



CHAIRE EUROPEAN  
ELECTRICITY MARKETS  
Fondation Paris-Dauphine



# THE IMPACT OF ELECTRIC VEHICLES ON THE ELECTRICITY SYSTEM

*Electric Vehicle Development in Europe Today*

Jérôme PERRIN, directeur scientifique



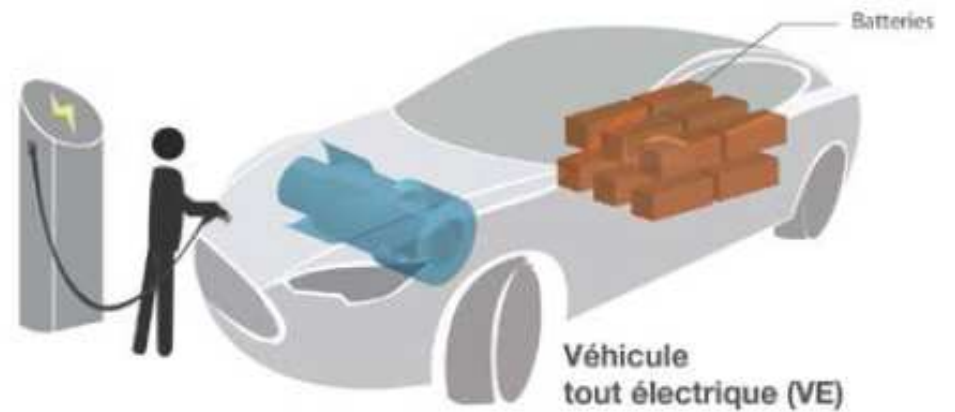
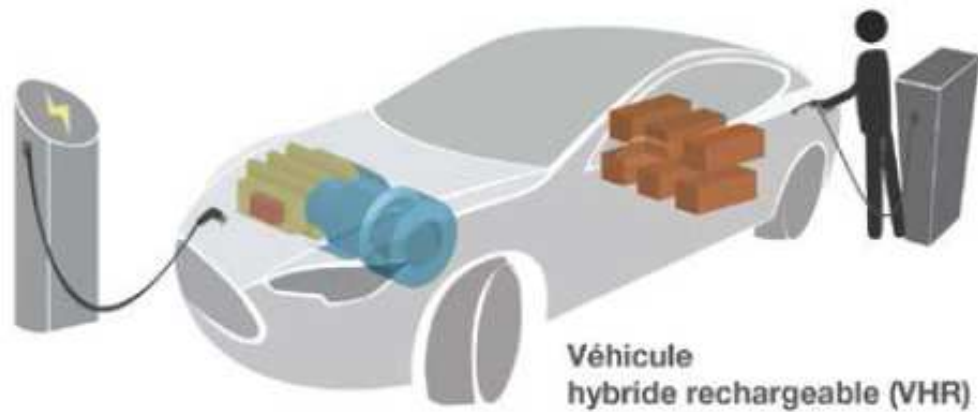
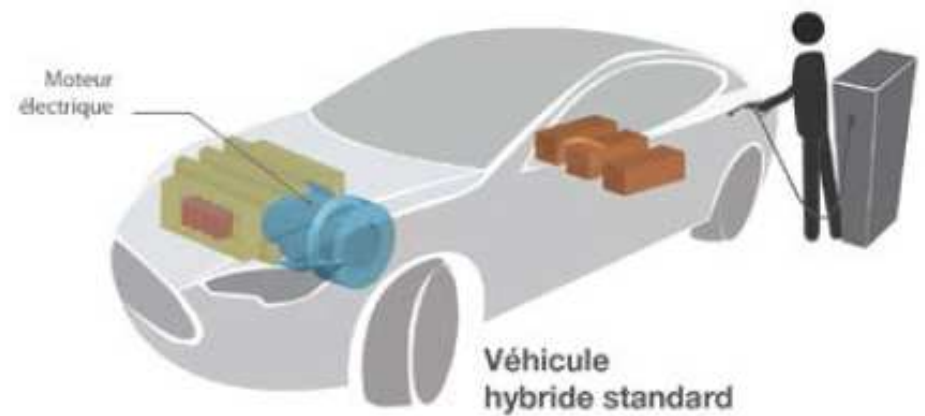
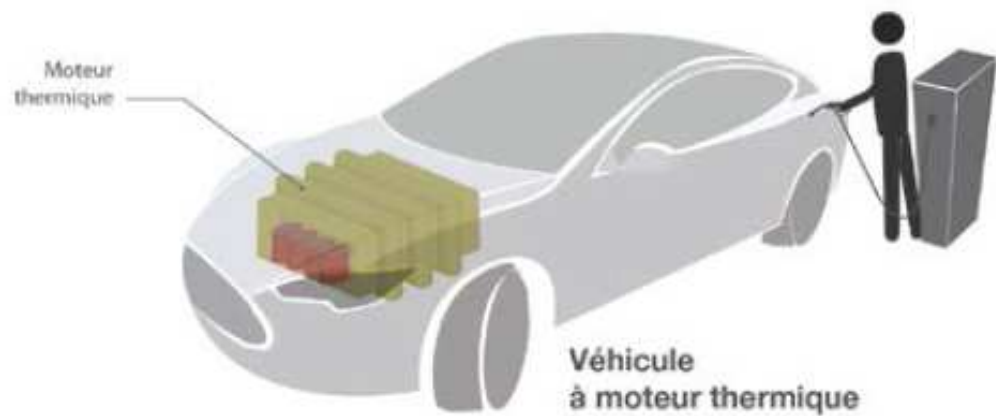
JÉRÔME PERRIN

17/10/2016

**GROUPE RENAULT**

# BATTERY ELECTRIC VEHICLES (BEV)

## PLUG-IN HYBRID ELECTRIC VEHICLES (PHEV)



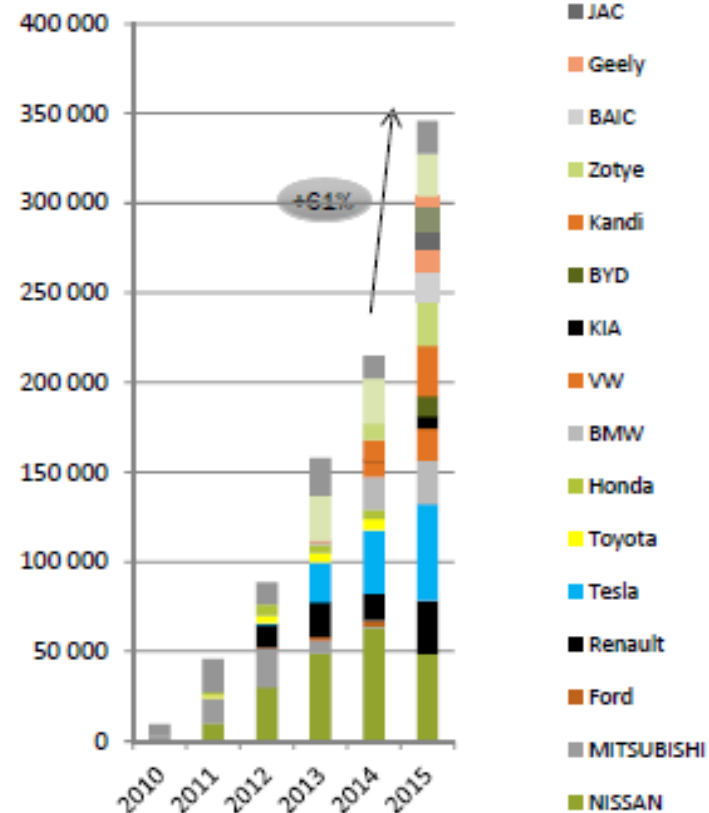
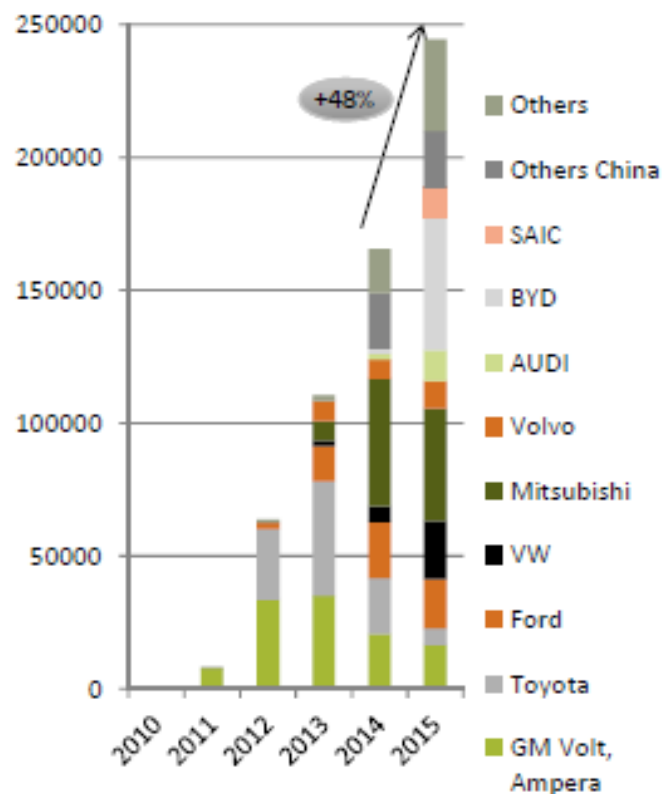
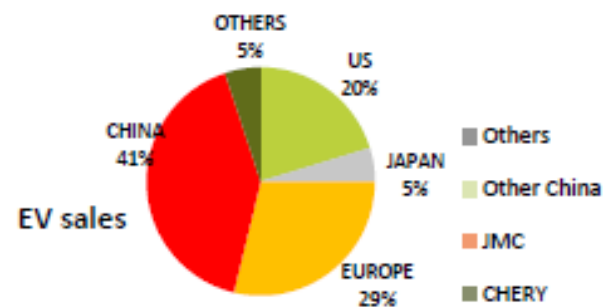
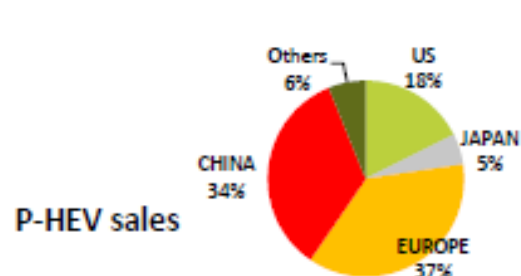
# DOCUMENTS

