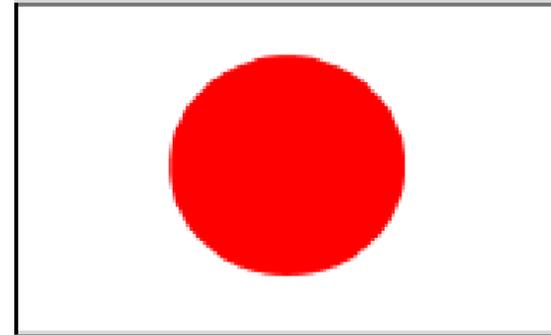


Directions and challenges for next generation vehicles (BEVs)



November 2025
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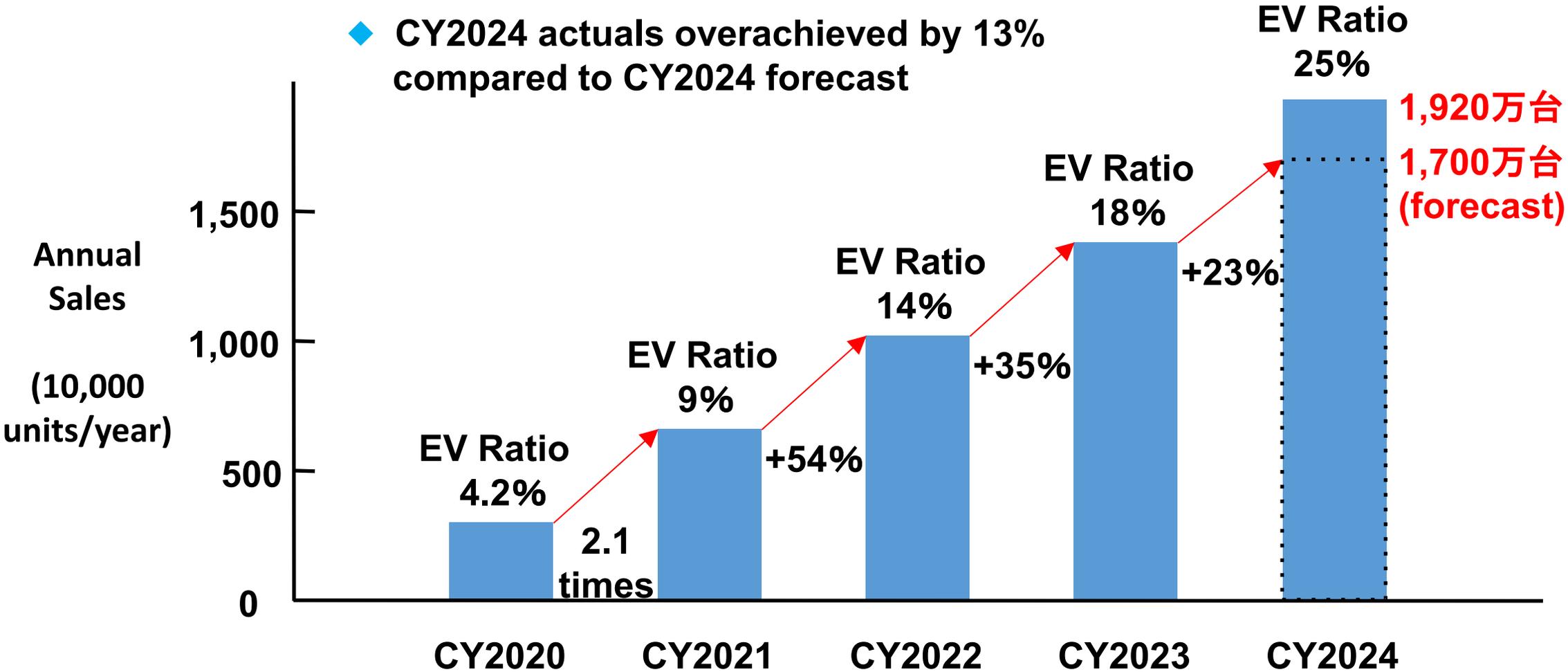


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1 . BEV dissemination in the world and ASEAN/Japan

Global EV sales (Passenger car : BEV+PHEV)

