Technical Session 2 — EV Technology Overview and Global Market Trends

EV Technology Overview and its Potential in the SAARC Region

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Trivia

When was the first Electric Vehicle Developed?

First Crude Electric Vehicle Is Developed

1832

Around 1832, Robert Anderson develops the first crude electric vehicle, but it isn't until the 1870s or later that electric cars become practical. Pictured here is an electric vehicle built by an English inventor in 1884.

Photo courtesy of the National Museum of American History.

Electric Cars Gain Popularity

1899

Compared to the gas- and steam-powered automobiles at the time, electric cars are quiet, easy to drive and didn't emit smelly pollutants -- quickly becoming popular with urban residents, especially women.

Photo courtesy of the Library of Congress.

Electric Cars Reach Their Heyday

1900 — 1912

By the turn of the century, electric vehicles are all the rage in the U.S., accounting for around a third of all vehicles on the road. Pictured here is Fifth Avenue in New York City around this time, showing the range in vehicle options available.

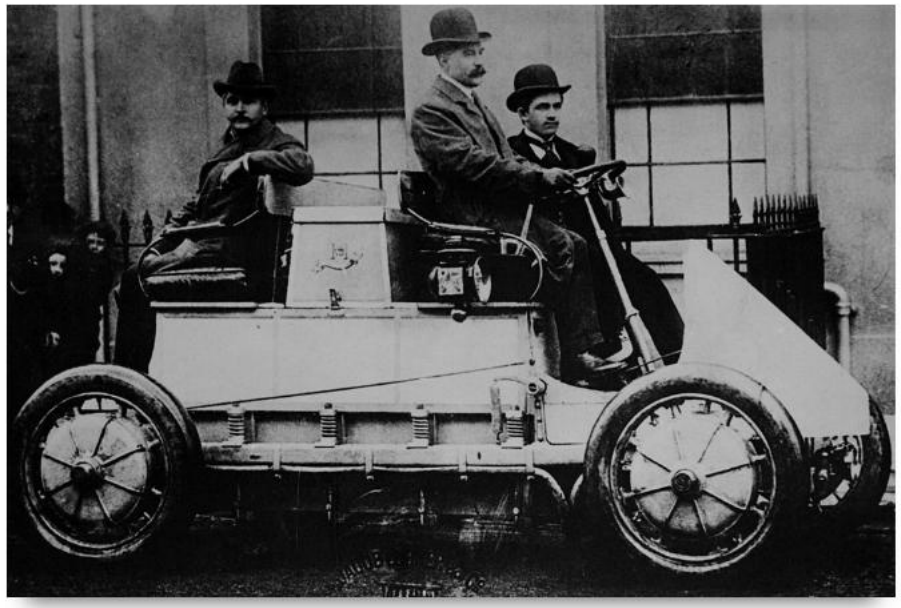


Photo courtesy of Wikimedia Commons.

World's First Hybrid Electric Car Is Invented

1901

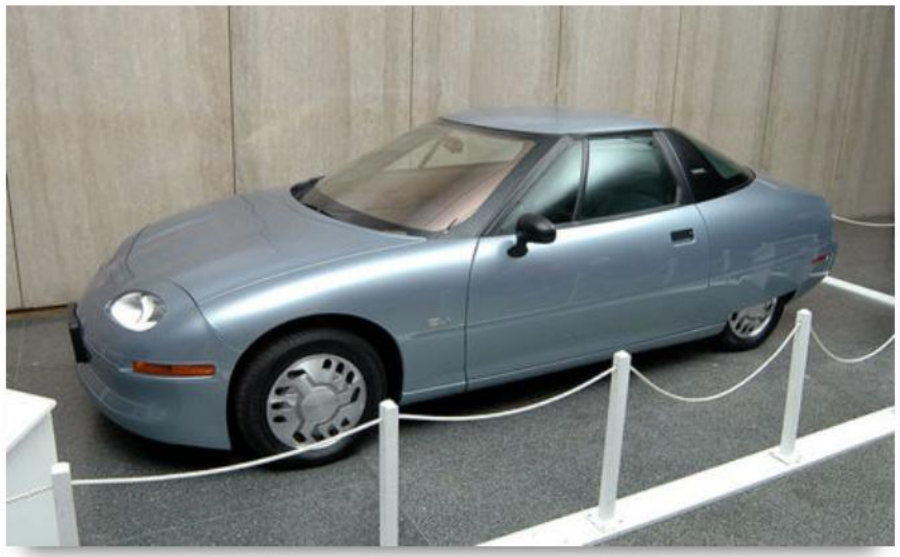
Ferdinand Porsche, founder of the sports car by the same name, creates the Lohner-Porsche Mixte -- the world's first hybrid electric car. The vehicle is powered by electricity stored in a battery and a gas engine.

Photo courtesy of Frank Lodge, U.S. National Archives.

The Next Generation of Electric Vehicles

1973

Many big and small automakers begin exploring options for alternative fuel vehicles. For example, General Motors develops a prototype for an urban electric car, which the company displayed at the First Symposium on Low Pollution Power Systems Development in 1973.



EV1 Gains a Cult Following

1996

GM releases the EV1, an electric vehicle that was designed and developed from the ground up. The EV1 quickly gains a cult following.

Silicon Valley Startup Takes on Electric Cars

2006

Tesla Motors, a Silicon Valley startup, announces it will produce a luxury electric sports car with a range of 200+ miles. Other automakers take note, accelerating work on their own electric vehicles.

First Commercially Available Plug-In Hybrid for Sale

2010

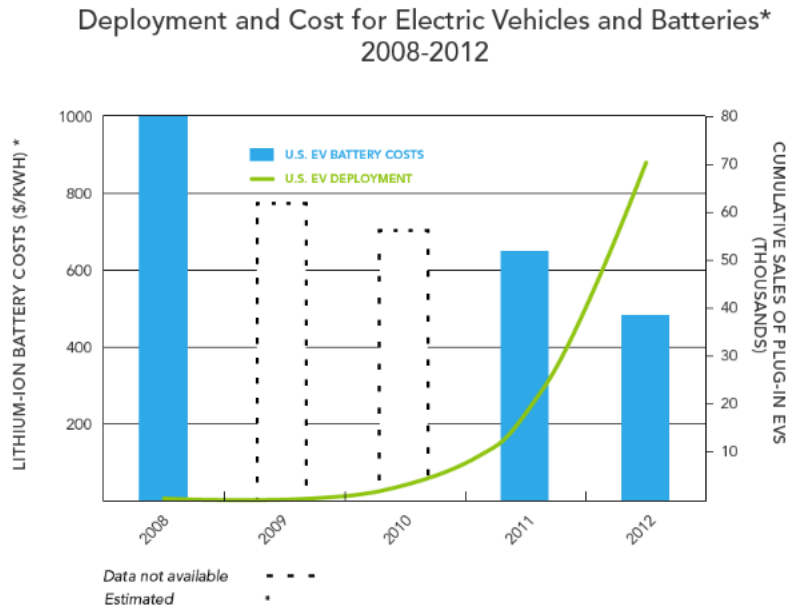
GM releases the Chevy Volt, making it the first commercially available plug-in hybrid. The Volt uses battery technology developed by the Energy Department.

Photo courtesy of Nissan North America.

Nissan Launches the LEAF

2010

In December 2010, Nissan releases the LEAF, an all-electric, zero tailpipe emissions car. In January 2013, Nissan begins assembling the LEAF in Tennessee for the North American market thanks to a loan from the Energy Department.



