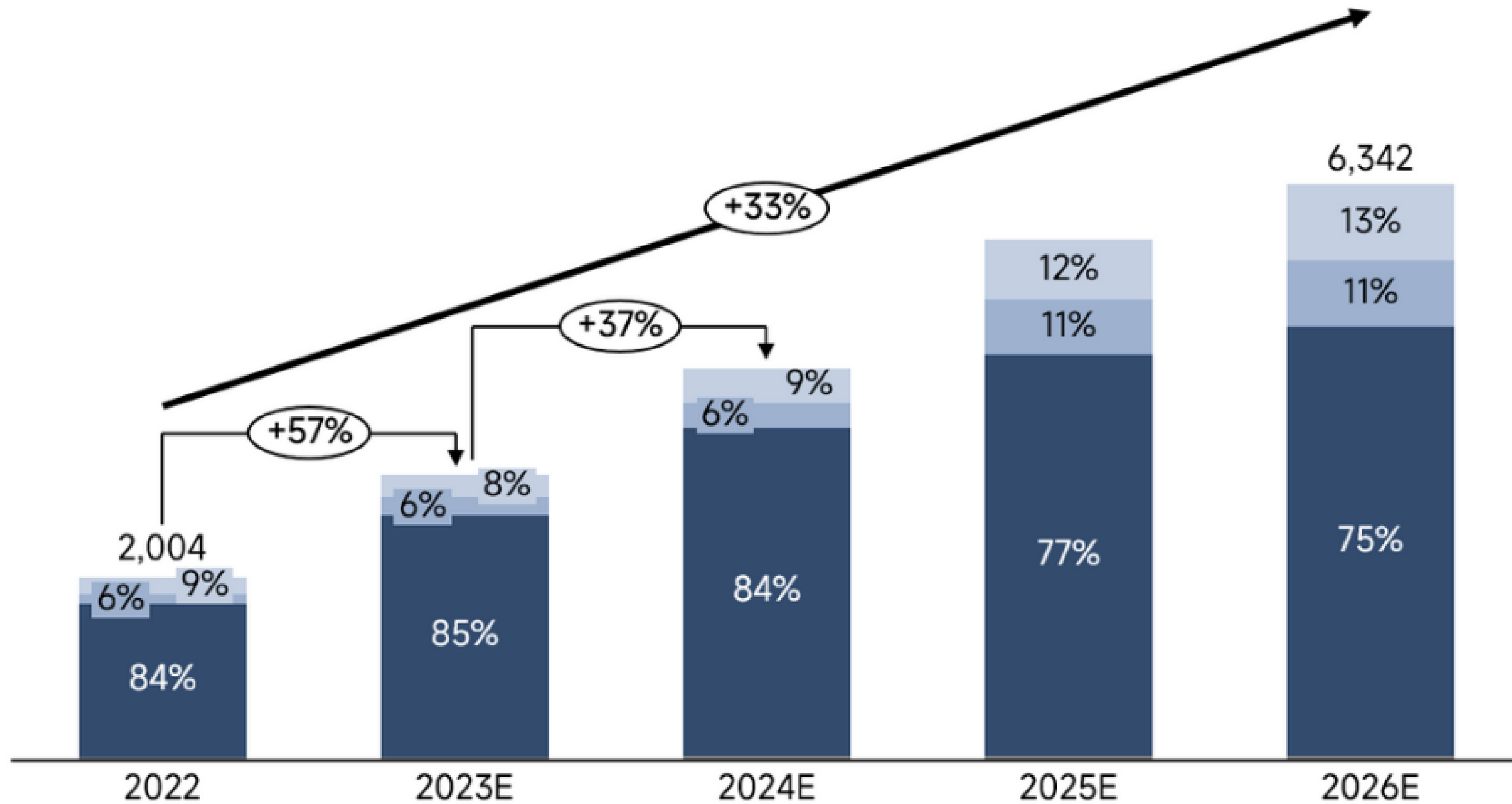


Development of Battery Technology for EV

The Global Battery Current Situation

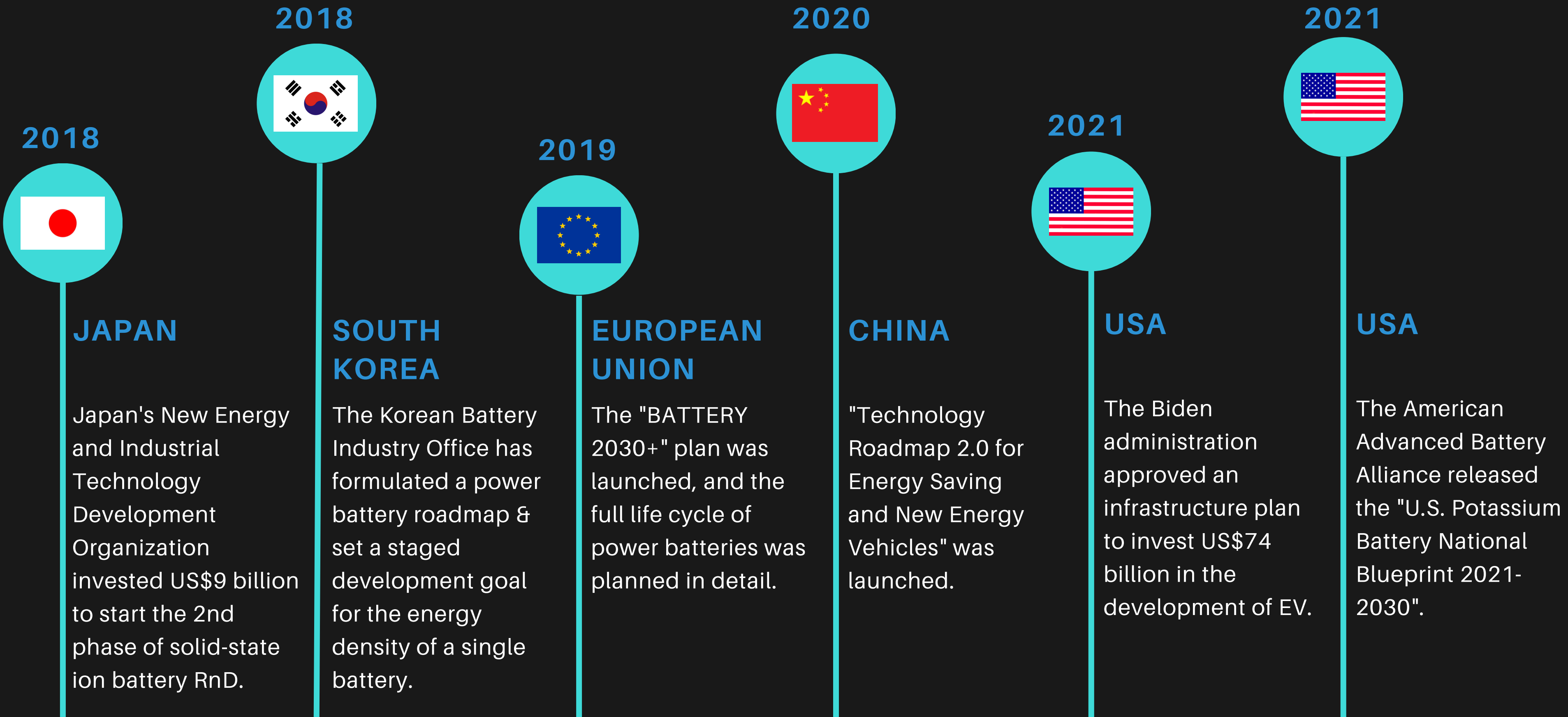
Unit: Gwh

■ EURO ■ America ■ Asia ■ Others



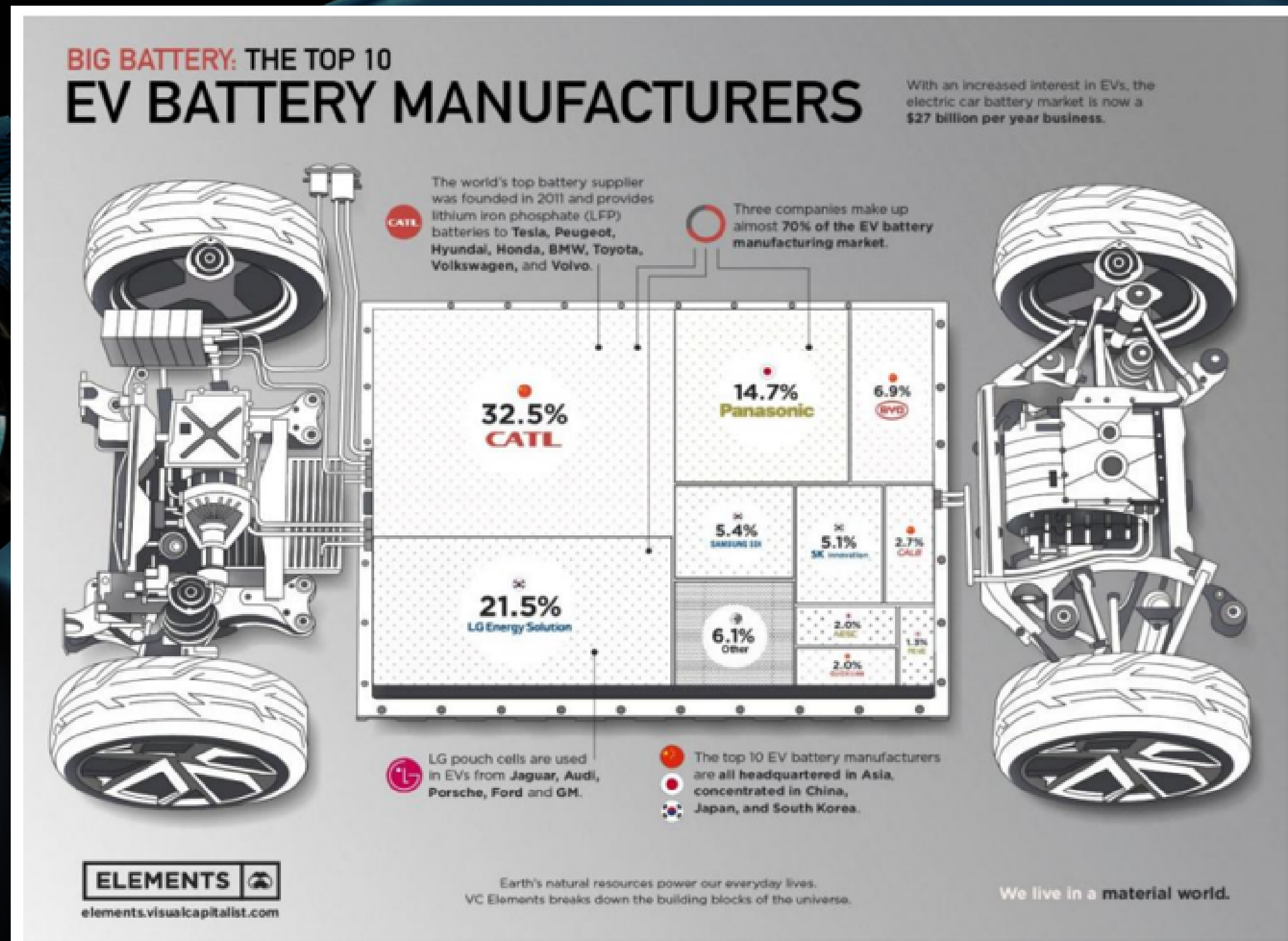
Global Battery Policy and Roadmap

China and the European Union focus on the development of lithium-ion batteries, while Japan, South Korea and the United States focus on the development of solid-state batteries.



Global Main Battery Suppliers Capacity

- The top 10 battery manufacturers are all located in China, South Korea and Japan.
- The three largest companies are CATL (32.5%), LG Energy Solutions (21.5%) and Panasonic (14.7%).
- Asia has and will continue to dominate battery manufacturing.



