



*Key steps for energy transformation in Central Europe*

# ***Decarbonization of passenger car transportation: goals and challenges***

Amela Ajanovic  
Energy Economics Group  
TU WIEN

*International multidisciplinary discussion seminar  
28th November 2023, Praha*



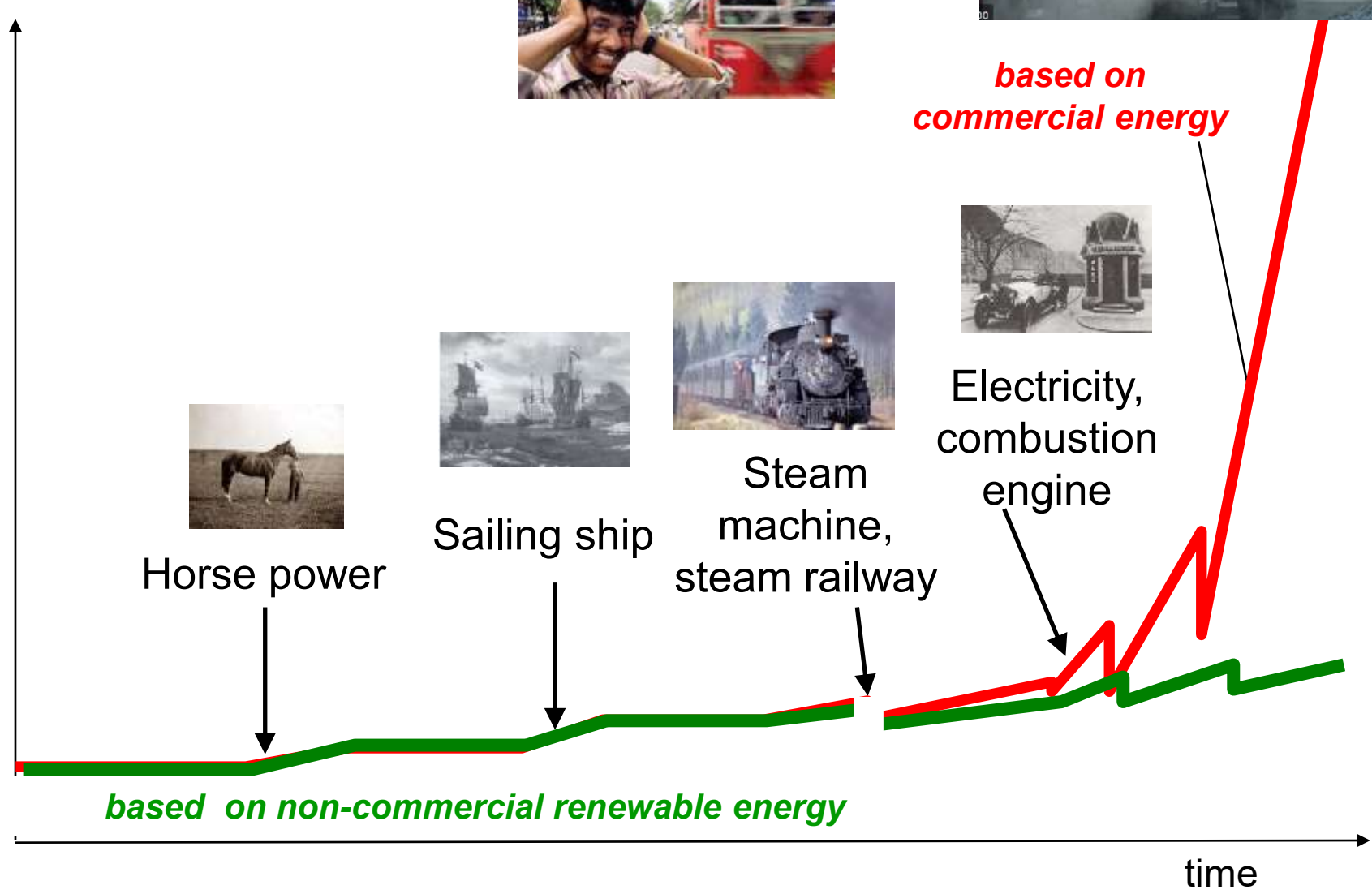
# *Content*



- Introduction
  - Developments and challenges
- Policy framework
- Alternative technologies: Electric vehicles
  - Major advantages and challenges
- Conclusion



