

2nd International Symposium on Energy System Analysis (ISESA)

The economics of sustainable solutions in transport : Electric vehicles

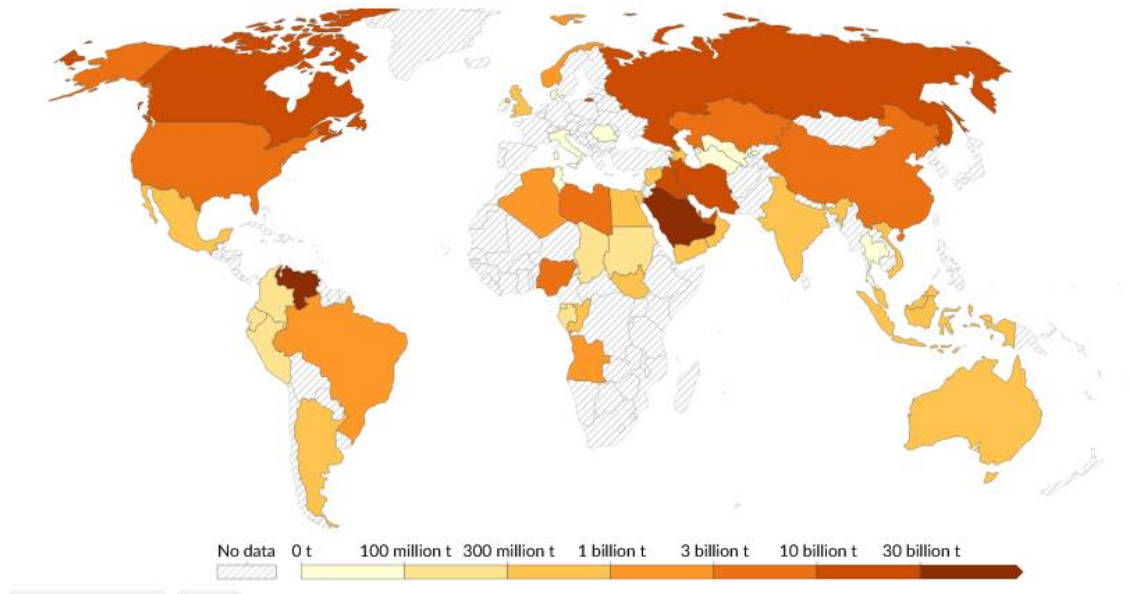
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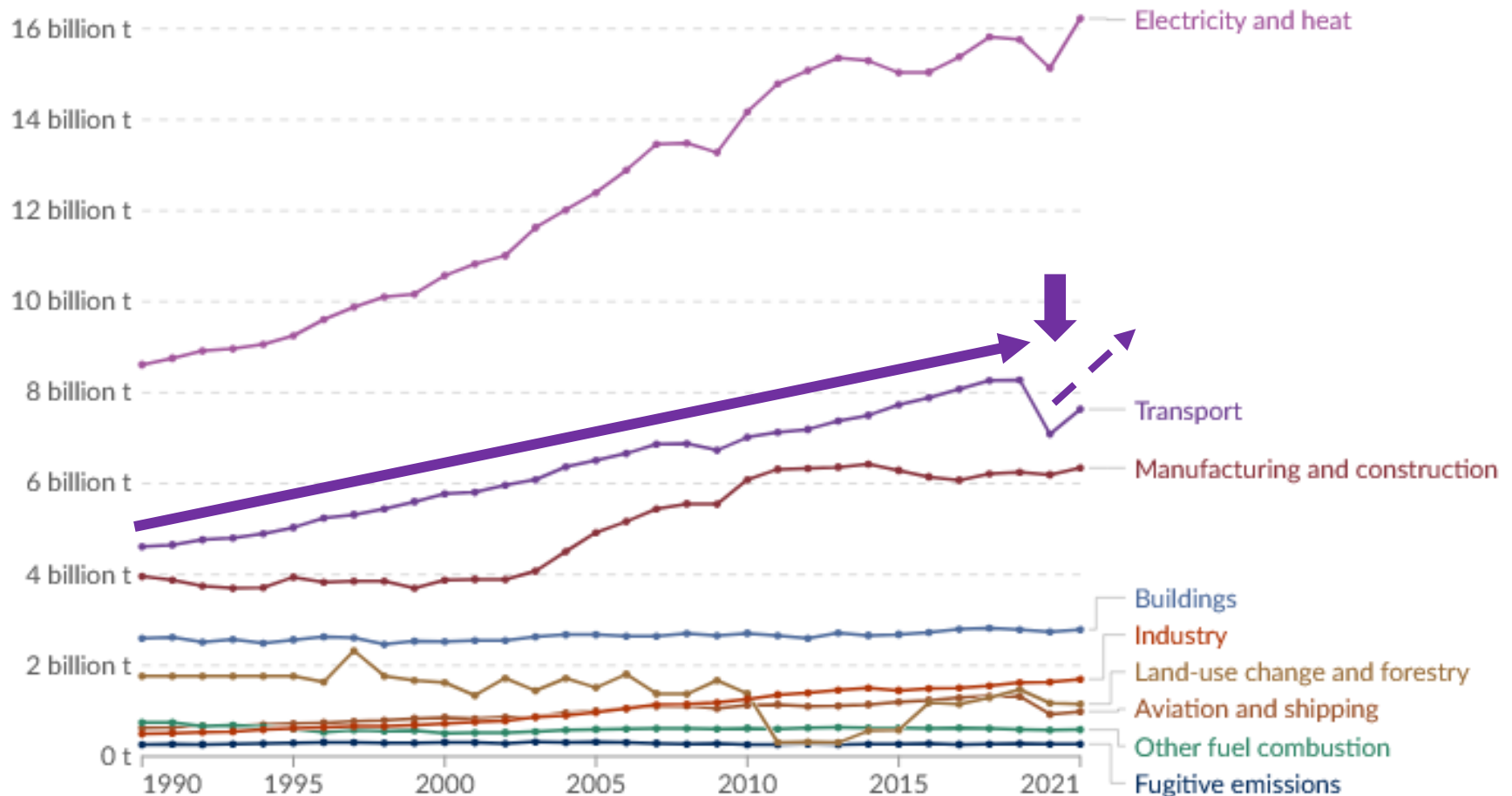
*October 13th and 14th, 2025
Stuttgart, Germany*

