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IEEJ Outlook 2025

Life Cycle Assessment of Automobiles
Singapore International Energy Week

The Institute of Energy Economics, Japan

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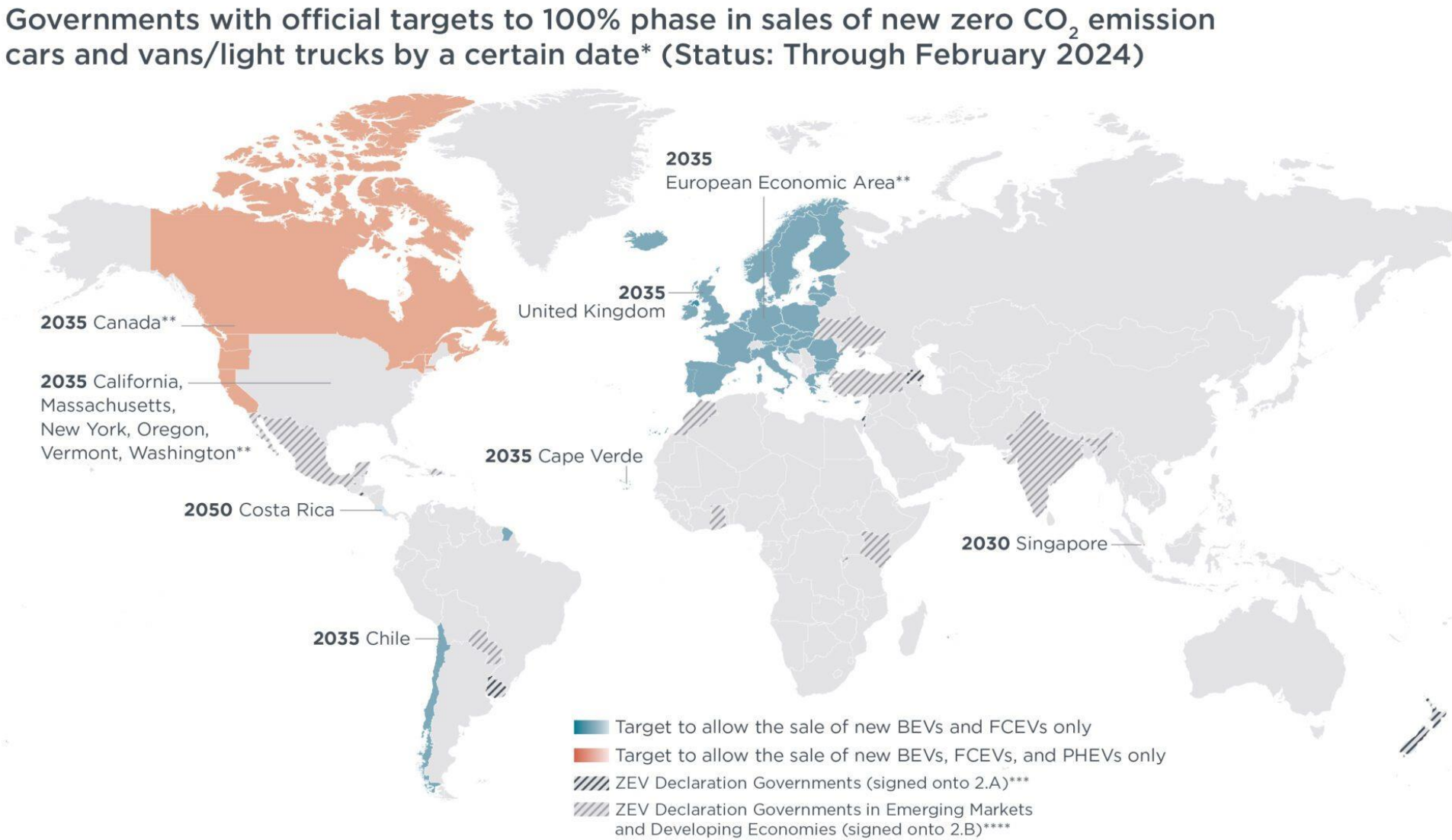
Governments with official targets to 100% phase in of EVs

