Battery Pass

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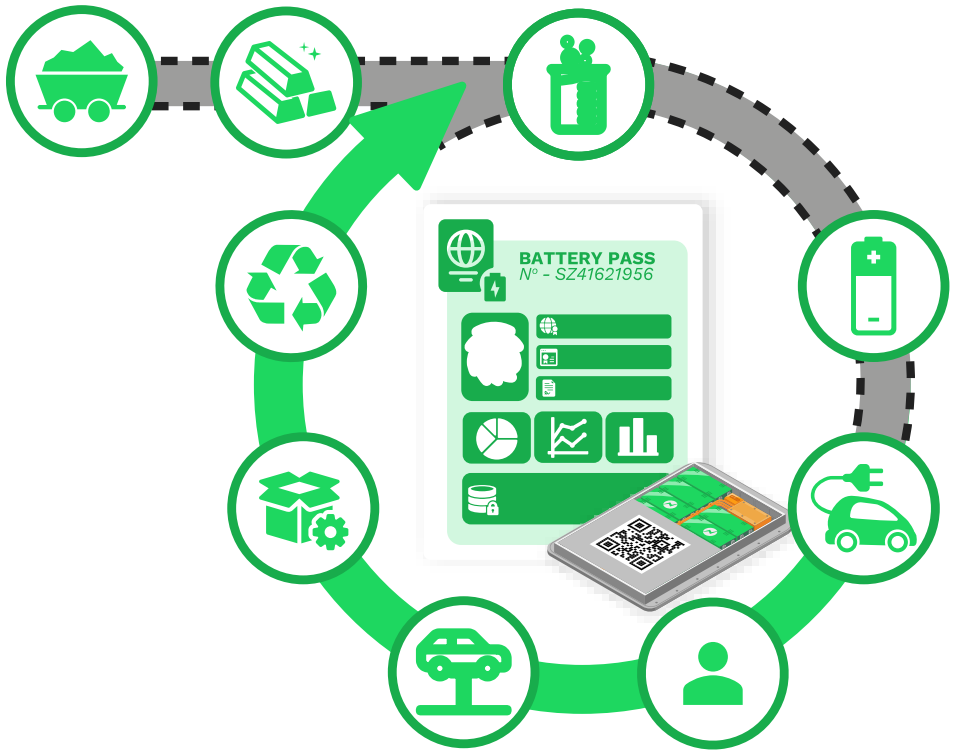
The Value of the EU Battery Passport

Executive Summary

An exploratory assessment of economic, environmental and social benefits



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The EU battery passport could create value for business, authorities and consumers – but to fully leverage its potential, interventions beyond regulation are needed

- **The battery passport as per the Battery Regulation promises to enable several direct use cases, in particular for circular management of batteries downstream of manufacturing** – additional specifications of voluntary data attributes, implementation of upstream traceability, integration in regulated downstream processes and systems, and aggregation of data attributes from different battery passports could expand value creation by enabling additional potential use cases
- **We assessed the benefits of the battery passport along twelve use cases qualitatively with a deep dive including an initial quantitative assessment on three selected use cases** to understand where and how battery passport data could lead to more efficient operations, product differentiation, and a digital and green market
- **Companies along the battery value chain should consider battery passports as a strategic opportunity to generate value.** We find that:
  - Information availability through the battery passport could **increase the credibility and reliability of supply chain data** and green claims for product differentiation, **enable informed purchasing decisions,** ease servicing, improve used battery transport risk assessment, **streamline the trade of used batteries,** enable industry benchmarking and an accurate market overview
  - Performance data could simplify the **residual value determination** and **reduce procurement including technical testing costs for independent operators by ~ 2-10%**
  - Composition and dismantling information could make the **recycling process more efficient** and **reduce the costs for pre-processing and subsequent treatment in recycling by ~ 10-20%**
- **The regulator should facilitate the realisation of this value by creating conducive conditions and by offering targeted support to companies struggling with capacity.** To fully materialise the value creation potential of the battery passport, we recommend:
  - The battery passport should be **integrated wherever possible into existing regulatory procedures and systems,** e.g. Green Public Procurement. Additionally, reported battery passport information should be leveraged for the design of upcoming policies and policy changes
  - **Additional data attributes should be allowed** in a separate “beyond regulation” battery passport section to enable the battery passport being used as a B2B tool
  - The battery passport **should be used in vehicle de-registration and export procedures,** which could **lead to more secondary active materials becoming available, potentially fulfilling ~ 5-20%** of material demand for projected European passenger vehicles in 2045
- **Consumers could benefit from battery passport information through informed purchasing decisions and residual value determination improvements.** The benefits of the battery passport and data need to be communicated effectively to motivate consumer engagement