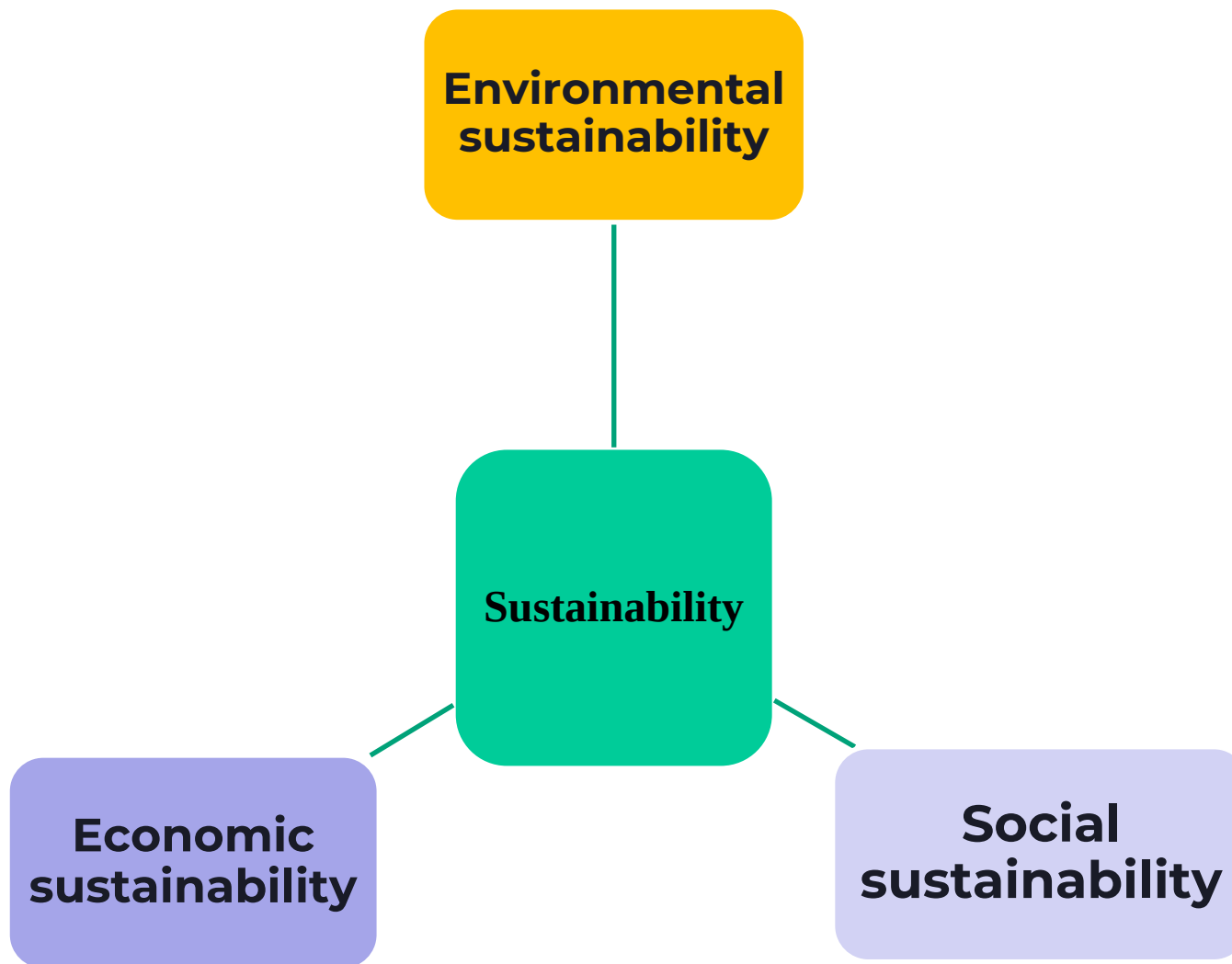
- Introduction
 - Recent developments
 - Sustainability
- Policy framework
- Zero-emission vehicles
 - Advantages and challenges
 - Economics and role of incentives
- EV across the regions
 - Europe, USA and China
- Conclusions

- oil products
- least-diversified
- energy import dependency



Oil proved reserves





EU - the first climate-neutral continent by 2050

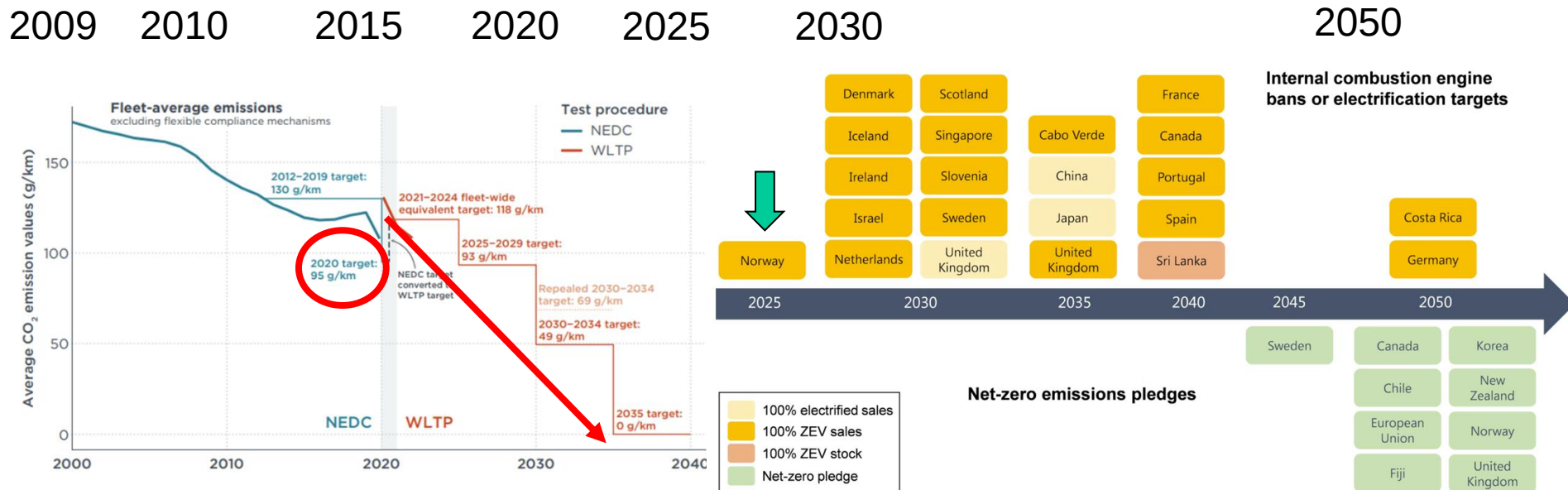
European Green Deal

RED III: at least **29%** renewables in the final energy consumption in the transport sector by 2030

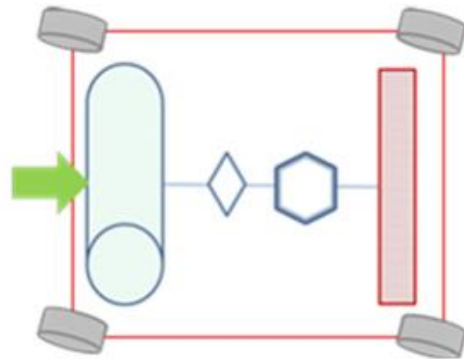
Sustainable and Smart Mobility Strategy

at least 30 million zero-emission cars will be in operation on European roads

nearly all cars, vans, buses as well as new heavy-duty vehicles will be zero-emission.