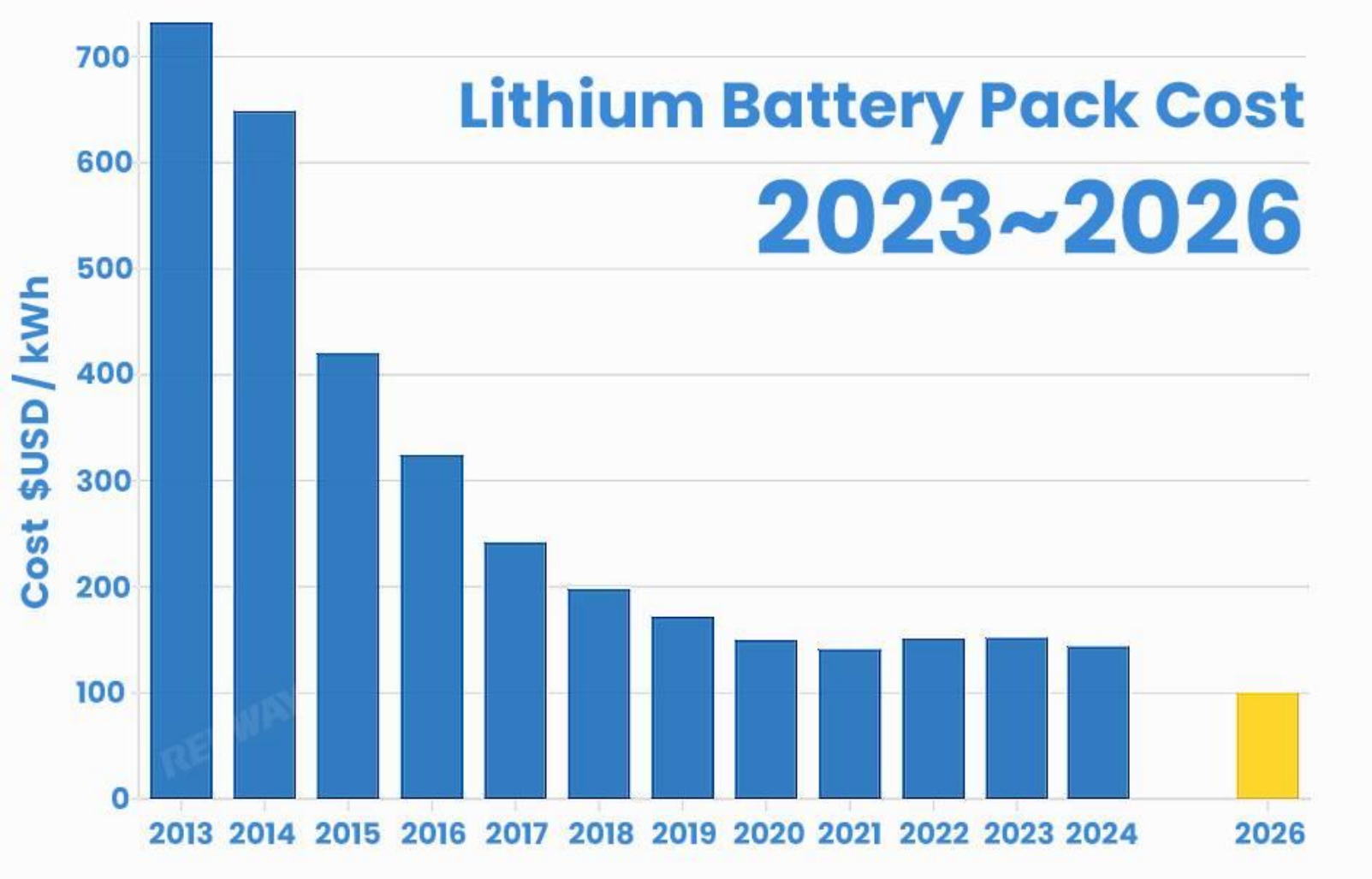
Graph courtesy of the Energy Department.

