the market in a given period produces a high level of uncertainty. This is mainly due to the large variety of products, applications and lifespan expectations, that would lead to very inaccurate and non-useful results. Examples are stationary batteries

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of different chemistries that may have a useful life in the application that is in the range of 20+ years.

An improperly designed statistical model will offer inaccurate results, flagging collection problems that do not exist in reality but are simply the result of imprecisions in the model, potentially leading to unwarranted and damaging political decisions. For this reason, EUROBAT believes that a notification system to measure batteries available for collection would be clearly preferable and would solve the problem of lack of reliable data.

One of the most interesting regulations to serve as example to develop this system is the Waste Framework Directive (2008/98/EC). Here we can identify different elements that could be useful for a future collection system of batteries. According to Articles 19-24-35 of this Directive, the Producers, the establishments or undertakings which collect or transport hazardous waste on a professional basis shall keep a chronological record of the quantity, nature and the origin of the waste, the destination, the frequency of collection, mode of transport and treatment method foreseen in respect of the waste. The producers should make this information available upon request to the competent authorities. At the same time, in case a hazardous waste is transferred to another Member State, this should be accompanied by an identification document, which may be in an electronic format, containing the specific data of the waste.

This system can serve as the foundation for the notification system of batteries becoming waste, reported by the generators. This system would not of course apply to consumers[9]. In essence, it would follow this process:

(1) the generator notifies the end of life status of the battery: "I have on hand a battery which I want to dispose of. It is now a waste and I will hand it over to a waste collector" (notification);
(2) the waste collector confirms he took custody and then;
(3) the recycler confirms he received and recycled the waste (validation).

A similar system applies already to all batteries that are classified as hazardous waste. For EV traction batteries and automotive batteries, the notification would be done by the professional who removed the battery from the vehicle or by the return point.

This then compares what became waste (notified amount) to what was recycled (validated amount), with this a 100% target could be achieved realistically. It will be applicable to the industrial battery sector, since these batteries are governed by B2B relations, and to automotive batteries. This system would have the great advantage of giving reliable data on collection of automotive and industrial batteries, offering a precise picture of the situation and also the possibility to promptly identify where problems in the collection and recycling chain might arise.

[9] For obvious reasons, this system would not apply to light mobility batteries (eBikes, eScooters…). These are industrial under current definitions but become waste at non-commercial end-users, hence follow the end of life logic of portable batteries. The collection efficiency of these batteries should be governed by a different set of rules, or alternatively they could be reclassified as portable.