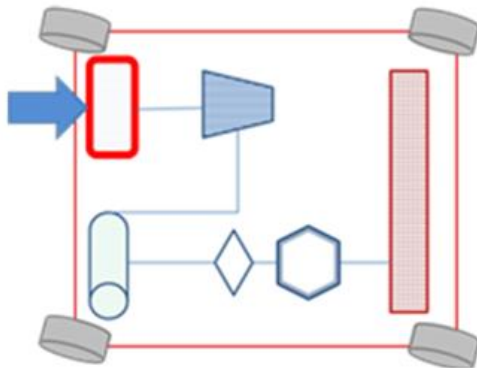


Zero-emission cars



BEV

ZEV



FCV



Advantages

- ✓ Energy efficiency
- ✓ Energy security
- ✓ Air pollution
- ✓ Noise reduction

Challenges

- Costs
- Driving range
- Charging time
- Charging infrastructure

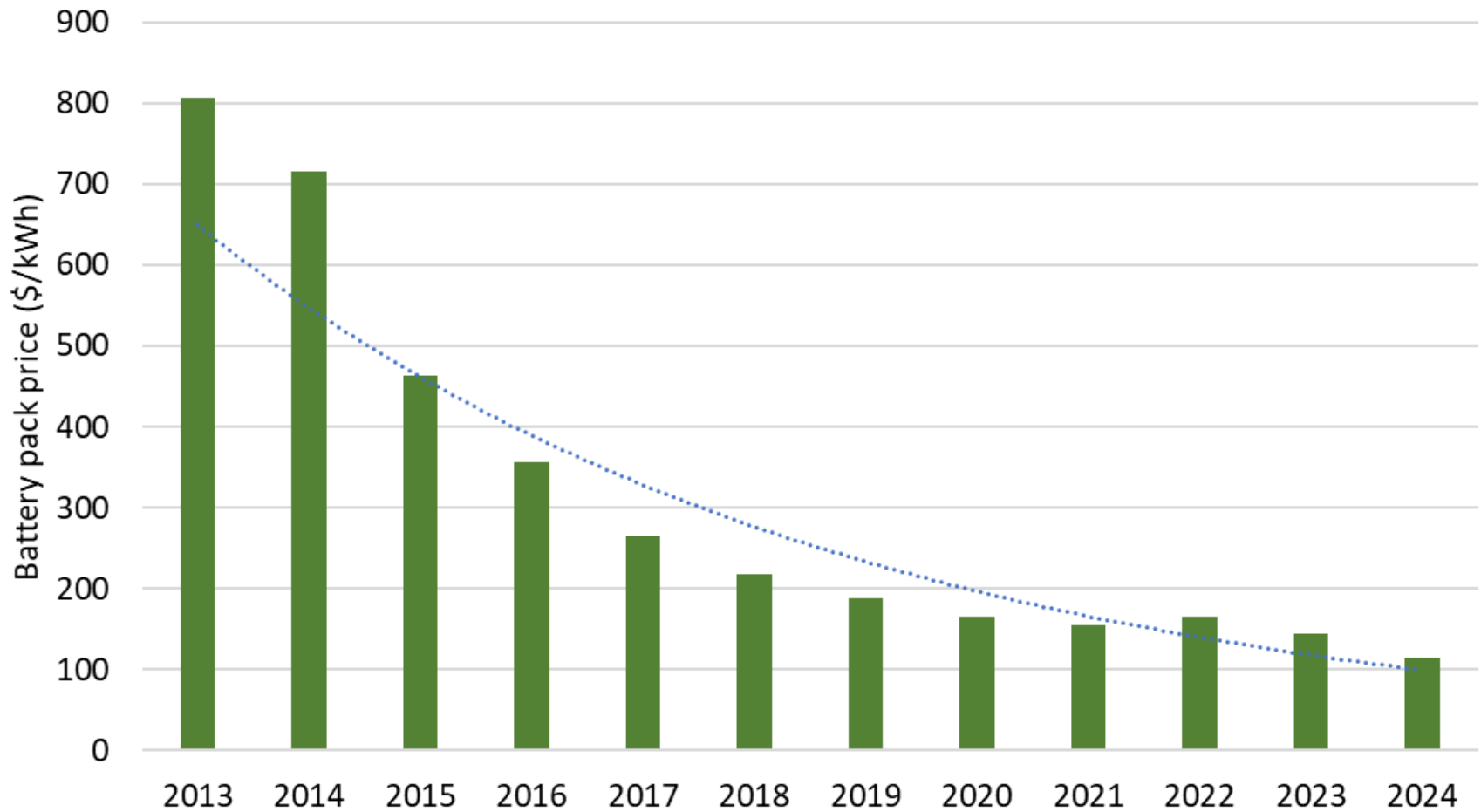
Challenges

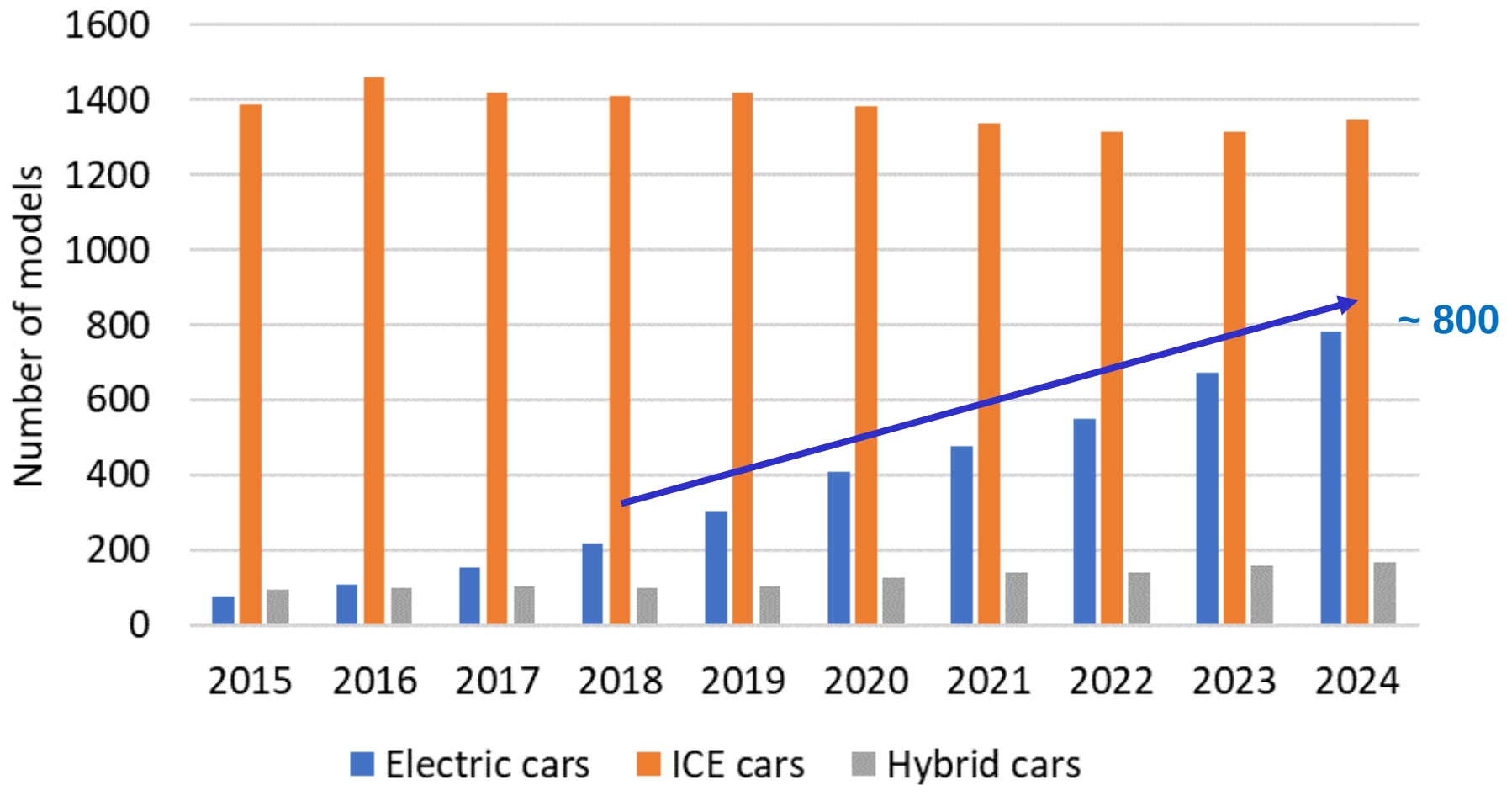
- High purchase price
- Lack of charging infrastructure
- Consumer uncertainty