Amount of transport services per capita

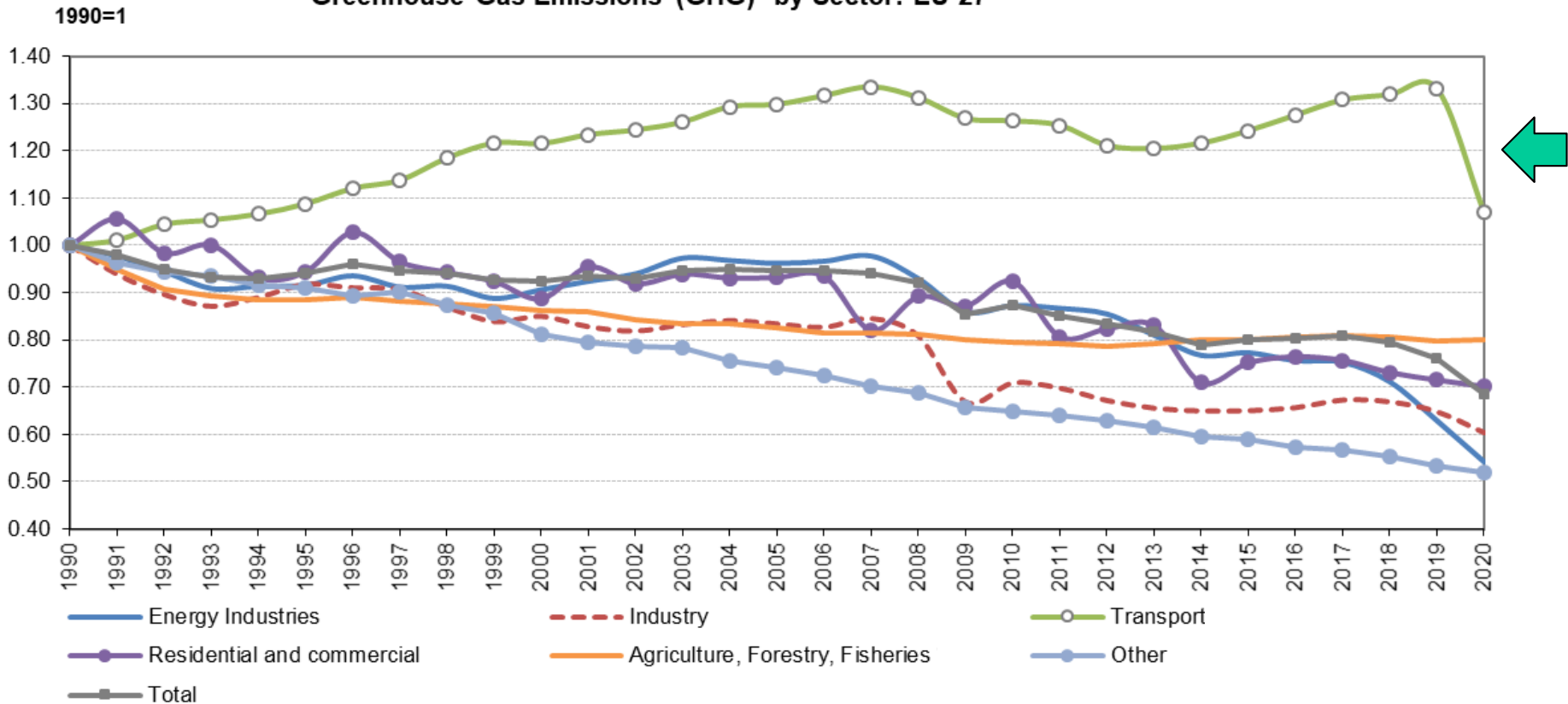




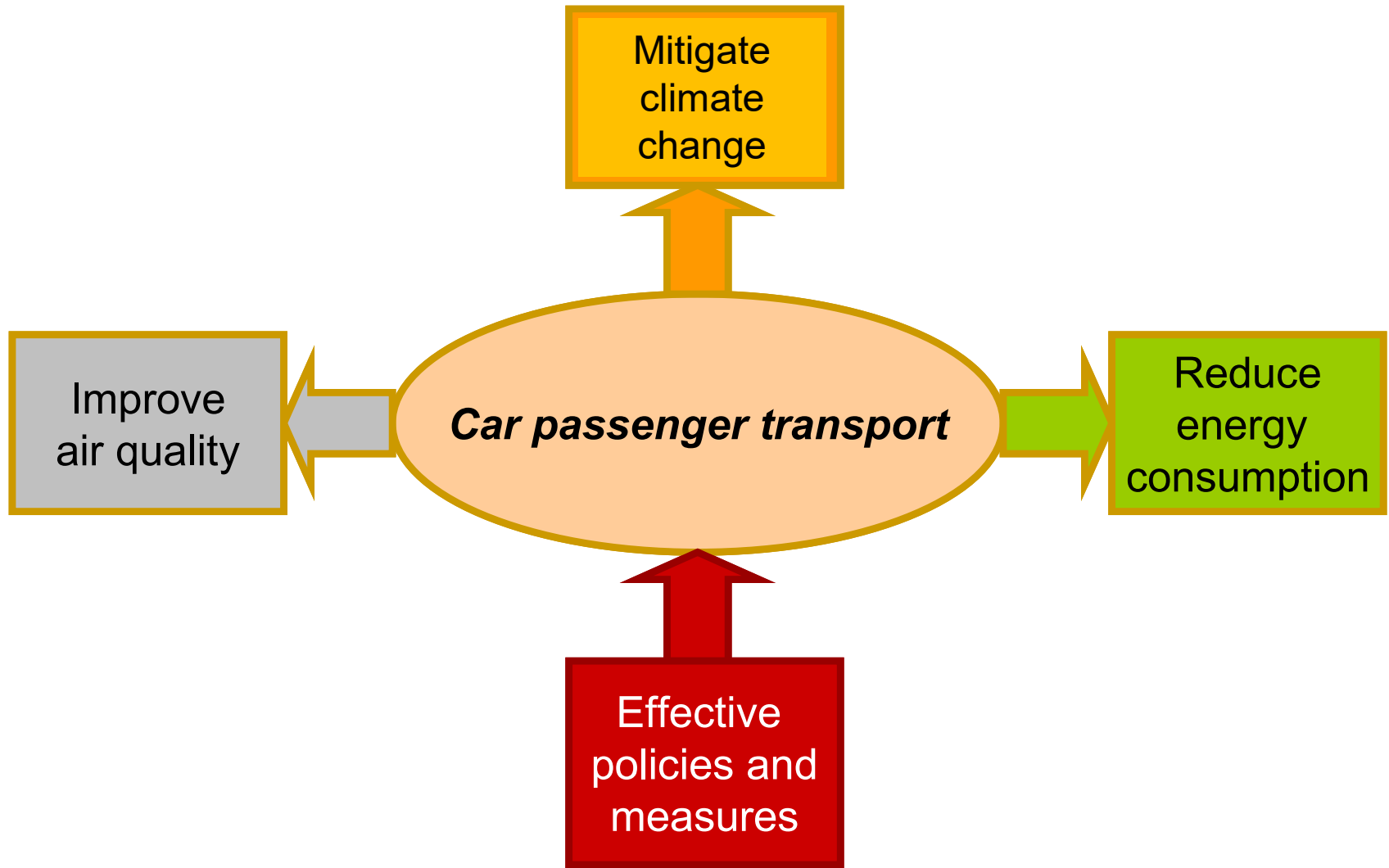
# GHG



### Greenhouse Gas Emissions (GHG)\* by Sector: EU-27



# The challenges for EU climate and energy policies





# EU targets



EU - the first climate-neutral continent by 2050

## European Green Deal

### 2030 climate & energy framework

40-32-32,5

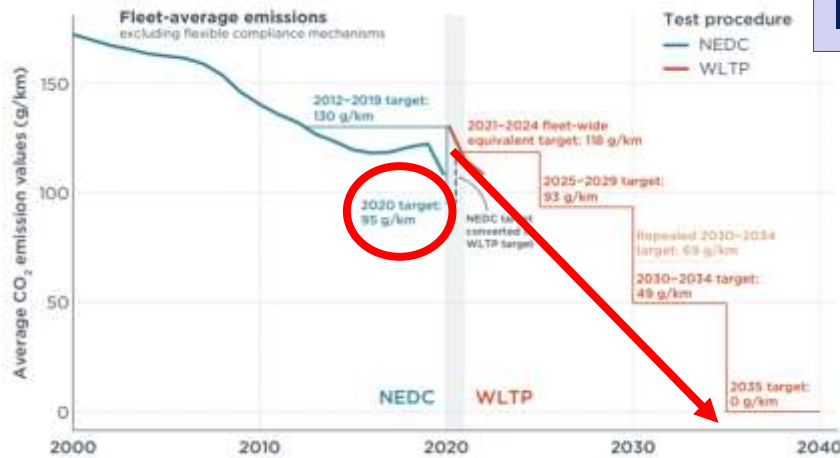
14%

### 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.

2009 2010 2015 2020 2025 2030 2050



ICE -50% in city

20% GHG (2008)