- **International Energy Agency**  
*Global EV outlook 2016. Beyond 1 million electric cars*
- **BIPE** – 09/02/2016  
*Outlook 2030 : Global New sales BEV & PHEV*  
*World Automotive Powertrain Outlook (WAPO) 2035*
- **Avicenne** - 21/09/2016  
*The rechargeable battery mkt & main trends 2015-2025*
- **Roland Berger** – 27/04/2016  
*Integrated fuels and vehicles roadmap to 2030+*
- **Stratas Advisors** - 22/09/2016  
*Global xEV: Sales & Stock Outlook (2016-2035)*
- **Bloomberg** - 25/02/2016  
*EVs to be 35% of global new car sales by 2040*



# GLOBAL ELECTRIC SALES, 2010-15

## BEV and PHEV per country & manufacturer



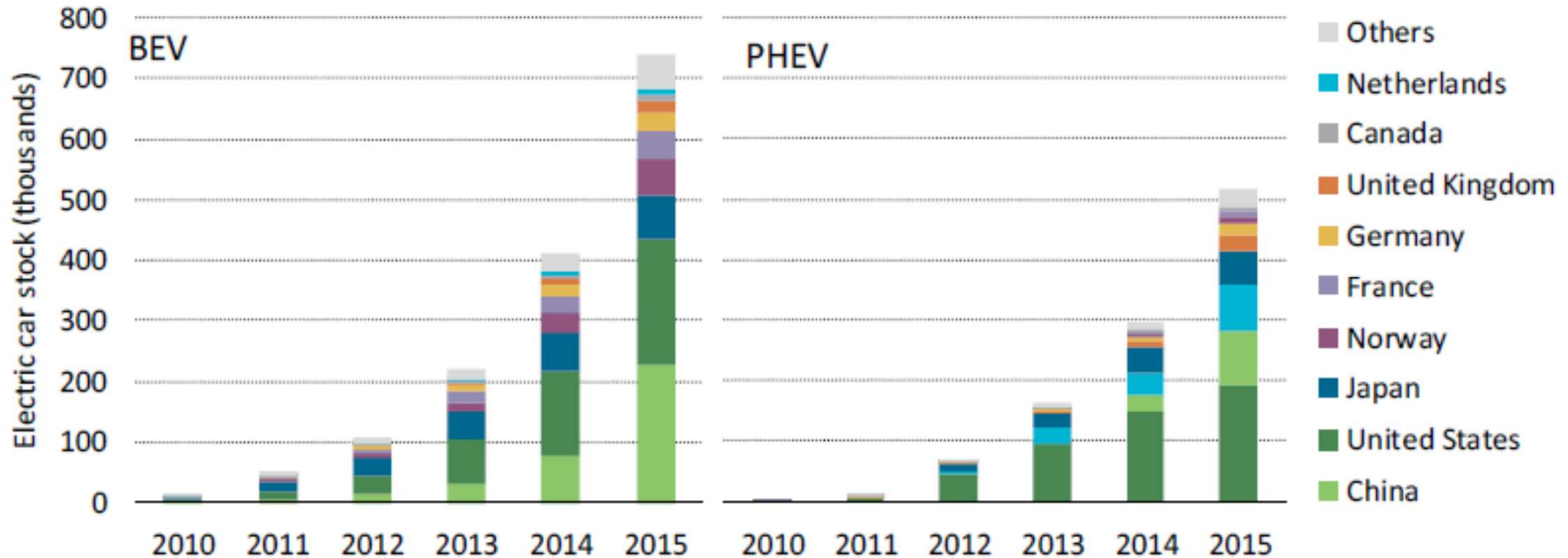
Source: AVICENNE ENERGY 2016

Others: Smart (3400), Fiat (4500), Bolloré (1200), PSA (2700), GM (2700), Daimler (4500),

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# GLOBAL ELECTRIC CAR STOCK, 2010-15

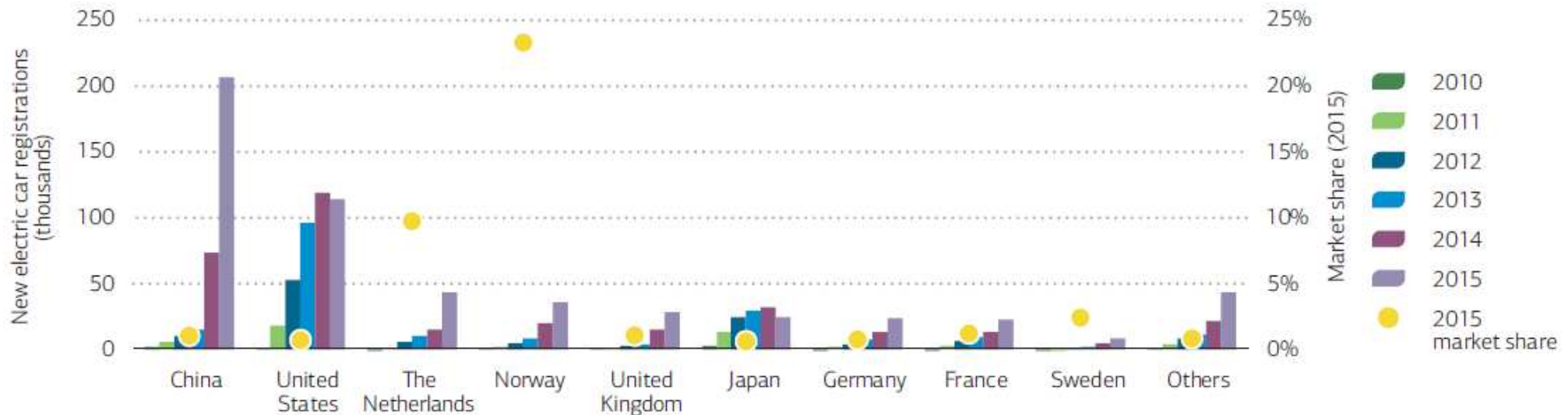
## *BEV and PHEV per country*



# EV SALES AND MARKET SHARE 210-2015

The year 2015 saw the global threshold of 1 million electric cars<sup>1</sup> on the road exceeded, closing at 1.26 million. In 2014, only about half of today's electric car stock existed. In 2005, electric cars were still measured in hundreds. 2015 also saw more than 200 million electric two wheelers on the road, and 170 000 buses, primarily in China.