Incentives

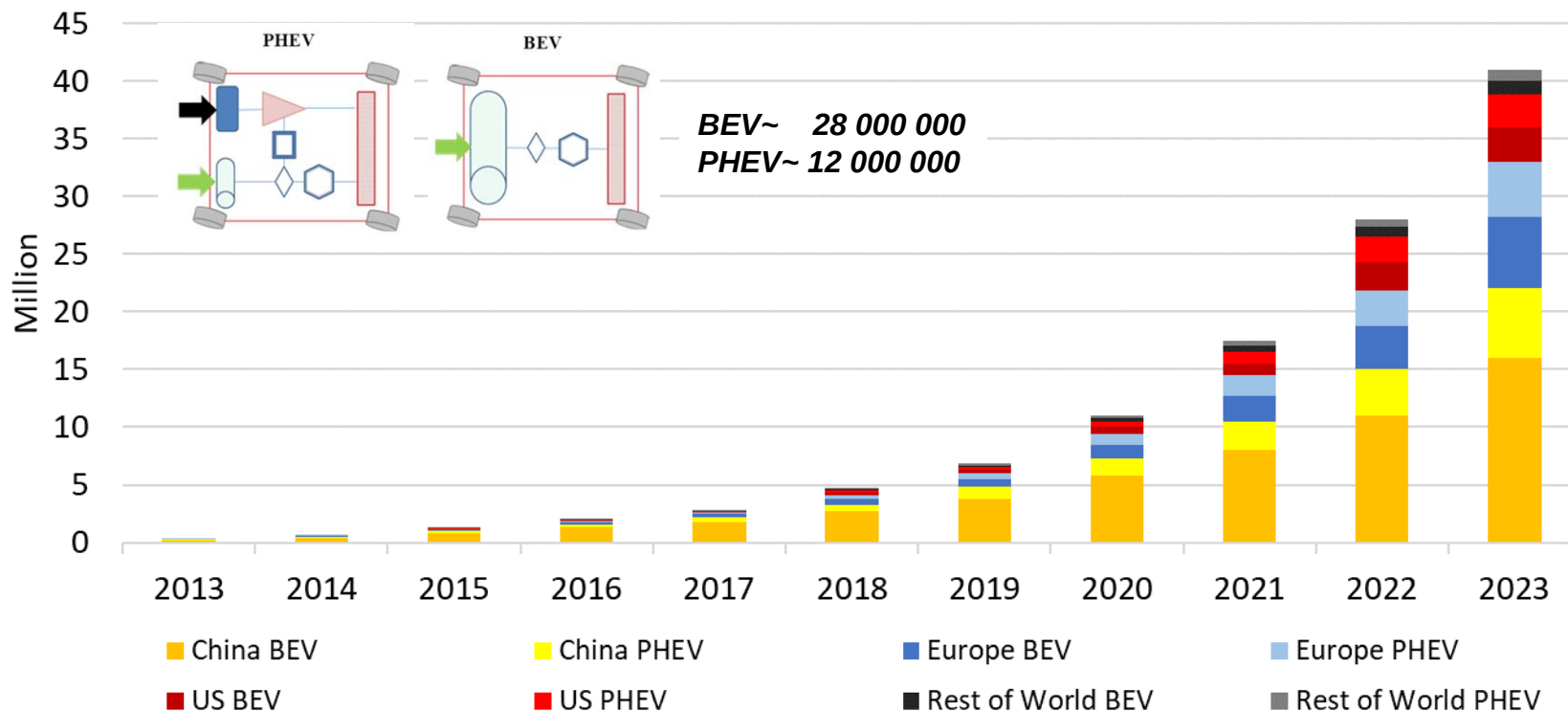
- Subsidies, tax breaks, scrappage schemes
- Grants for charging station installation
- Non-financial incentives (e.g. free parking spaces, possibility for EVs drivers to use bus lanes, permission for EVs to enter city centers and zero emission zones.)

