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218 - EV Legislation & Incentives Guide

The EV Legislation & Incentives Guide provides in-depth analysis of how and where legislation is impacting electrification in the automotive industry. It aims to help OEMs and lawmakers understand the regulations and incentives surrounding EVs today, as well as the legislation being worked towards by governments in different regions. The guide is released quarterly to provide the latest updates and offers an accompanying Excel version featuring deep, data-driven, analysis.

EV

Electric Vehicle

#219

EV Battery Technologies & Ecosystem

As EVs continue to proliferate in markets across the globe, automakers are racing to improve the efficiency, range, and bottom-line of their solutions. The common denominator behind these improvements is the vehicle battery – which already encompasses a wide, rapidly growing ecosystem of technologies, key players, infrastructure, and more.

With the battery itself employing cutting-edge technologies, and being the most expensive EV component, it has become the focal point of innovation and investment for the broader automotive industry. This innovation has in turn driven the ecosystem's growth – with an increasing number of companies dedicated to battery manufacturing and operations, and more frequent announcements of new technologies, systems, and partnerships. As a result, keeping track of its changes and new additions is becoming an increasingly difficult task.

This report profiles the key players and technologies involved in the EV battery ecosystem, while highlighting the factors encouraging innovation across the battery lifecycle. Offering accessible explanations of today's critical battery technologies, the report provides insight into the potential battery industry conditions of the future. It also addresses the recent trend of battery recycling and reuse – understanding its key initiatives and supporting technologies.

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Key questions answered

- Which battery technologies are the most promising and how do they work?
- Who is investing in major battery initiatives and which players are positioned to lead the market?
- What might the automotive and battery industries look like in the future and why?

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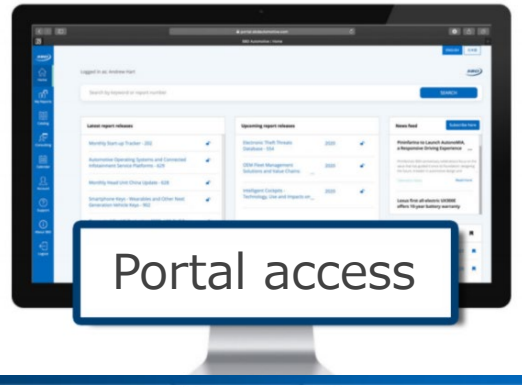

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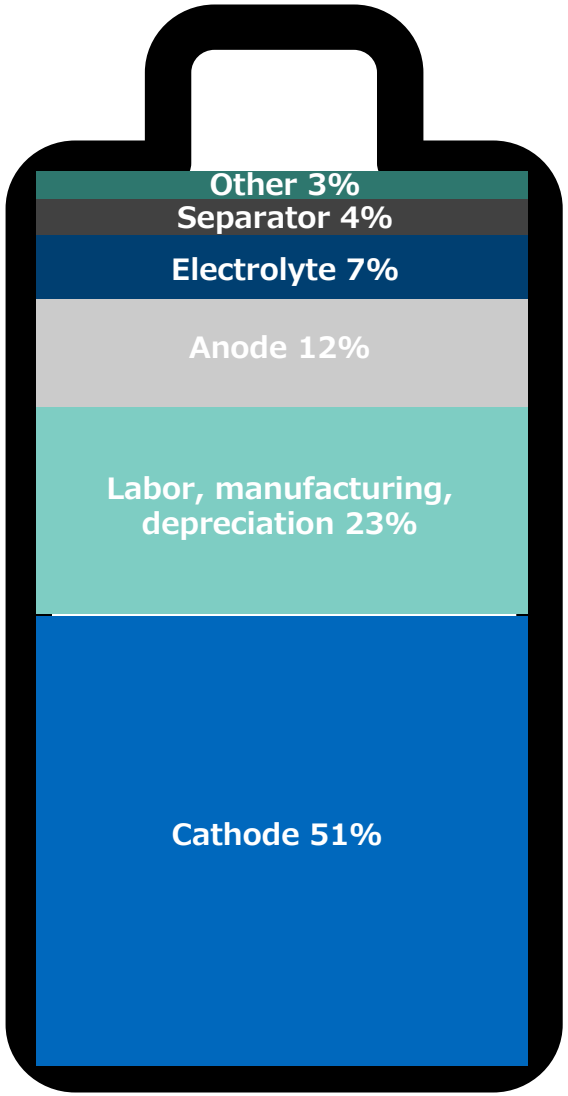
New chemistries show promises