## EV sales and market share in a selection of countries and regions, 2015

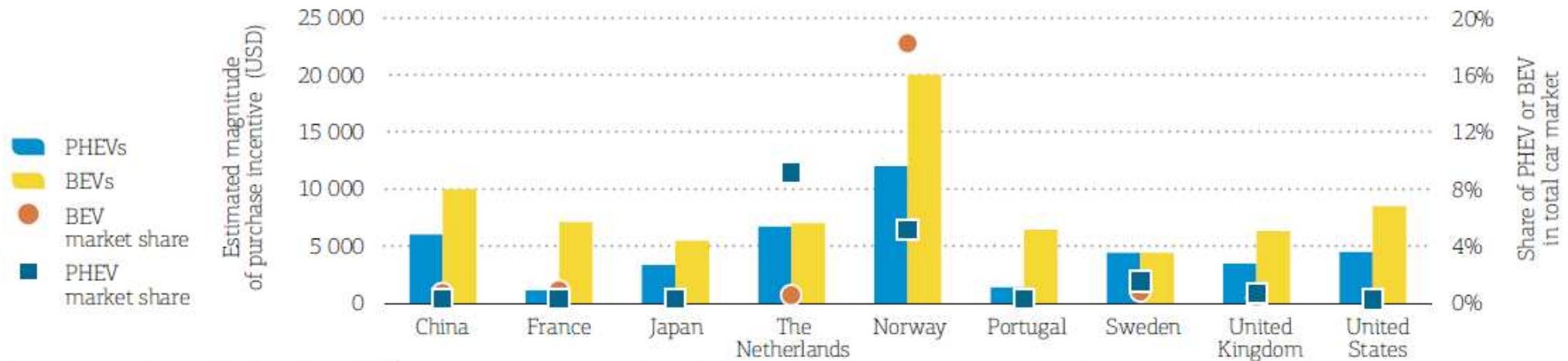


**Key point:** The two main electric car markets are China and the United States. Seven countries have reached over 1% EV market share in 2015 (Norway, the Netherlands, Sweden, Denmark, France, China and the United Kingdom).



Purchase incentives are among the most relevant and the most effective instruments promoting electric car sales.

## Estimates of purchase incentives and market shares for electric cars (BEVs and PHEVs), 2015

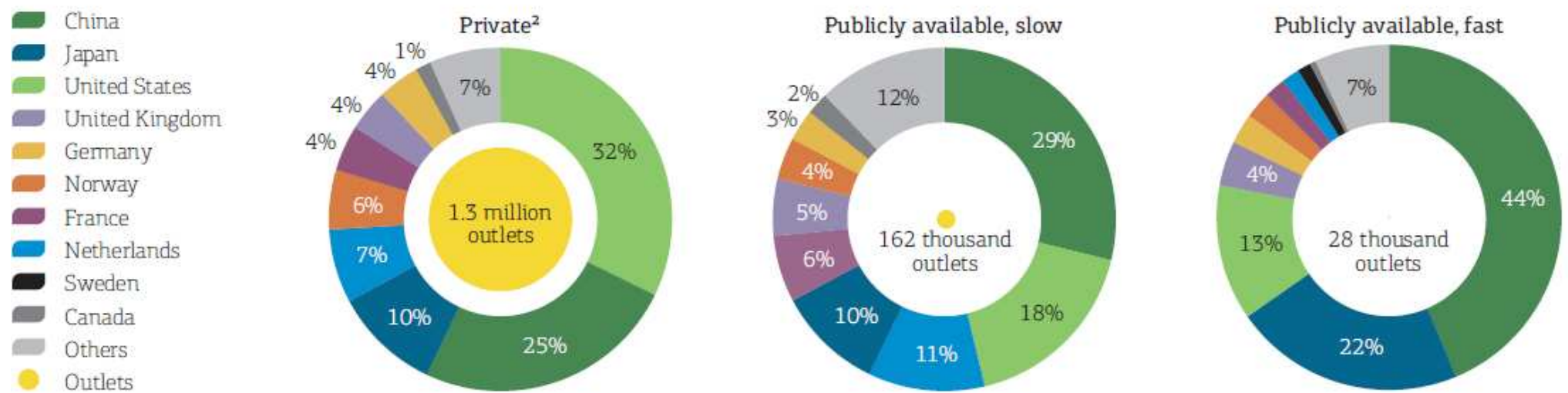


**Key point:** Policies deployed in different countries result in different purchase incentives and BEV over PHEV adoption patterns, with Norway's purchase incentives level standing out for both BEVs and PHEVs.

# CHARGING INFRASTRUCTURE 2015

There are an estimated total of 1.45 million electric car charging points worldwide in 2015. Publicly accessible charging facilities have been following the growth trend of the electric car stock in the past year.

Geographical distribution of the 2015 stock of EVSE outlets by charger type



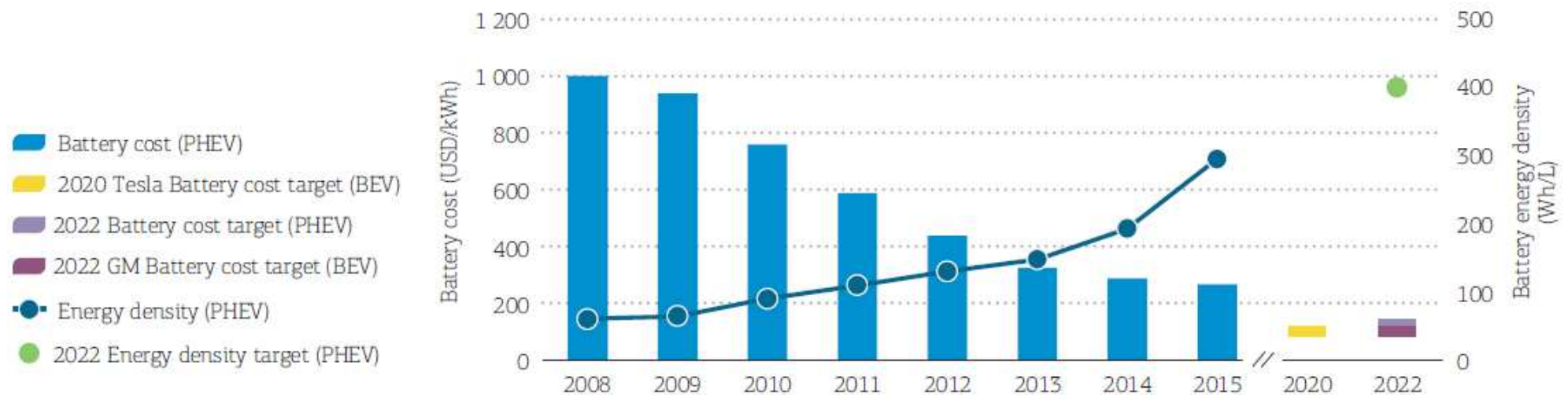
**Key point:** Country profiles differ with respect to the development of EVSE infrastructure. China and Japan account for more than 65% of fast-charging outlets. The geographical distribution of publicly accessible slow chargers is closer to the distribution of electric cars and private charging outlets.