Development History of China New Energy Vehicles

2001-
2008

2008-
2012

2012-
2016

2016-
2020

2021-
present

THE NATIONAL "10TH FIVE- YEAR PLAN"

Determination of
electric vehicle

THE NATIONAL "11TH FIVE- YEAR PLAN"

Ten Cities
Thousands
Vehicles

THE NATIONAL "12TH FIVE- YEAR PLAN"

Route based on
pure EV was
determined, and
new EV rose to
become a national
strategy

THE NATIONAL "13RD FIVE- YEAR PLAN"

Deepen the
technology and
expand the market

THE NATIONAL "14TH FIVE- YEAR PLAN"

- Annual production & sales volume of NEV in China has ranked first in the world for 7 consecutive years
- NEV is a strategic choice for the development of China's automobile industry

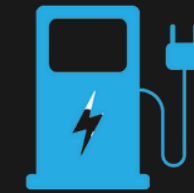
China's EV Market Trend



In 2022, the sales volume of NEV in China is 6.8 million, a YoY increase of 93.4%. The proportion of NEV sales will continue to increase from 13.4% in 2021 to 25.6%. By the end of 2022, the number of NEV in China reached 13.1 million.



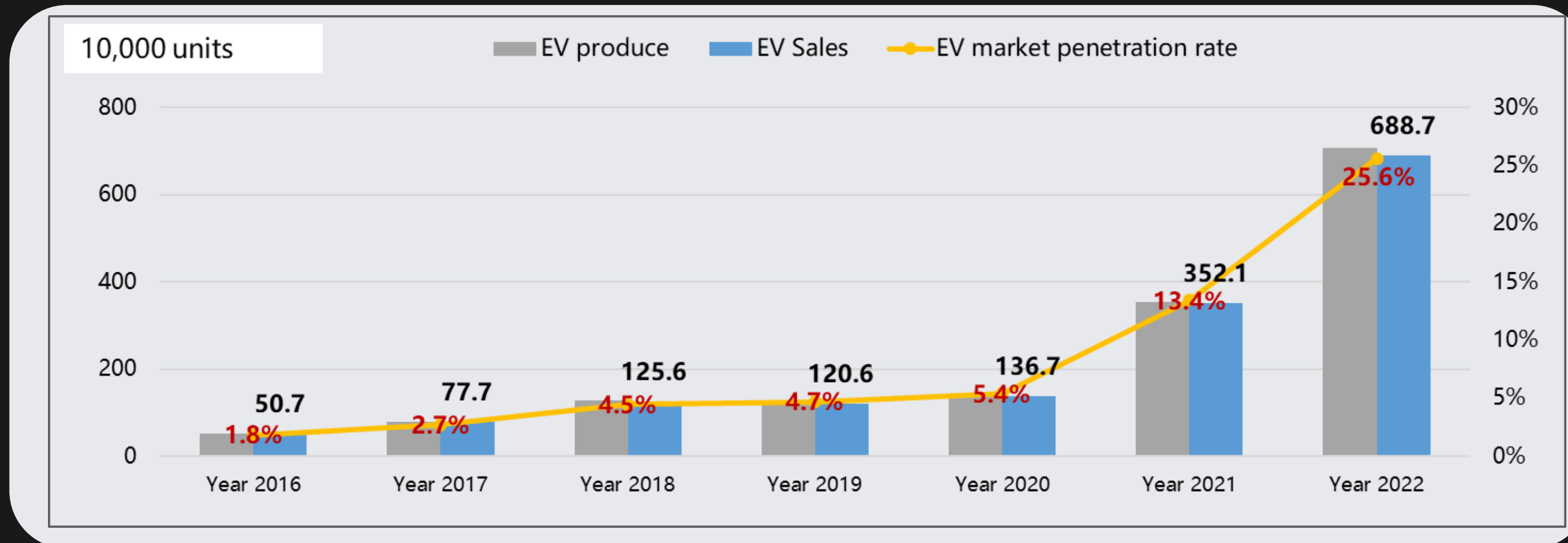
The installed capacity of power batteries in China reached 293.1GWh, a YoY increase of 95%



By the end of 2022, a total of 5.21 million charging piles and 1,973 battery swapping stations have been built nationwide.

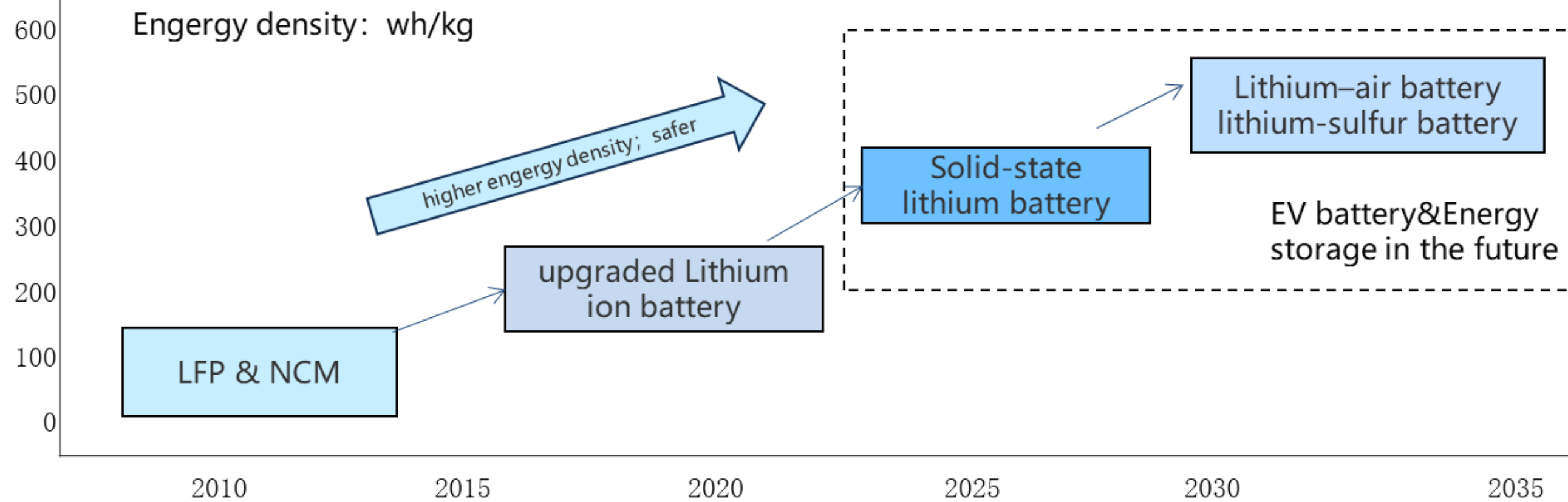


There are more than 3,000 charging piles operating companies in China, and 17 companies have more than 10,000 public charging piles.