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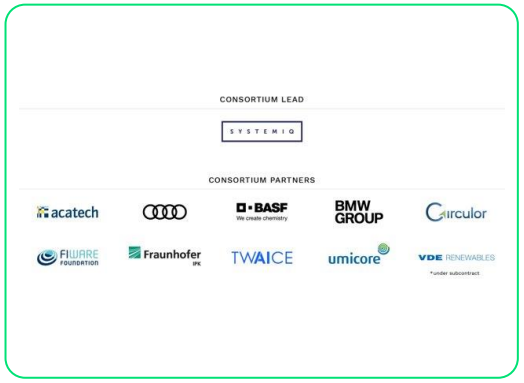
The battery passport, a breakthrough EU innovation, is actively supported by the Battery Pass consortium, which aims to create resources facilitating its implementation

The **battery passport** is a breakthrough EU innovation to digitally support sustainable, circular, high-performing batteries

- A **digital product passport** (DPP) is a novel concept **making available comprehensive life cycle information** of a physical product in digital format introduced by the European Union as part of its broader regulatory ambition towards sustainability and a digitalised economy
- The battery passport will be **required from February 2027 onwards** by the EU Battery Regulation, encompassing around 90 data attributes from seven content clusters for **electric vehicle (EV), light means of transport (LMT) and industrial batteries with a capacity > 2kWh**
- Next to the European Union, **similar** (regulatory) **efforts** on the introduction of a digital product or battery passport are **ongoing globally**

The **Battery Pass consortium** set out to create resources that support the implementation of the EU battery passport by industry



- The “Battery Pass” is a consortium of 11 partners from industry, science, technology and beyond, co-funded by BMWK **aiming to advance the implementation of the EU battery passport** and therefore also collaborating with other major initiatives in the DPP space (e.g. CIRPASS, GBA, Catena-X)
- Initiated and led by the systems change company Systemiq, the Battery Pass works to create **industry guidance** on content requirements, the **technical reference framework** for DPP, a **software demonstrator**, and a **value assessment**
- This document presents the first of two publications addressing the value assessment and focuses on **modelling the benefits of individual use cases qualitatively and quantitatively** (illustrative)

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The value assessment represents a collaborative effort of the Battery Pass consortium that covers a comprehensive scope and is validated by external stakeholders

Scope of the assessment and methodological process

Requirements			Value			Impact dimensions				
Mandatory requirements[1]	+	Voluntary additions	Benefits	vs.	Challenges and drawbacks	Economic (e.g. cost efficiency)	+	Environmental (e.g. GHG emissions)	+	Social (e.g. health and safety)

Battery Pass consortium partner perspective

15 Consortium group meetings

6 Sub-working groups

External battery industry perspective

>30 Expert interviews

2 Public consultations

- The value assessment was led by Systemiq in a **collaborative effort with the Battery Pass consortium and validated by external stakeholders** to incorporate the perspective of the entire battery value chain
- The scope includes **mandatory requirements as well as voluntary additions** and differentiates between benefits and drawbacks in three impact dimensions (economic, environmental and social)
- While all battery categories requiring a passport are included in the overall assessment, the **deep dives focus on EV batteries**, and a **separate analysis highlights differences for industrial batteries**