Battery pack prices



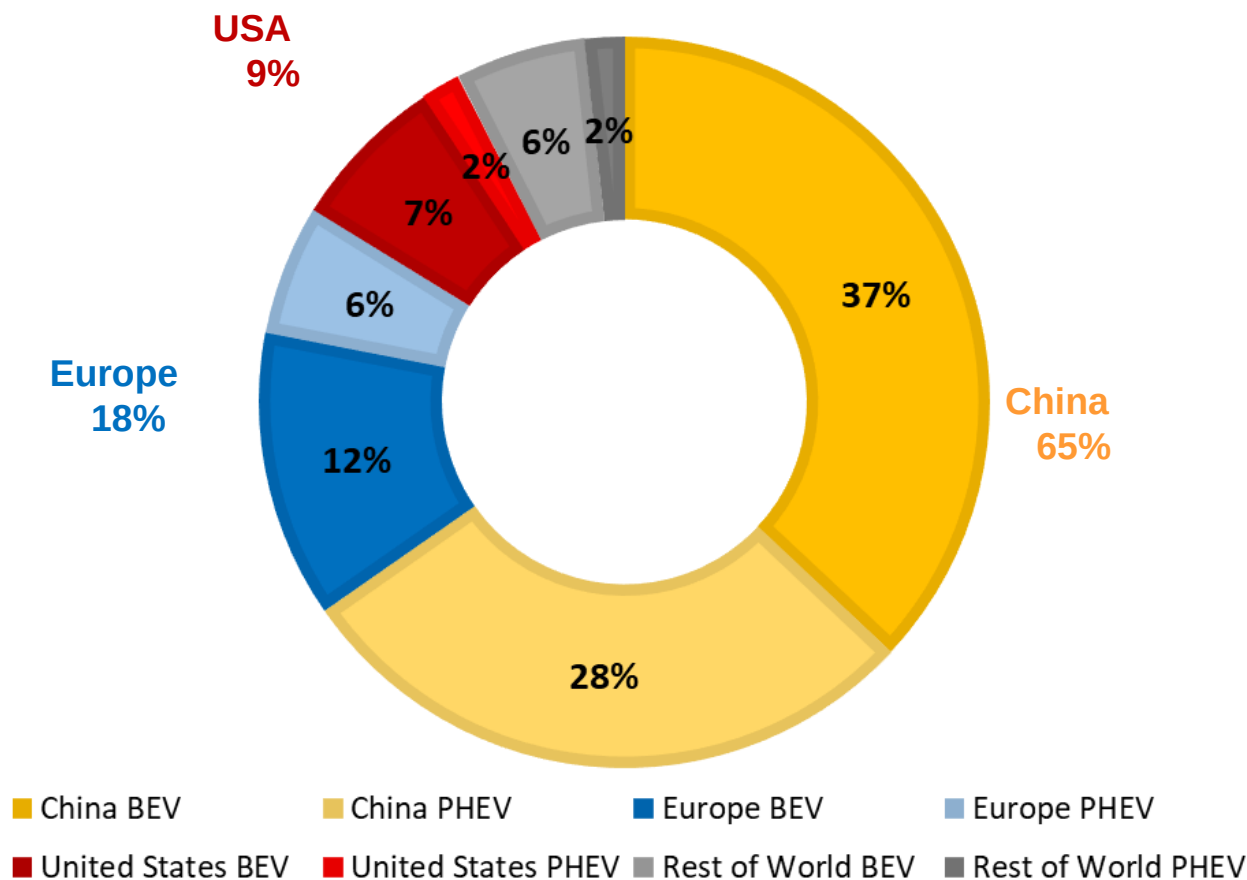


Global electric car stock



Over 40 million electric cars were on the road in 2023

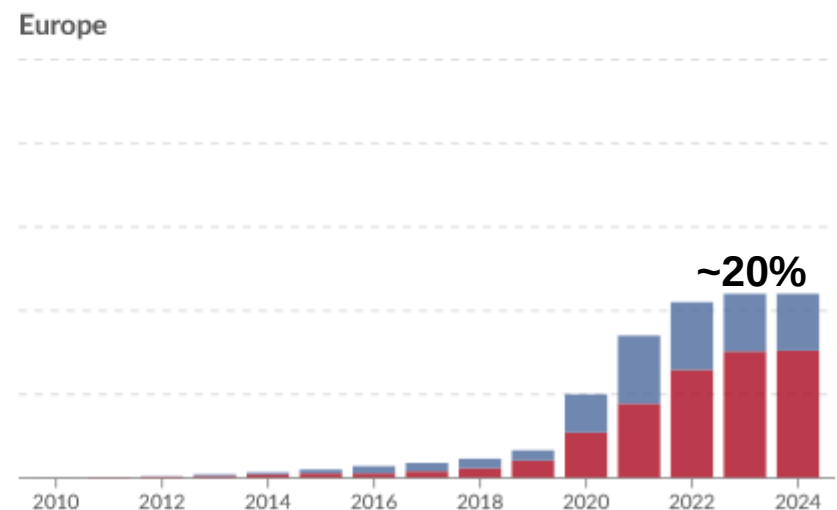
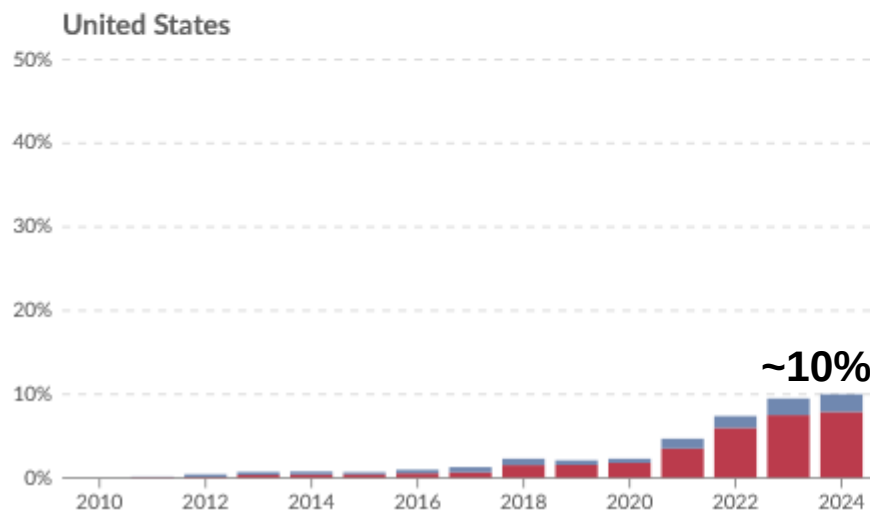
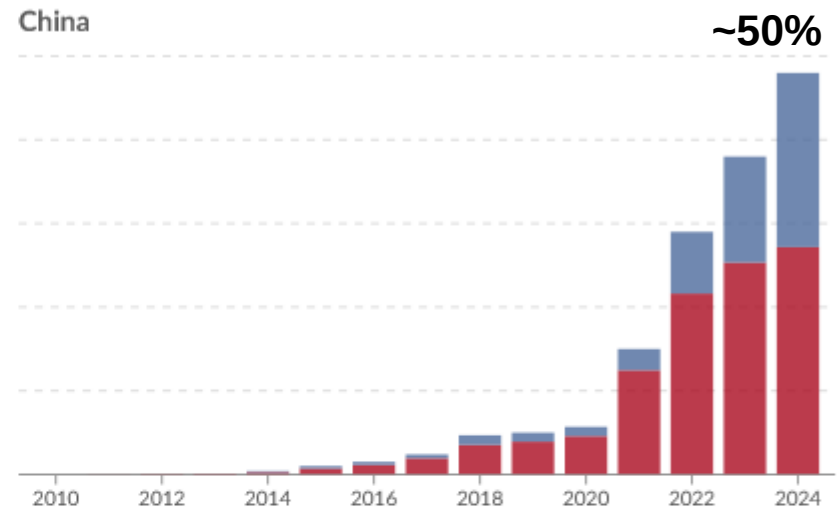
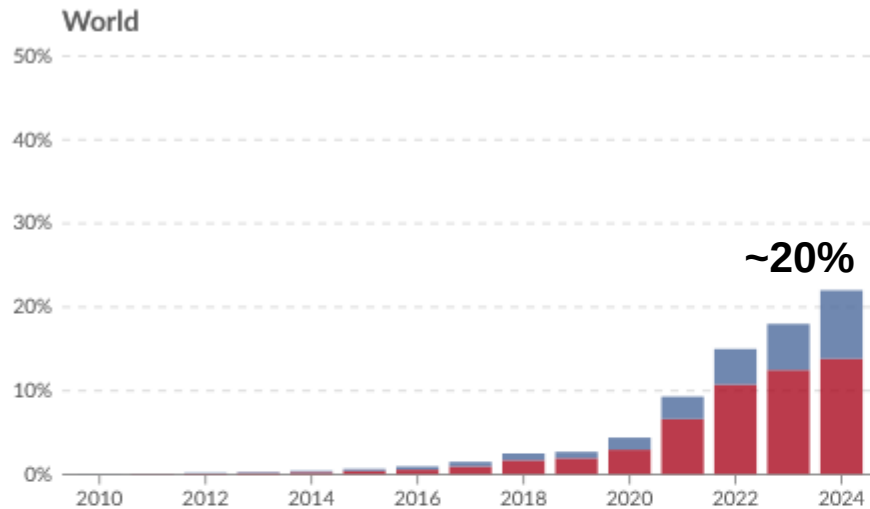
Global electric car sales > 17 000 000



In 2024, the global electric car stock reached almost 58 million cars.

