MARKET INTELLIGENCE REPORT

COBRA

KEY TECHNICAL, POLICY AND MARKET DEVELOPMENTS INFLUENCING THE ELECTRIC VEHICLE BATTERY LANDSCAPE

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INTRODUCTION

Summer has been busy in the battery value chain. In research, sought-after topics such as solid-state cells, battery passports, and wireless BMS were presented at the Battery Innovation Days, with key stakeholders explaining the main challenges and hinting at new funding opportunities. The European market keeps expanding capacities for not only the manufacturing of battery cells but for the production of their components. At the same time, new chemistries and charging concepts are gaining momentum. In policy developments, while the EU is still working on the implementation of the New Battery Regulation, the U.S. has taken initiative by implementing the Inflation Reduction Act which gives a boost to local battery production. On the state level, California introduced a roadmap for the electrification of transport and has made progress in developing new battery legislation with a focus on EV battery take-back.

This market intelligence report will elaborate on these most recent events and advancements in battery research, market, and policies. In addition, Jordi Jacas Biendicho from IREC (COBRA coordinator), will share his personal reflections on the battery developments and explain how the recent milestones in our project contribute to achieving more sustainable batteries in Europe.

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INNOVATIONS FOR EV BATTERIES

CONVERSATION WITH JORDI JACAS BIENDICHO (IREC)

What are the current challenges for battery research in Europe?

When we were starting the COBRA project almost 3 years ago, we were asked to advance the battery technology in four main directions: achieving energy density higher than 750 Wh/l, reducing the amount of critical raw materials (mostly cobalt) in battery cells, improving connectivity by integrating battery management systems with sensors, and reducing the cost of batteries to less than 90 €/kwh. ***All four challenges are still valid*** *– the progress in battery research requires time. Some new aspects that must be addressed are connected to extending battery lifetime and efficient end-of-life treatment: predictive maintenance, diagnostics, recycling, repurposing, reverse logistics, etc. On the other hand, since Europe has significantly developed its battery manufacturing capacity, advanced manufacturing methods and supply chain tracking are also more relevant than ever.*

How do COBRA and other H2020 projects contribute to these challenges?

We have recently achieved ***several milestones*** *in COBRA that bring us closer to achieving these goals. With the prototype of GEN 2 power cells, we managed to demonstrate a cobalt-free battery. Although there is still a lot of work to achieve the expected energy density and cycle life, the discharge capacity and nominal voltage are already very close to the batteries containing cobalt. We also managed to commission the prototype of the full battery pack using lighter and more sustainable materials, as well as design the new BMS incorporating smart sensing that will allow us to diagnose batteries with higher accuracy and facilitate 2nd life transition. The whole* ***LC-BAT-5 Cluster*** *is making great progress in these fields that hopefully will not stop at the research level but will be useful for the battery industry.*

What exploitation opportunities do you foresee for COBRA's results?

Our industrial partners are quite interested in continuing their work after the project finishes. ***ReSiTec*** *aims to commercialise the silicon powder for use in battery anodes,* ***Solvionic*** *thinks about spending further efforts on developing core/shell materials based on the polymeric shells, while* ***Aentron*** *plans to explore possible applications of aluminium housing systems. We have planned some exploitation workshops with the consortium to brainstorm how we can help these developments on the route to market.*

Which new chemistries are most promising for new EV batteries?

Apart from cobalt-free Li-ion batteries, I think one of the most important technologies to develop are ***solid-state cells****. If we can use the Generation 3b materials and figure out how to make the lithium metal work with the solid electrolyte, we could achieve a major leap in battery performance, easily surpassing the energy density of 1000 Wh/l. Still, this will require many years of development and in my opinion, the first solid-state EV batteries may only reach the market after 2035. Other battery chemistries that could be cheaper and more sustainable than Li-ion are e.g., sodium-ion which so far falls short of energy density expectations, and lithium sulphur which still struggles with achieving a lifetime sufficient for commercialisation.*

TECHNICAL DEVELOPMENTS

BATTERY INNOVATION DAYS ON THE NEW CHALLENGES IN RESEARCH

The Battery Innovation Days took place between September 13-14 in Brussels and online and provided an opportunity to gather insights and discuss strategic directions in European battery research. The representatives of key Research & Innovation initiatives (**Batteries Europe**, **Battery 2030+**, **BEPA**) in partnership with the **Batteries 1st and 2nd IPCEIs** and industrial stakeholders exchanged views on the most up-to-date topics: strategic autonomy for the EU battery value chain, developments in the commercialisation of solid-state batteries (SSB), improving BMS for the automotive industry, ensuring sustainable access to raw materials, battery passports, and more. The discussions revealed which challenges are still to be addressed by battery stakeholders, e.g., advancing TRL of SSBs, converging the battery passport initiatives, and roll out of the new European mines. The recordings from the event are available on the platform upon registration.