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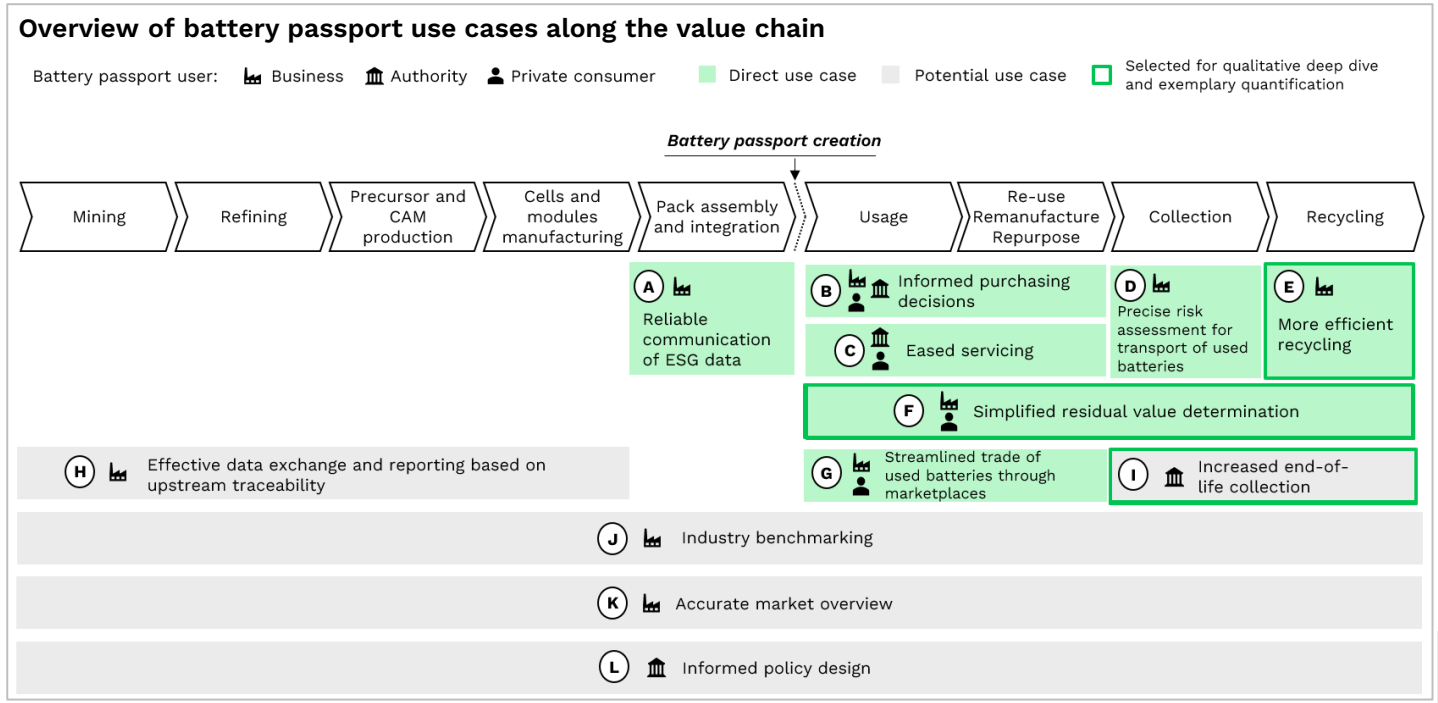
1. As per the EU Battery Regulation

Benefits of the battery passport will arise throughout the battery value chain, though particularly during a battery's service life

Overview of benefits and use cases

- The battery passport provides **added value** compared to the general reporting requirements[1] from the Battery Regulation by **collecting data in a digital format and making it securely accessible** to users with the respective access rights
- So called "**use cases**" describe **processes which could be improved by using the battery passport** and are **identified to understand** which **economic, environmental and social benefits** arise by using the passport
- We identified and qualitatively described **twelve battery passport use cases** along the value chain, of which we **assessed three in further detail** qualitatively and quantitatively
  - Seven "**direct**" use cases result from **mandatory data attributes** required by the EU Battery Regulation in combination with their respective access rights
  - Five "**potential**" use cases could be enabled provided certain **conditions** are in place which would go **beyond current regulatory requirements**