Electric Vehicle Battery Costs Drop

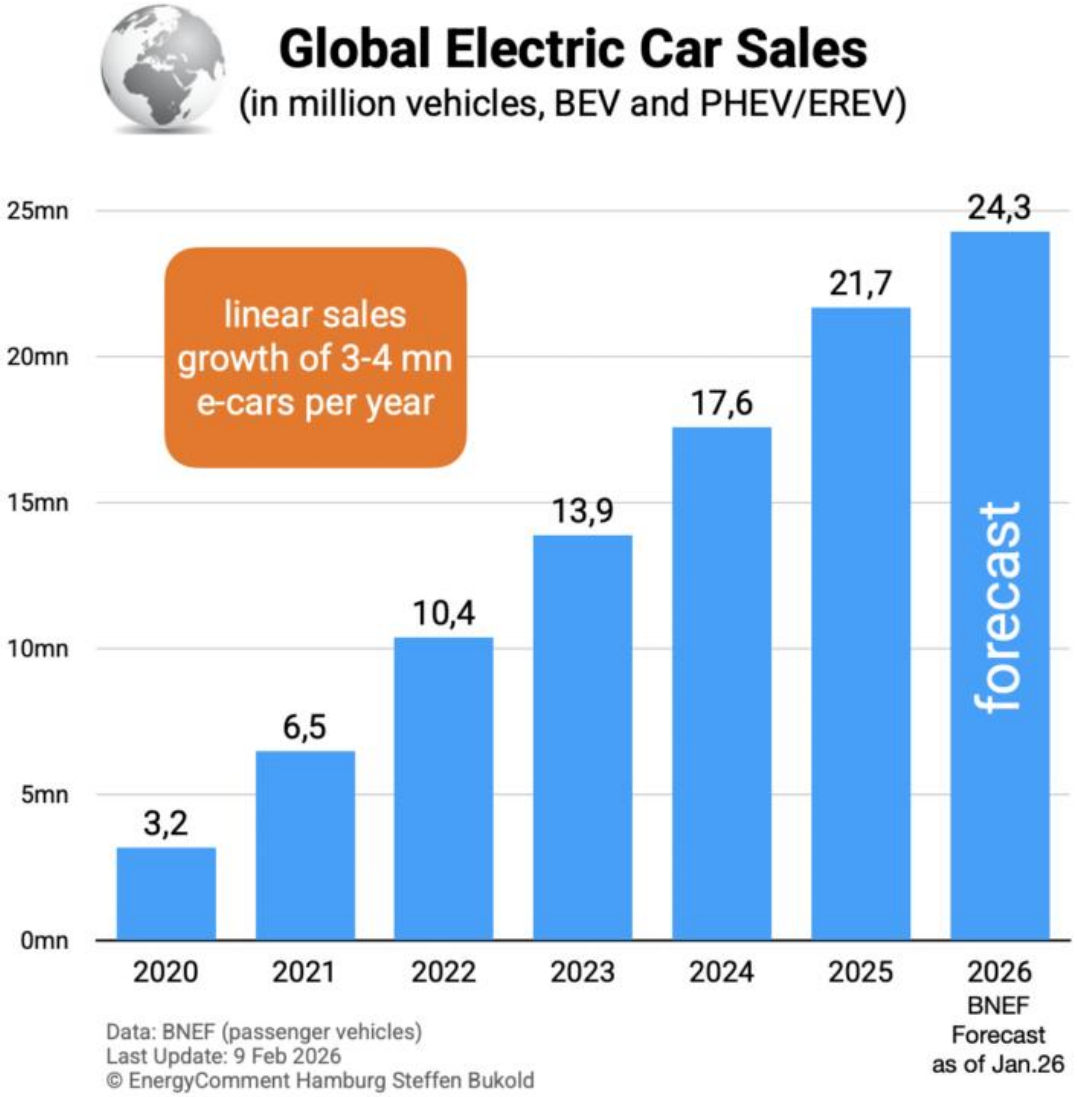
2013

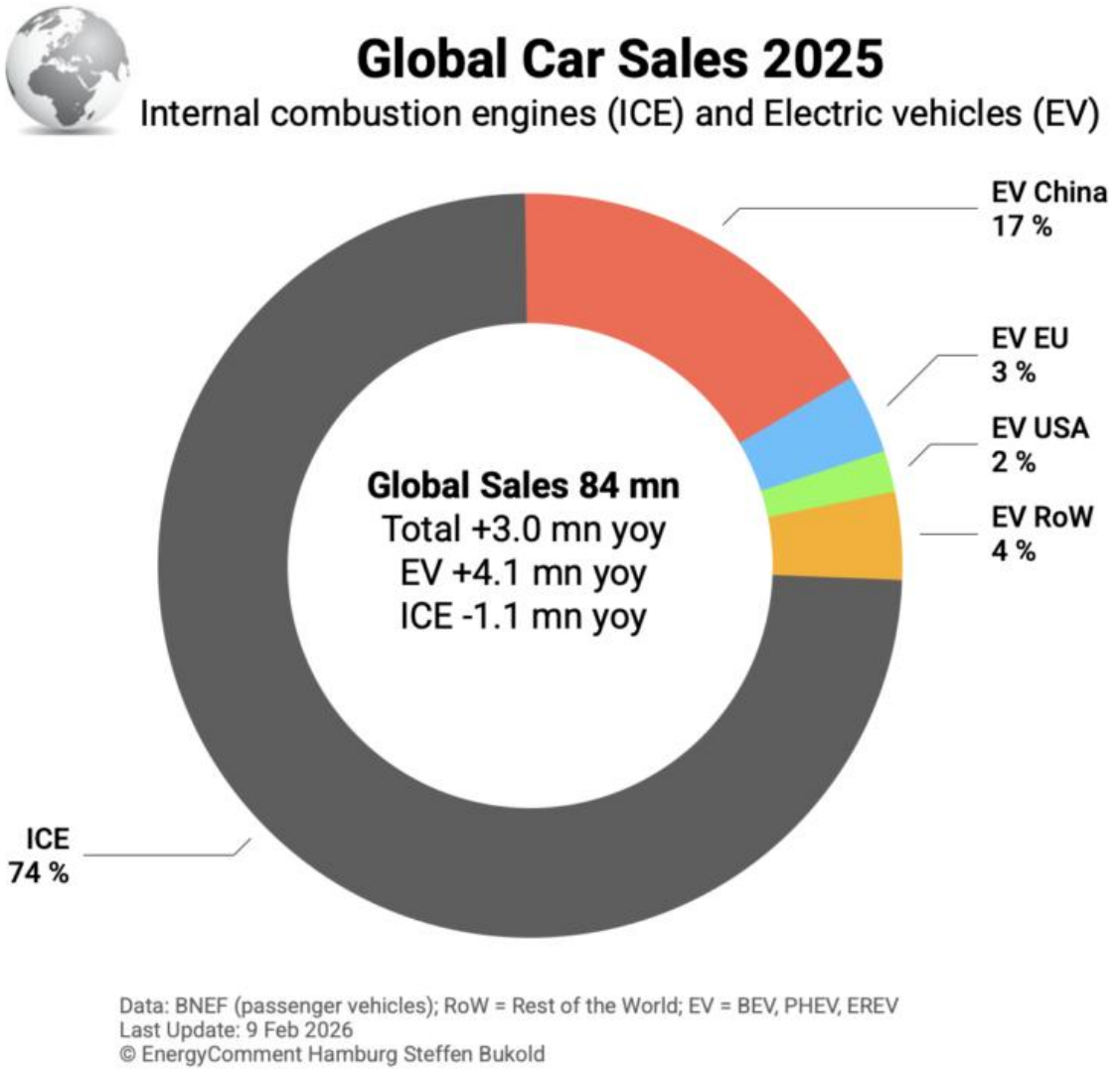
The battery is the most expensive part in an electric vehicle. Thanks to investments by the Energy Department, battery costs drop by 50 percent in just four years, helping make electric vehicles more affordable for consumers.

Downward Battery Price Trend



The Global Inflection Point

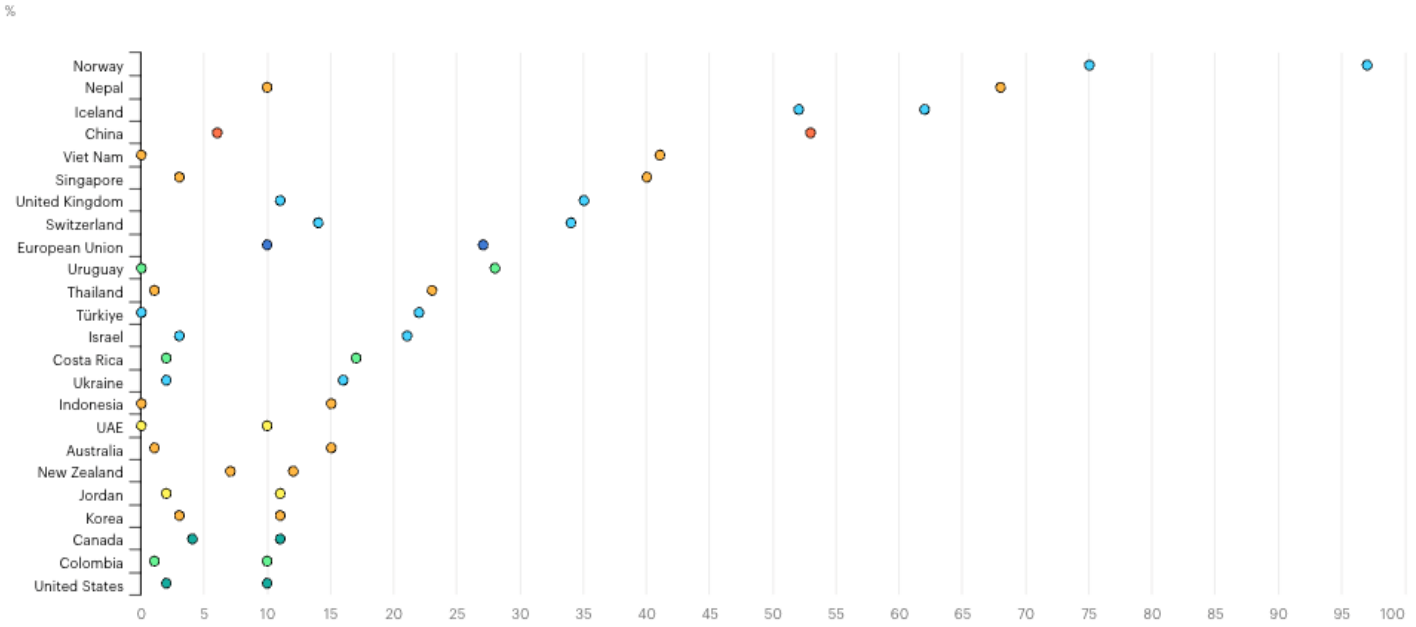




EVs Have Moved From Emerging Technology to Global Industry

- **21 million** electric cars sold globally
- Global electric-car sales grew by **~20%**
- **1 in 4 new cars** sold globally was electric

- EVs represented around **5%** of the global passenger-car stock
- EV adoption is increasingly spreading beyond China, Europe and the United States