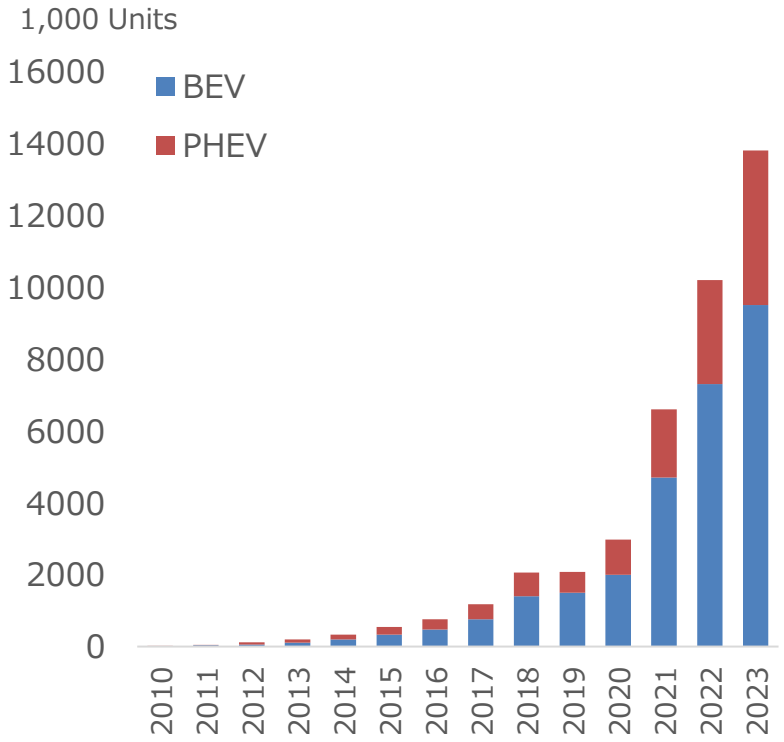


* Includes countries, states, and provinces that have set targets to only allow the sale or registration of new battery electric vehicles (BEVs), fuel cell electric vehicles (FCEVs), and plug-in hybrid electric vehicles (PHEVs). Countries such as Japan with pledges that include hybrid electric vehicles (HEVs) and mild hybrid electric vehicles (MHEVs) are excluded as these vehicles are non plug-in hybrids.

** The Canadian province of British Columbia has a regulation to enforce its 2040 target, as do California, Massachusetts, New York, Oregon, Vermont, and Washington for their 2035 targets. The European

Recent Trends in EV Sales and Factors

BEV/PHEV Sales (2010-2023)



Trends

- **EU**: As of August 2024, BEV sales decreased by 43.9% compared to the same period last year.
- **USA**: BEV's sales forecast for 2024 is 20% increase compared to the previous year. The pace has slowed down from the approximately 40% increase in 2023.
- **China**: BEV/PHEV sales in 2024 is projected to increase by 25% compared to the previous year. This will slow down from the 82% increase in 2022 and the 35% increase in 2023.

Factors

- **Germany :** Suspended provision of EV subsidies (December 2023)
- **France:** EVs produced in China are no longer eligible for subsidies
- **United States:** Consumers who adopt new goods and services at an early stage, called "Early Adopters," seem to have completed their purchasing cycle.
- **China:** Consumers are becoming more cost conscious**.**