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1. Reporting requirements independent from the battery passport

Seven direct use cases are enabled by mandatory data attributes and their respective access rights - they unlock value along the downstream value chain

Direct use cases

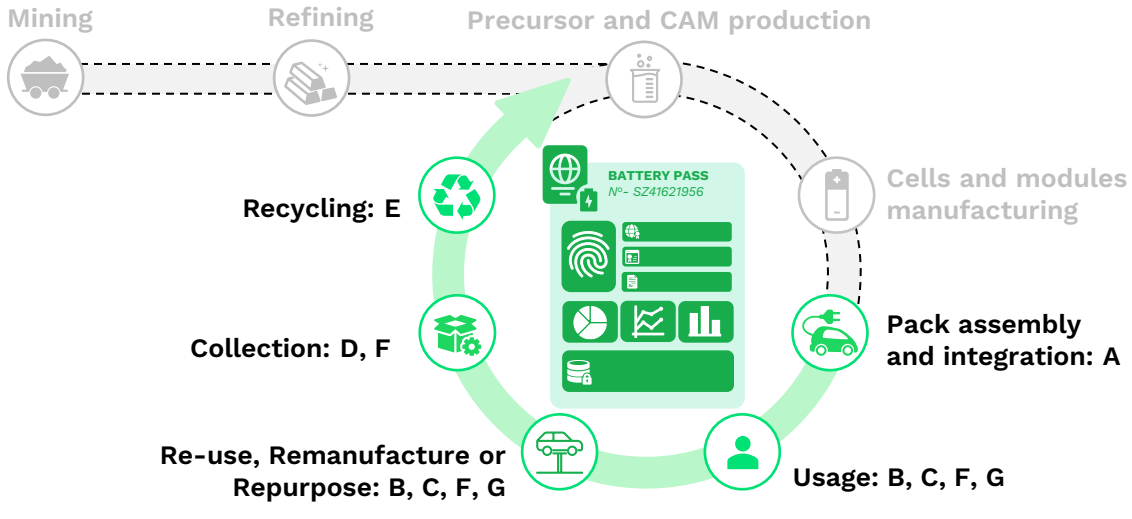
Mandatory data attributes + respective access rights

Use case	Benefit
(A) Reliable communication of ESG data	
(B) Informed purchasing decisions	
(C) Eased servicing	
(D) Precise risk assessment for transport of used batteries	
(E) More efficient recycling processes	
(F) Simplified residual value determination	
(G) Streamlined trade of used and waste batteries through marketplaces	

Benefit: Economic, Environmental, Social

Level of benefit: No, Low, Middle, High

Distribution of direct use cases along the value chain



Direct value add along several dimensions (environmental, social and economic)

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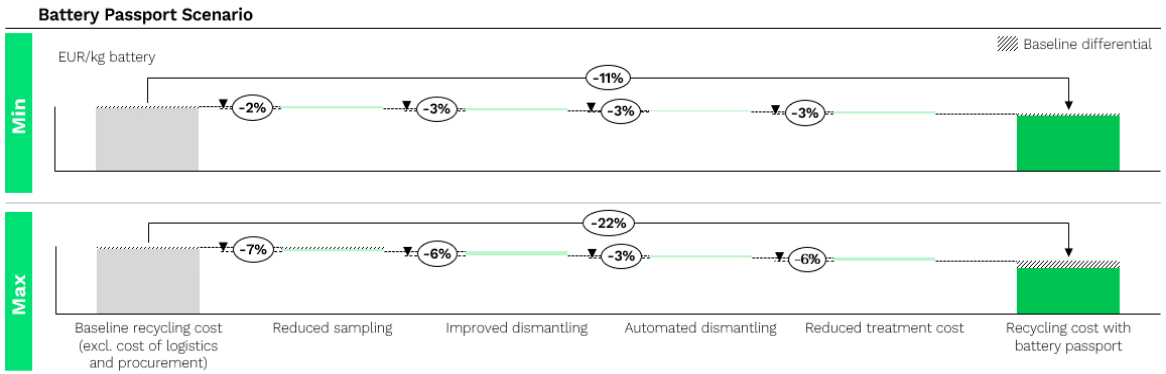
Two deep dives indicate that the battery passport could lead to significant cost savings for recyclers and second-life operators as well as substantial environmental impact reduction