Battery Components Cost Shares



Overview

The cathode material is still the most expensive component in EV batteries by far accounting alone for over 50% of the whole battery cost.

Of the batteries already on the market **the majority of are based around different cathode chemistries**:

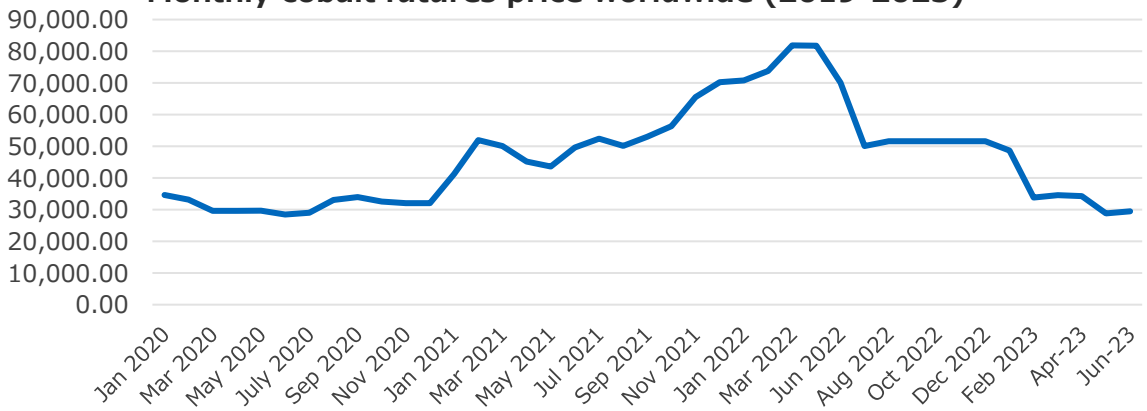
NCM	NCA	LFP	LMO	LCO	LTO	NiMH	Na-Ion
$LiNiMnCoO_2$	$LiNiCoAlO_2$	$LiFePO_4$	$LiMn_2O_4$	$LiCoO_2$	$Li_4Ti_5O_{12}$	Ni(OH)2 + MH	Various
Cathode	Cathode	Cathode	Cathode	Cathode	Anode		

Along with the Na-Ion batteries introduced very recently by Chinese manufacturers with not too many details shared about the new products, more **chemistries being developed** and relatively close to commercialization **promise significant advantages over the batteries already sold on the market**:

Chemistry	Advantages	Current Limitations
Semi-Solid-State	• Higher energy density • Improved safety	• Manufacturing complexity • Higher costs
Solid-State	• Higher energy density • Improved safety • Higher cycle count	• High costs
LiS	• Higher energy density • Improved safety	• Extremely limited cycle count
Al-Air	• High potential energy density • Higher sustainability • Lower costs • Better safety	• Currently non-rechargeable

Cobalt sources concentration and usage reduction

Monthly cobalt futures price worldwide (2019-2023)