Source : IEA Global EV Data Explorer、and various other sources

Major Vehicle OEM's EV Target

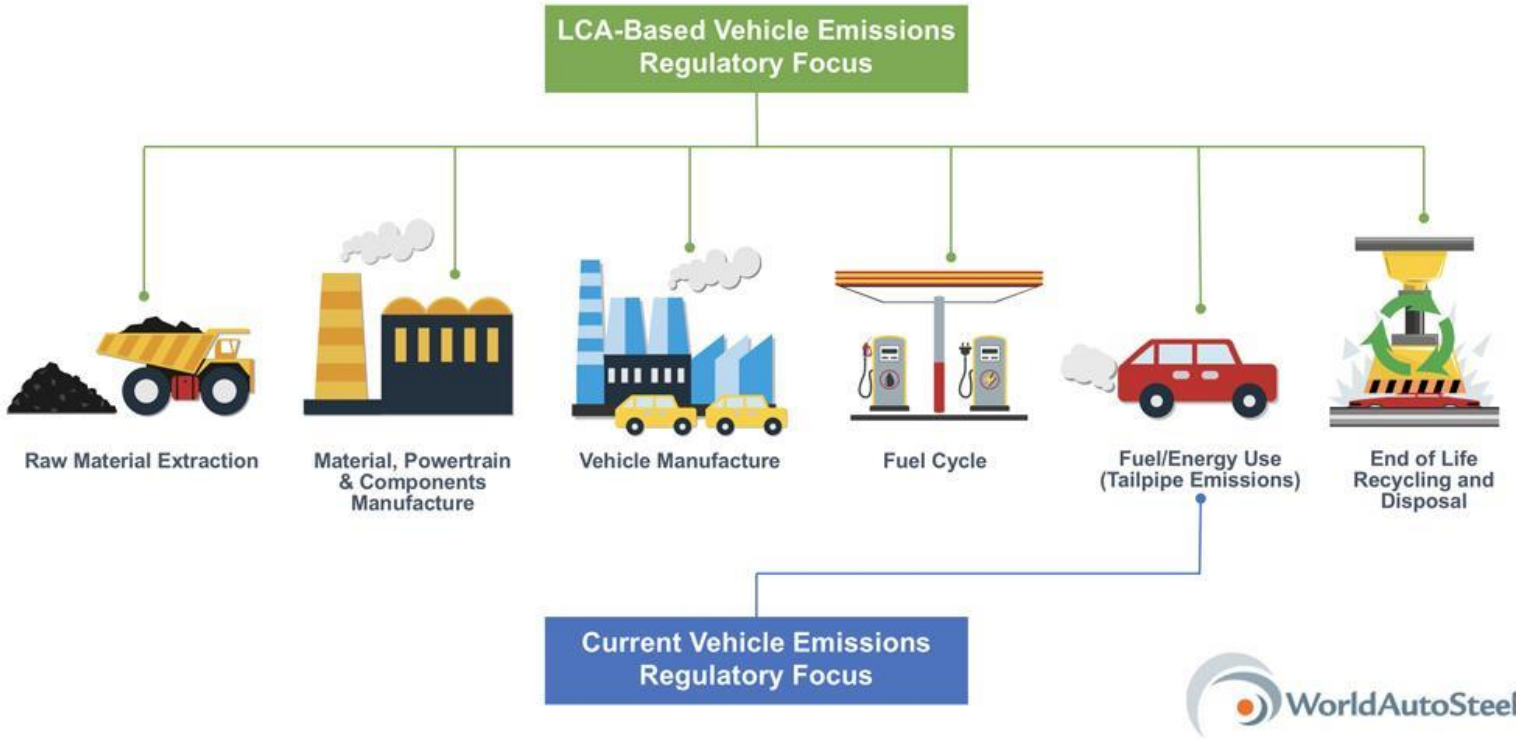
Mercedes Benz	• **Revised its plan to make all new car sales electric by 2030**, "as long as the market allows." In the 2030s, the company will **continue to sell** electric vehicles equipped with engines, such as **plug-in hybrid vehicles**. (February 2024)
Ford	• **Postpone about $12 billion in EV investment** as buyers become more cautious. • The company isn't cutting back its spending on future electric vehicle models. But it now plans to **ramp up its EV manufacturing capacity**, and its spending on that capacity, **more gradually than previously planned**. (August 2024)
GM	• **Push back** the planned opening of an **electric pickup truck plant** in suburban Detroit and has **delayed a Buick plug-in** amid uncertain growth in battery-powered car sales (July 2024)
Toyota	• **Lower sales target** of BEV from 1.5 million units in 2026 to 1 million units (September 2024)
Volvo	• Volvo Cars aims for 90 to 100 % of its global sales volume by 2030 to consist of electrified cars, meaning **a mix of both fully electric and plug-in hybrid models** – in essence, all cars with a cord. (September 2024)