Deep dive use case E: More efficient recycling processes

- Data available from the battery passport could **enable recycling process improvements** leading to economic (pre-processing and recycling cost reduction), environmental (secondary material increase, CO_2 reduction) and social (health and safety improvements) benefits
- An initial quantification of potential improvements of the mechanical-hydrometallurgical process route, indicates that composition and dismantling data might **decrease recycling costs for pre-processing and treatment by ~ 10-20%** based on current generic recycling cost estimations for NMC batteries

Recycling costs reduction through the battery passport

Micro perspective: Example High-Nickel NMC (622) EV Battery; generic mechanical-hydrometallurgical recycling cost (excl. cost of logistics and procurement)
Note that LFP battery recycling has different unit economics – however, the general pre-processing cost reduction levers could apply similarly.



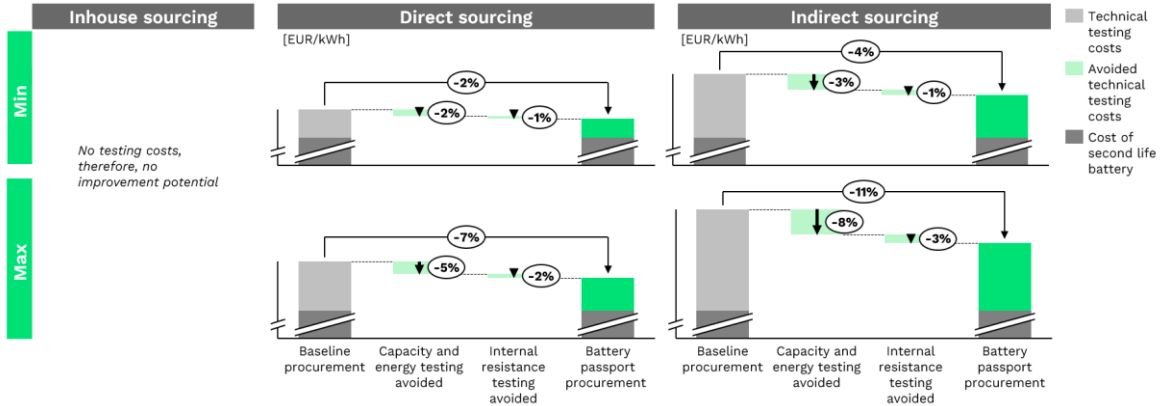
- Additionally recovered active materials **could meet up to 25% of the difference between the technically possible maximum recovery rates and recovery rate targets** from the battery regulation

Deep dive use case F: Simplified residual value determination

- Historic performance and durability information available through the battery passport could **improve the residual value determination process** by reducing the need for technical tests and improving the accuracy of the assessment. Thereby, decisions between second-life and recycling could be facilitated
- An initial quantification of the residual value determination process for three different battery sourcing scenarios shows that through avoiding technical tests, **~2-10% of the procurement including technical testing costs could be reduced** for independent second-life operators

Second-life procurement and technical testing costs reduction through the battery passport

Micro perspective: Baseline procurement incl. technical testing costs for three different battery sourcing scenarios and reduction enabled by the battery passport



- Due to the decrease of costs, we estimate a proportional increase in batteries going into second-life, which **could fulfil ~ 6-20% of the demand for stationary battery energy storage** in Europe

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Conditions beyond regulatory requirements (upstream traceability, integration into official downstream processes and aggregated data) could enable five potential use cases

Potential use cases

Conditions required beyond regulatory requirements

Application of traceability systems for data collection

The Battery Regulation and passport data requirements increase the need for reliable and credible data in upstream value chains. This could be enabled by gathering the data via traceability systems which, when complementing battery passport solutions, could unlock another use case through optimising data processing and use.