# BATTERY ENERGY DENSITY AND COST

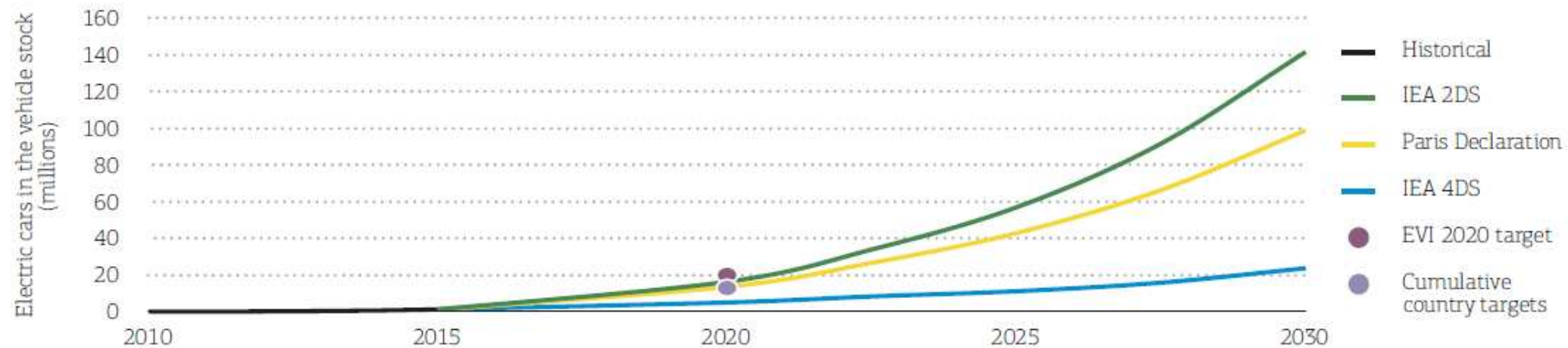
Since 2008, battery costs were cut by a factor four and battery energy density had a fivefold increase. Technological developments hold the promise to continue to deliver improvements in the forthcoming years.

Evolution of battery energy density and cost



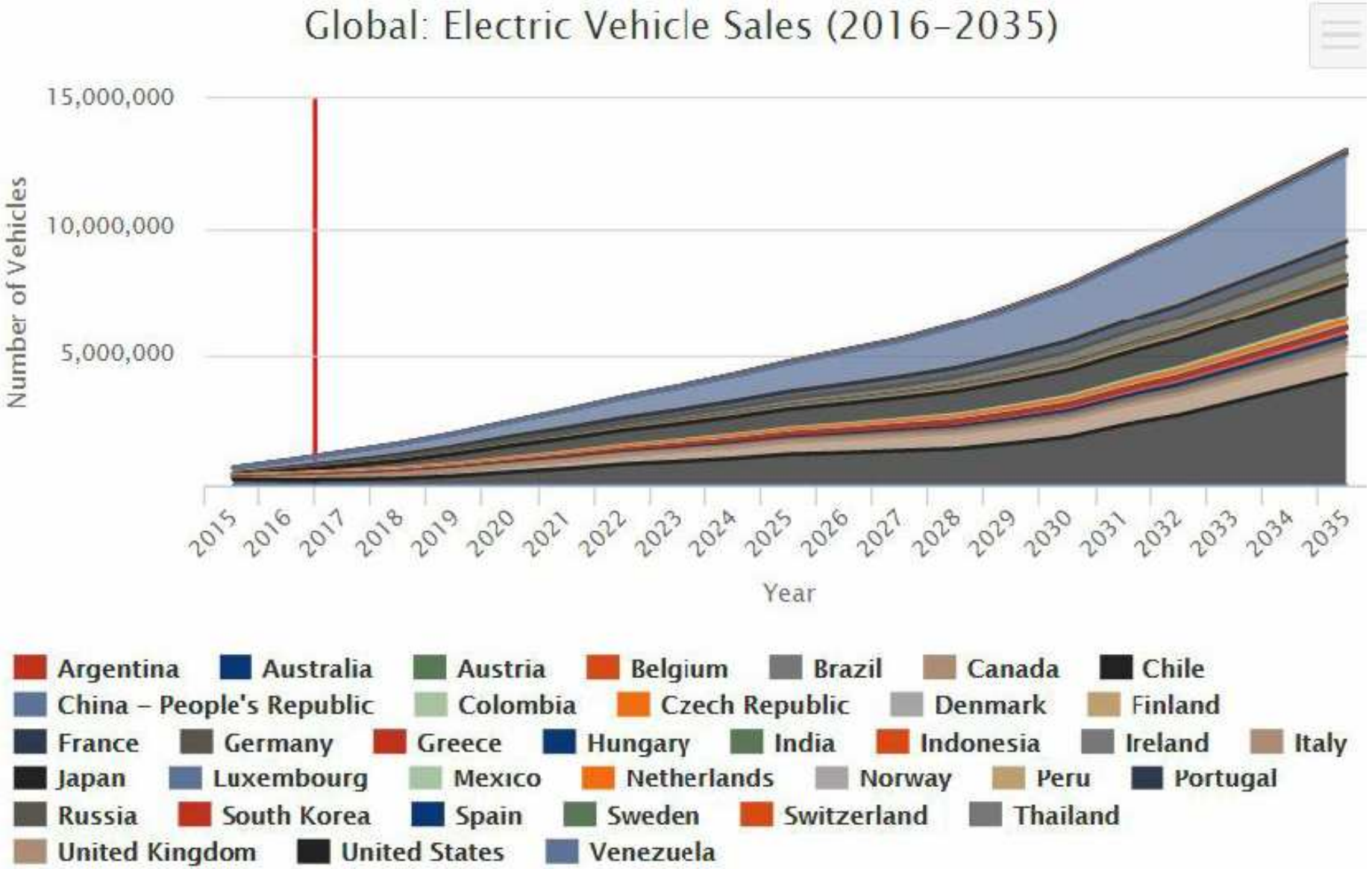
**Key point:** The trends of battery energy density and cost over the past decade give encouraging signs on the possibility of meeting targets defined by carmakers and the United States Department of Energy (US DOE) for 2020 and 2022.

# EV STOCK EVOLUTION TO 2030



**Key point:** Individual country commitments would bring 13 million electric cars on the road by 2020. The EVI aims at a deployment of 20 million electric cars by 2020. In both cases, reaching 2020 deployment targets for BEVs and PHEVs requires a sizeable growth of the electric car stock. Meeting 2030 decarbonisation and sustainability goals requires a major deployment of electric cars in the 2020s.

# GLOBAL EV SALES 2016-2035

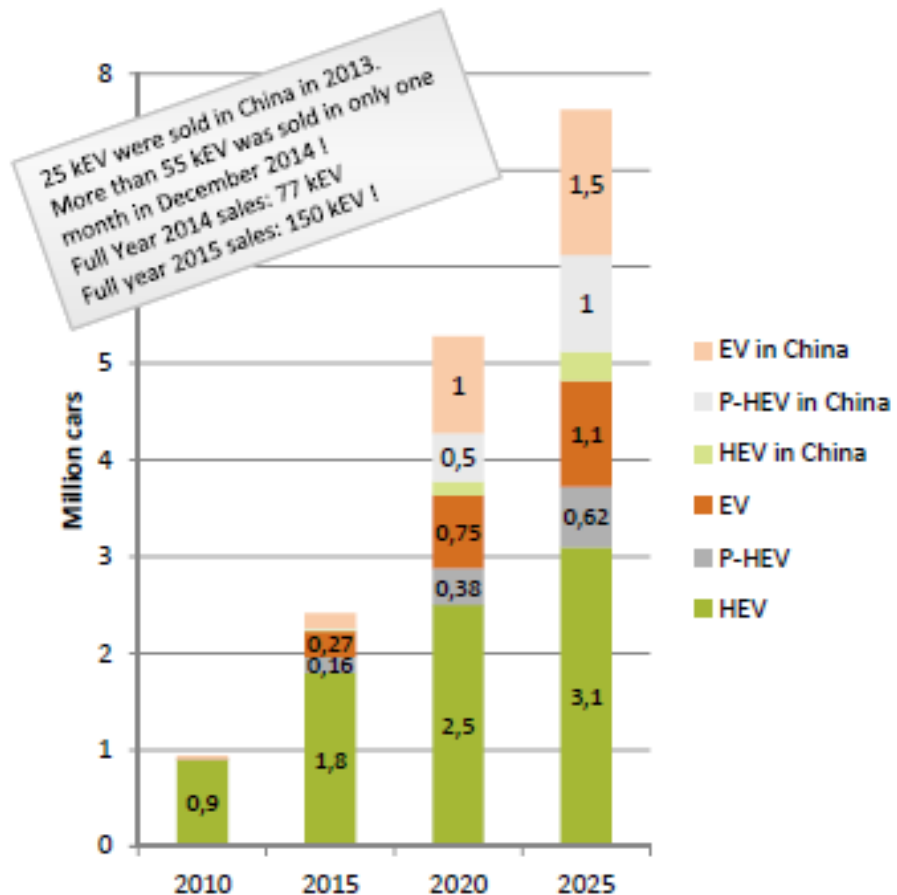
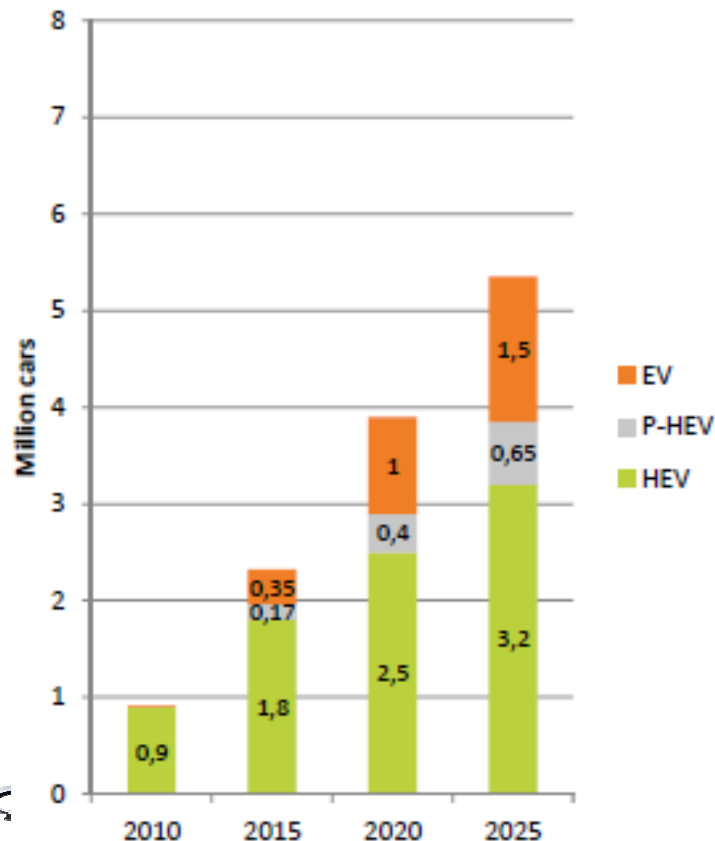