Share of new EV cars sold

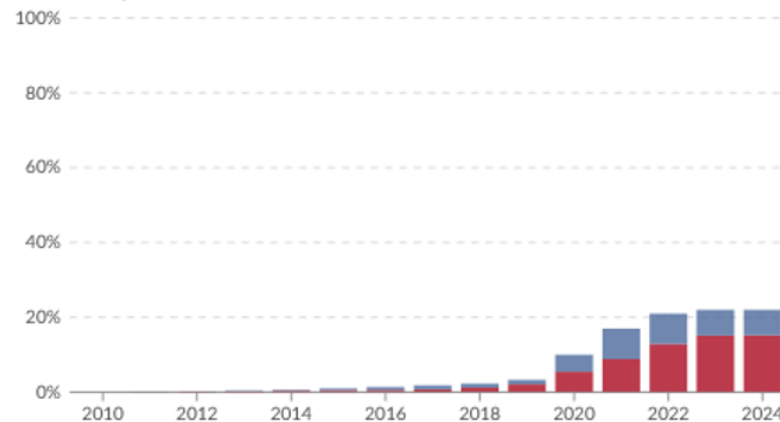
■ Battery-electric ■ Plug-in hybrid



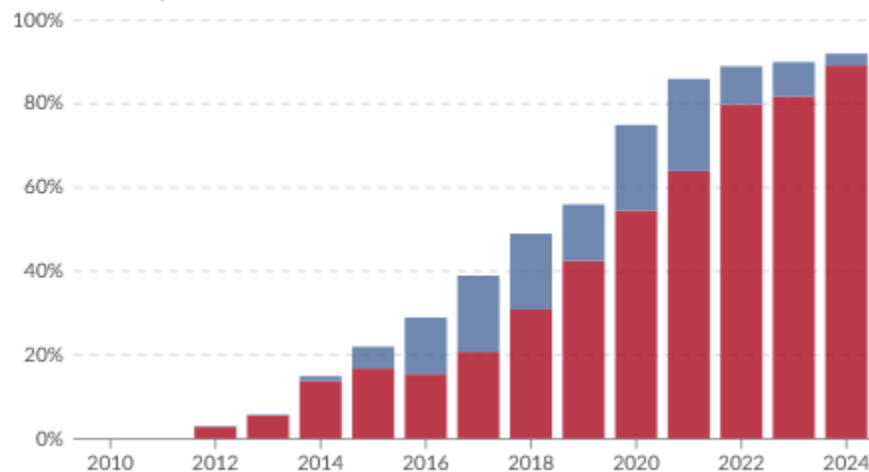
Share of new EV cars sold

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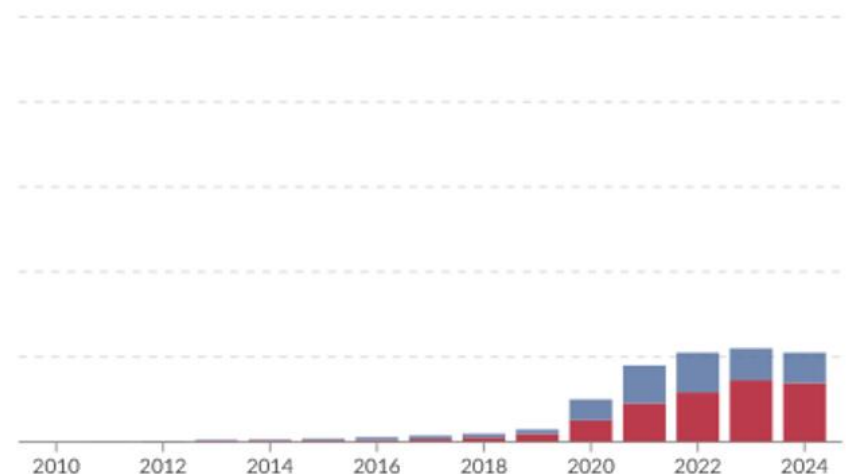
Europe



Norway



European Union (27)



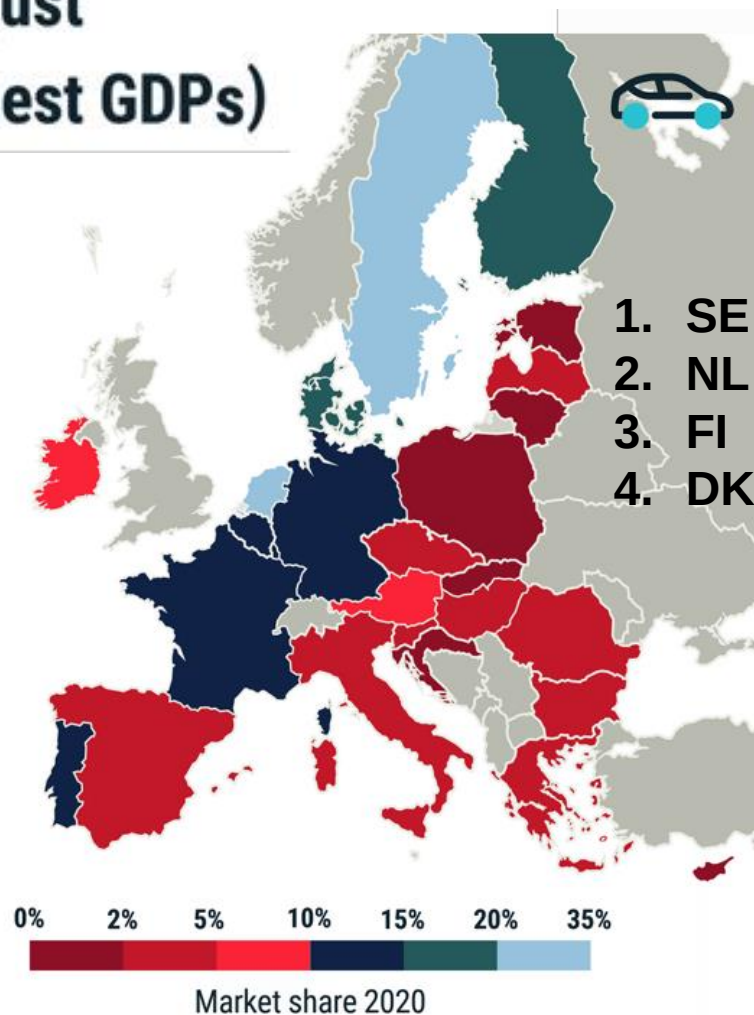


Share of new cars sold that are battery-electric and plug-in hybrid, 2010 to 2024

73% of all electric cars are sold in just
4 countries (with some of the highest GDPs)