Li-batteries and Its Routine in the Future

- LFP (Lithium iron phosphate) and NCM (Nickel Cobalt Manganese) is the traditional Li-batteries used in EV widely.
- Prismatic, pouch, cylindrical battery is the main forms of current industry used in SGMW, Tesla, BYD and other OEMs.
- Solid-state lithium battery, Lithium-air battery and lithium-sulfur battery are being developed soon enough, and the energy density can be over 500wh/kg around 2030.



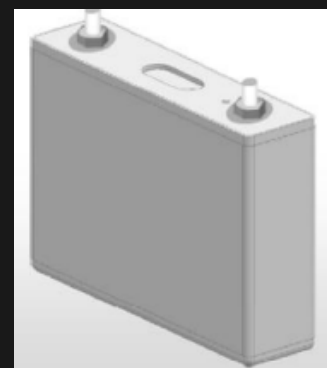
Current Battery Types and Applications

- Energy type battery is high used in passenger and commercial vehicles with a lower price.
- High-end batteries both energy and power being used in luxury EV with fast charging system
- Power type battery is used in hybrid NEVs with a higher life cycle and higher price.

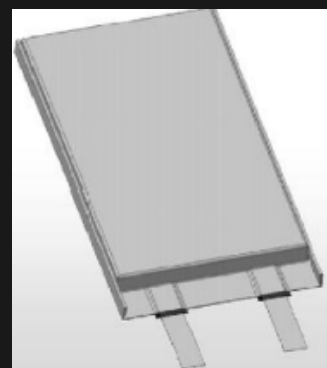
			2025	2030	2035
Overall objective	Energy battery	Popular	specific energy > 200Wh/kg	specific energy > 250Wh/kg	specific energy > 300Wh/kg
			life > 3000times/12 years	life > 3000times/12 years	life > 3000times/12 years
			cost < 0.35 Yuan/Wh	cost < 0.32 Yuan/Wh	cost < 0.30 Yuan/Wh
		Commercial	specific energy > 200Wh/kg	specific energy > 225Wh/kg	specific energy > 250Wh/kg
			life > 6000times/8 years	life > 6000times/8 years	life > 6000times/8 years
			cost < 0.45 Yuan/Wh	cost < 0.40 Yuan/Wh	cost < 0.35 Yuan/Wh
		High-end	specific energy > 350Wh/kg	specific energy > 400Wh/kg	specific energy > 500Wh/kg
			life > 1500times/12 years	life > 1500times/12 years	life > 1500times/12 years
			cost < 0.50 Yuan/Wh	cost < 0.45 Yuan/Wh	cost < 0.40 Yuan/Wh
	Battery with both energy and power	Compatible	specific energy > 250Wh/kg	specific energy > 300Wh/kg	specific energy > 325Wh/kg
			life > 5000times/12 years	life > 5000times/12 years	life > 5000times/12 years
			cost < 0.60 Yuan/Wh	cost < 0.55 Yuan/Wh	cost < 0.50 Yuan/Wh
		Fast charging	specific energy > 225Wh/kg	specific energy > 250Wh/kg	specific energy > 275Wh/kg
			life > 3000times/10 years	life > 3000times/10 years	life > 3000times/10 years
			cost < 0.70 Yuan/Wh	cost < 0.65 Yuan/Wh	cost < 0.60 Yuan/Wh
Power battery	power type	specific energy > 80Wh/kg	specific energy > 100Wh/kg	specific energy > 120Wh/kg	
		life > 300,000times/12 years	life > 300,000times/12 years	life > 300,000times/12 years	
		cost < 1.20 Yuan/Wh	cost < 1.00 Yuan/Wh	cost < 0.80 Yuan/Wh	

Li-battery: The Balance of Performance and Cost

- The cost of materials mainly depend on the selection of positive electrode materials
- The selection of positive electrode materials plays a leading role in the energy density and safety of power batteries
- The shortage of cobalt resources has a great impact on power batteries
- The cost of lithium-ion battery cells continues to drop, making it difficult for other new technologies to compete
- Lithium battery technology: Future battery costs will be in the range of \$65-70/kWh by 2030 and will be the best choice recently