# HEV, PHEV AND BEV FORECASTS 2025

Thanks to very high incentives, China will change the game

2013 forecasts: HEV, P-HEV & EV market forecasts up to 2025

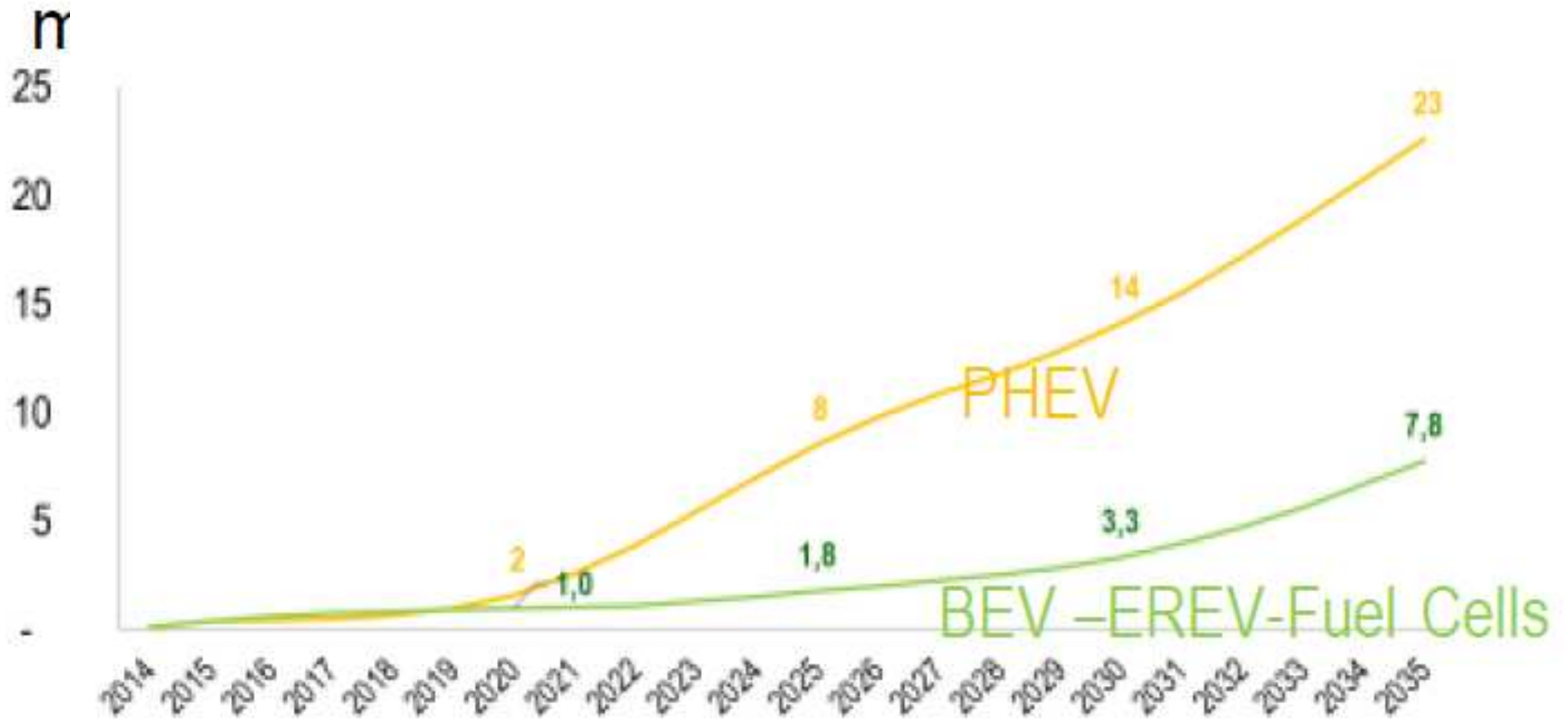
2016 forecasts: HEV, P-HEV & EV market forecasts up to 2025