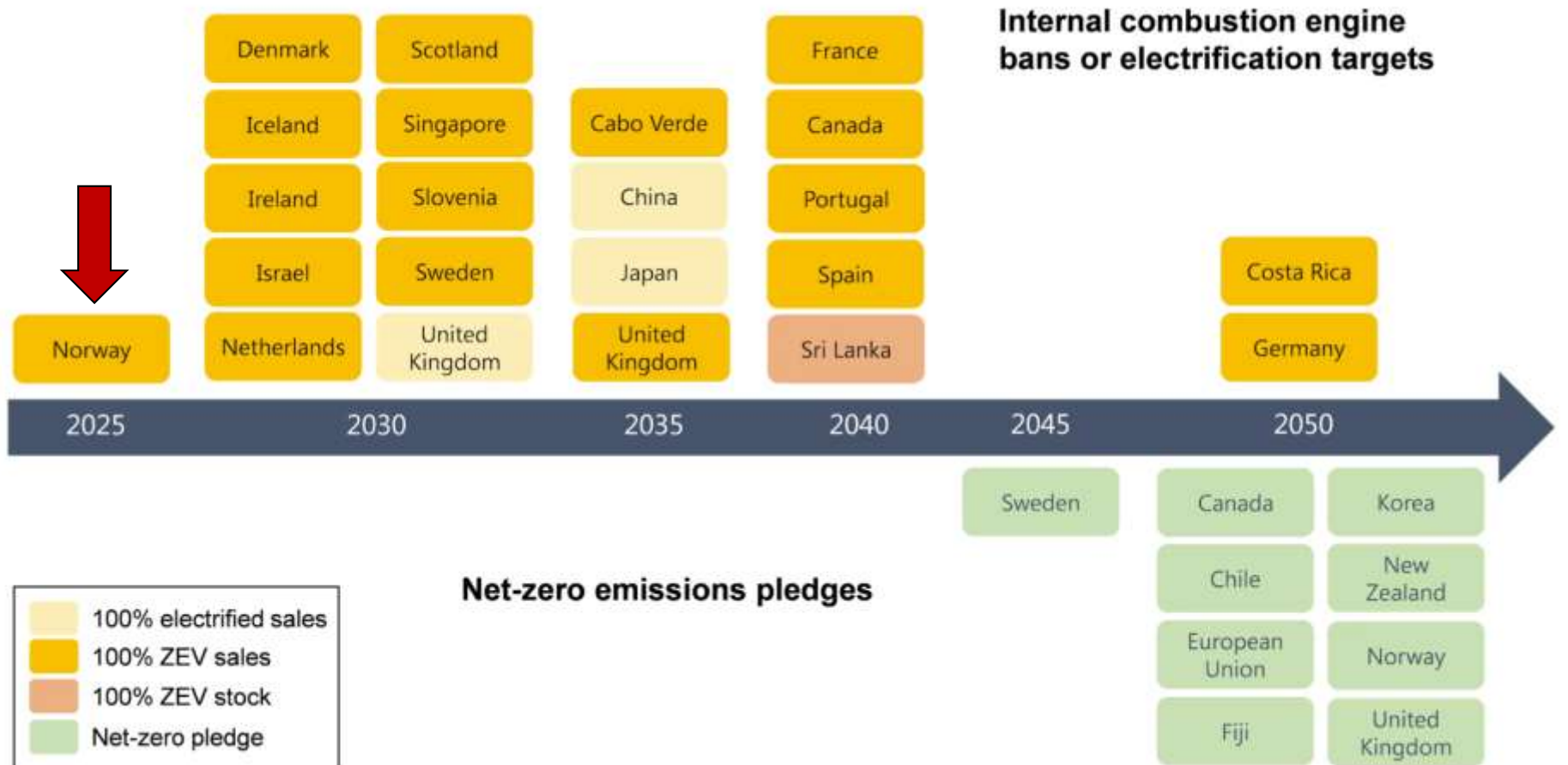
No ICE in city

60% GHG (1990)

Transport White Paper



# Announced 100% ZEV sales targets and bans on ICE vehicle sales





# *Electric vehicles*



## Paris Declaration on Electro-Mobility and Climate Change & Call to Action:

- more than 100 million EVs
- 400 million two and three-wheelers



## Monetary measures:

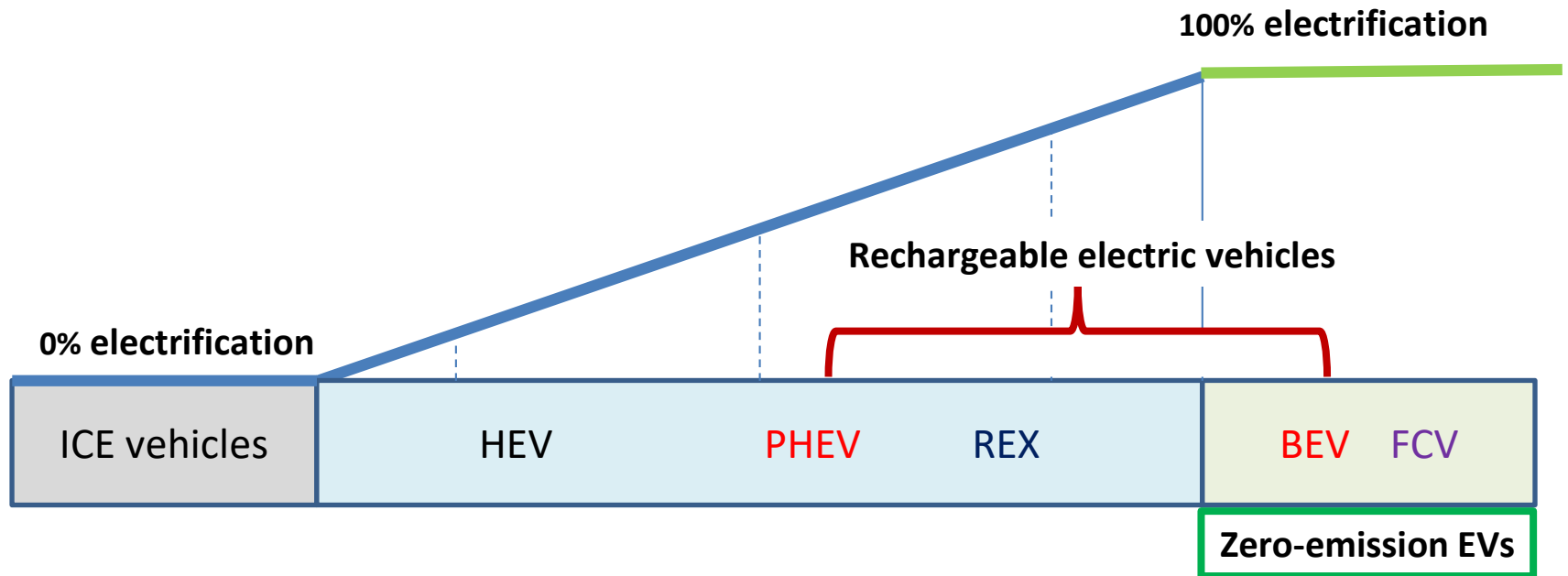
- road taxes
- annual circulation tax
- company car tax
- registration tax
- fuel consumption tax
- congestion charges



## Non-monetary measures:

- free parking spaces,
- possibility for EVs drivers to use bus lanes,
- wide availability of charging stations,
- permission for EVs to enter city centers and zero emission zones.