◆ CY2024 actuals overachieved by 13% compared to CY2024 forecast



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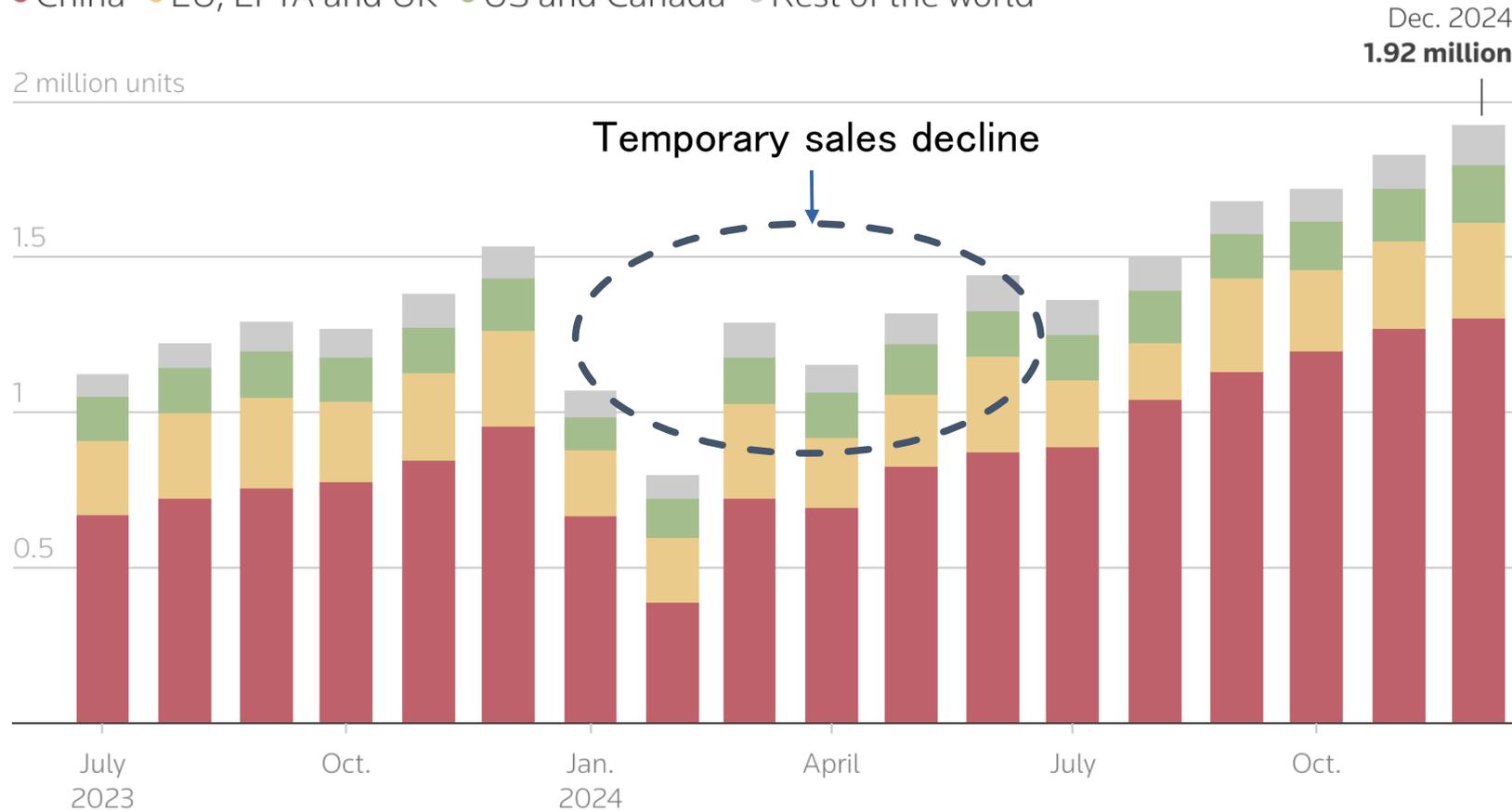


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Global EV sales by re (Passenger car : BEV+PHEV)

- ◆ Growth in China, but growth in EU/USA+others has plateaued.
- ◆ China is also shifting from BEVs to PHEVs, and the growth of BEVs themselves is slowing.

● China ● EU, EFTA and UK ● US and Canada ● Rest of the world



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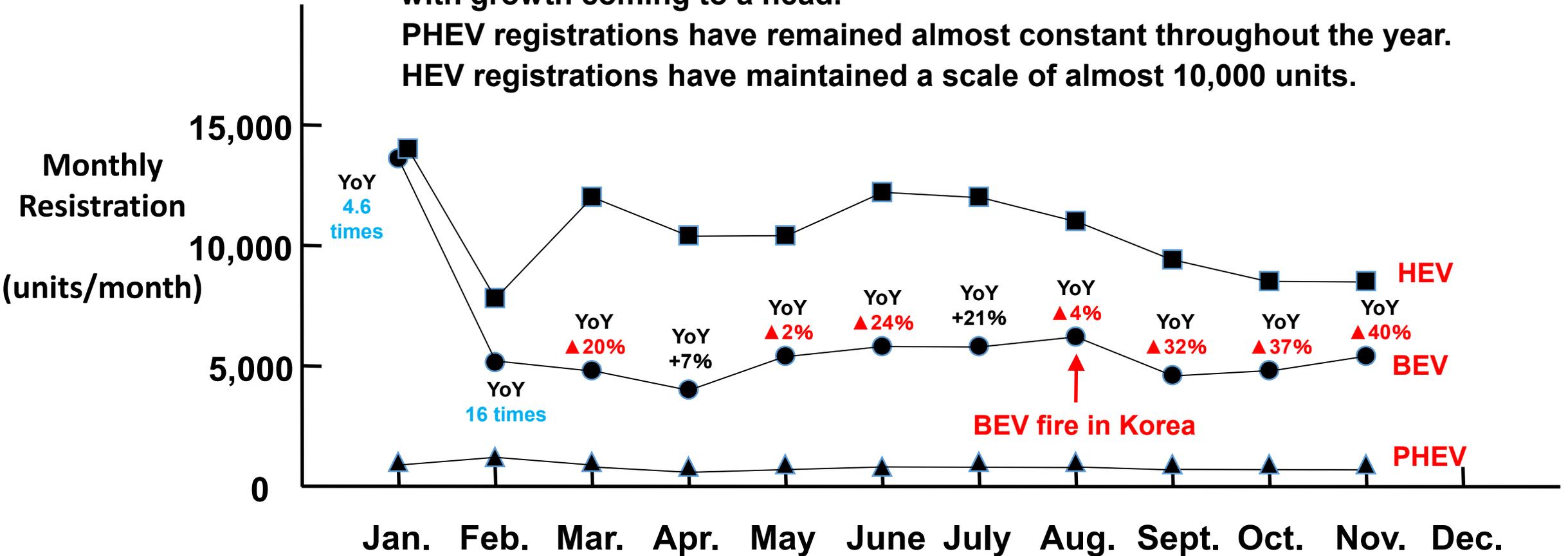
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Source: Rho Motion | Reuters, Jan. 13, 2025 | By Sumanta Sen