Source : IEA Global EV Data Explorer、and various other sources

Lifecycle Assessment of EVs

- In estimating **CO2 emissions from automobiles**, **Life cycle assessment (LCA)** is required as a fair evaluation. This includes CO2 emissions from production/manufacturing, fuel supply, energy use and end of life/recycling.

- Since the availability of CN fuel, power supply mix, energy infrastructure, and social conditions vary greatly depending on the country and region, LCA analysis can offer **country/region specific different perspectives for CO2 emissions from automobiles**.

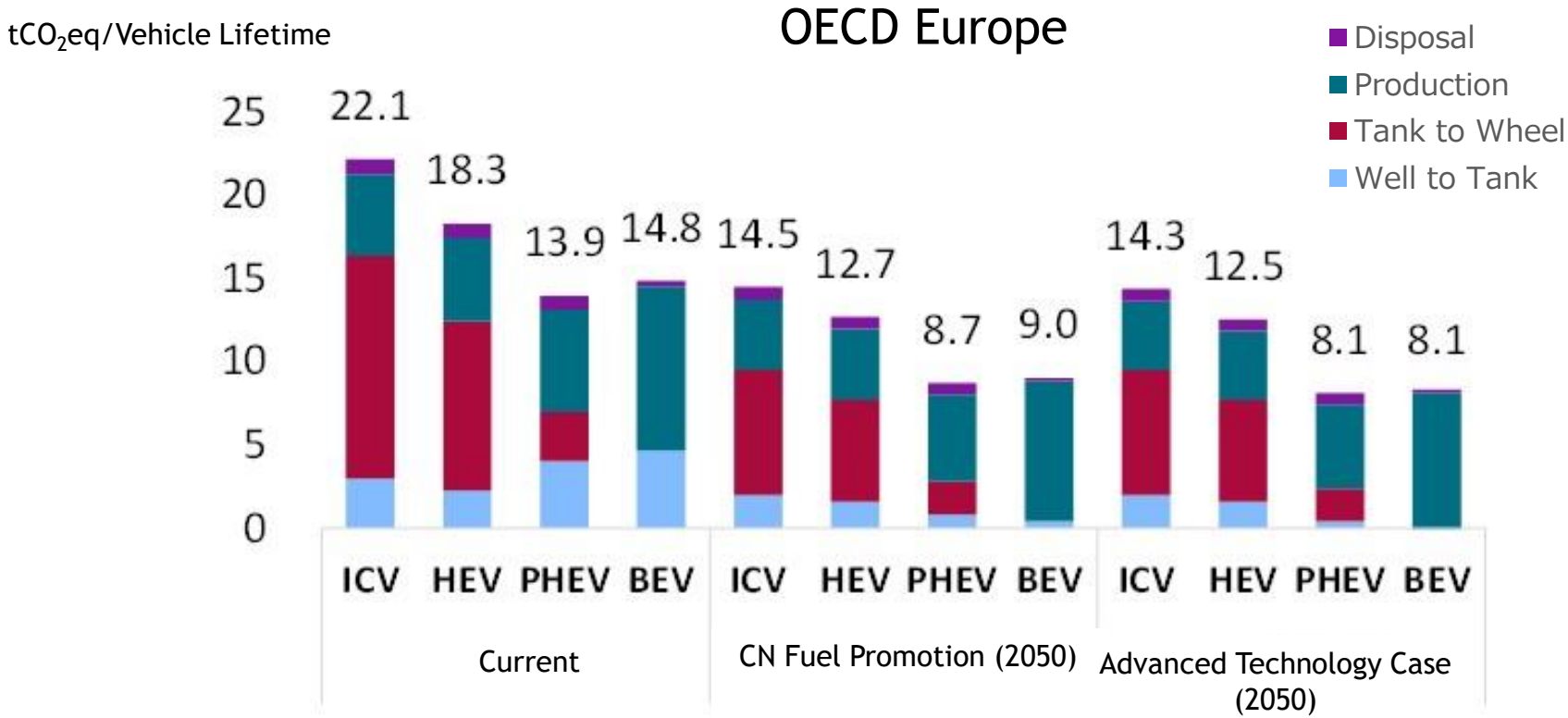


Source: World Auto Steel

Powertrain's CO2 Emissions Differ by Region

OECD Europe

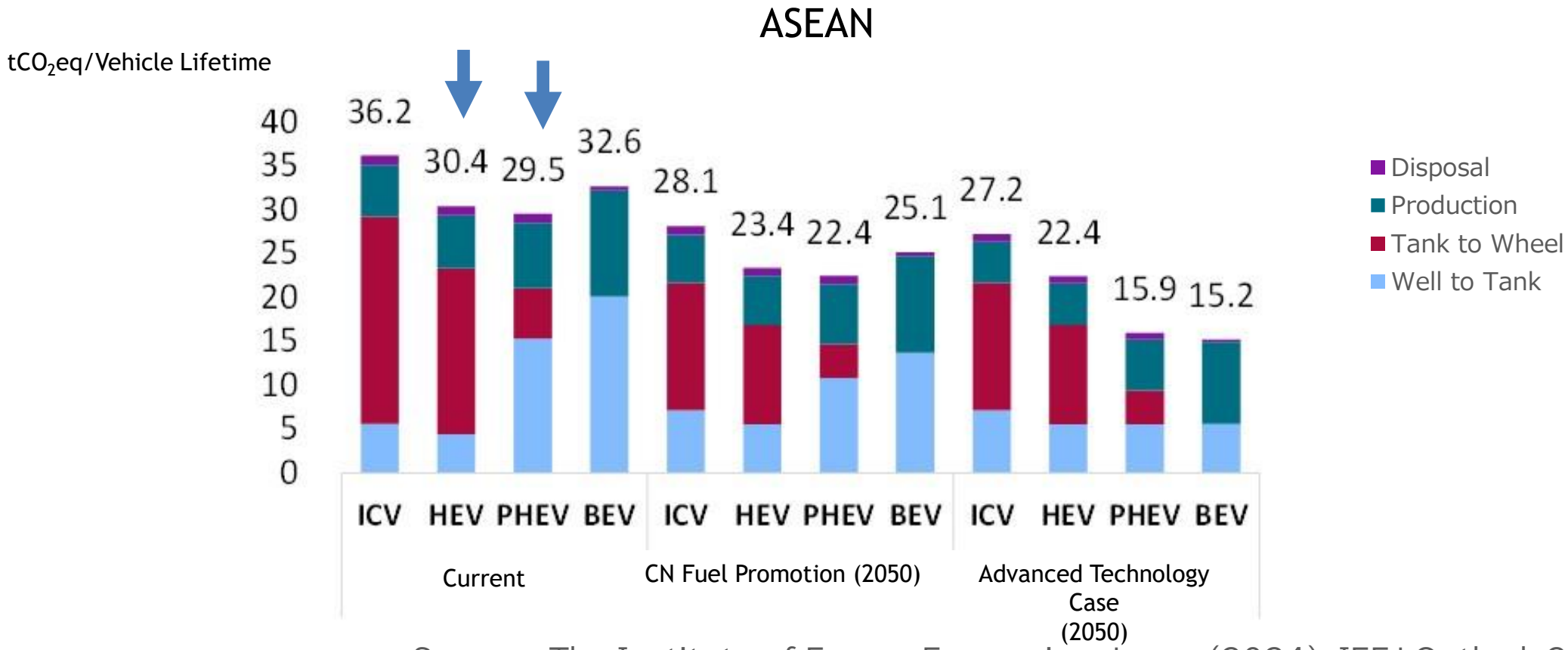
- **Current:** In OECD PHEV shows the lowest CO2 emissions.
- **Carbon Neutral Fuel Promotion Case (2050): Combined with biofuels,** PHEV offer the lowest CO2 emissions
- **Advanced Technology Case (2050) : With decarbonization of power generation progressing,** PHEV and BEV offer the lowest lifecycle CO2 emissions.