Integration into official downstream processes

To ensure battery collection, additional information on the downstream status as well as integration into official processes such as export control are needed. This would unlock another use case.

Aggregation of data from different passports

Aggregation of data from different battery passports, solved through an EU Commission-provided infrastructure or managed by specialised service providers, could provide additional information on market or organisation level and thereby unlock further use cases.

Use case

Benefit

Use case	Economic	Environmental	Social
(H) Efficient data exchange and reporting based on upstream traceability	High	High	High
(I) Increased end-of-life collection	High	High	Middle
(J) Industry benchmarking	High	Middle	High
(K) Accurate market overview	Middle	Middle	No
(L) Informed policy design	Middle	High	High

Benefit: Economic, Environmental, Social

Level of benefit: No, Low, Middle, High

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The third deep dive highlights the potential for a substantial macroeconomic benefit of the passport by leading to more secondary material available on the European market

Deep dive use case I: Increased end-of-life collection

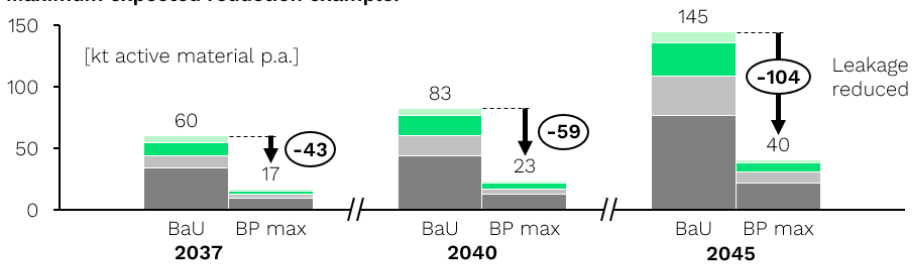
- Integration of the battery passport into regulated downstream processes with additional data attributes could **support authorities in identifying and thereby reducing illegal exports and illegal treatment**. This would result in benefits such as increased supply security, recycling revenue increase, health and safety, as well as reduced emissions
- An initial quantification shows that a reduction of battery leakage through the battery passport could lead to **more secondary active materials available** that could **fulfil ~ 5-20% of projected European passenger EV demand** in 2045

Reduction of battery leakage through the battery passport leading to additionally available secondary materials

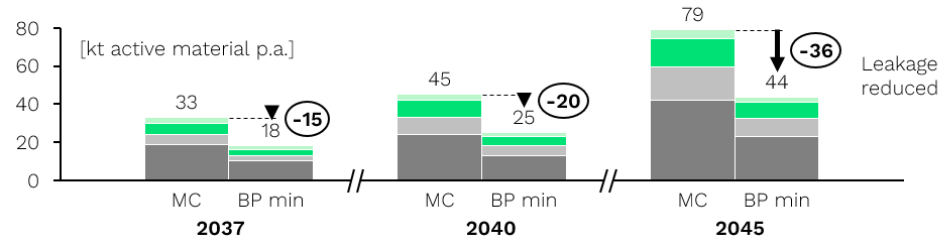
Macro perspective: Materials available on the European market

Leakage of batteries in baseline vs battery passport scenarios

Maximum expected reduction example:



Minimum expected reduction example:



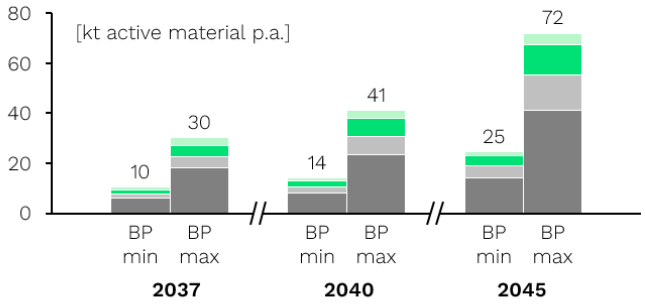
Cobalt Lithium Manganese Nickel

Secondary material additionally available

By reducing the amount of battery leakage from the European market through battery passport levers, we estimate that by 2045:

- ~ 2-5 kt cobalt
- ~ 4-10 kt lithium
- ~ 5-15 kt manganese
- ~ 15-40 kt nickel

could be additionally available each year.