Source: investing.com

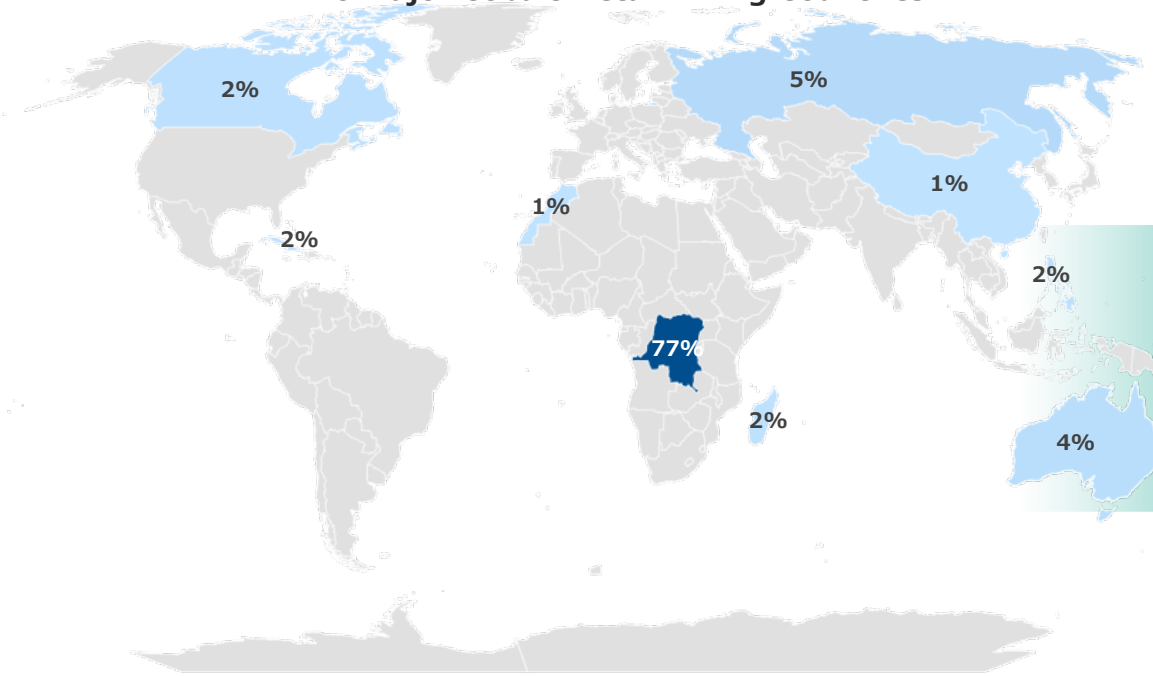
Geopolitics/Sustainability

1.2 Reducing the reliance on Cobalt

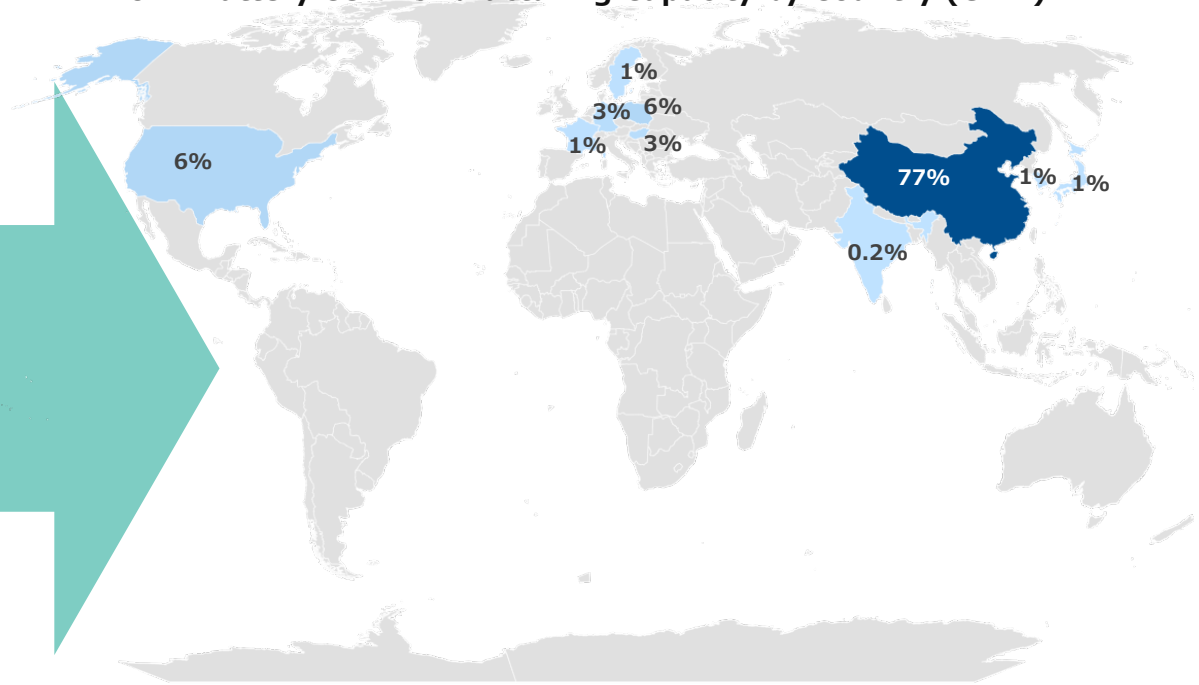
The continued effort to reduce the usage of cobalt along with a general slowdown after the pandemic already produced an effect with **Cobalt futures prices dropping quickly in the first six months of 2023** as shown in the graph on the left.