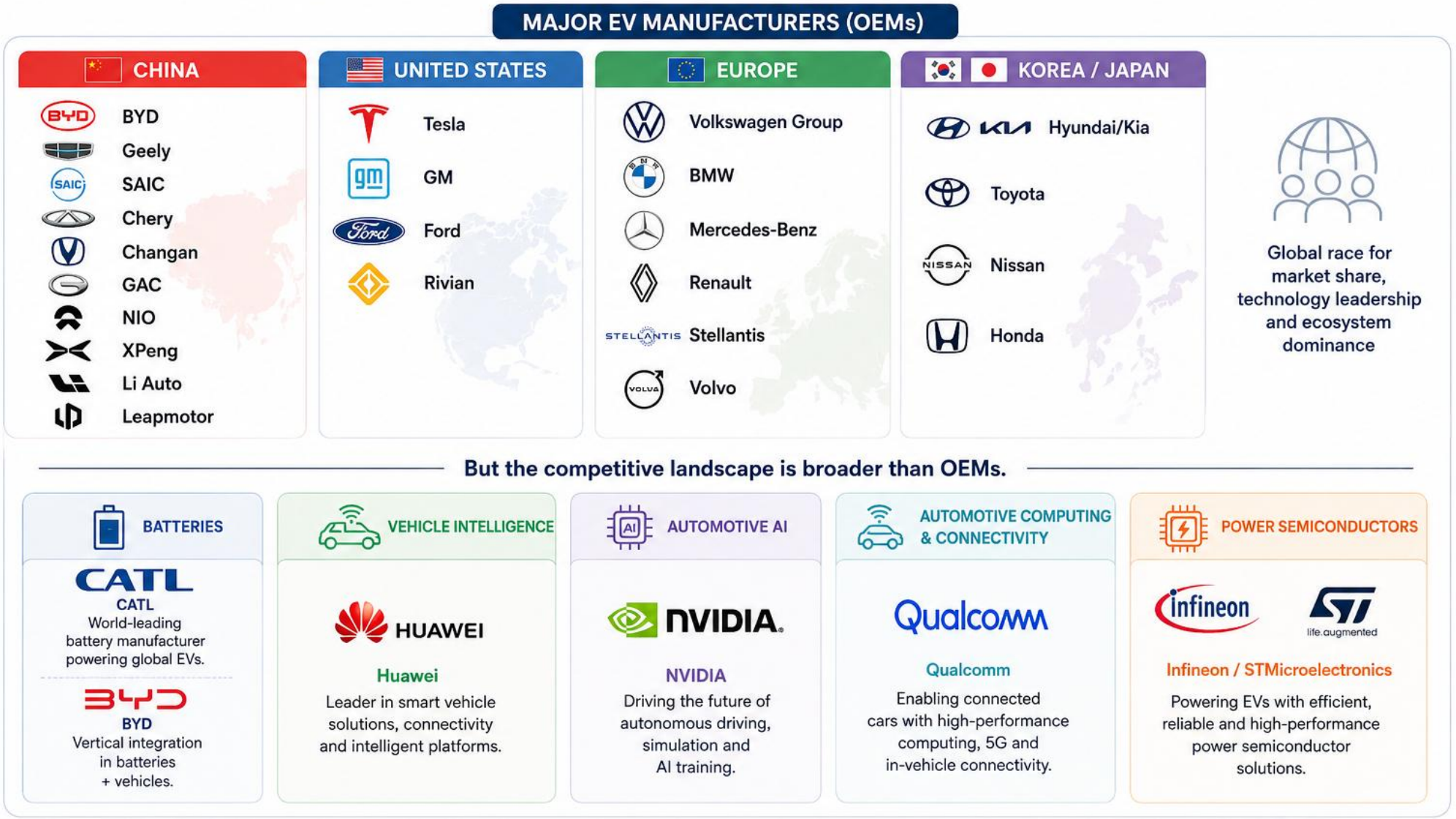


Market	Approx. sales / share
China	>13 million / ~55% of new-car sales
Europe	~4.2 million / 28%
United States	~1.5 million / ~10%
Other markets	~2 million

China remains the dominant market, but growth is increasingly coming from emerging economies as lower-cost EVs become available.

The EV Industry Is Becoming a Global Competition

Leading players across regions are accelerating innovation, scale, and ecosystem control.



INSIDE A TESLA Y MODEL

KEY COMPONENTS AND THEIR FUNCTIONS

EXPLODED VIEW OF TESLA Y MODEL

1 Glass Roof
Panoramic glass roof with UV protection and thermal insulation.

2 Body Structure
High-strength aluminum alloy body provides safety, durability and lightweight.

3 Frunk (Front Trunk)
Additional storage space in the front for convenience.

4 Seating System
Ergonomic seats with premium comfort and 5-seater configuration.

5 Battery Pack
High-energy lithium-ion battery pack integrated in the floor for low center of gravity and maximum range.

6 Drive Units (Dual Motor)
Dual permanent magnet motors provide all-wheel drive, high performance and efficiency.

7 Power Electronics
Inverters, DC-DC converter and on-board charger manage and convert electrical power.

8 Suspension System
Independent suspension for superior handling, comfort and stability.

9 Thermal System
Liquid cooling system maintains optimal temperature for battery and powertrain.

10 Underbody Protection
Aerodynamic undertray reduces drag, improves efficiency and protects vital components.

KEY FUNCTIONS

1 Safety
Strong structure, airbags and advanced safety features ensure maximum protection.

2 Performance
Dual motors and AWD deliver instant torque, quick acceleration and smooth drive.

3 Efficiency
Integrated systems and aerodynamics optimize energy usage and extend range.

4 Technology
Advanced electronics and software enable smart features and over-the-air updates.

5 Comfort
Spacious cabin, premium materials and minimal noise for a comfortable ride.

6 Sustainability
Zero tailpipe emissions and sustainable design for a cleaner future.

7 Storage
Frunk and large cargo space provide practical storage for daily use and trips.

8 Thermal Management
Maintains ideal temperature for performance, safety and battery longevity.

9 Connectivity
Always connected with navigation, controls and entertainment seamlessly integrated.

10 Reliability
Built with precision engineering for long-term reliability and durability.

The EV Technology Stack

Three Layers That Define a Modern EV Platform

01

Energy & Propulsion

Battery cell chemistry, pack architecture, and the electric motor.

This is where raw-material access and cell manufacturing scale determine cost leadership, currently China's strongest layer.

02

Power Electronics & Controls

Inverters, onboard chargers, and thermal management.

A capital- and patent-intensive layer where component suppliers (not just OEMs) capture significant value.

03

Software & Connectivity

Vehicle operating systems, over-the-air updates, and the sensor/compute stack for driver assistance.

Increasingly the layer that defines brand differentiation and recurring revenue.

At policy level, the important question is how these layers interact and where investment and competitive advantage sit.

Energy and Propulsion:

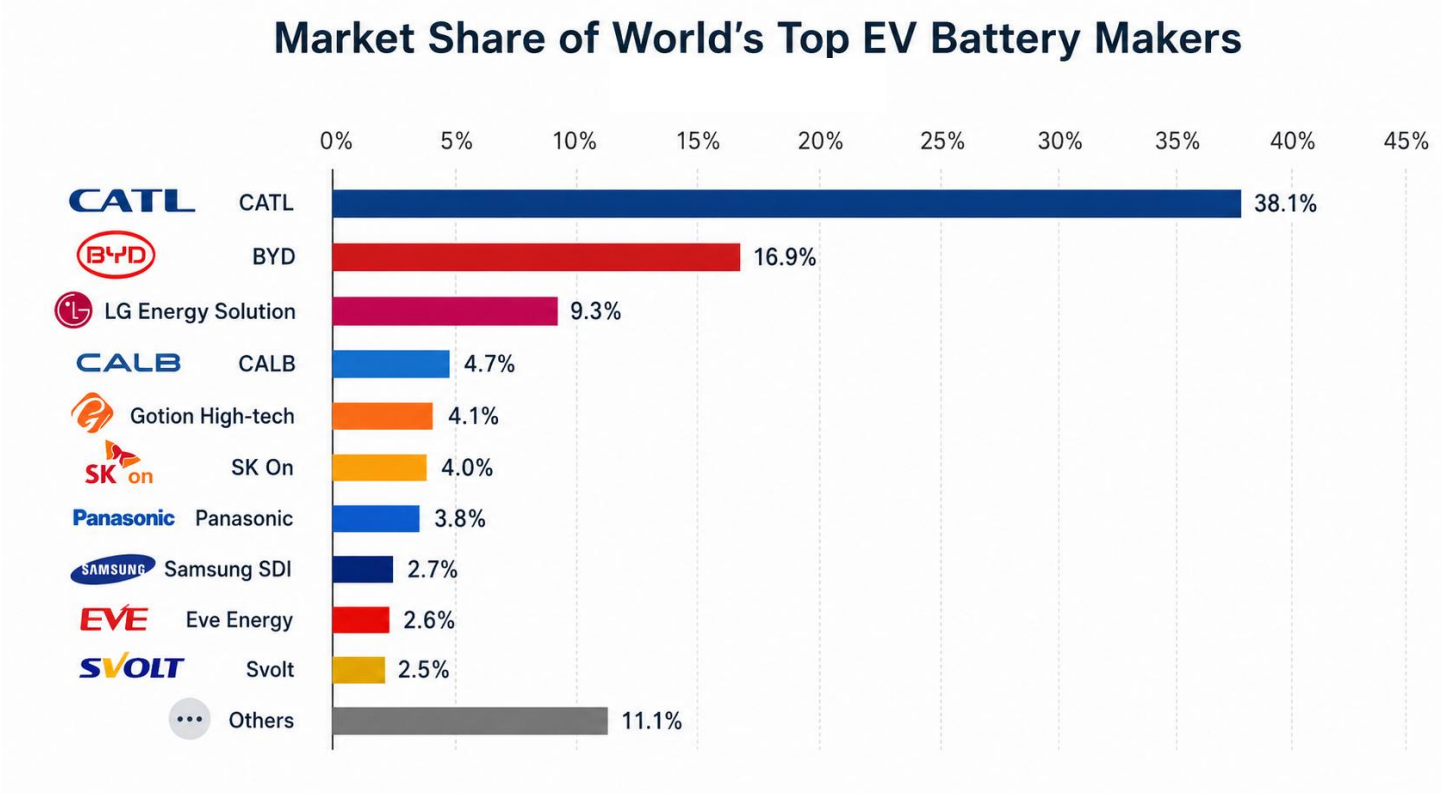
The Battery Remains the Core Technology of the EV

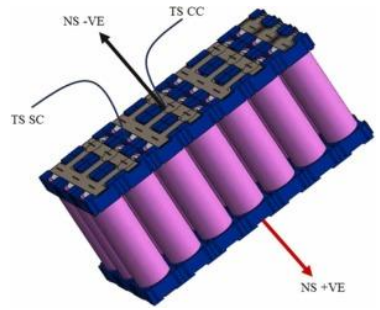
The battery influences:

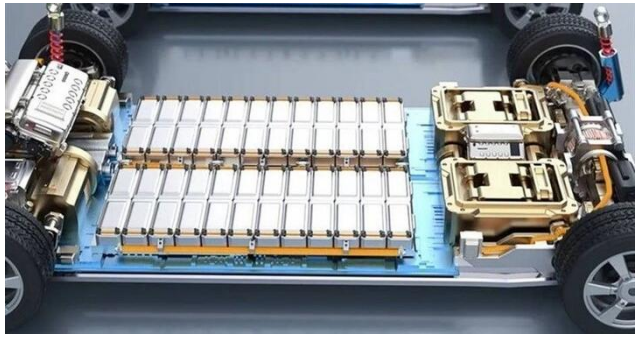
- Vehicle cost
- Driving range
- Vehicle weight
- Charging speed
- Acceleration
- Safety
- Durability
- Thermal performance
- Resource requirements

Global EV battery deployment reached approximately:

1.2 TWh







Energy and Propulsion (Cont'd)

ELECTRIC PROPULSION TECHNOLOGY: *Electric Motors: The Other Half of the EV Powertrain*

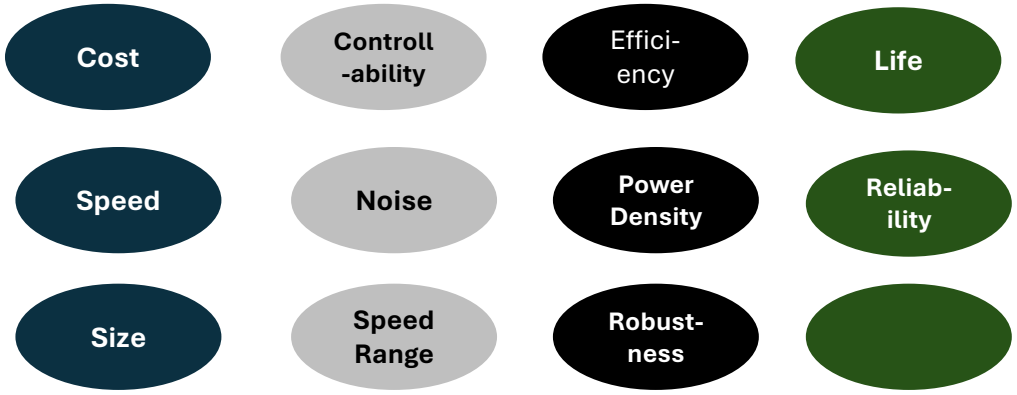
Motor Families

- **Permanent Magnet Synchronous Motor**
  - high efficiency / power density
- **Induction Motor**
  - no permanent magnets
- **Switched Reluctance**
  - no permanent magnets / different control approach