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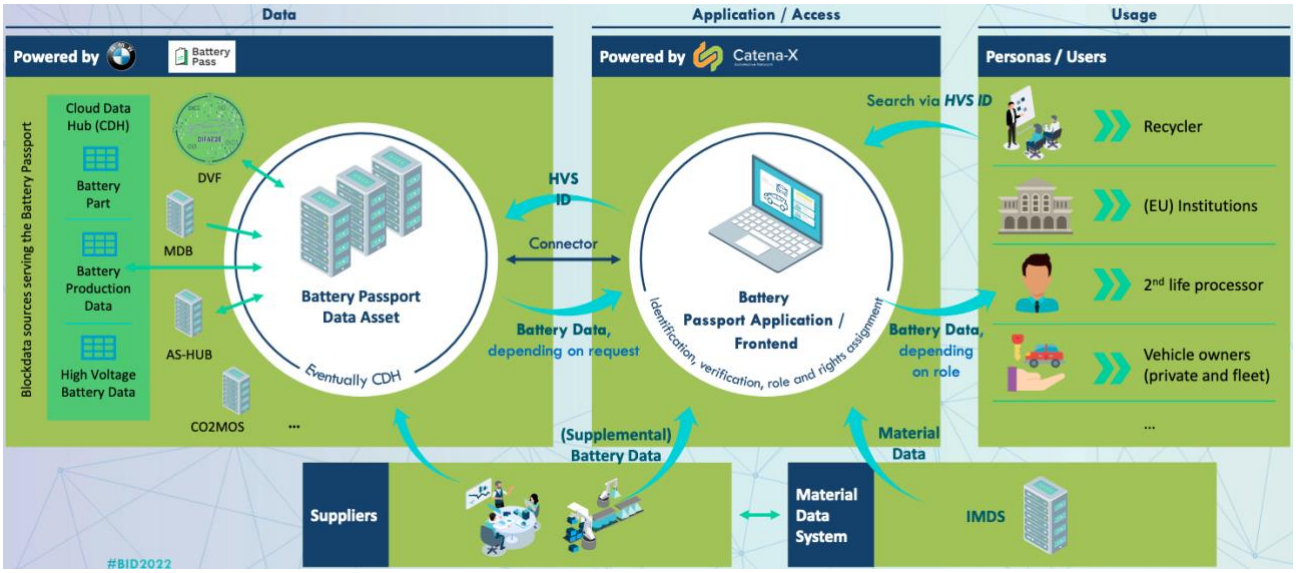
HOW CAN THE EU BATTERY PASSPORT WORK?

During the Battery Innovation Days, a BEPA representative, Dr Franz Geyer outlined the EU initiatives building battery passport functionalities. The German Government has funded two complementary projects: Battery Pass and Catena-X. **Battery Pass** led by a consortium of 11 partners focuses on preparing digital infrastructures for the exchange of basic battery data and their updates. **Catena-X** is going to establish a platform (frontend) being the first integrated, collaborative open data ecosystem for the automotive industry. Both initiatives aim to collaborate with **Gaia-X** for standards of the EU cloud initiative. Some challenges identified by the projects include building new business models and incentives for sharing data, the harmonisation of data creation methods during diagnostics, and IP rights vs. open data considerations.