Electric cars **< 3% of total sales**
= average GDP **< €17,000**

Electric cars **> 15% of total sales**
= average GDP **> €46,000**

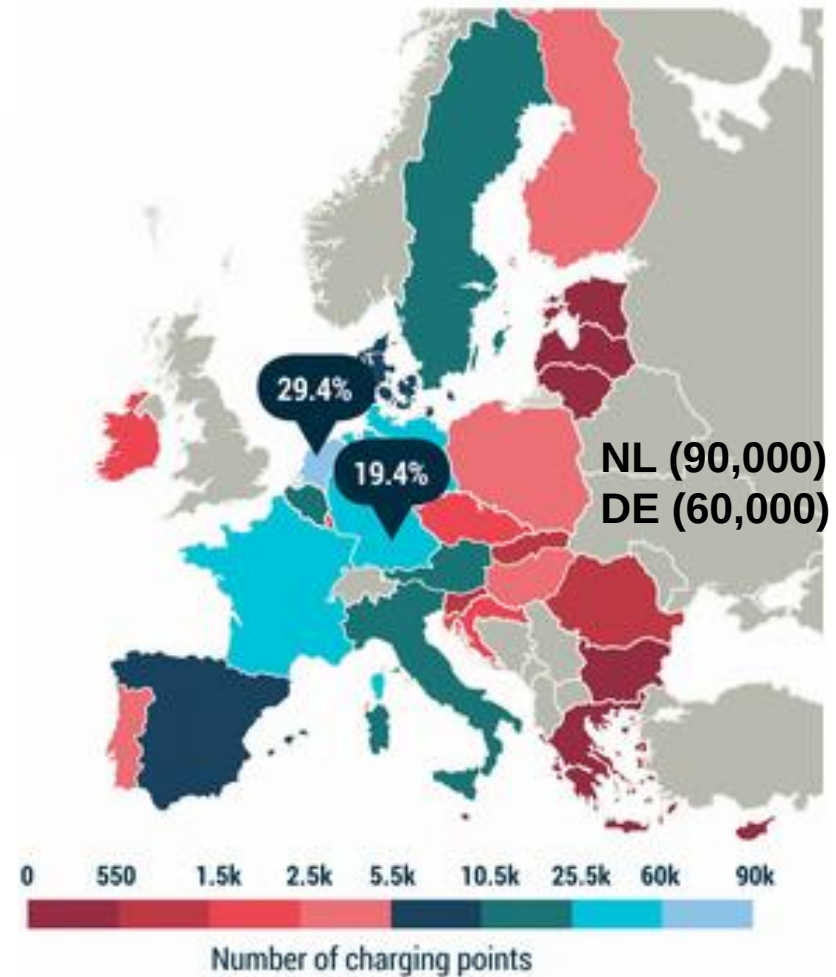


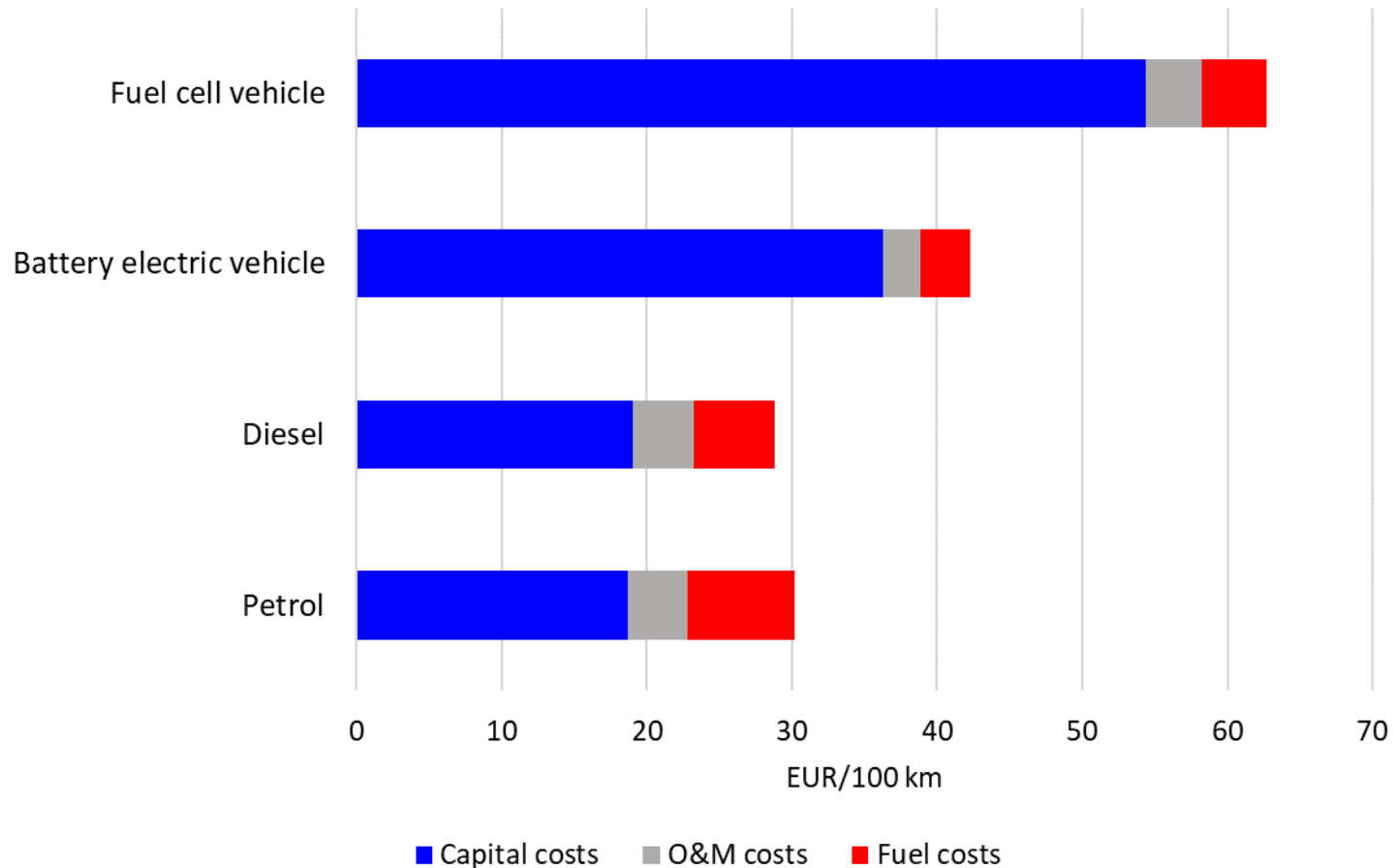
**Some 50% of all charging points:
Concentrated in just 2 EU countries**