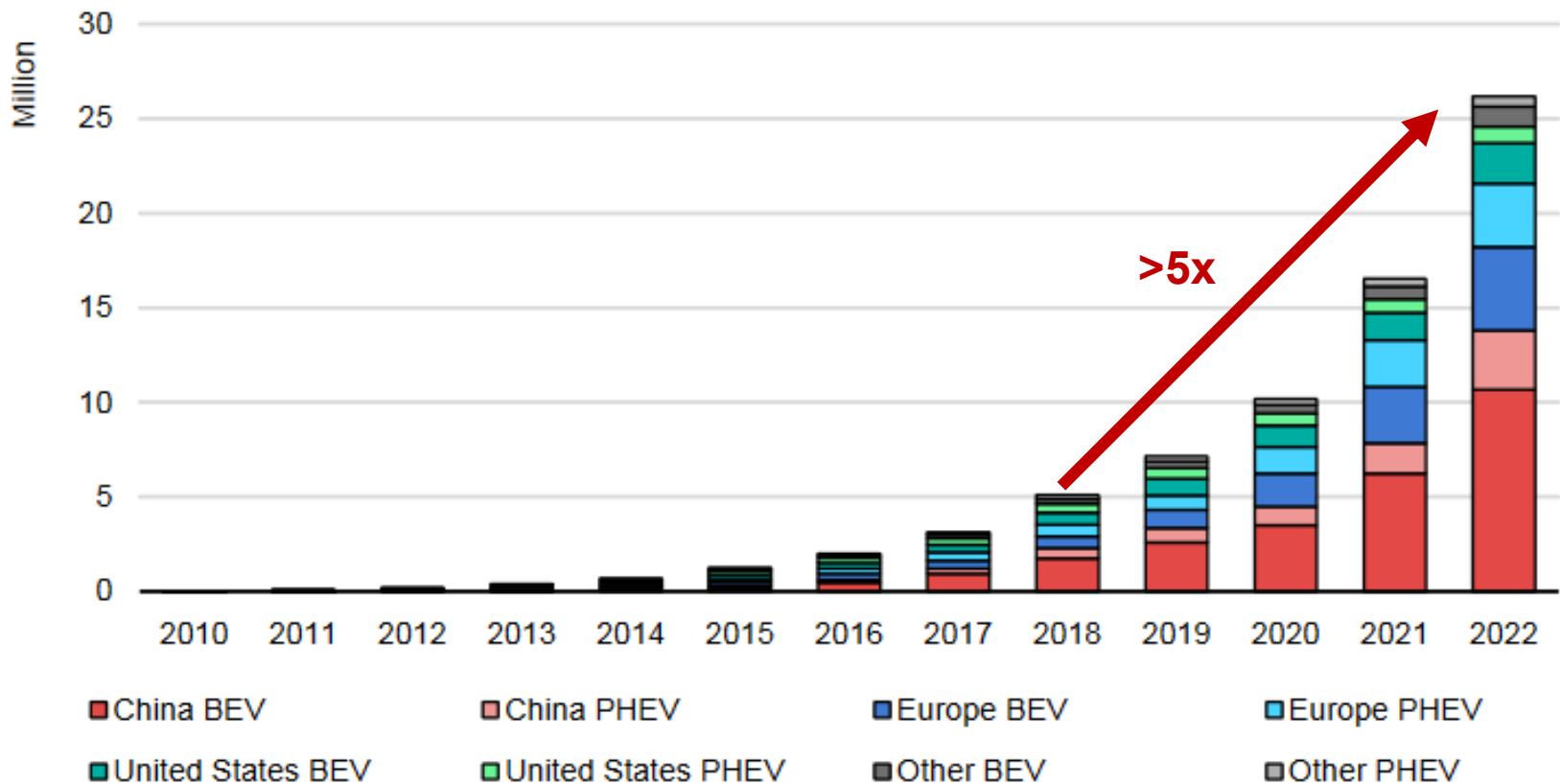




Level of electrification of electric vehicles

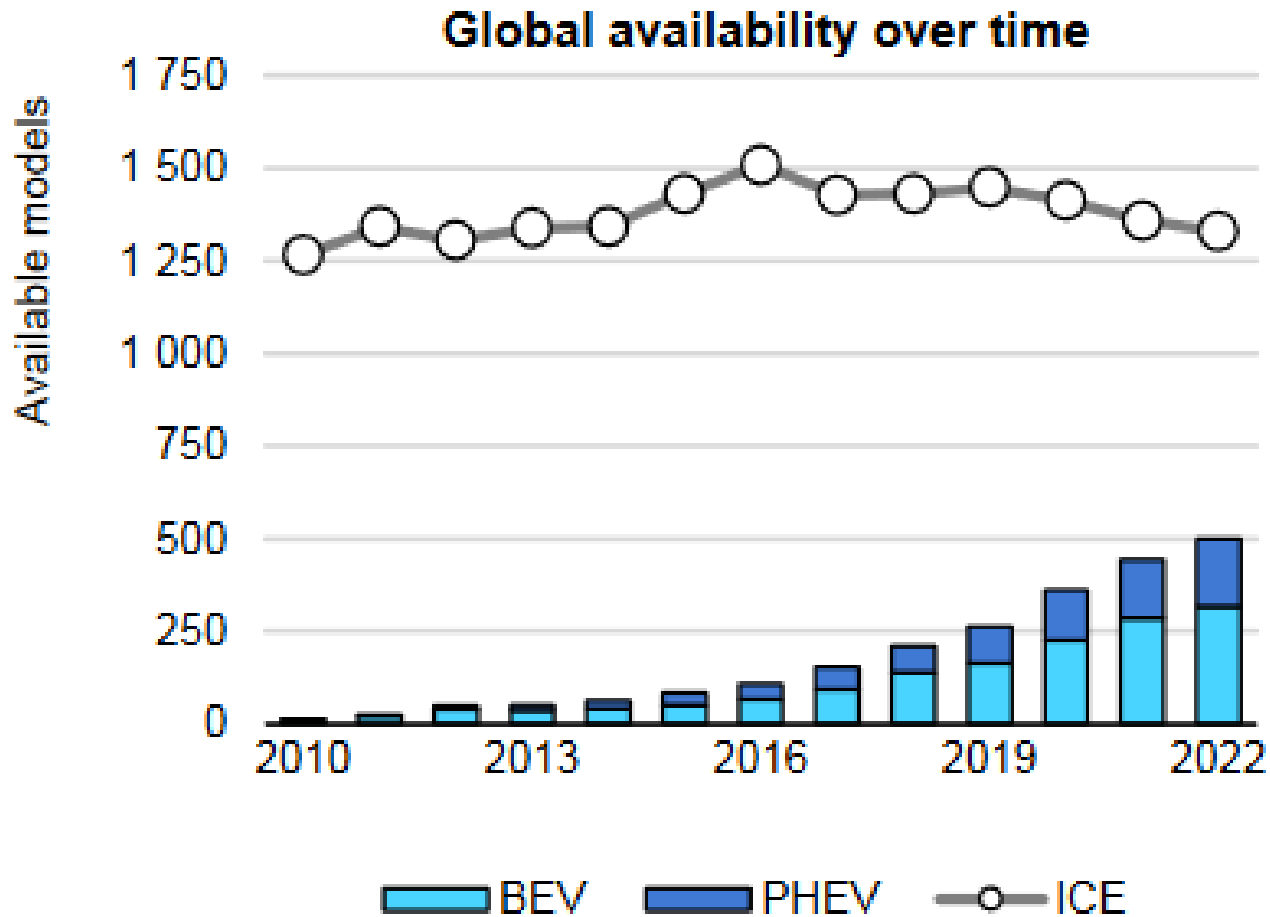