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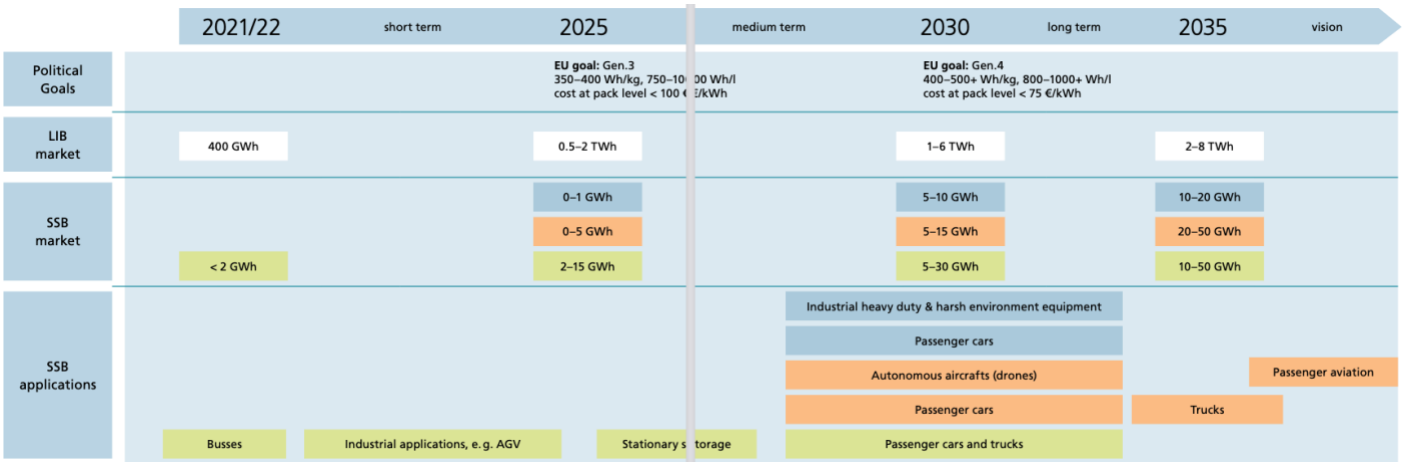
SOLID-STATE BATTERY ROADMAP 2035+ BY FRAUNHOFER ISI

The recent technical developments and commercialisation efforts in the field of solid-state batteries (SSB) were presented during the Battery Innovation Days by Thomas Schmaltz – senior scientist at Fraunhofer ISI. This year, the institute published a roadmap for SSBs by 2035+, which has become a reference for research and industry in Europe. It is expected that solid-state batteries will first be used in passenger cars in 2030 with **energy densities surpassing 1000 Wh/l**. There are several cell concepts that are in development: oxide electrolyte SSB, polymer electrolyte SSB and sulphide electrolyte with Si anode or Li metal anode. Global R&D efforts have increased significantly in the last several years, with China leading in number of publications followed by the U.S., and the EU. In terms of patent applications, Japan is leading and the EU is in 5th place with a decreasing number of patents filed in the last years. This is also reflected by the industry working on solid-state battery cells – most of them are from China, Japan, and the U.S.



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FREE4LIB PROJECT TO INNOVATE RECYCLING PROCESSES

A new Horizon Europe project in the field of batteries has just been launched. FREE4LIB aims to achieve **6 new processes to recycle end-of-life (EOL) LIBs** (dismantling, pre-treatment and 4 materials recovery processes) delivering innovative recycling solutions to reach efficient materials recovery (metal oxides, metals and polymers). The project will also offer **technologies to improve 3 processes that aim at the reuse of metals and polymers and the synthesis of electrodes** in the same value chain as secondary raw materials, for the remanufacturing of more sustainable batteries. The project will be developed by a Spanish technological centre CARTIF (coordinator) and 21 European organisations including COBRA partners AVL, IREC and Eurecat.

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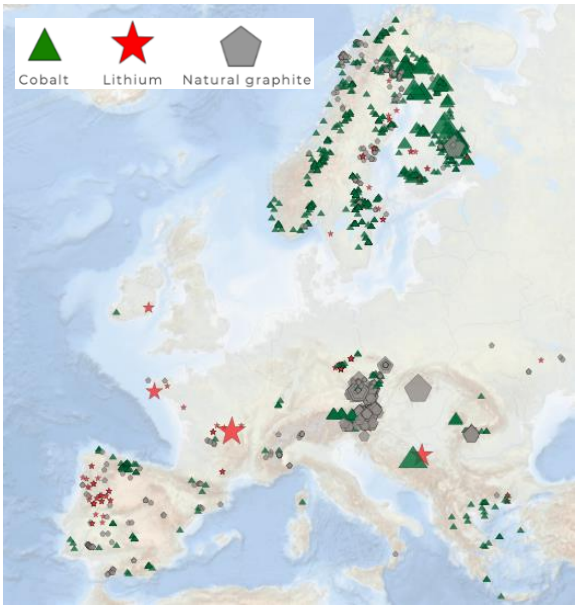
MARKET DEVELOPMENTS

GRAPHITE MINING IN SWEDEN UNDER QUESTION



The EU plans to increase the independence of the battery value chain but the majority of raw materials for new cells are still imported from other continents. Natural graphite which is the main ingredient of the battery anodes has reserves in Sweden. In 2011, the Australian mining company Talga Group requested an environmental permit to start the extraction of natural graphite in the north of Sweden. They believe this would provide **enough material to power 2 million EVs in Europe** each year. The national authorities have not issued a decision yet, though. The main concerns revolve around the proximity of drinking water reservoirs and encroachment on the indigenous Sami population. Nevertheless, the supply of 'innovation-critical' minerals has to be secured in one way or another, therefore, Sweden's Economy Ministry looks into how to streamline the permitting process for new mines.