Permanent Magnet types

Magnet free types

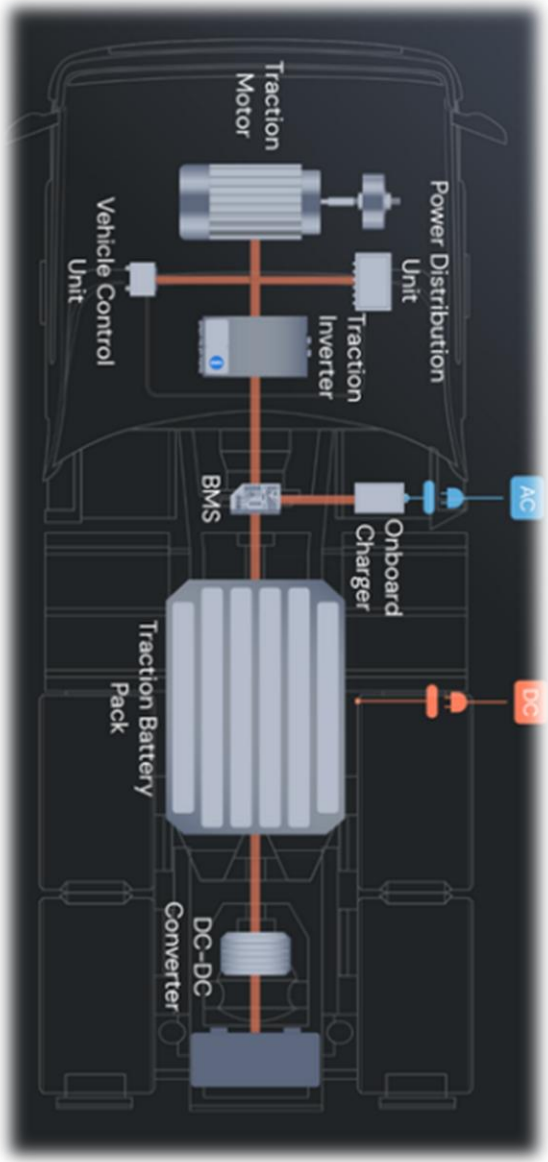
Common performance criteria

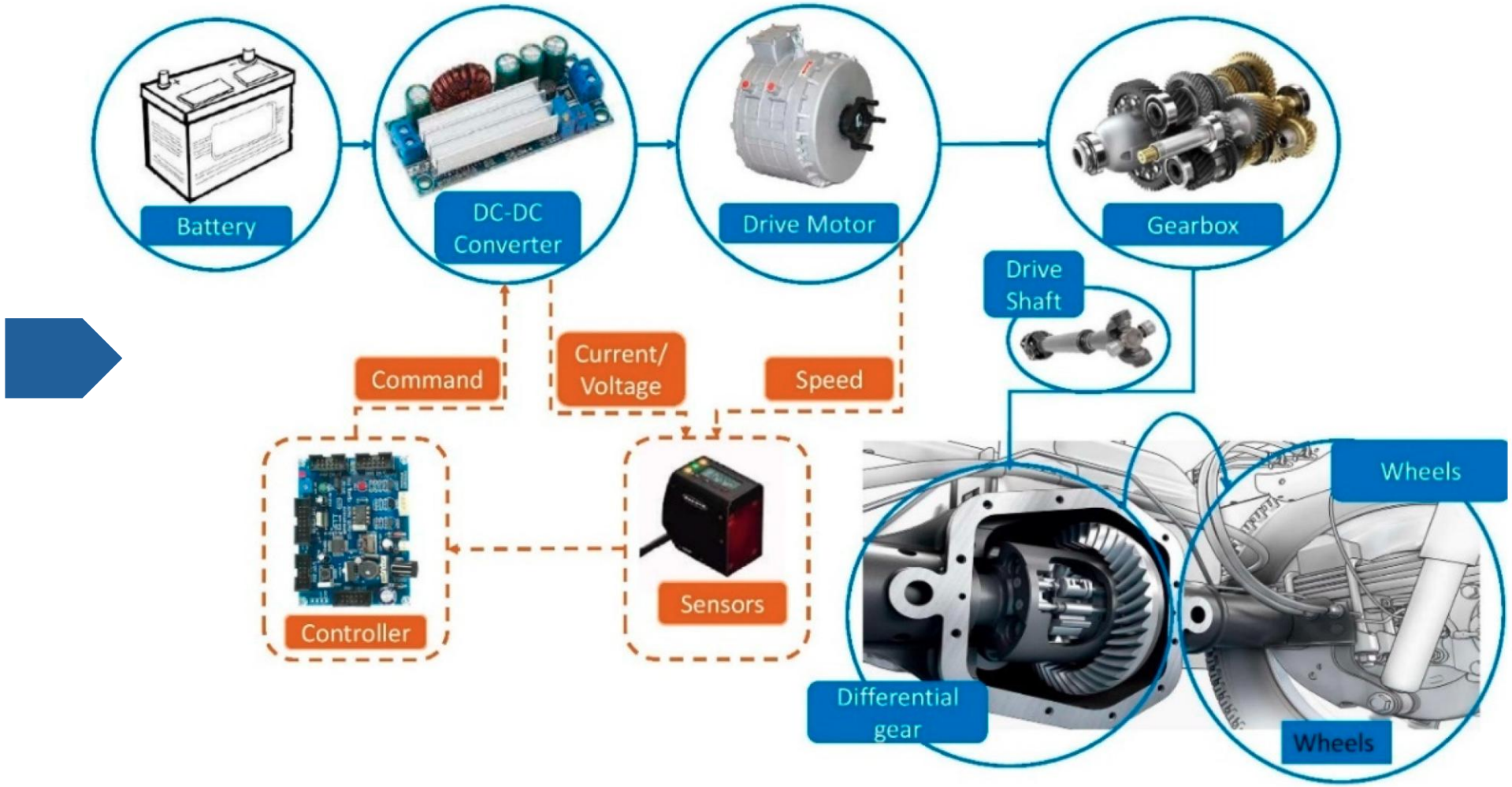


The industry is trying to simultaneously achieve:

- Higher efficiency
- Higher power density
- Lower cost
- Higher speed
- Less rare-earth dependence

Power Electronics & Controls



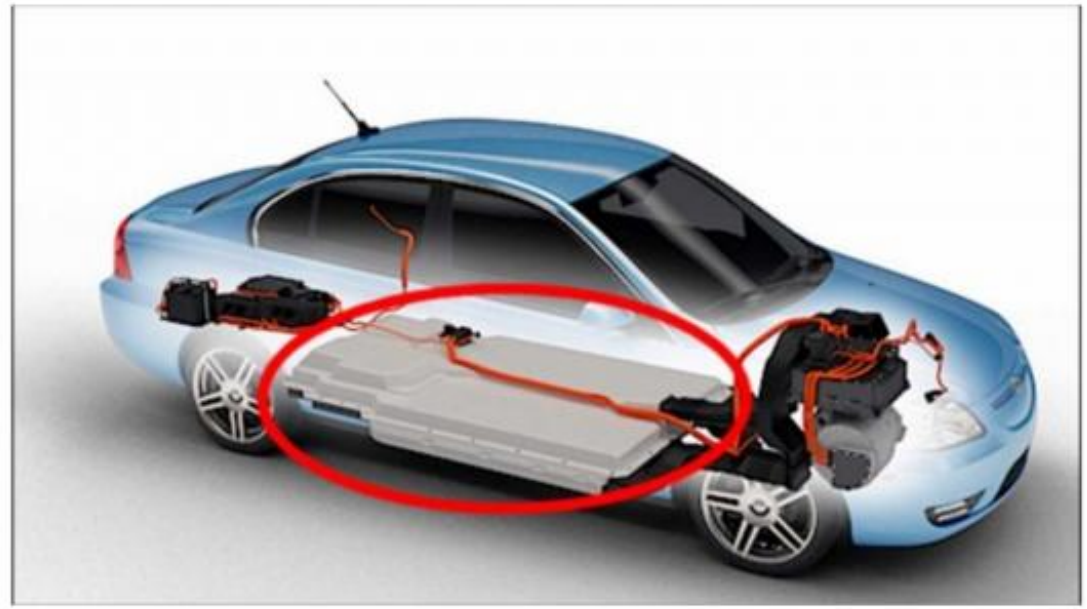


What is the most expensive item in EV ?

A. Battery
B. Motor
C. Software
D. Body and Materials
E. Electronics
F. None of these

Components: ICE vs. EV

2000



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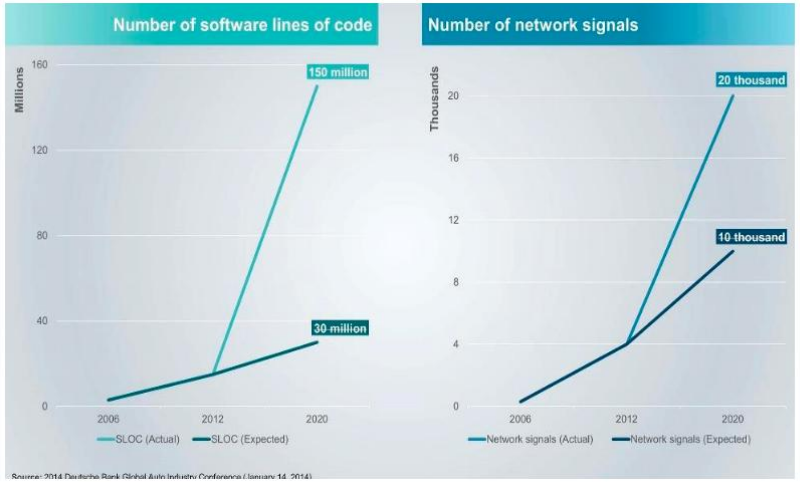
Software & Connectivity

EVs are simple, but is it really?