Prismatic

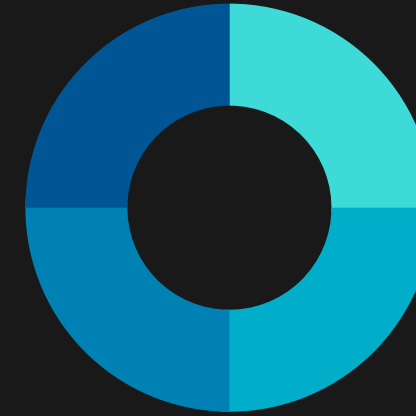


Pouch

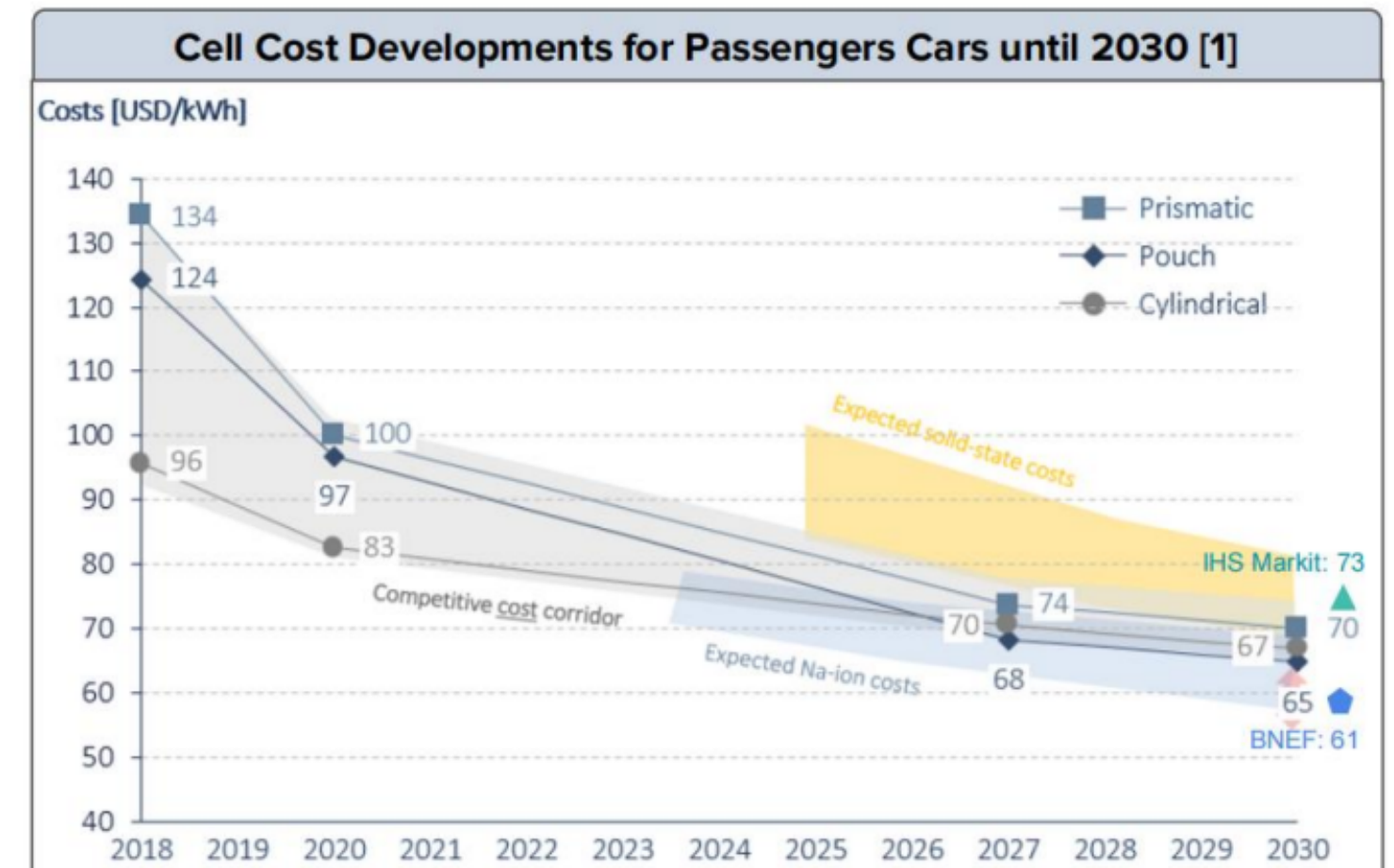


Cylindrical

- The four key factors for EV industry:



1. Material Innovation
2. Process Innovation
3. Structure Innovation
4. System Innovation

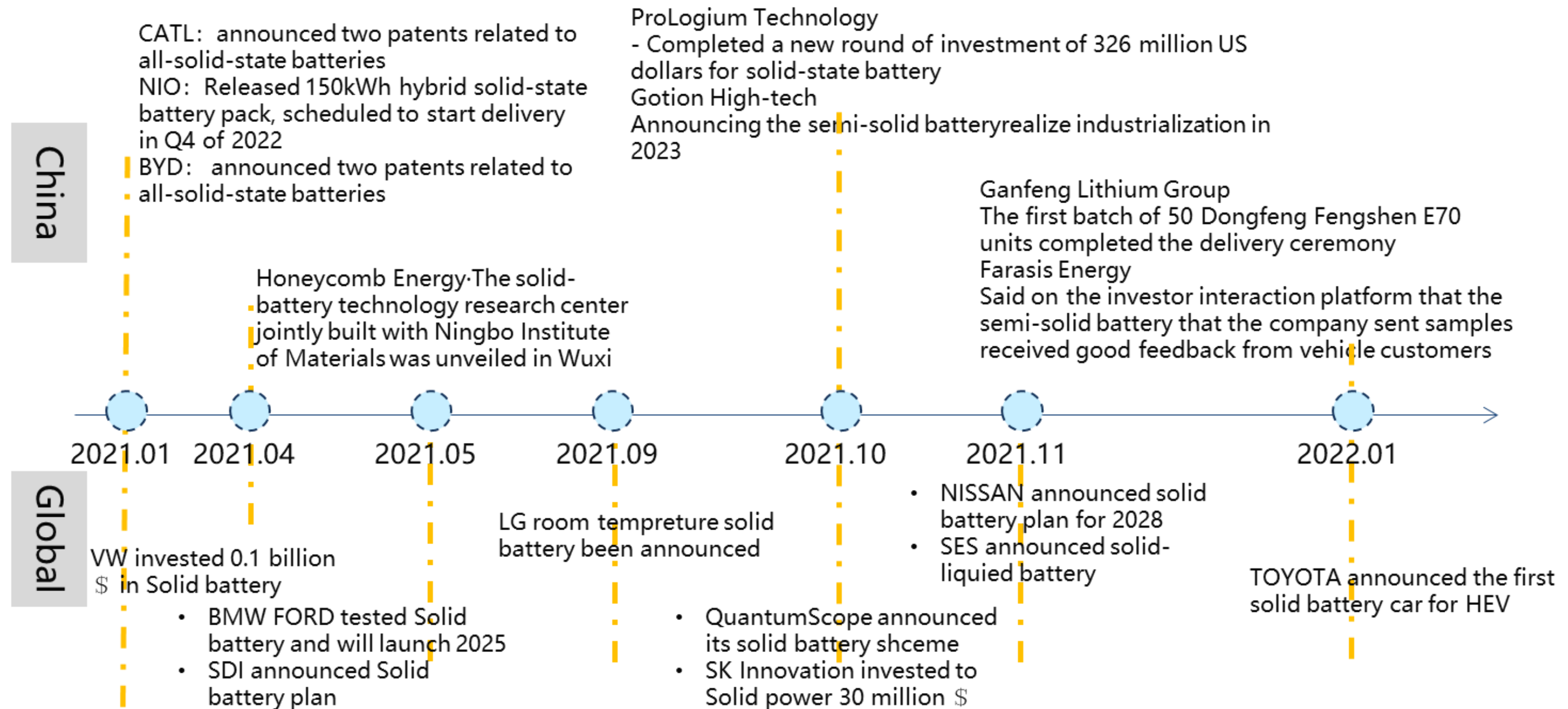


1. High-volume production of >8 GWh/a with dedicated facility

Note: Cost values tabulated by P3 Consulting, unless otherwise specified.