Source : Reuters 3

EV Resistration Status in Thailand (Passenger car : BEV · PHEV · HEV)

- ◆ BEV has been on a negative YoY trend since March, with growth coming to a head. PHEV registrations have remained almost constant throughout the year. HEV registrations have maintained a scale of almost 10,000 units.



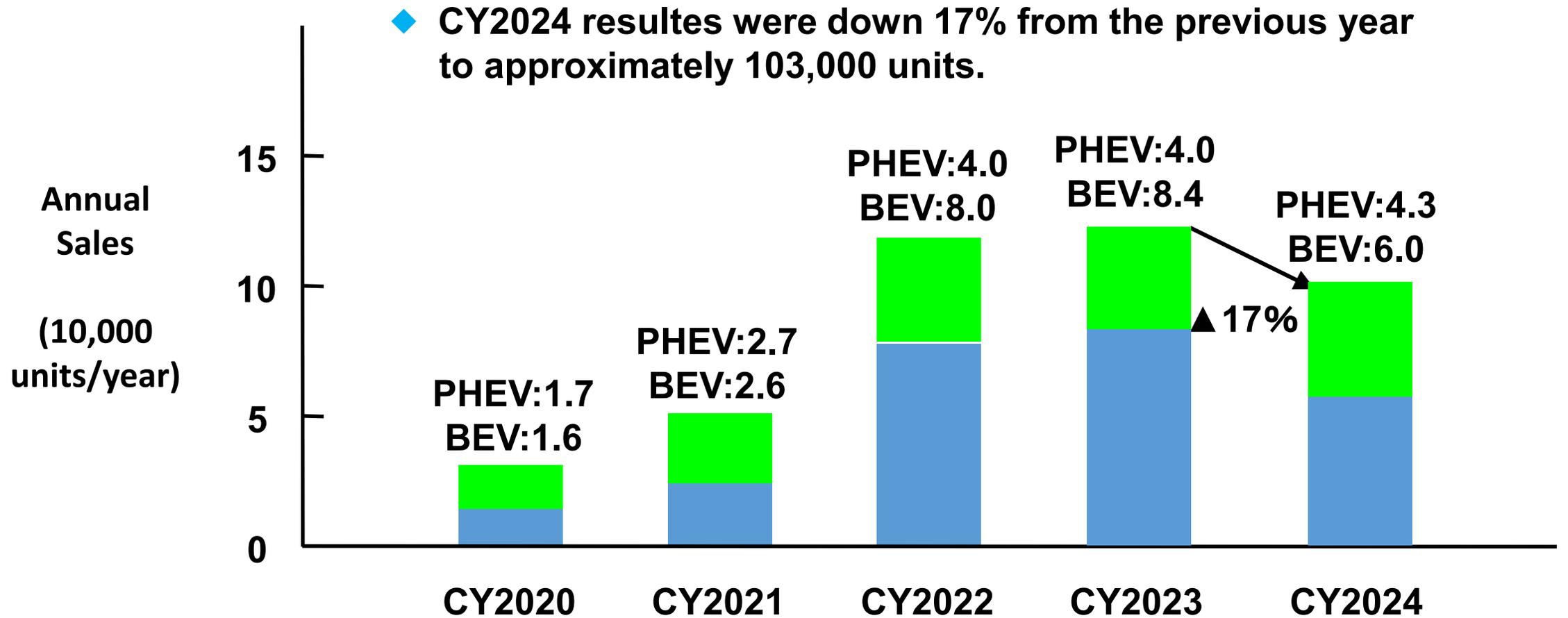
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Source : JETRO 4

EV sales in Japan (Passenger car : BEV+PHEV)



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Source : Next Generation Vehicle Promotion Center 5