Huge Increase in System and Software Complexity

Machine	Software: Million Lines of Code (MLOC)
2009	
F-22 Raptor	1.7
F-35 Joint Strike Fighter	5.7
Boeing's 787 Dreamliner	6.5
An Average Car	10
Mercedes-Benz S Class	20
2017-18	
Ford F-150	150



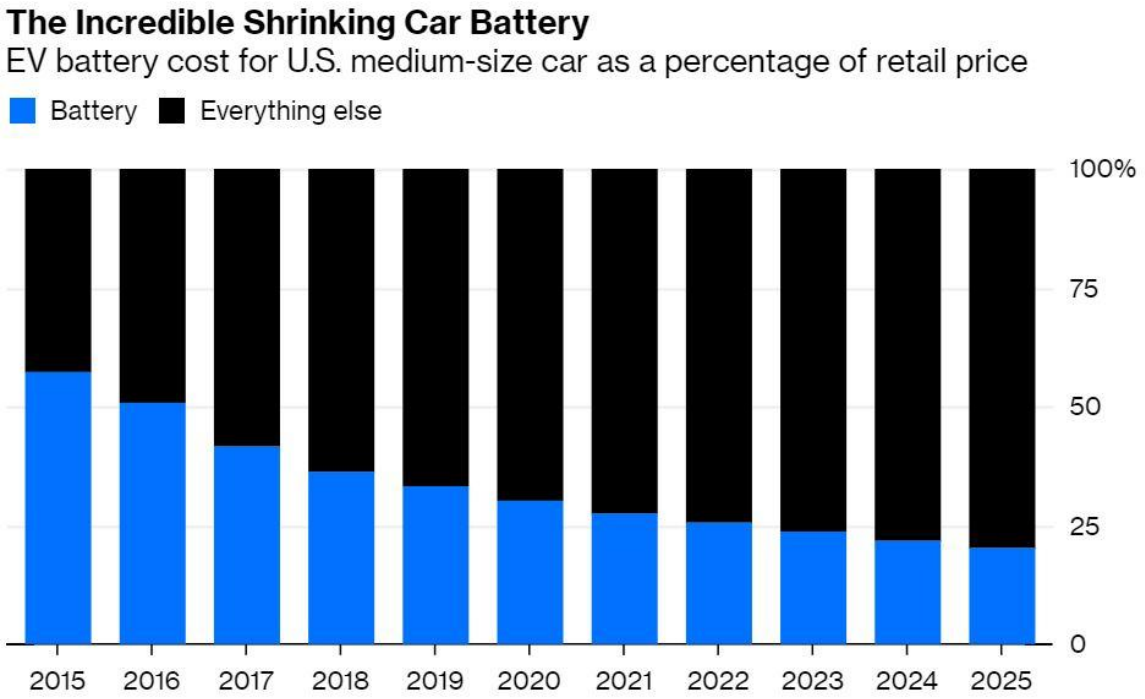
Source: AIG

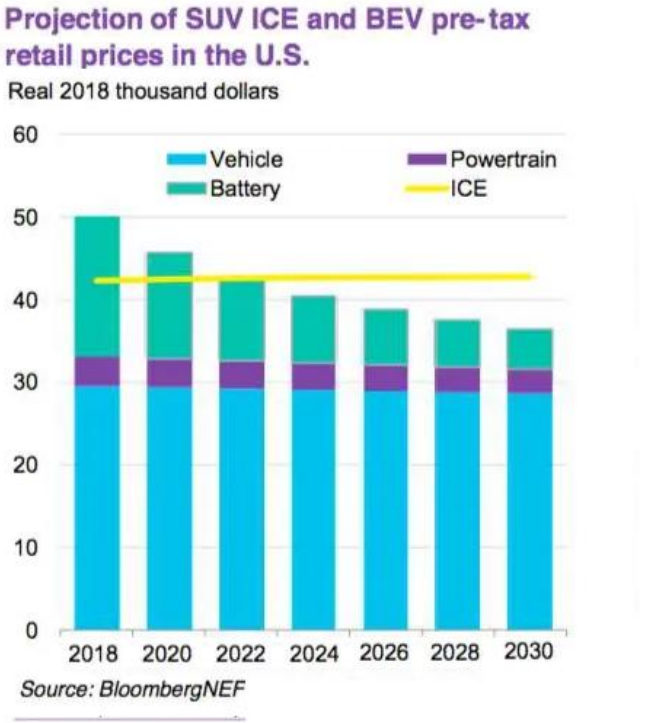
Source: McKinsey

Demystifying EVs

Total Cost of Ownership

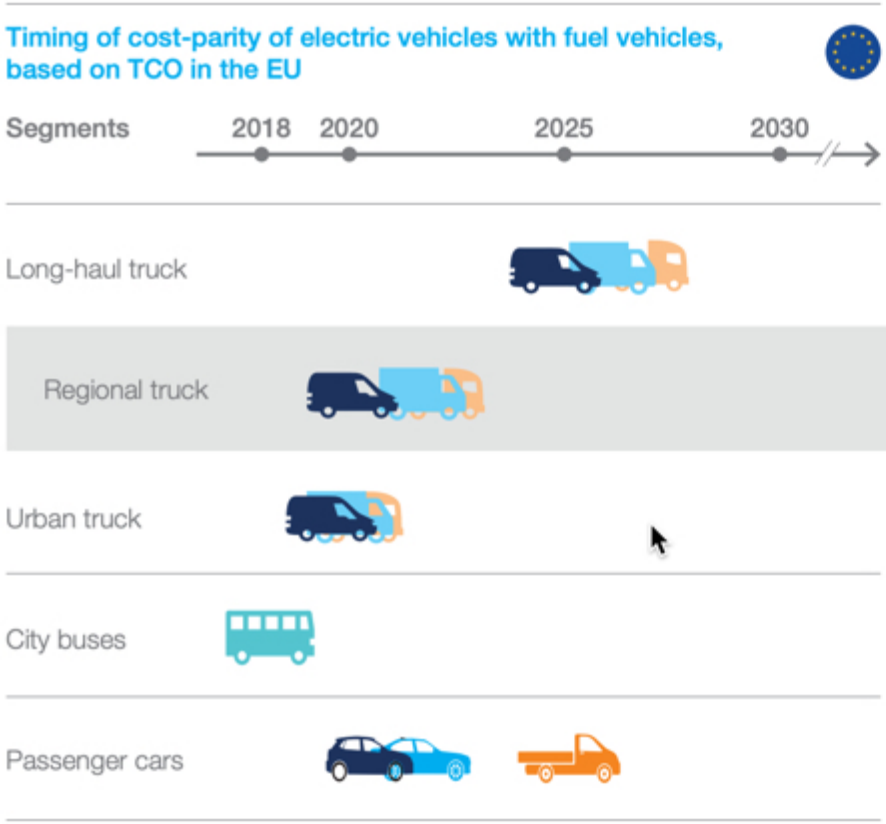
i. The upfront cost of EVs is more than 25% of the cost of FFVs. However, there are two important points to note;
   i. EV prices will be at par with FFVs by 2025-2031 according to many international agencies such as Bloomberg, BNP Paribas, McKinsey, and others.
   ii. Regarding the total cost of ownership, some EV segments are already cheaper than FFVs. This is especially true for 2/3-wheelers and passenger cars.





Total Cost of Ownership (Cont'd)

ii. FFVs are between 20-30% efficient while EVs are 90% or more efficient. If the electricity generation is from high-efficiency plants coupled with renewable sources, then EVs are much more efficient than FFVs. For example, a 1,500cc petrol vehicle may give 10-15km/ltr while an equally powerful EV will give an efficiency equivalent of 50km/ltr. This improvement in efficiency provides a silver lining for EV adoption where financial savings offsets the high upfront cost of EVs.