Continuing this trend will be important for the EV battery industry to improve ESG and make the whole battery supply chain more sustainable and resilient by avoiding the excessive concentration highlighted in the figures below.

10 Major Cobalt Metal Mining Countries

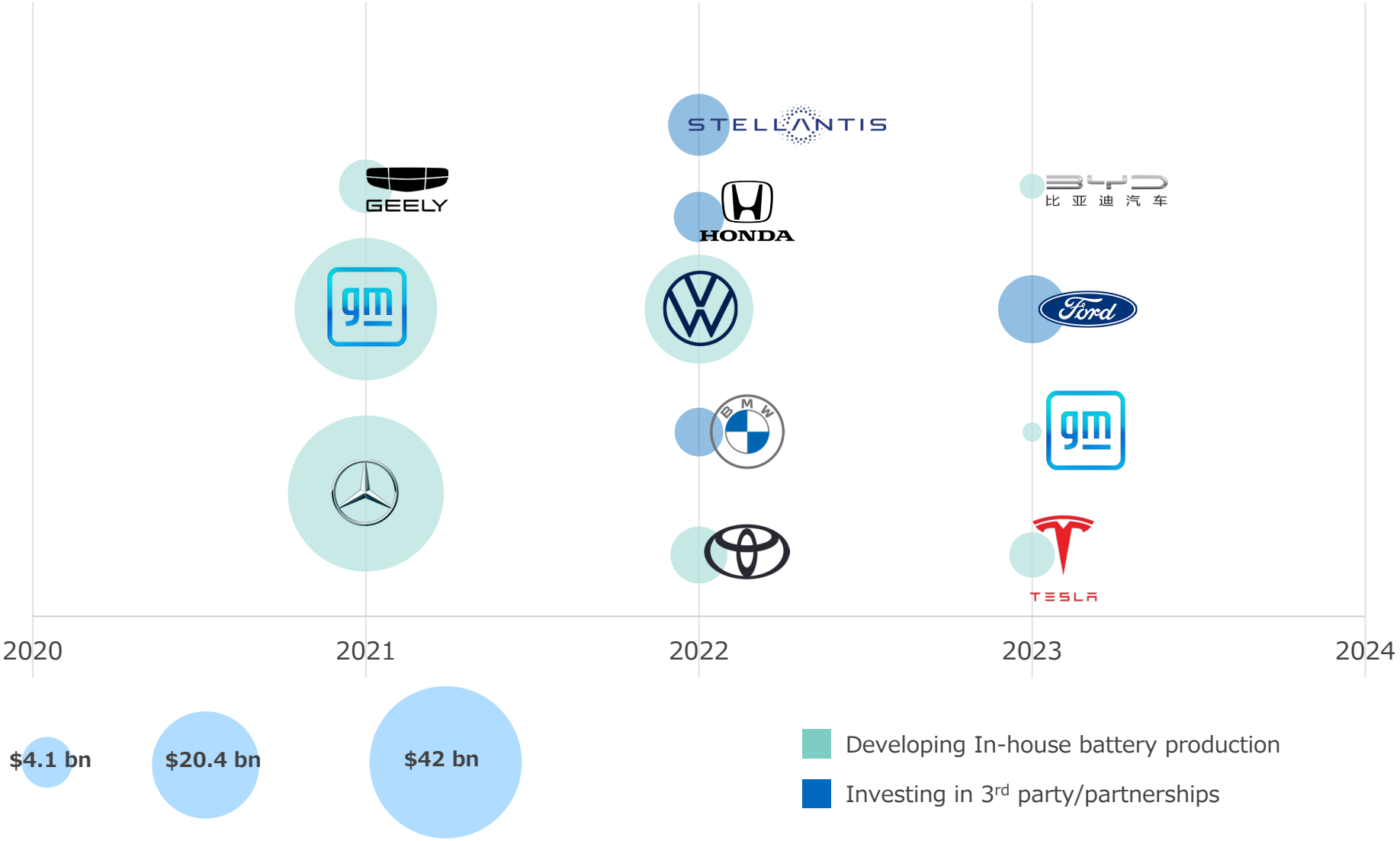


2022 Battery Cell Manufacturing Capacity by Country (GWh)



Automotive OEMs

Latest EV-Battery expansion-plan-related investment announcements (in $ Bn)

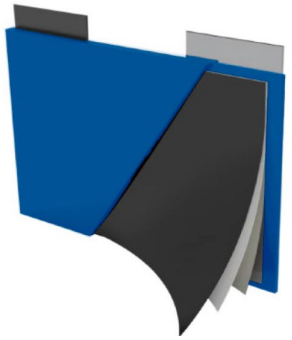


Highlights

Auto OEMs are focusing on the development and production of electric vehicle batteries with an **estimated investment of $515 billion over the next 3 to 8 years**.

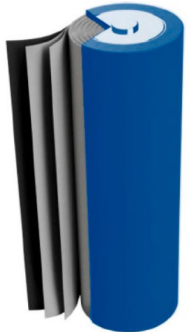
- Some investments made by OEMs come with partnerships with major EV battery manufacturers, such as **Stellantis with Samsung SDI and LG Energy Solution ($2.5 bn and $4.1 bn), or Ford with CATL ($3.5 bn)**.
- The largest investments are usually allocated for the development of in-house projects such as **EV battery production plants**, and were mostly announced in early 2021, as the pandemic restrictions eased.
- Financial details of marginally smaller partnership deals such as Renault's with startup Verkor were not disclosed, but are **expected in the hundreds of million range**.

Battery cell formats and diffusion



Pouch

- In pouch cells, several foils made of the cathode, separator, and anode materials are layered in the shape needed. Then they are usually covered in aluminum foil layered with polymer sheets, providing a light and flexible solution.
- Pouch battery cells are the least common, representing slightly over 17% of the current batteries installed in 2022.



Cylindrical

- Cylindrical cells are composed by long sheets of aluminum and copper (with cathode and anode layered on) with a separator are rolled together to form a cylinder. The format is resistant to deformation and relatively easy to manufacture.
- A quarter of the installed batteries in 2022 are cylindrical with Tesla accounting of almost 100% of those.

Prismatic

- In prismatic cells the long sheets of aluminum, separator, and copper foil are rolled in an elliptical way and placed in a rigid casing. The layering process is used as well.
- Prismatic cells are the most common format representing over 57% share of the market. Additionally, almost 39% is represented by BYD's Blade battery cells (22% of the total) in 2022.
- BYD Blade battery is a prismatic LFP cell that is developed by its subsidiary FinDreams to improve the space use efficiency improving over regular LFP batteries by 50%.

Highlights

Pouch, cylindrical, and prismatic are the three battery cell formats used today and they mostly feature either NMC or LFP battery chemistries.

NCA chemistry is featured only in cylindrical cells, which are fitted by Tesla, while prismatic blade cells are developed by BYD only with LFP chemistry, popular in China. In the remaining groups, NMC is the dominating chemistry.

Source: EV Volumes

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