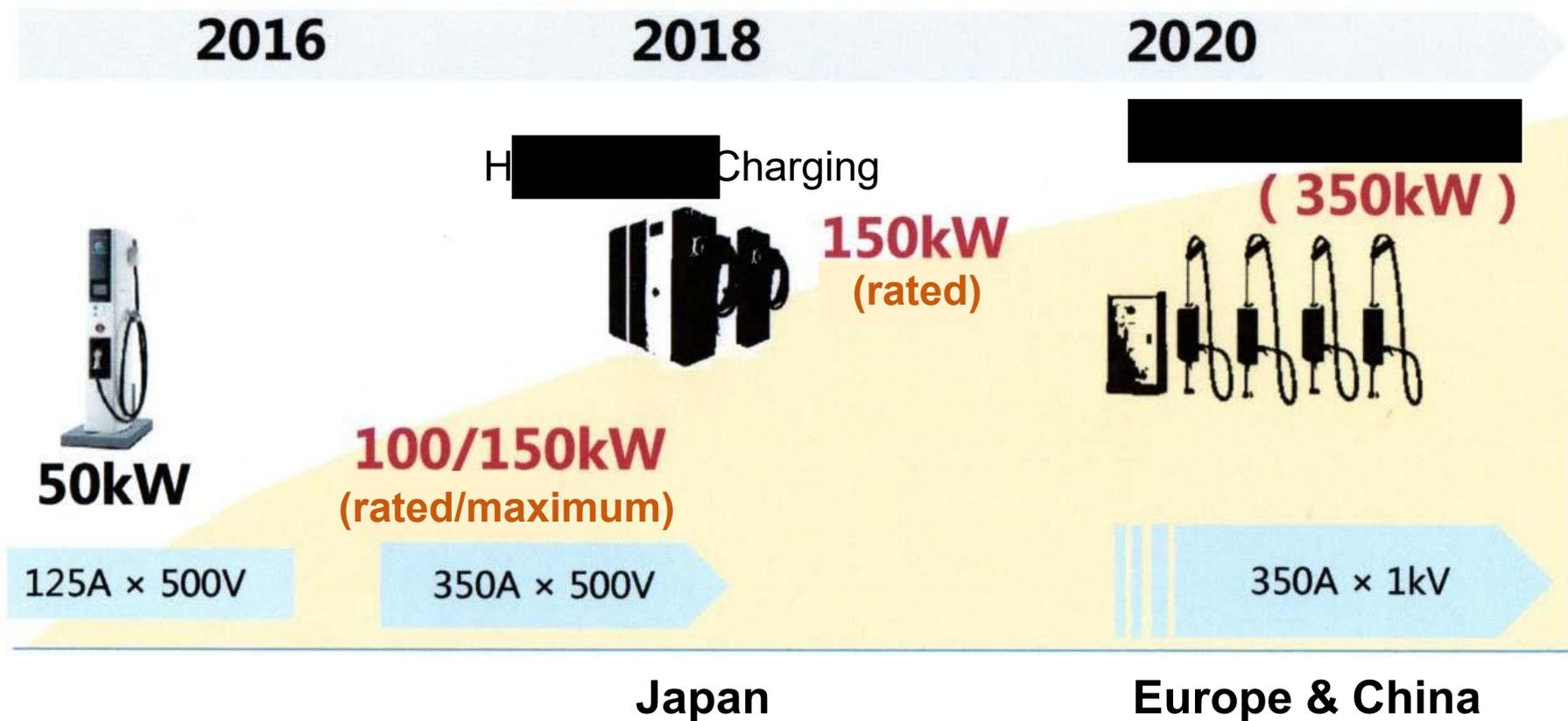
Japan : High running costs of regular size passenger cars

- ◆ Light BEVs and PHEVs that can be normally recharged at home can be operated at about half the cost of conventional gasoline vehicles because nighttime power can be applied. On the other hand, BEVs for regular size passenger cars with larger battery capacity require quick recharging, which adds to the amortization cost of the charger and does not provide an economic advantage.

Charge and refueling method		Charging and Refueling costs	Fuel Economy Electricity Expense	running costs (Yen/km)	evaluation
Stationary Charging (light BEV · Prius PHEV)		32.6 Yen/kWh	6km/kWh	5.4 Yen/km	○
Quick Charge	Tesla Supercharger (250kW)	58.8 Yen/kWh	↑	9.8 Yen/km	✕
	Tesla Supercharger (120kW)	75 Yen/kWh	↑	12.5 Yen/km	✕
Refueling	Prius HEV Prius PHEV	170 Yen/l	28.6km/l 26.0km/l	5.9 Yen/km 6.5 Yen/km	○
	ICE vehicles(base)	↑	17.0km/l	10 Yen/km	(base)

Integration of Charging Standards between Japan and China

- ◆ Due to extended cruising distance, the battery capacity has been increased, and the charging time has increased accordingly. Expensive high power quick charging equipment is increasing to shorten the charging time.



Summary so far

Investigate the reasons for stagnant demand for BEVs in Europe, USA and elsewhere and ensure that the situation does not recur.

- Electricity prices spike due to Russia's invasion of Ukraine
- Lack of safety due to Korean battery fire
- Overall, the utilization rate of recharging facilities is small, making it difficult to establish a business. The operational cost of regular size passenger cars, which require quick recharging, is high, and the shift BEVs is not progressing.