29.4% Netherlands

19.4% Germany

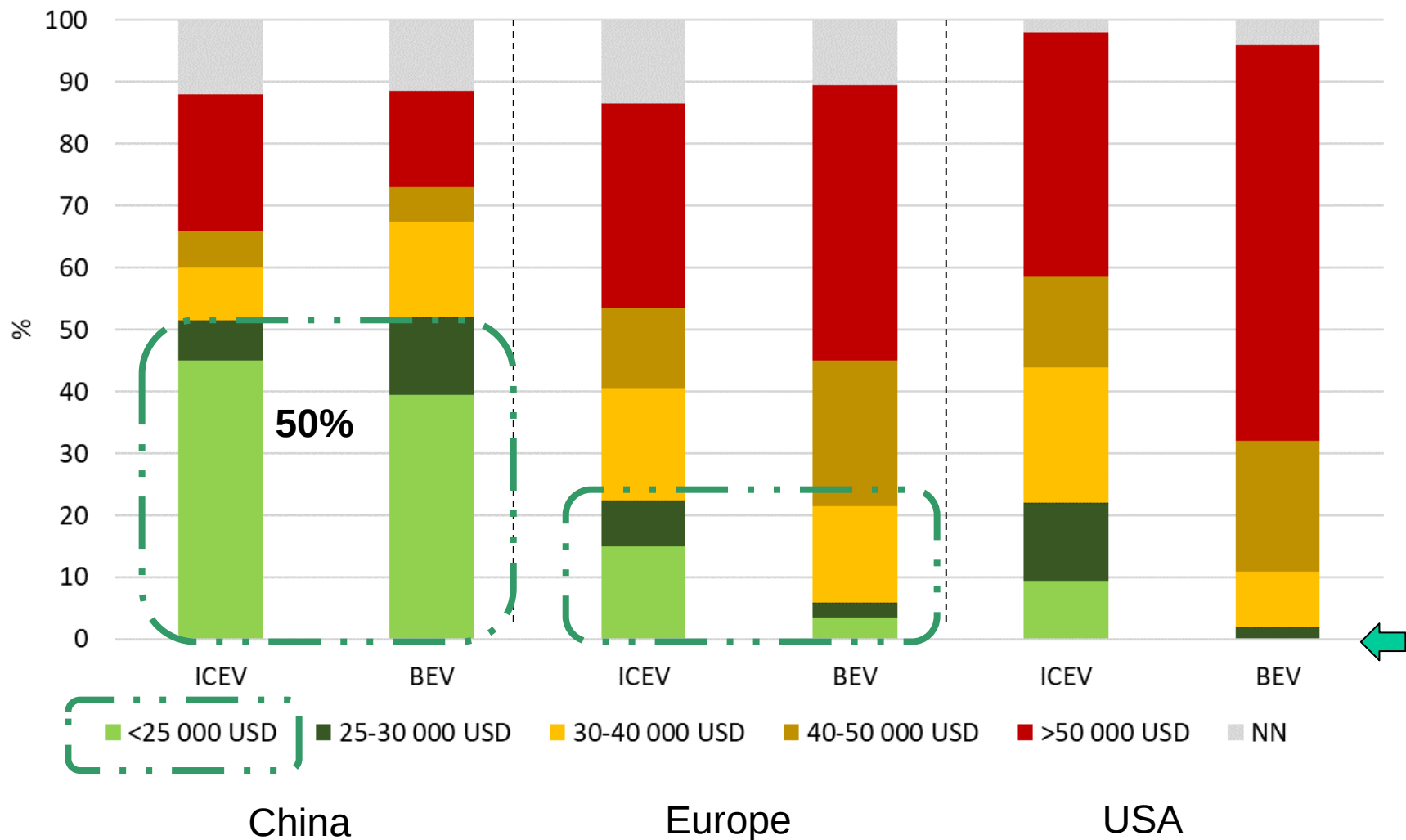
**NL + DE < 10%
of the entire EU surface area**





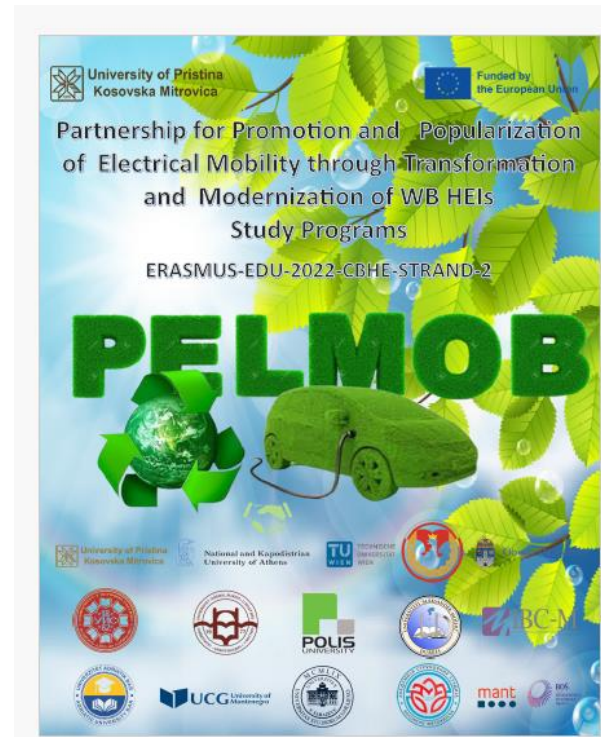
Average car capacity: 80 kW, driving range for all cars 15000 km/year

Price range distribution of available car models: ICEV vs BEV



A fragmented landscape

- ✓ Varied national-level incentives
 - ❖ West Europe vs Eastern Europe
 - ❖ West Balkan Countries



Very consistent & holistic strategy

Financial incentives... VAT exemption...significantly reducing their purchase cost

Tax reductions... reduced annual road traffic insurance taxes, reduction on ferry, public parking, and toll road fees

Fossil fuel car taxes... fossil fuel cars face high purchase taxes and road use taxes

Infrastructure support

Zero-emission vehicle target... Norway aims for 100% of new passenger cars sales to be zero-emission by 2025 (97%)

Favorable market conditions:

- EVs are almost 100% powered by renewables
- Small population (~5.5 million) with high income levels
- Car market is heavily influenced by government taxes.... fiscal policy → consumer choices

Category

Key Measures

Federal Purchase Credits

Up to \$7.5K new, \$4K used,
\$7.5K–\$40K commercial

Charging Infrastructure

Credits (up to \$100K), domestic
sourcing mandates

State Incentives & Regulation

Rebates, tax credits, ZEV
mandates

Industrial Support

Manufacturing grants (battery
cells, supply chain)... EV chargers
& components must be USA-
made

Fleet Electrification

Federal agencies aim to transition
light-duty fleets to ZEVs by 2027

Fuel Economy & PHEV

CAFE standards, PHEV
technology incentives

- ✓ Mix of carrots (incentives) and sticks (regulation)
- ✓ Strong push on domestic manufacturing & supply chains
- ✓ Infrastructure as the cornerstone of adoption

Top-down, centralized approach & industrial goals

- ❖ Direct subsidies (until 2022)
- ❖ Dual-credit system
- ❖ Massive infrastructure investment

- ✓ World's largest BEV market...global leader in clean vehicle technology

- **Consistency matters** ... stable, long-term frameworks are essential for sustained market growth and investor confidence.
- **Economic competitiveness** ... smart tax/VAT design makes EVs economically competitive.
- **Infrastructure investment** ... reliable networks reduce range anxiety and boost adoption.
- **Supply-side regulation** ... drives industrial scaling, innovation and forced automakers to invest
- **Gradual phase-out of incentives** ... phasing out incentives smoothly maintains market stability.
- **Economic efficiency and policy stability** ... pillars of a sustainable transport transition.

Ajanovic A., R. Haas, M. Schrödl (2021). **On the Historical Development and Future Prospects of Various Types of Electric Mobility**, *Energies* 14 (4), 1070

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