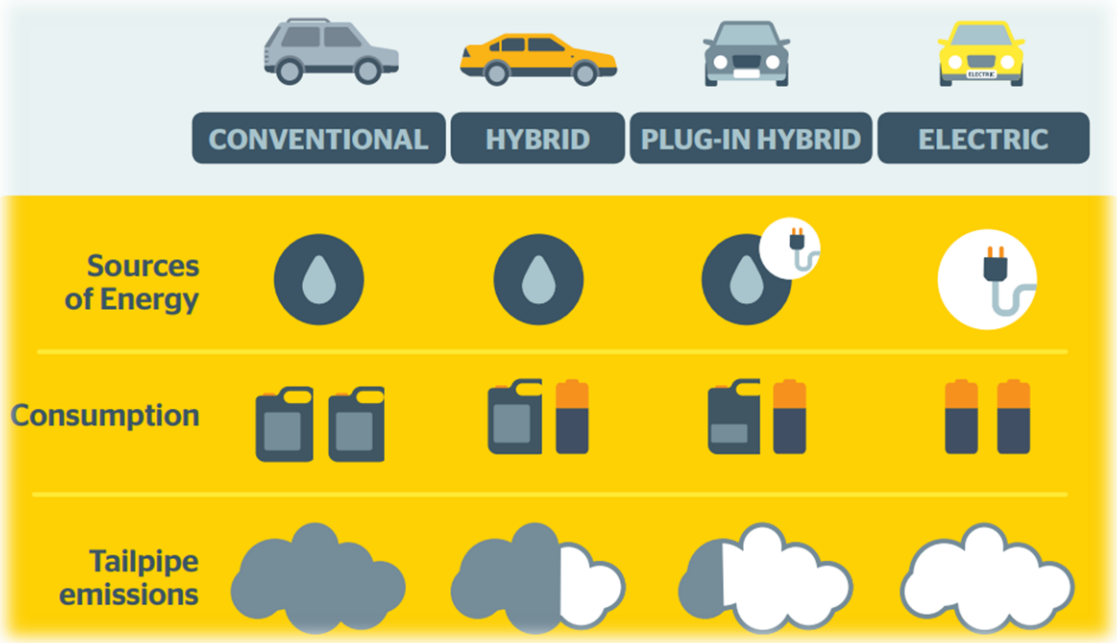


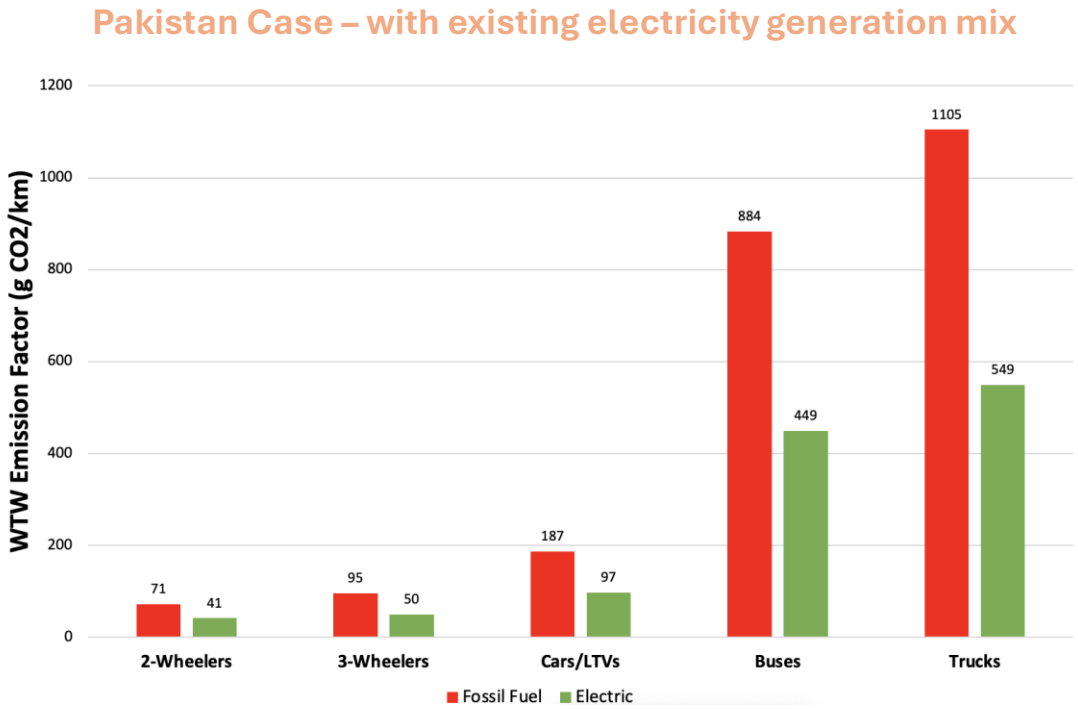
Are EVs zero-emission vehicles ?

i. EVs have zero tailpipe emissions which means that with a reasonable adoption the air quality in cities will improve drastically.

ii. The emissions from electricity generation from where EVs are charged are also less because of the efficiency of EVs and renewables in the energy mix.

iii. Details of well-to-wheel emission offsets of various categories are given in the following picture.





Strategic Opportunities for the Region

01

Two/Three-Wheeler Manufacturing

The segment with the fastest global electrification and the one SAARC already manufactures at scale, India's 2W/3W base is a genuine regional asset.

02

Hydropower-Backed Charging & Assembly

Nepal and Bhutan's hydropower gives them a structural cost advantage for energy-intensive assembly and charging that few countries can match.

03

Battery Recycling & Second-Life Storage

As the region's first EV cohort ages, recovered battery materials and second-life stationary storage represent an under-built domestic industry.

04

Software & Fleet-Management Services

A layer that requires talent, not capital-intensive manufacturing, an area where the region's existing IT services strength could translate directly.

Risks & Structural Watch-Outs

Mineral supply-chain dependence	The region has almost no domestic lithium, nickel or cobalt processing — every chemistry shift is a fresh import-dependency decision.
Standards fragmentation	Adopting different connector and battery-swap standards across SAARC countries would forfeit the manufacturing-scale advantage a common approach could offer.
Competing with entrenched capital	Thailand, Indonesia and Vietnam are years ahead in attracting OEM investment — SAARC is competing for the same capital pool, not starting fresh.
Technology timing risk	Betting policy incentives on a specific chemistry (e.g. building entirely around today's NMC/LFP mix) risks stranding investment if solid-state arrives faster than expected.

The EV Transition Is Actually Several Transitions

Automotive transition
ICE → Electric propulsion

Energy transition
Petroleum → Electricity

Materials transition
Oil → Lithium / nickel / graphite / copper / rare earths

Industrial transition
Mechanical manufacturing → Electrochemical + electronic manufacturing

Digital transition
Hardware-defined → Software-defined

Infrastructure transition
Fuel stations → Charging stations

Q&A

Top Selling Electric Vehicles in the World

CleanTechnica

February 2026

BEV PHEV

	Car model	Segment	Sales volume	
1.	Tesla Model Y	D	72,710	
2.	Tesla Model 3	D	32,234	
3.	Geely Xingyuan / EX2	B	28,432	
4.	BYD Song / Seal U (BEV+PHEV)	D	24,339	(1,610 + 22,729)
5.	BYD Seagull / Dolphin Mini	B	22,659	
6.	Xiaomi YU7	E	20,200	
7.	Li i6	D	16,007	
8.	BYD Yuan Plus / Atto 3	C	13,462	
9.	Toyota BZ4X	D	12,419	
10.	Fang Cheng Bao Tai 7	E	11,695	
11.	NIO ES8 / EL8	E	11,299	
12.	BYD Dolphin	C	10,603	
13.	BYD Seal 06 (BEV+PHEV)	D	10,116	(3,802 + 6,314)
14.	AITO M7 (BEV+PHEV)	E	10,093	(9,091 + 1,002)
15.	BYD Yuan Up / Atto 2	B	9,510	(7,224 + 2,286)
16.	BMW iX1 / X1 PHEV	C	8,922	(5,831 + 3,091)
17.	Skoda Elroq	C	8,683	
18.	Hyundai Ioniq 5	D	8,495	
19.	BYD Sealion 07	D	8,399	
20.	VW ID.4	C	8,150	