Investigation into the reasons for the continued growth in demand for BEVs in China

- In China, traffic congestion caused by recharging is frowned upon, and PHEVs are chosen to reduce recharging opportunities.
- In order to shorten the charging time, the Chinese government has introduced expensive high-power charging facilities (350kW class), efforts are being made to resolve dissatisfaction through priority acquisition of license plates, etc.
- On the other hand, if the all solid-state batteries under development in Japan are adopted, there will be no need to install expensive equipment.

→Can ASEAN governments withstand continued high spending ?



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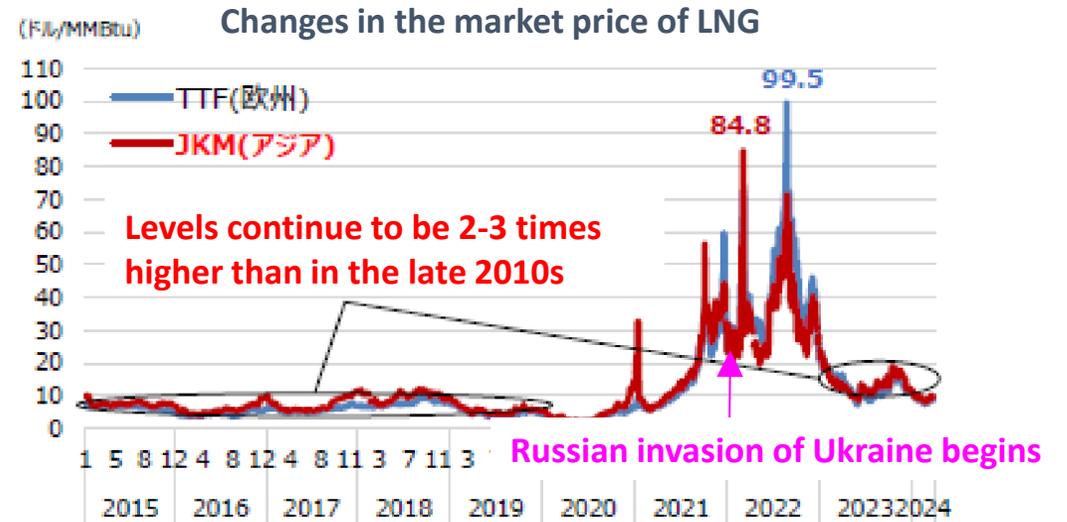
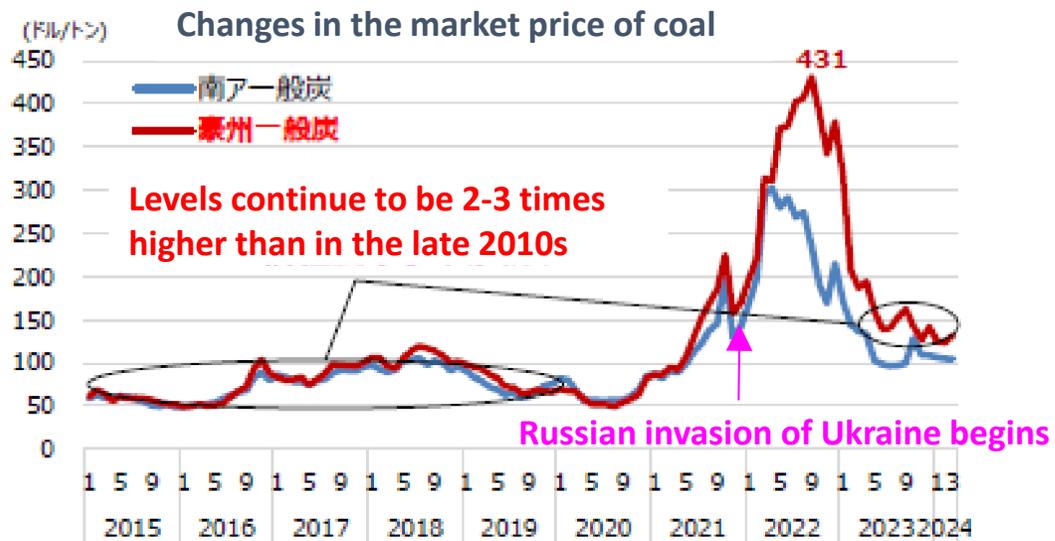


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2. Estimated reasons for the decrease in BEV sales in the first half of 2024

Europe : Surge in BEV maintenance costs due to skyrocketing energy costs

- ◆ Energy costs skyrocketed along with Russia's invasion of Ukraine. The resulting disruption of CNG supply through a pipeline to Europe caused BEV maintenance costs to skyrocket, and synchronized with the elimination of subsidies, sales volume plummeted. Subsequently, a large number of inexpensive BEVs made in China were exported to Europe, so the government decided to impose additional tariffs to ensure employment. Nevertheless, VW's plant closure could not be avoided, leading other major manufacturers to review their EV business.