- Moreover, the additional availability of secondary active material in the EU market could **increase recycling revenue by ~ 5-15%** and **cause a ~ 2-10% reduction of carbon emissions** associated with raw material extraction of active materials required to meet EV battery demand

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A separate analysis for industrial batteries shows the applicability of all use cases while highlighting differences due to technological, usage, and business characteristics

The added value is strongly affected by industrial batteries' different applications and characteristics

- **Differing characteristics and use patterns** of industrial applications (e.g. energy storage, electric logistics solutions, heavy duty) **as well as correspondingly varying business processes reduce benefits**
- The **broad range of technologies/chemistries** (Li-ion, Pb-acid, Ni-based or redox-flow) used in industrial batteries introduces specific characteristics that **distinguish the value assessment** for subgroups of industrial batteries
- Benefits associated with detailed **dynamic battery passport data** are **not applicable** to industrial batteries **without battery management system/ connectivity**

General use case applicability to industrial batteries — ✓ Equally applicable – Less applicable ✗ Not applicable

Use Case	Applicability
(A) Reliable communication of ESG data	✓ All industrial batteries
(B) Informed purchasing decisions	✓ Industrial batteries with BMS – Industrial batteries without BMS
(C) Eased servicing	– All industrial batteries
(D) Precise risk assessment for transport of used/waste batteries	✓ Industrial batteries with BMS – Industrial batteries without BMS ✗ Industrial batteries with external storage
(E) More efficient recycling processes	✓ Industrial batteries with Li-Ion and emerging chemistries – Industrial batteries except Li-Ion and emerging chemistries
(F) Simplified residual value determination	– All industrial batteries
(G) Streamlined trade of used/waste batteries through marketplaces	✓ All industrial batteries
(H) Efficient data exchange and reporting based on upstream traceability	✓ All industrial batteries
(I) Increased end-of-life collection	– All industrial batteries
(J) Industry benchmarking	✓ Industrial batteries with BMS – Industrial batteries without BMS
(K) Accurate market overview	✓ Industrial batteries with BMS – Industrial batteries without BMS
(L) Informed policy design	✓ All industrial batteries

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We acknowledge that the battery passport also presents challenges that could lead to drawbacks diminishing the overall value when unmitigated, which we will assess further

Challenges and drawbacks

- While unmitigated challenges may decrease the passport's overall value, the **benefits** derived from above explained use cases are **expected to outweigh the drawbacks**
- **Technical and battery passport system challenges** are expected to mostly **affect** the **passport issuer** and require industry collaboration, investment in emerging technology and authority support in enforcing standards
- **Capability and resource challenges** are estimated to mainly **impact SMEs** and necessitate early intra-organisational alignment, harmonised requirements and financial support

Challenges

Difficulties or obstacles that **stakeholders are facing when creating, maintaining or using the battery passport**

1 Technical and battery passport system

- Connected to required technical design of the battery passport
- Relevance varies based on stakeholder's role in the system

Reinforcing

2 Capabilities and resources

- Linked to stakeholder's individual abilities
- Relevance varies based on stakeholder's size[1] and capabilities

Outlook The Battery Pass consortium will **continue the value assessment** by assessing challenges and drawbacks in more detail, considering systemic perspectives and quantifying cumulative benefits.

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1. Only applicable for businesses

Thank you!

For **additional Battery Pass resources** on the full Battery Passport Value Assessment, Battery Passport Content Guidance, Battery Passport Technical Guidance and Software Demonstrator, please visit: https://thebatterypass.eu/resources/

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