# Electric vehicles

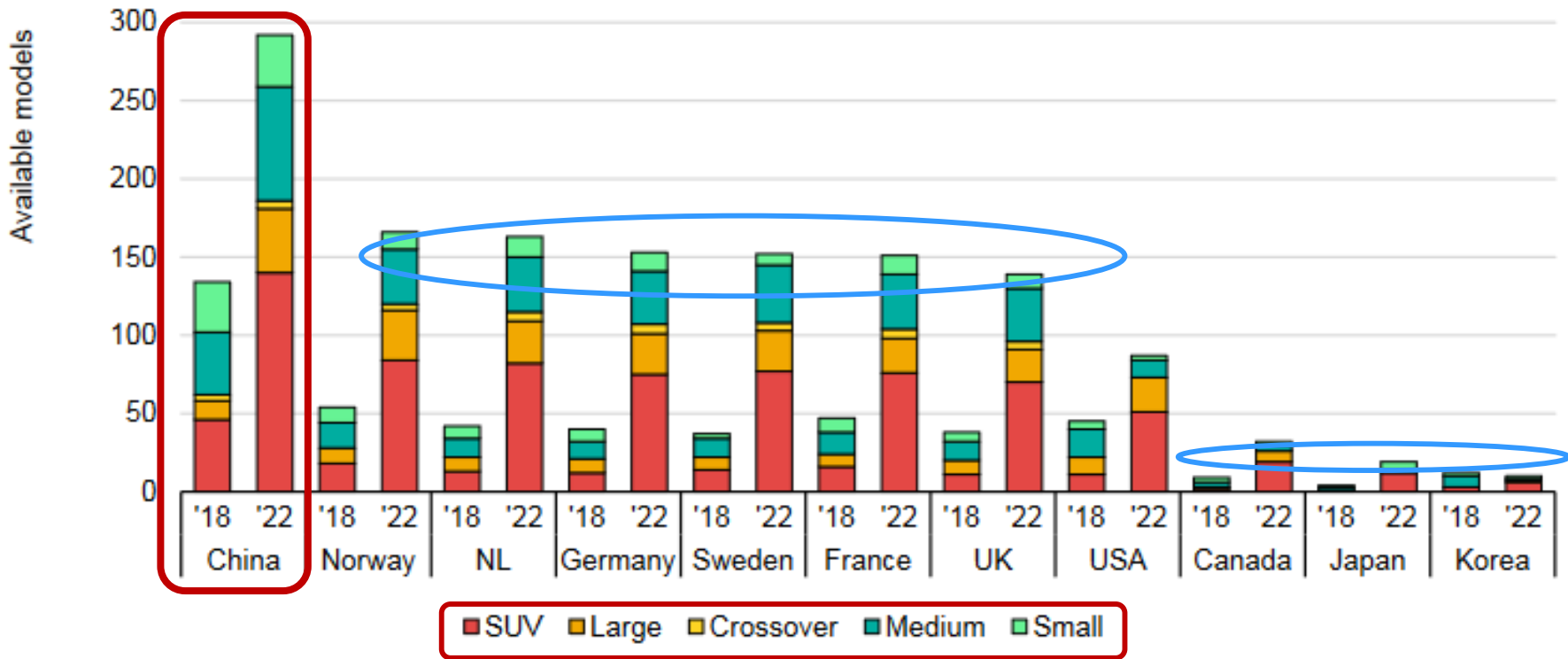


IEA. CC BY 4.0.

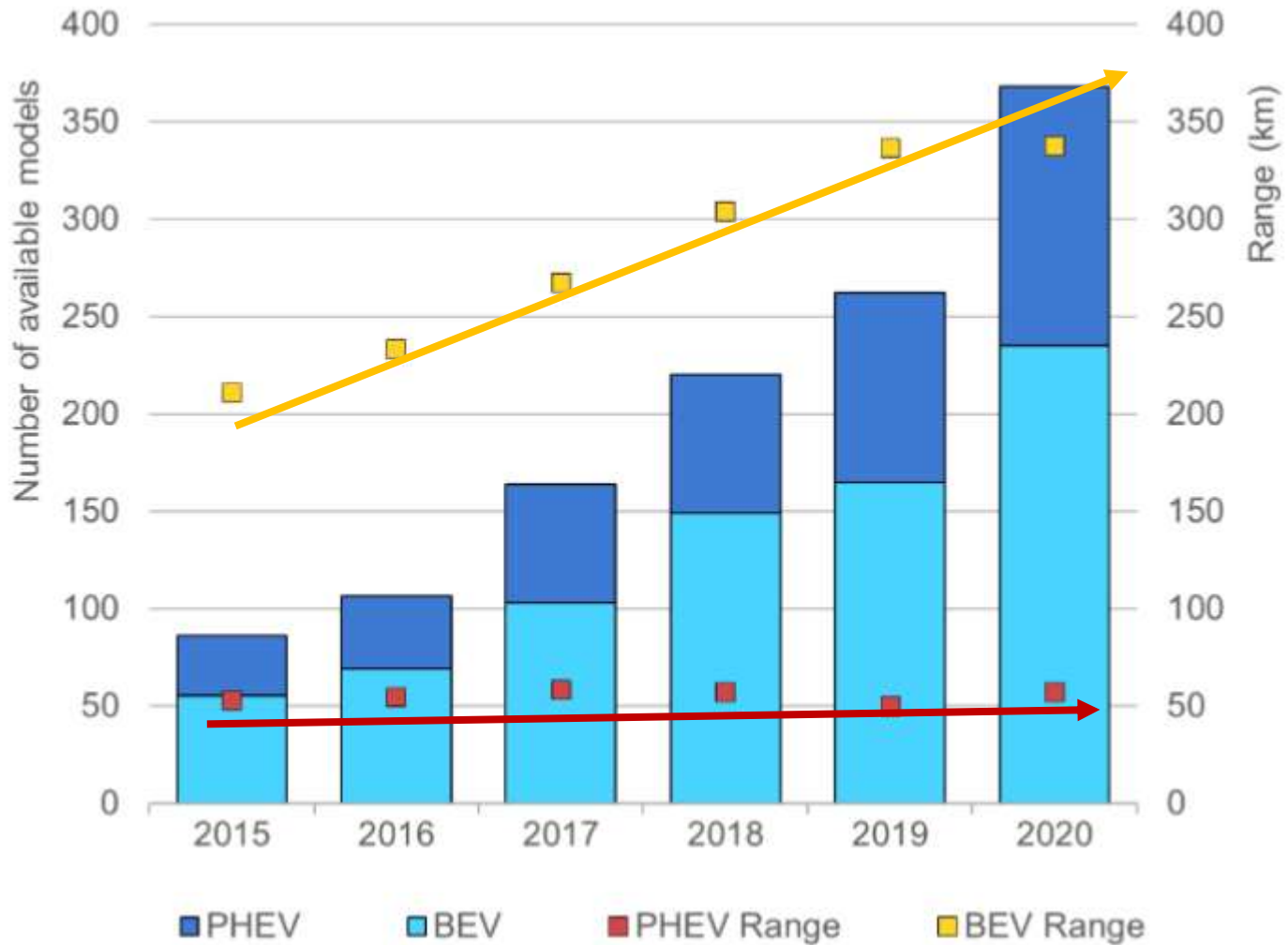
Over 26 million electric cars were on the road in 2022