USA : Lack of charging facilities and networks

- ◆ In the U.S., the need for long-distance travel has always been high, and the sense of uneasiness about recharging facilities is higher than in Europe. As a result, many customers switch to BEVs once and then return to engine-powered vehicles. Survey results show that 46% of U.S. BEV owners would like to return to engine-powered vehicles.
(Global average is 29%, 15-24% in Europe, 12% in Japan)
- ◆ In the U.S., the need for need for engines is increasing as BEVs are stuck in Chicago and other northern parts of the country due to a major cold snap caused by climate change.
 - The battery performance itself is reduced by the drop in temperature.
 - In addition to the above, the increased need for heating significantly reduced the cruising range.
 - Low availability of recharging facilities prevents timely recharging when they want to recharge/
(10,000 quick-charging facilities for every 120,000 gas stations in the U.S.)
- ◆ In California, where the need for BEVs is particularly high, charging facilities are poorly maintained and are not being renewed in a timely manner due to the effects of copper thieves and the eight-year useful life of the equipment.
Tesla's charging facility organization has been disbanded, which will likely hinder the maintenance of future charging facilities. As a result, sales of BEVs, which require charging facilities, have not grown, while sales of HEVs and PHEVs have grown.



Thailand : Potential issues to be seen in the future

- ◆ In Thailand, vehicle inspections are conducted every seven years, and the market needs an annual mileage of approximately 30,000km, so customers expect a quality guarantee of 200,000 to 250,000km. On the other hand, Chinese-made BEVs, which are currently the mainstream for sales, do not last until after vehicle inspections expire, and various problems have occurred after sales. For example, when flooding occurs after a scorch, battery packs located under the floor are flooded and malfunction.→Charged for expensive repairs comparable to a new car replacement (in some case, they may be left unrepaired)
- ◆ The resale value of BEVs is low and they do not have the same trade-in value as engine cars. Therefore, it is necessary to reduce the burden on customers through battery lease sales, car sharing, and subscriptions.
- ◆ With the passage of time, it is highly likely that new problems will continue to manifest themselves in the future due to the lack of service capacity of Chinese manufacturers. Failure to bridge the gap between customer expectations and manufactures' practical capabilities will lead to a future shift away from BEVs.



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Source : TJRI (Thailand Japanese Investment Research Institute) 12

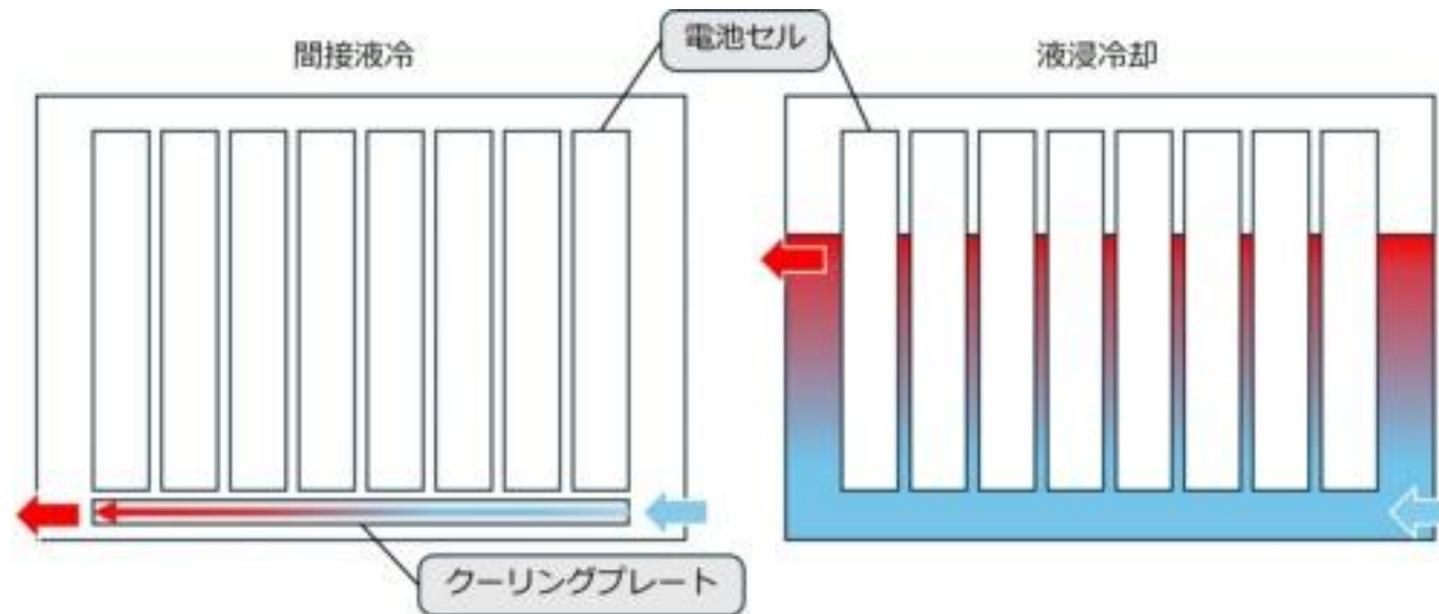
General : Lack of safety due to battery fire accident

- ◆ In 2024, a fire broke out in a Chinese-made battery while charging a BEV in the underground parking lot of an apartment building in South Korea, spreading fire to 100 cars in the vicinity and destroying the apartment building.
- ◆ In 2023, a Mitsui O.S.K. Lines cargo ship was transporting 3,000 BEVs off the coast of the batteries and the ship sank.