The Technical Route and Prospect of Solid-state Batteries

- Lithium batteries/battery companies and vehicle manufacturers are actively deploying solid-state battery technology
- The industry is still in the stage of semi-solid-state development to all-solid-state, and the technical problems of all-solid-state batteries still need to be solved



The Technical Route and Prospect of Solid-state Batteries

It is difficult for lithium batteries to meet the energy density development requirements of medium and long-term power batteries.

The lithium industry is still in the stage of semi-solid-state development to all-solid-state

- Solid battery has obvious advantages:
- High energy density; High safety performance; Low battery weight

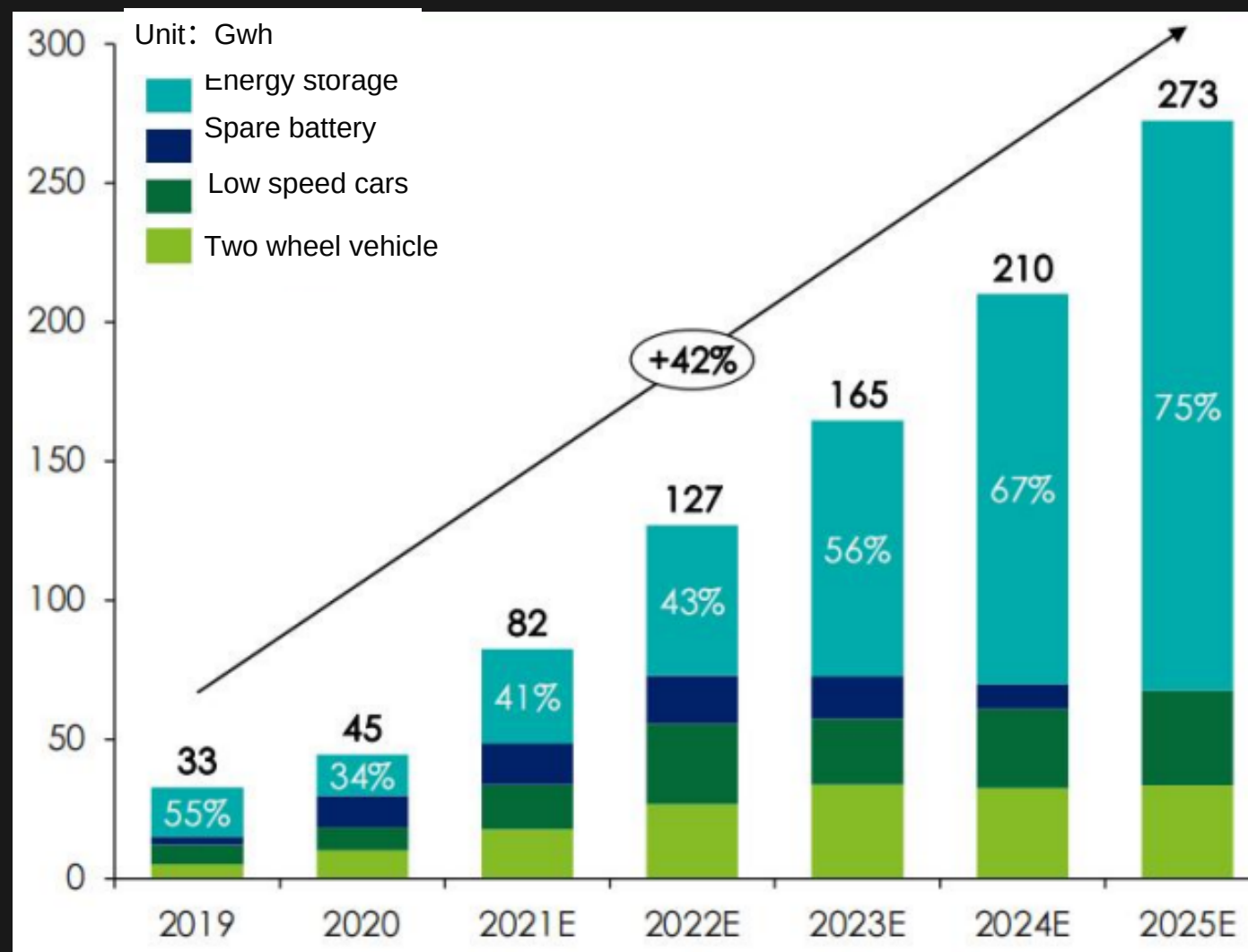
The technical bottleneck of the commercial application of all-solid-lithium batteries:

- Battery life; Fast charging performance of batteries will be limited.

THE TECHNICAL ROUTE AND PROSPECT OF SODIUM-ION BATTERIES

Sodium-ion batteries have great application potential in the energy storage scenario, and sodium-ion batteries are expected to be used in energy storage and low-speed electric vehicles in the future.

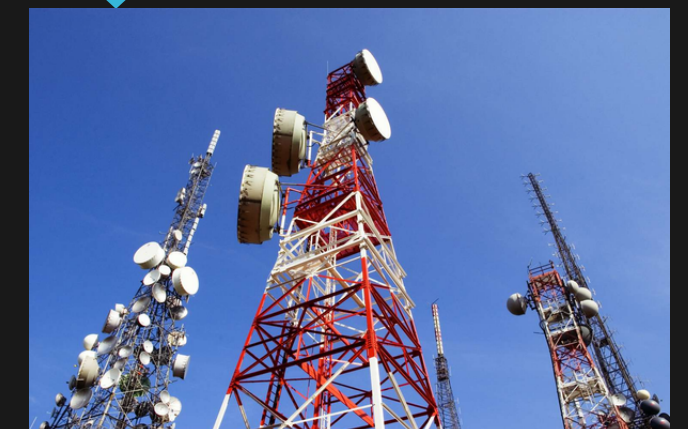
Sodium-ion battery leader Zhongke Haina actively promotes industrialization; CATL will speed the improvement of the industrial chain & process and is expected to expand the application scenario of sodium ion batteries