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NIO PLANS TO EXPAND SWAPPING STATIONS IN EUROPE

NIO, a Chinese EV manufacturer considered one of the main competitors of Tesla, has plans to roll out hundreds of its battery swapping stations in Europe. The company finished a pilot in Norway, in which 800 SUVs were sold, and 2 swapping stations were installed. Now NIO aims to offer two more EV models this year and **expand their swapping stations network outside of China by 1000**, mainly in Western European countries like Germany, Sweden, Denmark, and the Netherlands. The unique selling point of NIO is the lower upfront costs of EV ownership by leasing the battery instead of selling it. In this way, the company can also offer more convenient and faster charging options, e.g. battery swapping at dedicated stations (3 minutes) or on-call valet charging. This interesting model has become very popular in China but not so much in Europe and the U.S. where NIO is still facing some reluctance from customers and regulatory barriers.

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UMICORE AND VOLKSWAGEN WILL MANUFACTURE BATTERY CATHODES

The recently announced €3 billion joint venture aims to manufacture cathode materials and their precursors for **160 GWh cell capacity per year, by the end of 2030**. The production is said to be located in the newly inaugurated Umicore's plant in Nysa, Poland, and will supply the battery cell plant of PowerCo (VW's battery company) in Salzgitter, Germany. Both partners intend to include, at a later stage, elements of refining and battery recycling based on Umicore's technology under a license agreement with the JV. Other European manufacturers are also expanding the scope of their activities upstream, e.g., Northvolt plans to build a 100 GWh/year cathode plant in Borlänge, Sweden, which will be used to supply EV makers like VW, BMW, Volvo, and Scania.

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SERBIAN ELEVENES PRODUCED THE LARGEST LFP CELL IN EUROPE

ElevenEs is an industrial spin-off project of Al Pack Group, a multinational aluminium processing company based in Subotica, Serbia. After a 2-year development program, the spin-off produced a **prototype of the largest LFP cell in Europe that will be shipped for customer testing at the end of 2023**. The main customer segments for the cell include industrial applications (forklifts, mining trucks, buses etc.), stationary energy storage systems, and city EVs. ElevenEs, initially supported with early-stage investment by EIT InnoEnergy, now aims to close the Series B financing round this year and reach the giga-scale production of 8GWh annually by the end of 2025. The LFP (Lithium Iron Phosphate) batteries have lower energy density than the more popular NMC but they can last longer, they are less expensive and do not require the use of nickel or cobalt.

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POLICY DEVELOPMENTS

INFLATION REDUCTION ACT AND RECYCLING OF EV BATTERIES

In August the U.S. president signed the Inflation Reduction Act (IRA) – an expansive legislation which includes measures relevant to the manufacturing and recycling of electric vehicles. Consumers who purchase EVs will be able to receive up to $7.500 in tax credits, provided that the assembly of the cars occurs in North America. Additionally, the EV battery components must not have been extracted, processed, or recycled by a 'foreign entity of concern', which includes China and Russia. This puts pressure on local battery manufacturing capacities, as well as the procurement of rare metals like cobalt, nickel and lithium. It is expected that the IRA will **boost the local recycling industry** to partially cover the new rise in demand for raw materials.