General : Development of technology to prevent thermal runaway of batteries

- ◆ French energy Total company has developed an immersion-cooled battery using an insulating fluid called 'Cellshield. The system has been installed in a Renault EV, and demonstration tests have confirmed that the charging time has been reduced by half and that thermal runaway has been suppressed. Renault will apply this technology to lithium iron phosphate and bring it to market in 2028 at half the battery cost. This will result in CO2 emissions of ▲70-90%.



3. innovation technologies for future BEV dissemination

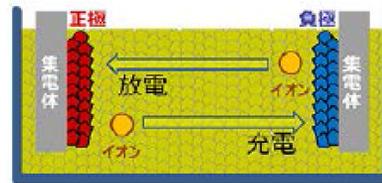
Improvement of Electricity Utilization Technology (1)

◆ Practical application of All-Solid-State Batteries (Circa 2027~2028)

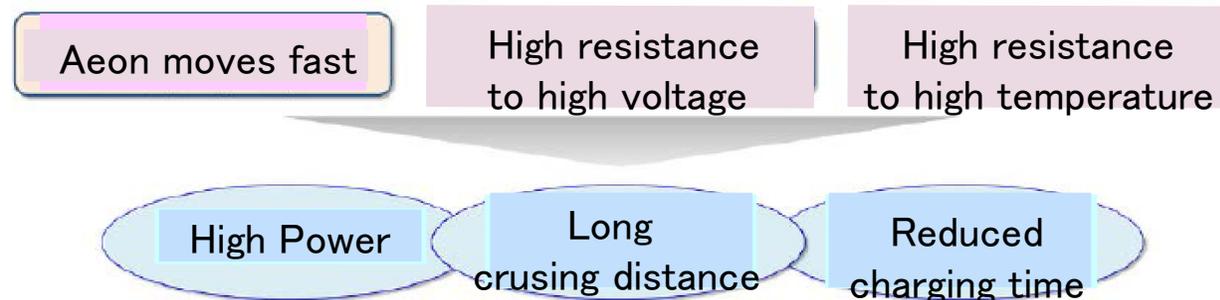
In Japan, Toyota, Nissan and Honda have completed demonstration tests and are entering the production preparation stage.

【Expected Effects】

- Electrolyte is solid. → No risk of electrolyte and **no fire**.
- Fast moving ions and high voltage tolerance. → **short charging time**
- High resistance to high temperatures → No need for cooling, **making it easy to reduce size and weight**



Electrolyte is solid



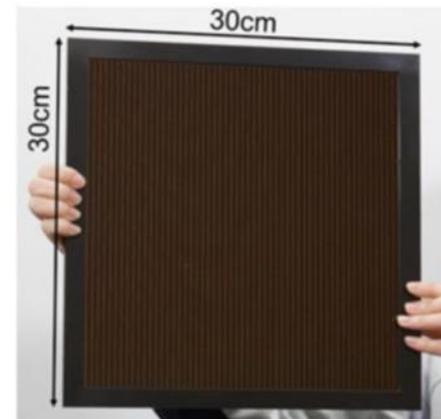
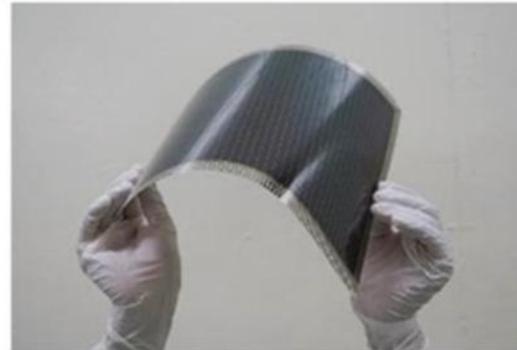
Improvement of Electricity Utilization Technology (2)

◆ Practical application of perovskite photovoltaics (Circa 2030)

In Japan, TOYOTA and its suppliers are in the process of developing reliability and manufacturing methods.

【Expected effects】

- Since the batteries can be recharged by leaving them outdoors, there are no need to invest in expensive recharging facilities.
- The flexible shape of the product allows it to be attached to hoods, roofs, etc,
- This allows for ventilation of the interior while the vehicle is parked, reducing power consumption for air conditioning.



Improvement of Electricity Utilization Technology (3)

- ◆ **Practical application of wireless power Transfer (Circa 2035) · · Elemental technology development has been completed and is in the demonstration stage**
Honda is developing a coil unit that can be recharged while driving, with the aim of commercializing a high-capacity type that can be used by truck, buses, and passenger cars.
【Expected effects】
 - The onboard battery can be made smaller by supplying power while the vehicle is running.
 - Priority will be given to practical application for trucks and buses, which have limited routes, followed by passenger cars.



Vehicle-side unit (DWPT system)



Road-side unit (DWPT system)



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Source : Nikkei XTECH 18

4 . Summary

Summary

◆ Estimated reasons for the decrease in BEV penetration in the first half of 2024

Although circumstances differ from country to country, the following two cases are considered to have had the greatest impact.