Source : The Institute of Energy Economics, Japan (2024). IEEJ Outlook 2025

Powertrain's CO2 Emissions Differ by Region
ASEAN

- **Current:** HEV and PHEV are the lowest and almost the same level in lifecycle CO2 emissions.
- **Carbon Neutral Fuel Case (2050): Combined with biofuels,** PHEV and HEV show the lowest lifecycle CO2 emissions.
- **Advanced Technology Case (2050) : With decarbonization of power generation progressing,** PHEV and BEV offer the lowest lifecycle CO2 emissions.

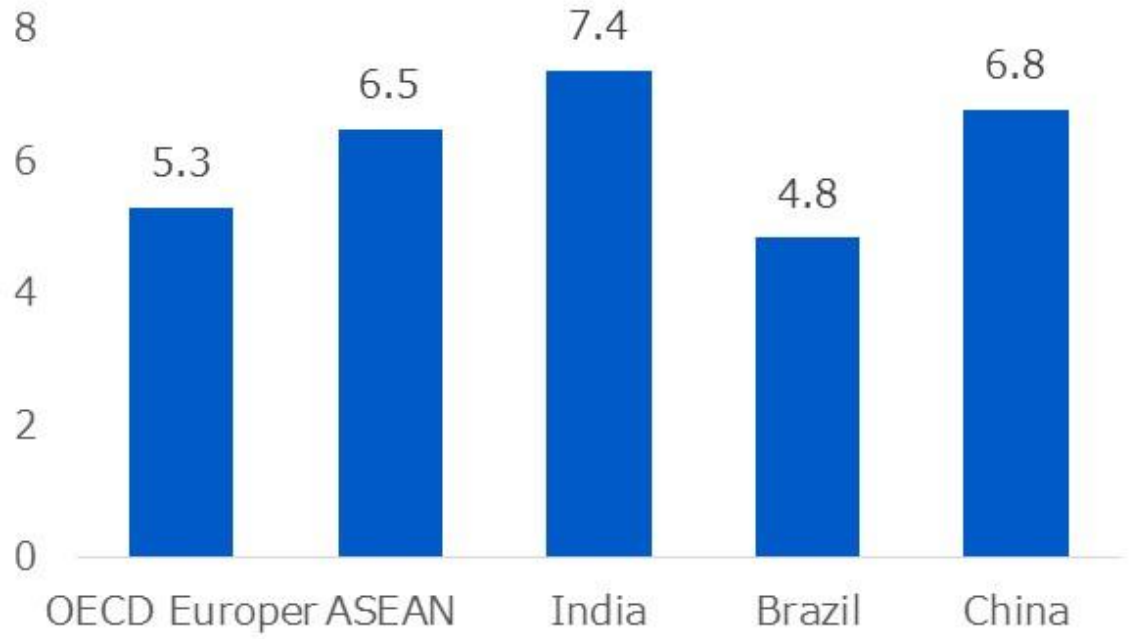


Source : The Institute of Energy Economics, Japan (2024). IEEJ Outlook 2025

CO2 emissions for BEV battery production differ by country

- **A battery production requires higher energy**, and results in higher CO2 emissions than other parts. It will significantly **affect the LCA-based CO2 emissions**.
- In particular, Brazil is already progressing in the decarbonization of power sources, and if batteries are imported from China, battery-related emissions will increase by **1.4 times**.