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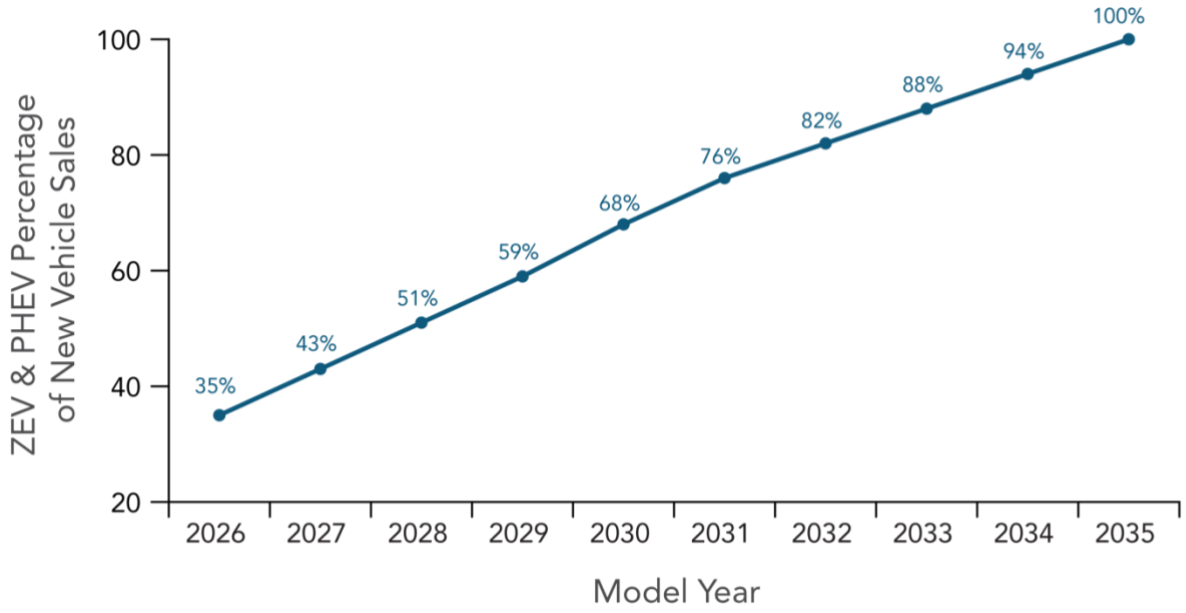
CALIFORNIA FOLLOWS THE PATH TO ZERO-EMISSION VEHICLES

Transportation is responsible for approximately 50% of greenhouse gas emissions and 80% of air pollutants in California, U.S. For this main reason, in 2012, the state decided to implement the Advanced Clean Cars (ACC) Program. Its continuation, ACC II, has just been announced, proposing aggressive targets for the phase-out of internal combustion engine vehicles, similar to the ones proposed by the European Commission. **By 2035 100% of new cars and light trucks sold in California will be zero-emission vehicles (ZEVs)**, including plug-in hybrid EVs. Efforts to achieve this objective will be tracked with a roadmap presented in the graph below. The new targets come with a list of requirements and incentives. For example, the **Clean Cars 4 All** programme provides up to $9,500 to low-income drivers who scrap their older vehicles and want to purchase a car that produces fewer emissions. Over the next three years, California will invest $3.9 billion in ZEV adoption.



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PROGRESS TOWARDS BATTERY RECYCLING POLICY IN THE US

California doesn't only aim to lead the way in the phase-out of ICE vehicles, but is also considering the circularity aspects of EV batteries. In 2019, the state assembled an Advisory Group that consisted of 19 representatives from automotive, battery and waste industries, public interest organisations, and governmental agencies. That stakeholder group recently released a **report** containing policy recommendations, some of which are based on the measures proposed in the EU New Battery Regulation e.g., physical labelling, digital identifier and BMS access. Interestingly, the stakeholders **rejected** several solutions connected to the circular economy: recycled content standards, minimum material recovery targets, and a reporting system for EV batteries retired from use, recycling, and recovery rates. Nevertheless, some measures supported by U.S. stakeholders are **more progressive** than the European ones, for example, the development of strategic collection and sorting infrastructure, a universal diagnostic system, and more specific EPR provisions.

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PORTABLE BATTERIES WILL HAVE TO LIVE LONGER IN THE EU?

On August 31, the European Commission proposed an ambitious **new regulation** on eco-design requirements for mobile phones, cordless phones, and slate tablets. The document introduces several rules aiming to increase the sustainability of portable batteries, which are often prematurely replaced and not sufficiently used or recycled. The first of these rules assumes that the batteries will either be easily replaceable, or their design will have to meet minimum standards: maintaining at least **83% of original capacity after 500 charging cycles** and 80% after 1000 cycles. Secondly, the buyers of smartphones will also get access to 15 of the most important kinds of spare parts for at least 5 years, as well as access to repair instructions for at least 7 years after the last day of marketing devices. The EC believes that **extending the lives of smartphones by five years would be like taking 5 million cars off the road**. Some industrial stakeholders have voiced their concerns that the proposed changes will lead to higher waste from overproduced spare parts and higher prices for customers. Manufacturers are also worried about treating third-party repair professionals as equal to the authorised workshops.

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