- ① Energy costs skyrocketed due to Russia's invasion of Ukraine→Directly linked to sharp decline in demand in Europe.
- ② Lack of safety due to battery fire in Korea→Directly linked to sharp decline in demand in ASEAN. As HEVs and PHEVs are expected to become increasingly popular in ASEAN, new BEV-related issues are likely to emerge over time, leading to a future shift away from PHEVs.

◆ Innovative technologies for future BEV proliferation

Currently, BEVs are on the dance floor of popularization and are likely to become popular again after the following technologies that solve the shortcomings of lithium-ion batteries are out to practical use.

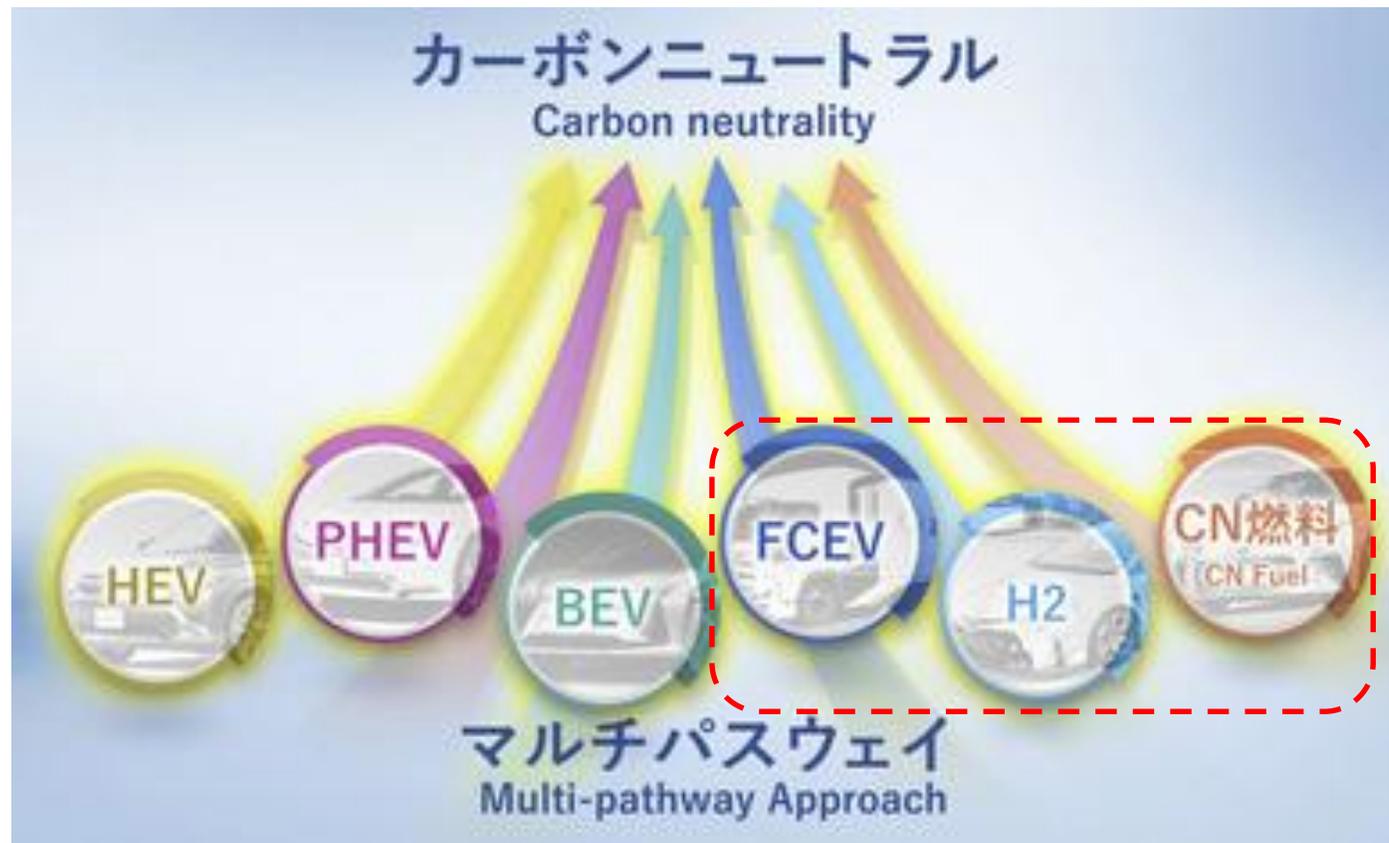
As with lithium-ion batteries, costs are expected to decline with mass production.

- ① Practical application of All-Solid-State Batteries (Circa 2027~2028)
- ② Practical application of Perovskite Photovoltaics (Circa 2030)
- ③ Practical application of Wireless power Transfer (Circa 2035)

→These Japanese technology development plans are consistent with ASEAN BEV dissemination plans.

Solutions other than electrical application technology

- ◆ CN can be achieved through hydrogen utilization, CN fuel utilization, etc. in addition to electricity utilization technology.



Thank you for your attention !



A blue clover with a smiling face in the center, a long blue stem, and the text "Energy Conservation Symbol" and "SMART CLOVER" below it. The clover has four leaves, and the stem is curved. The text is in a blue, sans-serif font. The entire graphic is enclosed in a blue rectangular border.



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