CO2 emissions for BEV battery production by country (tCO_2eq)

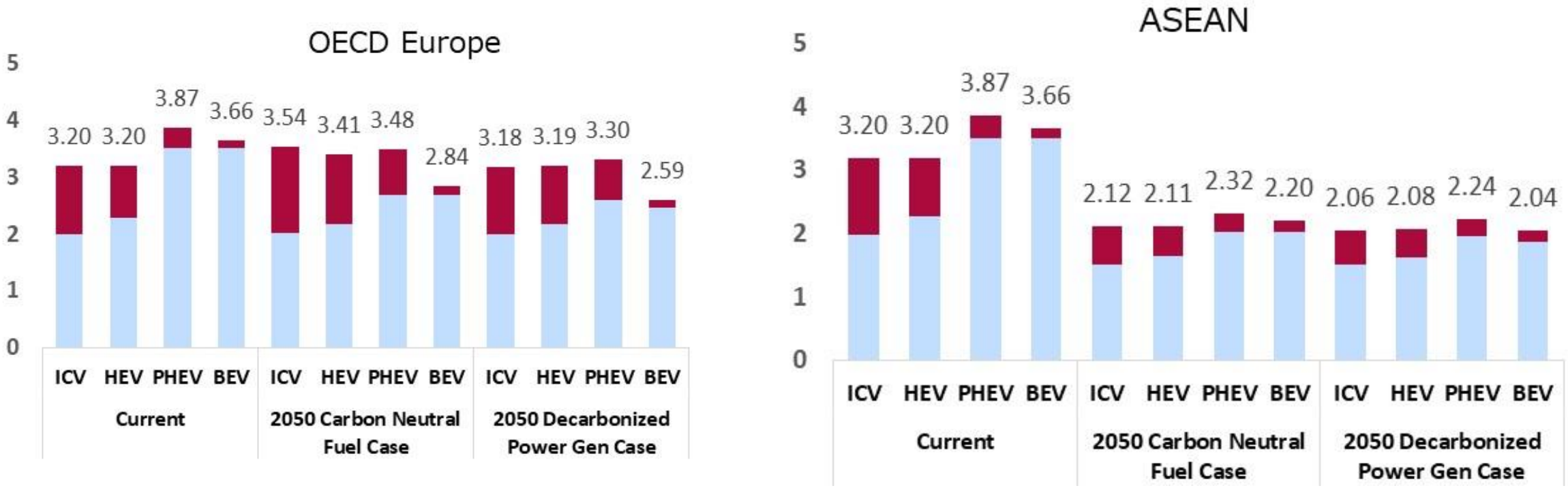


Source : The Institute of Energy Economics, Japan (2024). IEEJ Outlook 2025

Cost of Vehicle Ownership

- Aside from the cost of vehicles, energy prices (electricity and fuel) are the important factors affecting the cost of vehicle ownership. OECD Europe will benefit from low electricity price in future, while relatively fuel prices will remain lower compared with electricity in ASEAN.

Cost of Vehicle Ownership (USD 1,000/Year)



Source : The Institute of Energy Economics, Japan (2024). IEEJ Outlook 2025

Implications

- Now that the pace of BEV sales is slowing down, it is important to consider **the possibility of using CN fuel** as one of the "**realistic solutions**" when considering various paths to reduce CO2 emissions from automobiles.

- Consideration must be given to regional characteristics, such as the **“Affordability” of powertrains, fuel prices, and electricity generation mix**.

- In reducing CO2 emissions from future automobiles, it is important to consider realistic solutions, taking regional characteristics into considerations.