# GLOBAL EV SALES TO 2035

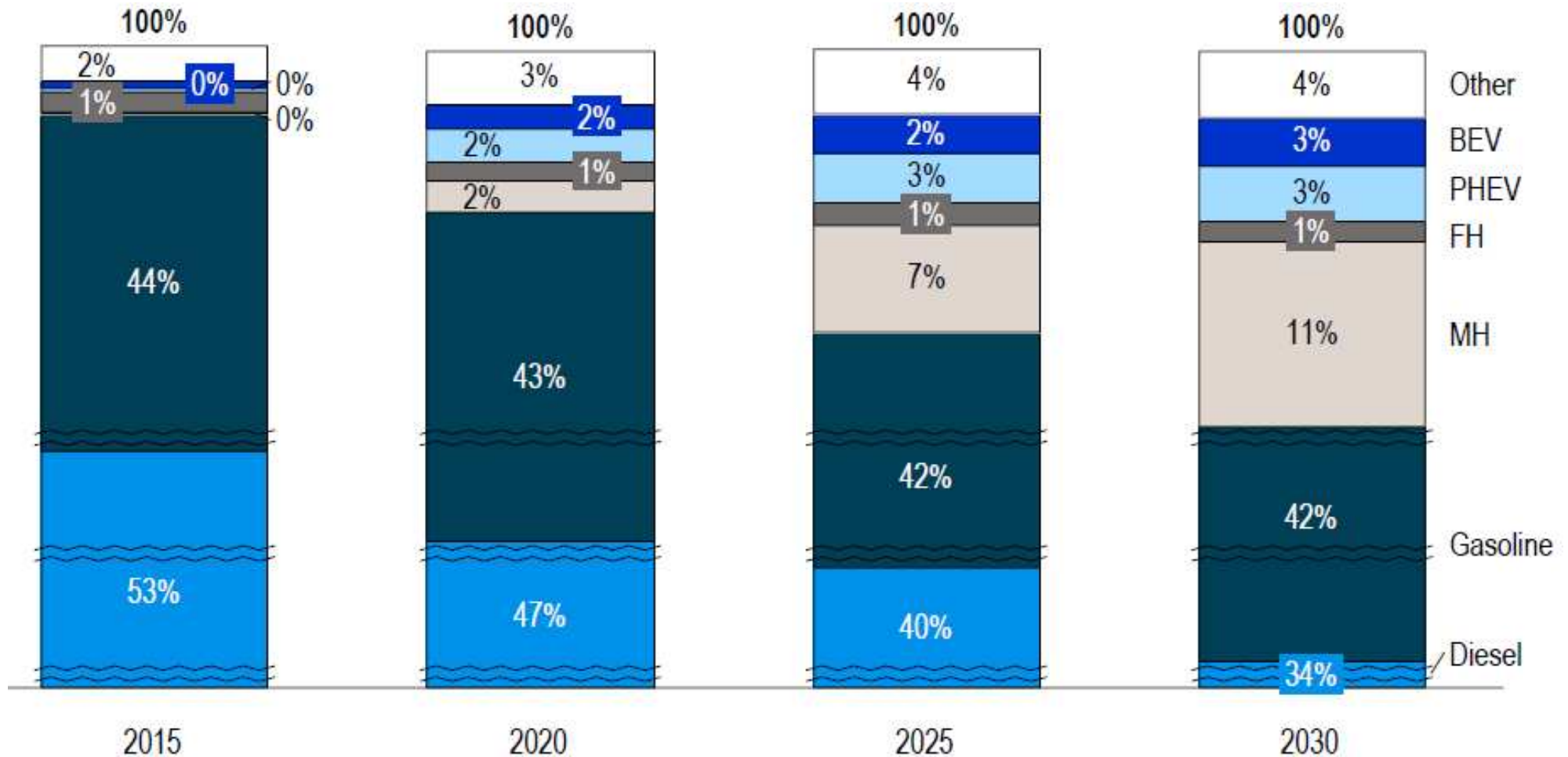
More PHEV than BEV





# POWERTRAIN SHARES IN NEW VEHICLE SALES

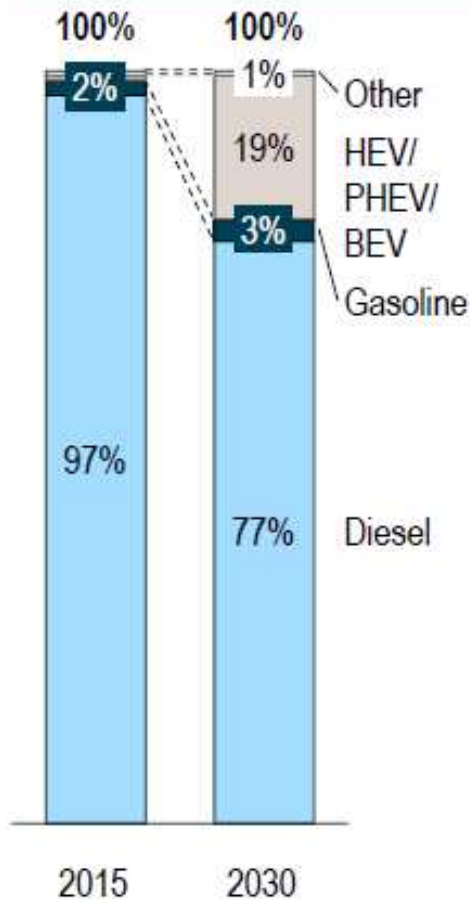
## *EV share grows at the expense of diesel share*



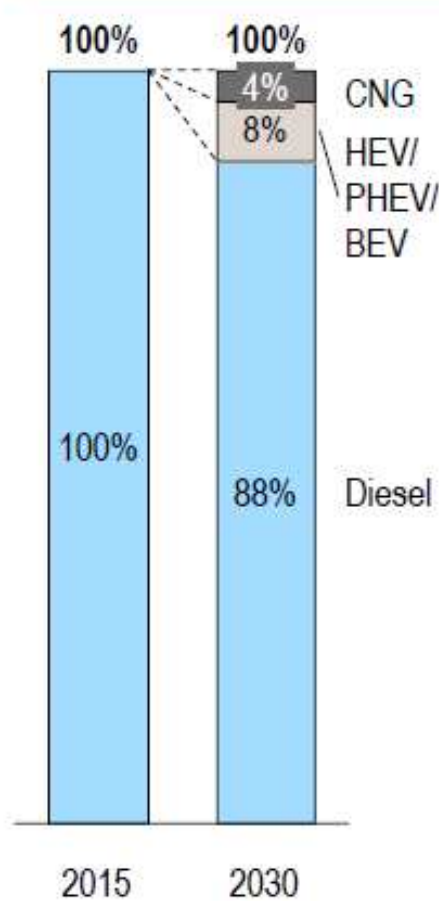
Shares might not add up to 100% due to rounding