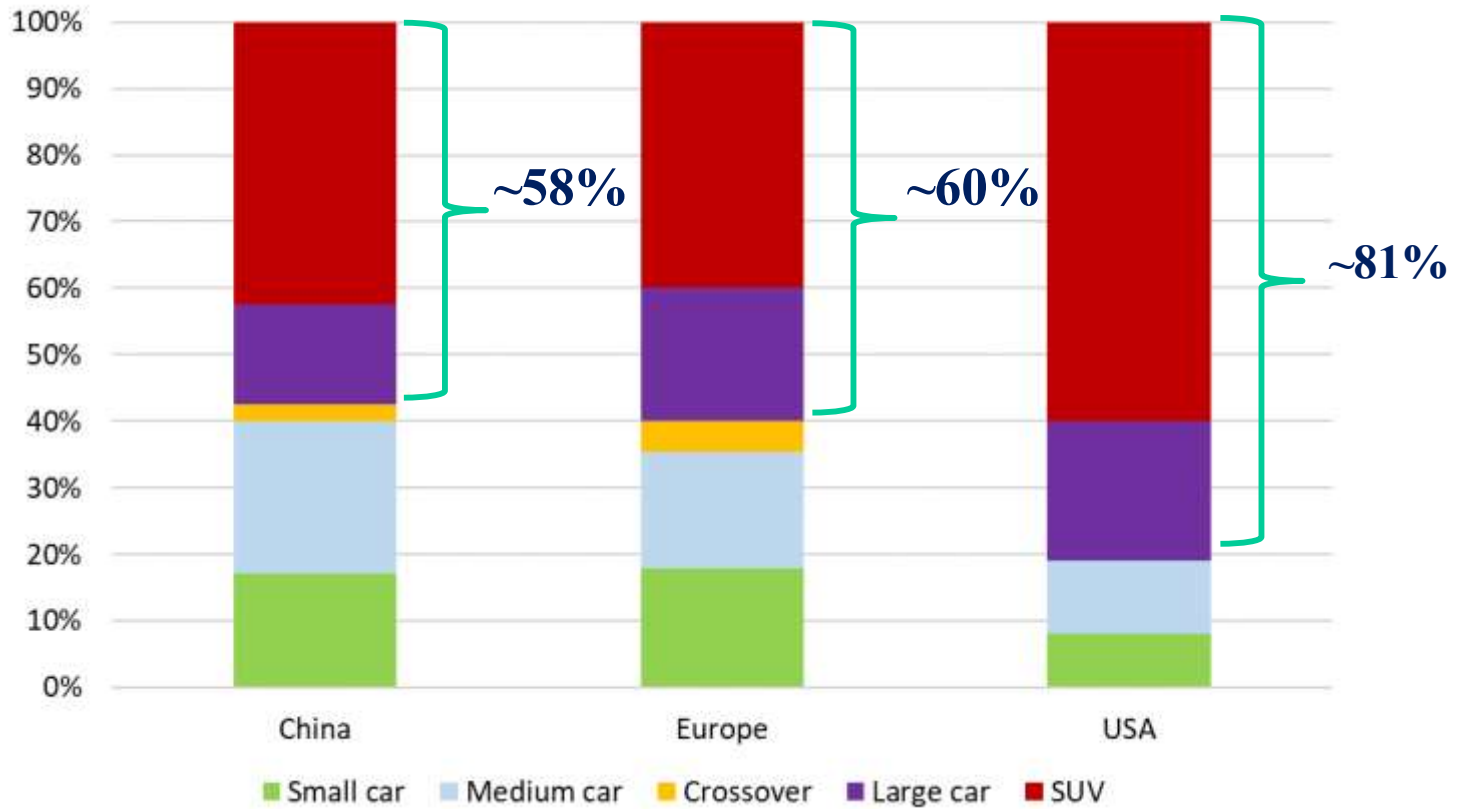


Electric car model availability in selected countries by size, 2018-2022



Electric car models available globally and average range, 2015-2020







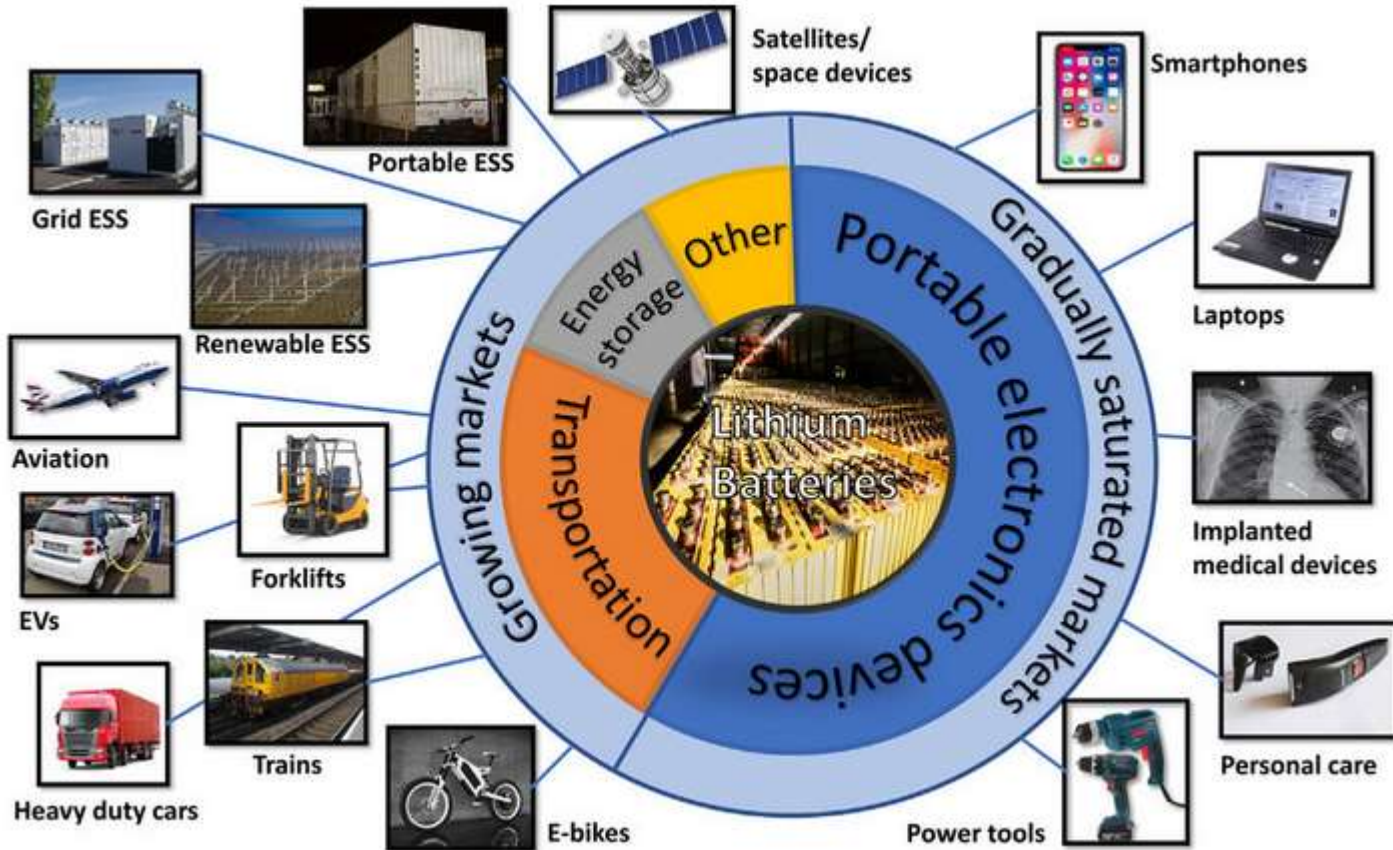
# *Lithium-Ion Battery*



- mostly used in EVs
- ✓ impressive energy density, more than 200 Wh/kg
- ✓ 80 to 90% charge/discharge efficiency