Home & Commercial Storage



Energy Station Storage



Commucation Station Storage

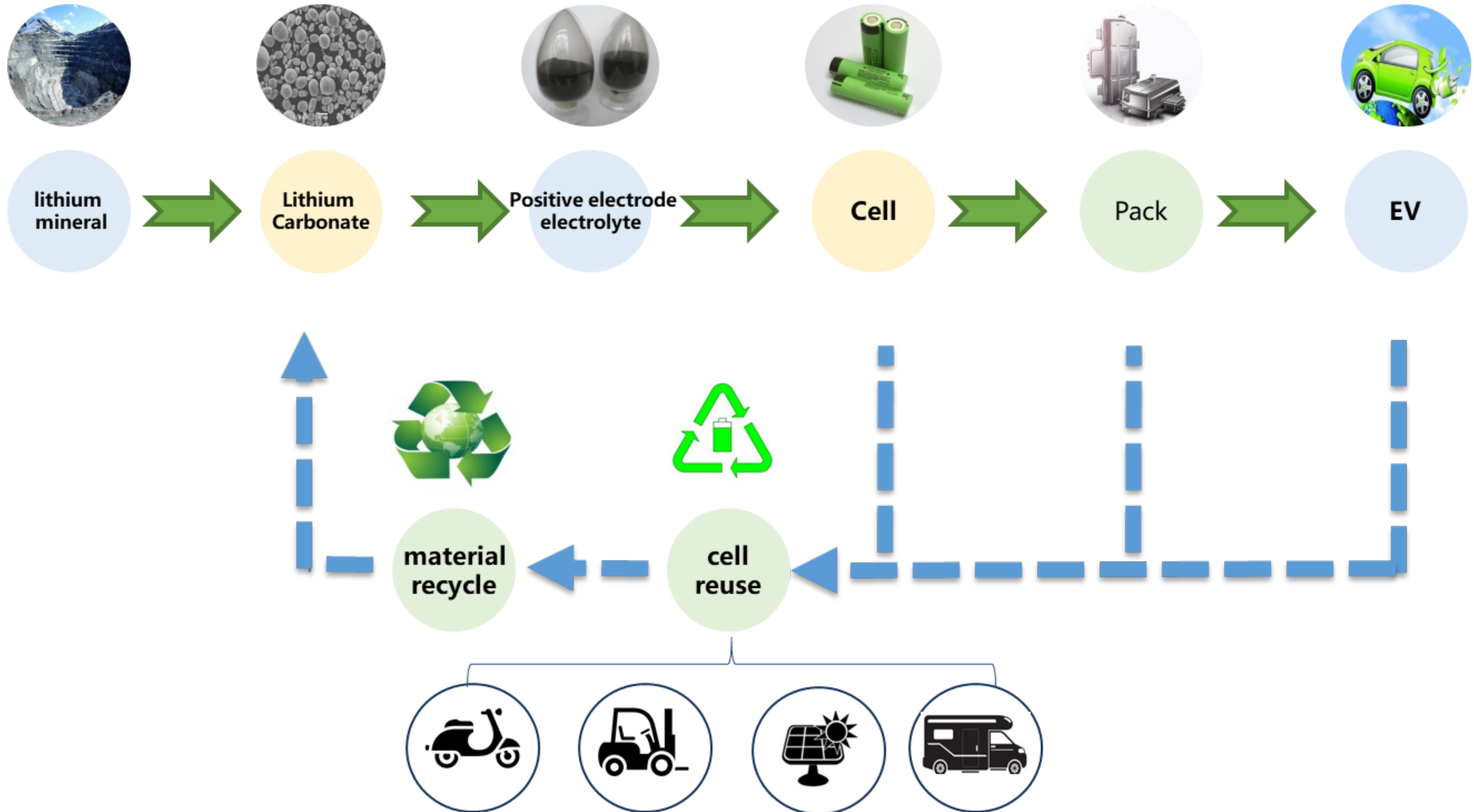


Two Wheels Vehicle



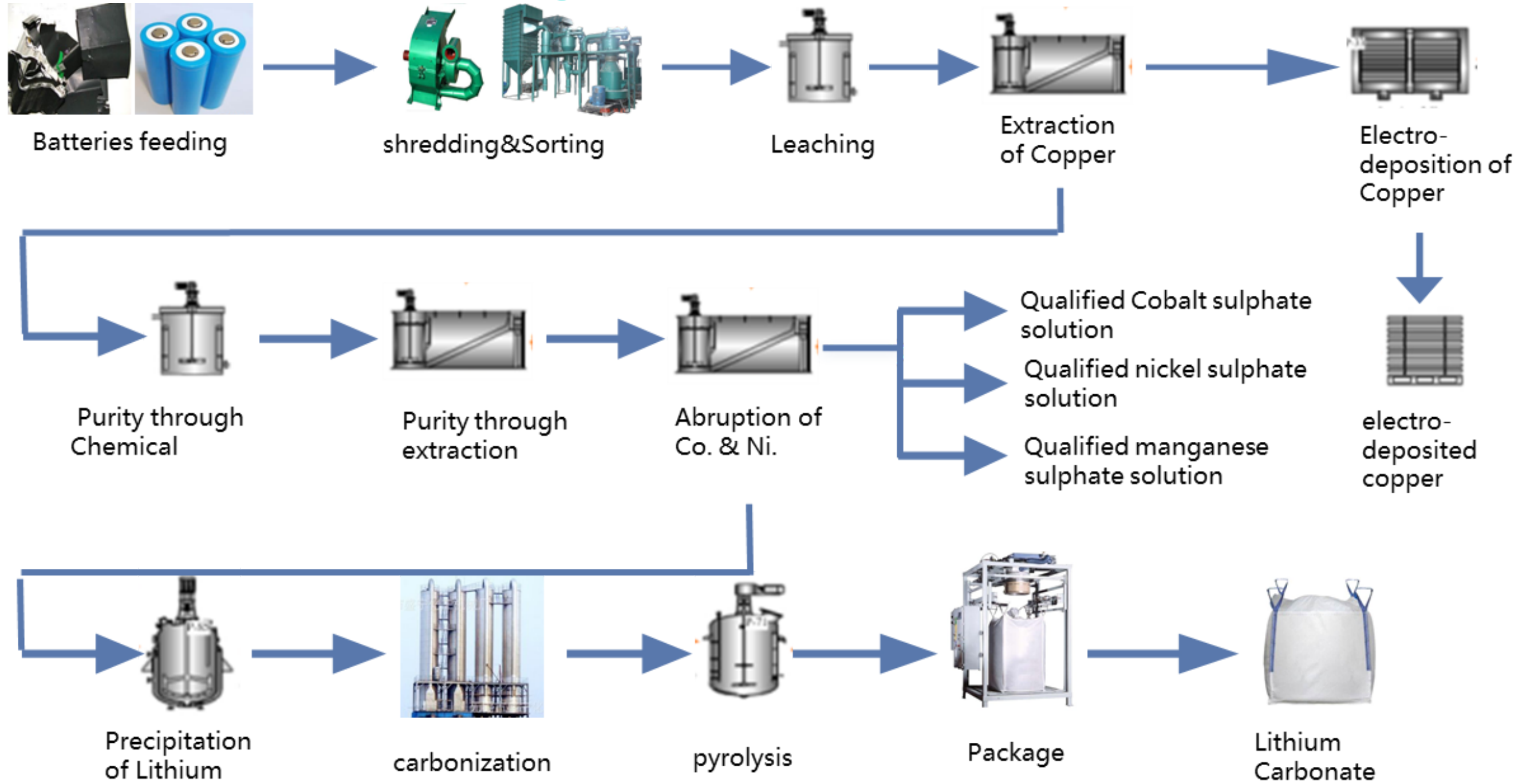
Low Speed Cars

Li-Battery Lifetime and Environmental Protection



Recycled battery can be used for both reuse and material recycle

Waste Battery Recycling Process



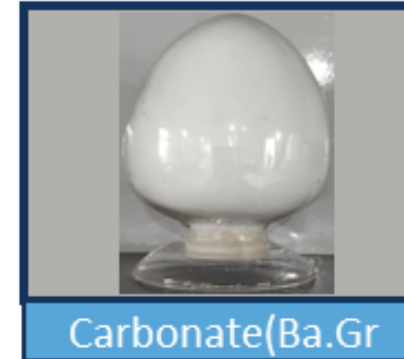
Cobalt Sulphate



Nickel Sulphate



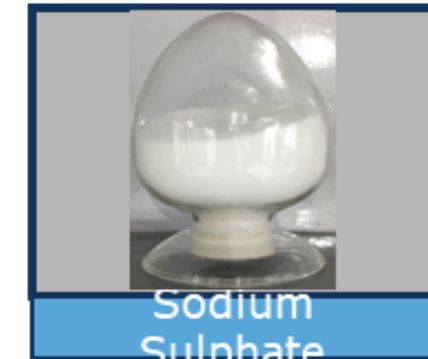
Manganese Sulphate



Carbonate (Ba, Gr)



deposited

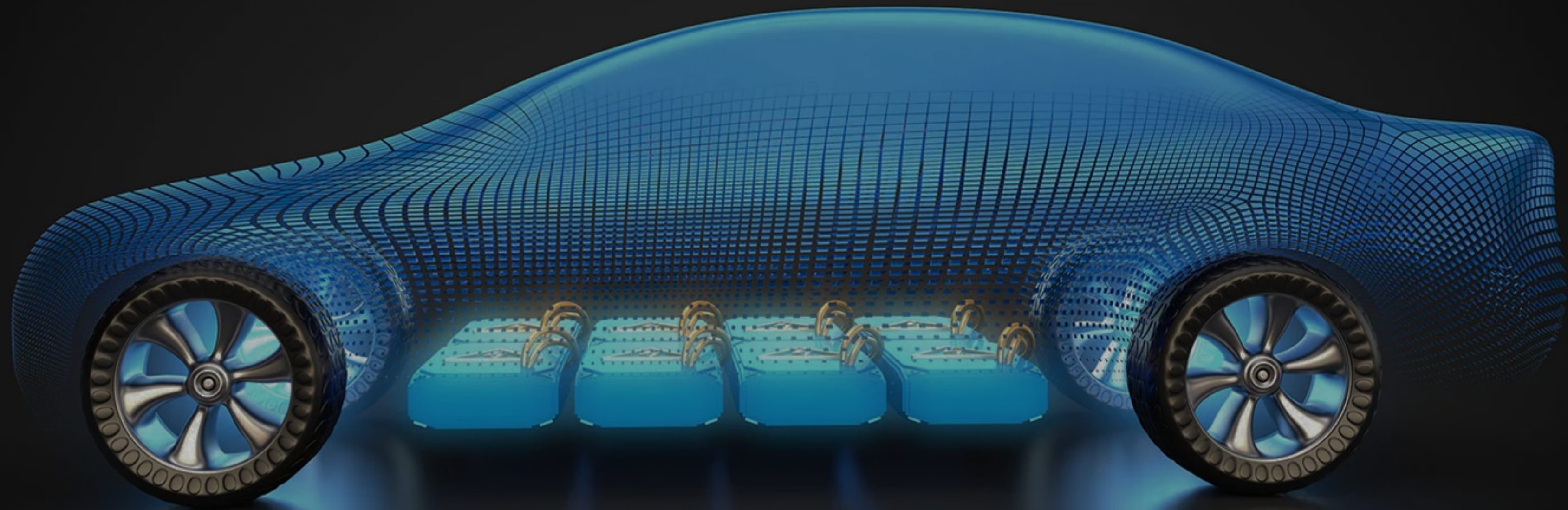


Sodium Sulphate

Indonesia as Global Player in Battery for BEV



1. Indonesia's nickel reserves are 72 million tons, accounting for 52% of the world's total nickel reserves (139.419 million tons).
2. Indonesia has clarified its goals and directions for the development of NEV, and issued policies such as tariffs, luxury taxes, and VAT reductions for qualified vehicles and parts.
3. Indonesia will be the largest NEV market in ASEAN
4. Indonesia can build its own complete EV industry chain and boom the development of electric vehicles of the world, and will attract more battery companies and OEMs coming to Indonesia to start NEV business.
5. NEV industry chain can help Indonesia to achieve Carbon peak by 2030 and carbon neutrality by 2070



THANK YOU