# POWERTRAIN SHARES 2015 / 2030

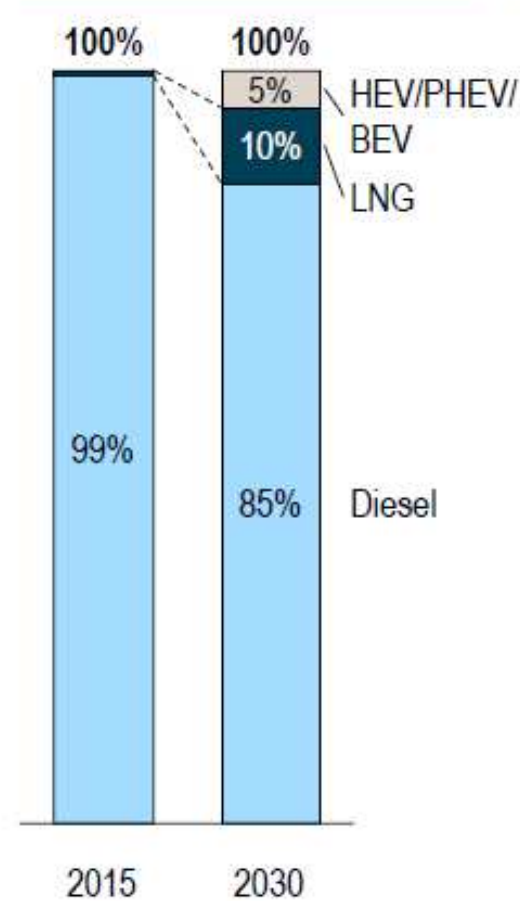
Light commercial vehicles



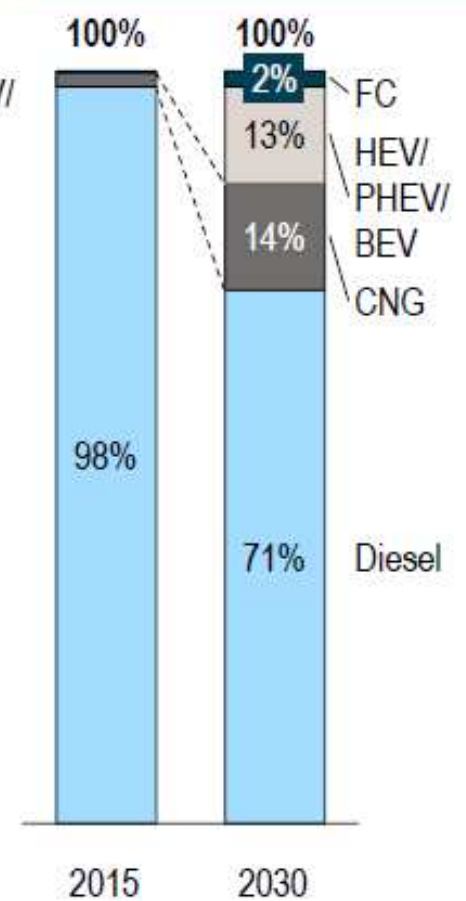
Medium duty vehicles



Heavy duty vehicles

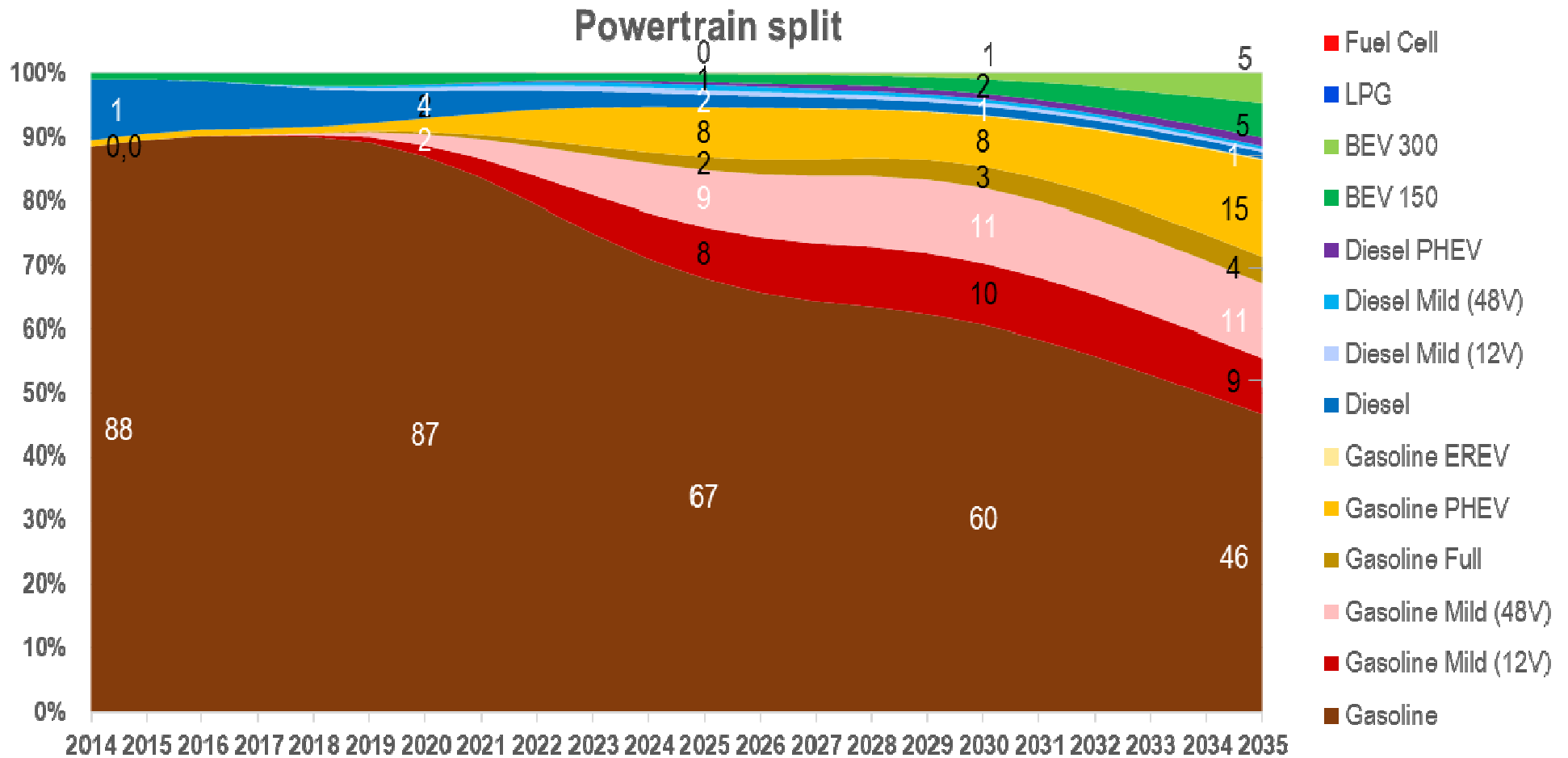


Buses/Coaches



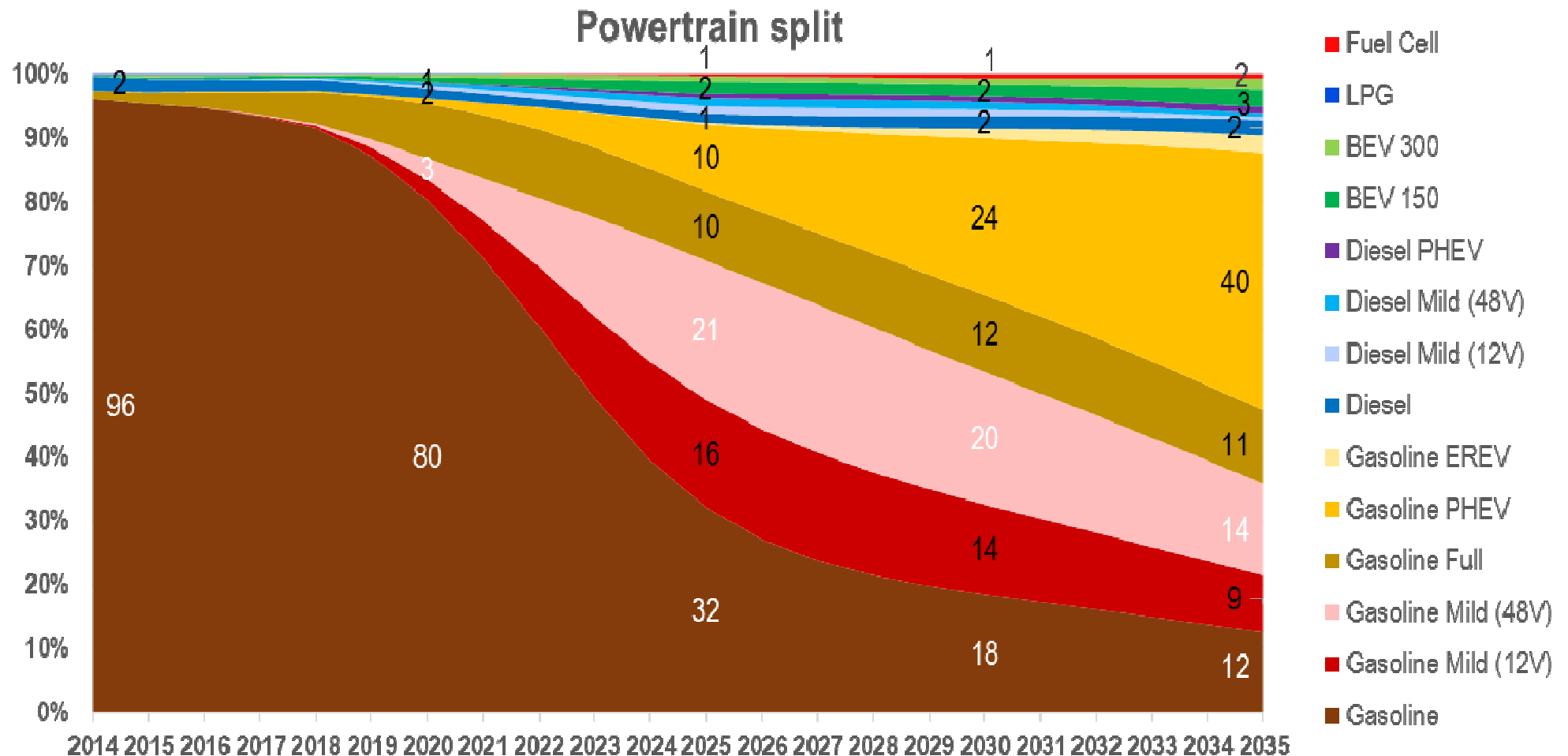
# POWERTRAIN SHARES TO 2035 : CHINA

Provided long-distance driving remains limited, China will become the major BEV market on the long-run