- short cycle lives and significant degradation with age.
- fire safety risk if charged improperly
- relatively high costs

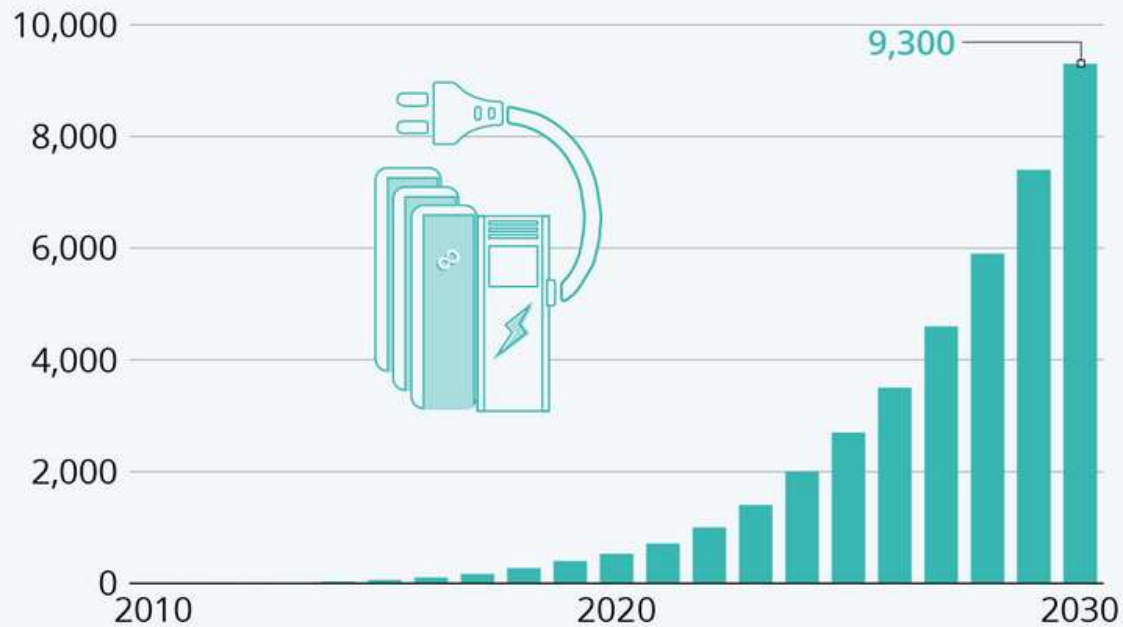


# Lithium-Ion Battery



## High Demand for Lithium-Ion Batteries

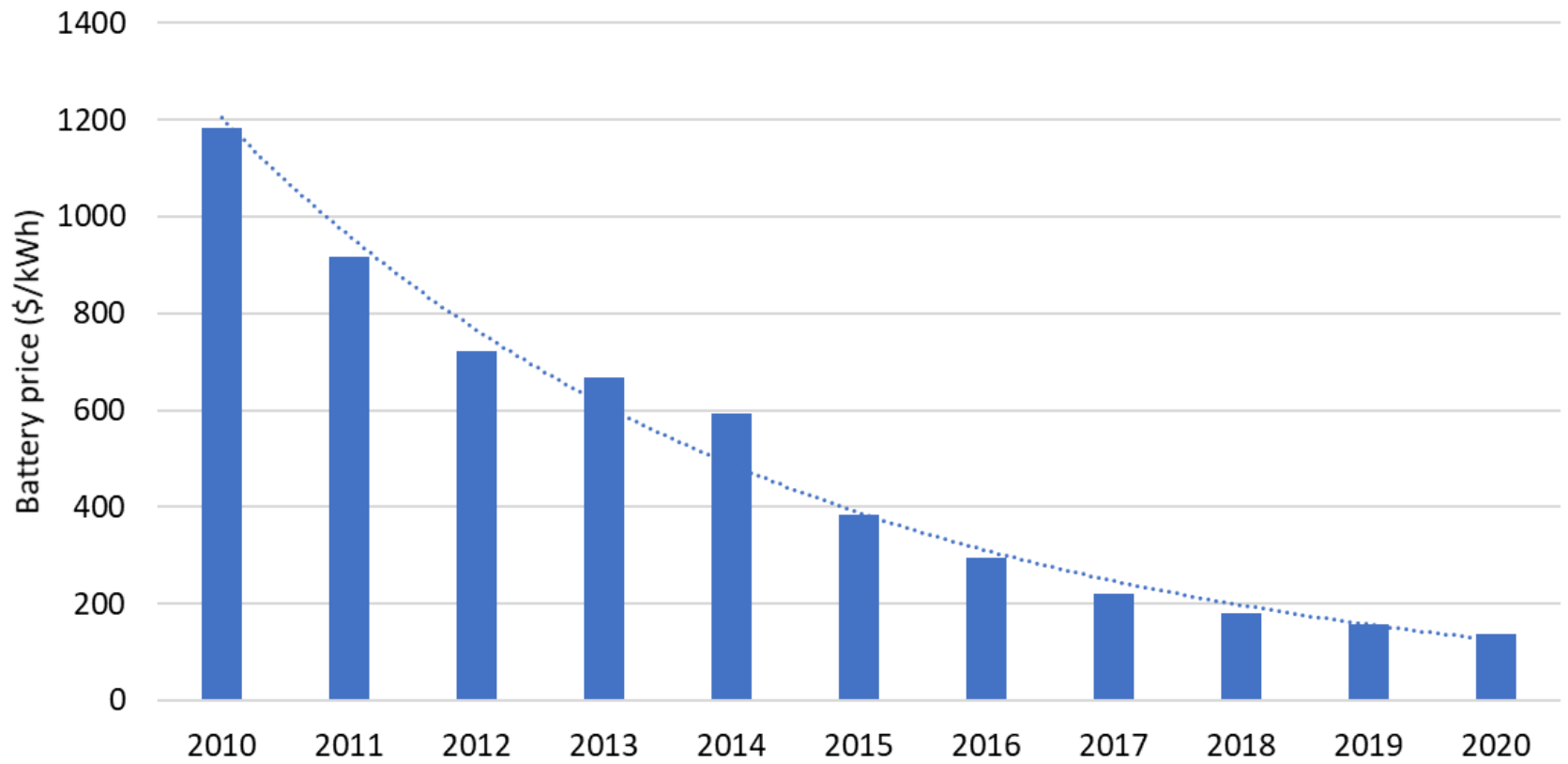
Cumulative lithium-ion battery demand for electric vehicle/energy storage applications (in GW hours)