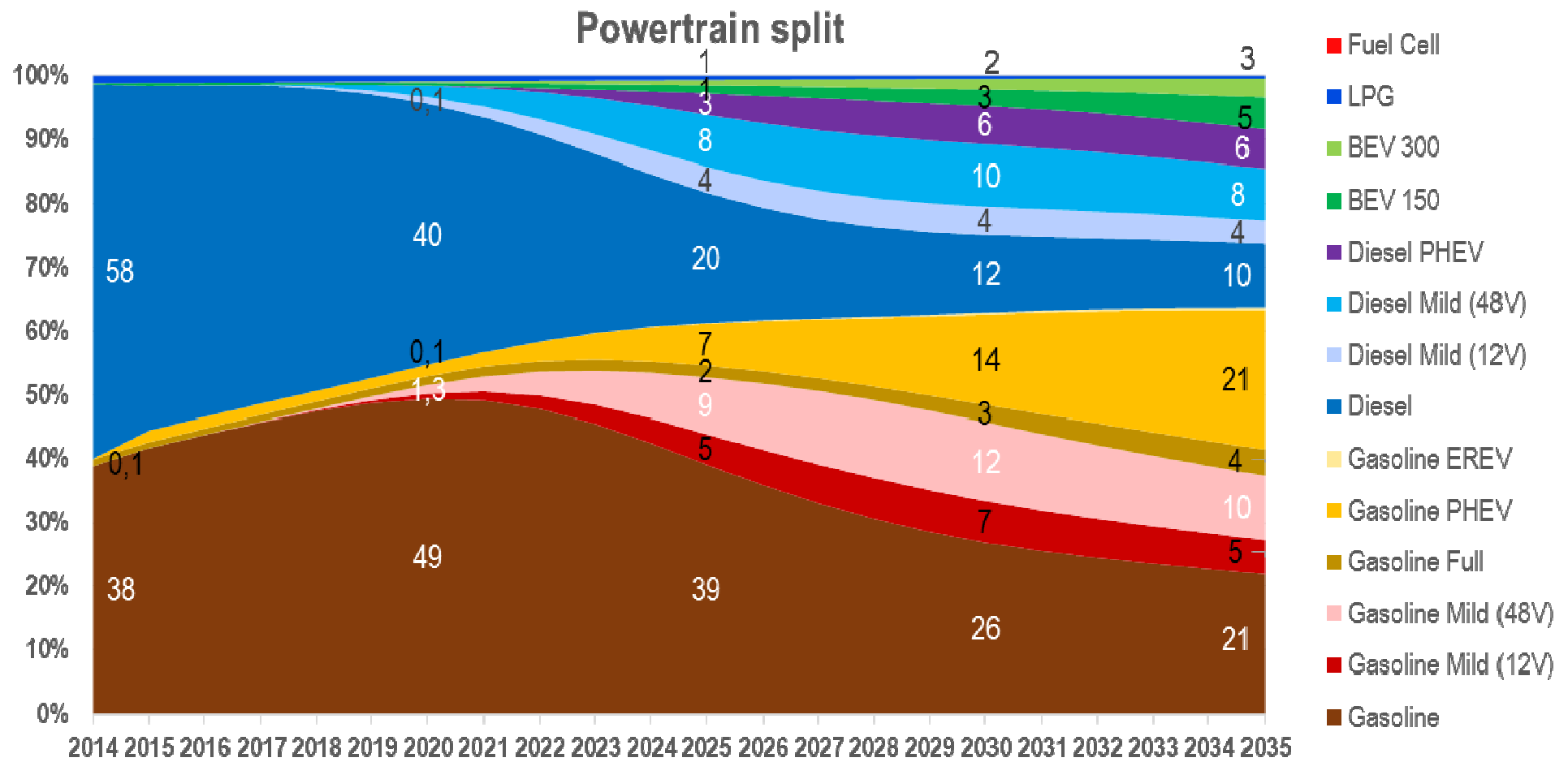
# POWERTRAIN SHARES TO 2035 : USA

**PHEV will boom in the next decade whereas BEV are not adapted to usage patterns and will only benefit from local regulations**



# POWERTRAIN SHARES TO 2035 : EUROPE

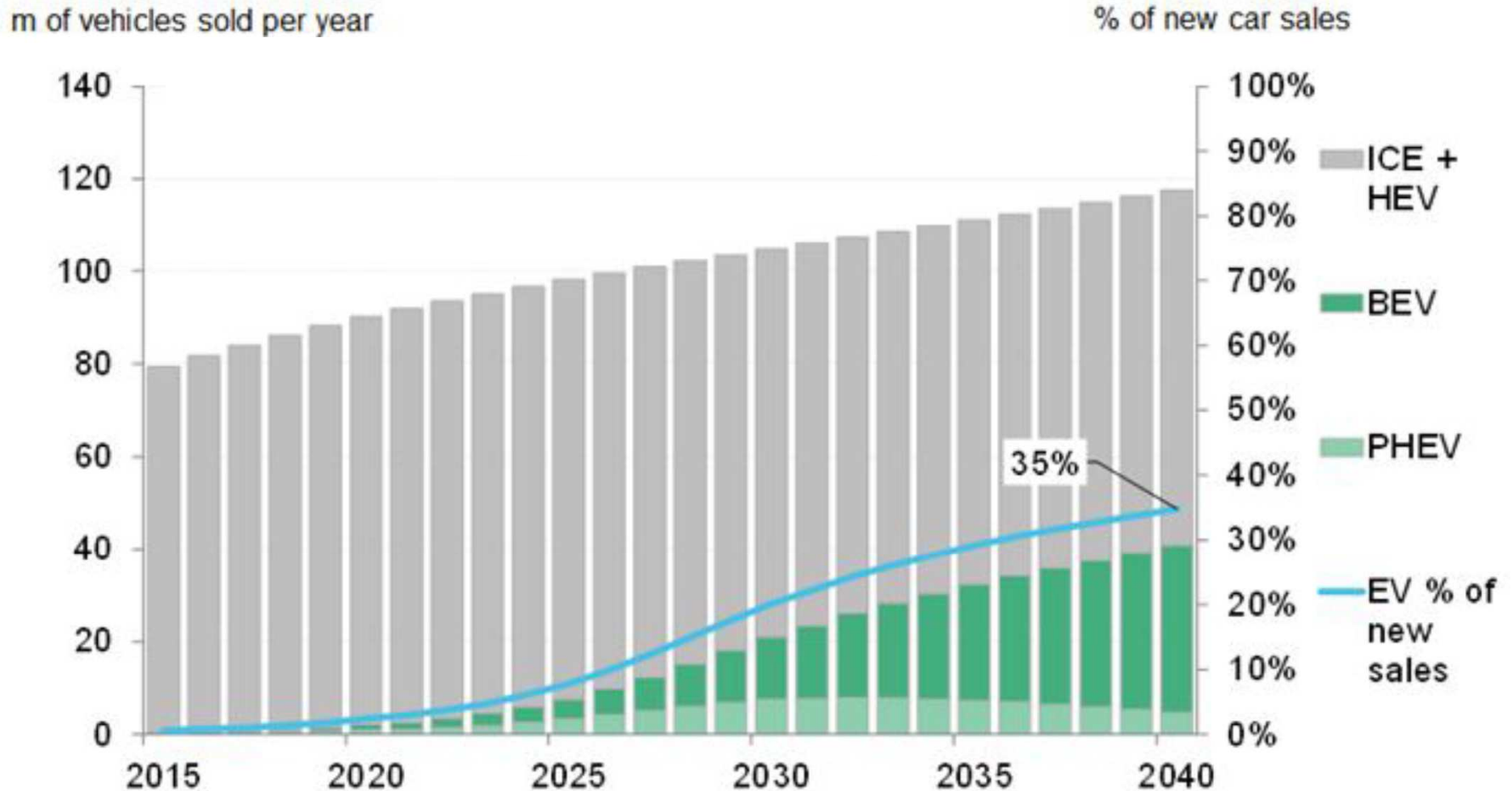
Both PHEV and BEV will take-off in the next decade mostly at the expense of diesel powertrains





# GLOBAL CAR MARKET AND EV SHARE TO 2040

Possible inversion of the PHEV/BEV ratio in the long run due to new generations of long-range mid-priced BEV's



# GLOBAL EV FORECAST COMPARISON

Uncertainty on global EV sales forecast  
and on the long-term PHEV/BEV ratio

<b>Sales</b>				
Scenario	Powertrain	2020	2025	2030
BIPE Green Constraint	BEV	1 351 434	2 270 912	3 401 518
Bloomberg	BEV	936 455	3 745 819	13 110 368
BIPE Green Constraint	PHEV	1 265 130	4 171 103	8 457 032
Bloomberg	PHEV	1 404 682	4 214 047	7 959 866

# CONCLUSION

- The EV (BEV+PHEV) market share now exceeds % levels in Europe
- The global EV sales should exceed 10 million units and the EV stock exceed 100 millions units by 2030
- The EV market share in Europe will grow mostly at the expense of diesel powertrains
- The ratio between PHEV and BEV depends on regional conditions (govt incentives, long distance trips)
- A new generation of low cost Li-ion batteries and long range BEV's is emerging