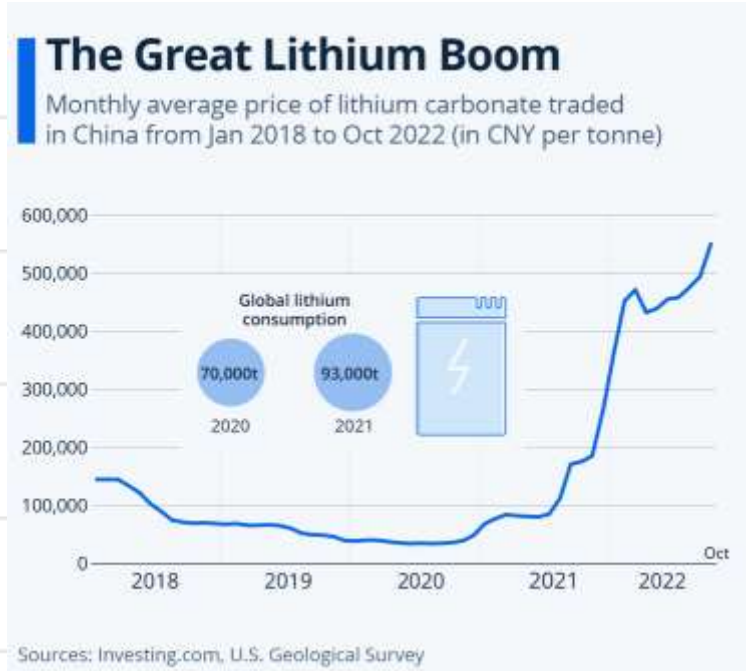


Source: Bloomberg



# Battery pack prices

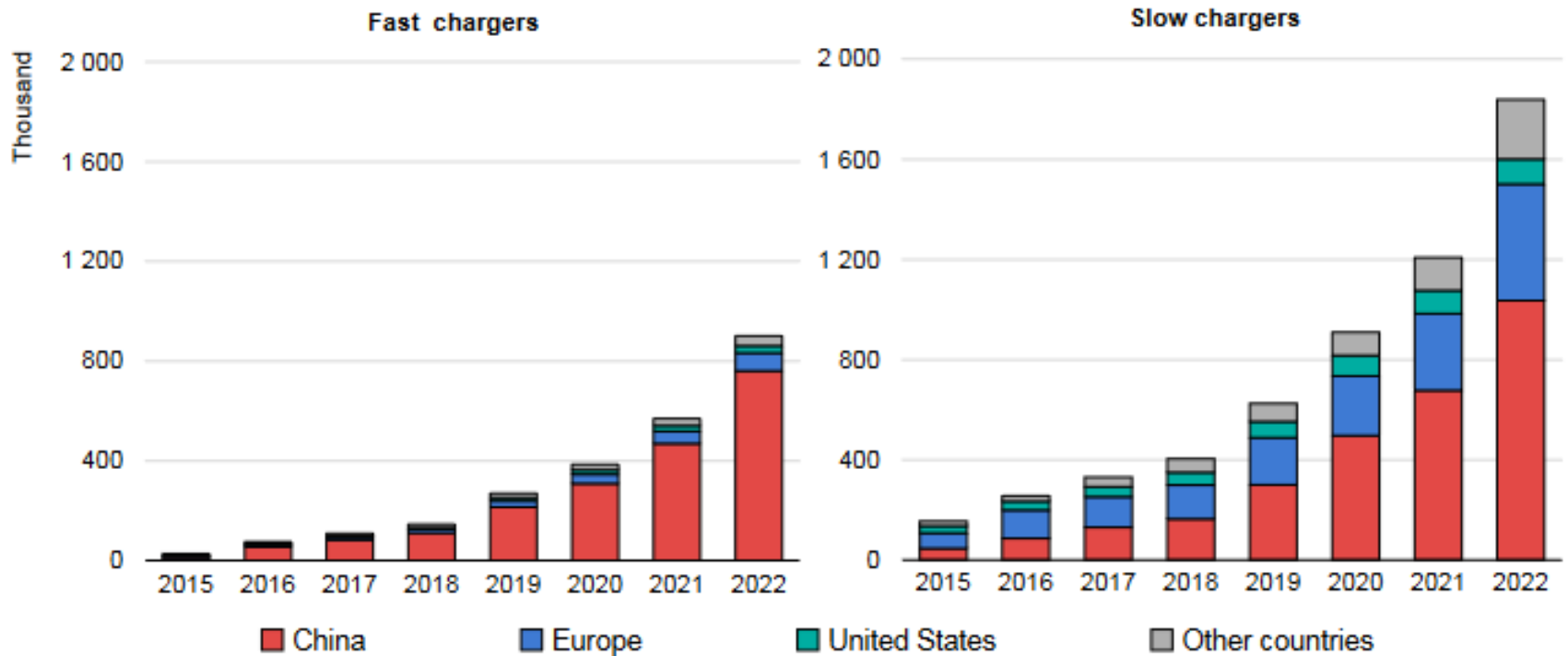




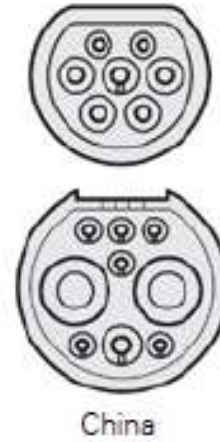


# Charging infrastructure

Installed publicly accessible light-duty vehicle charging points by power rating and region, 2015-2022



# Connector Types





# Connector Types



The plug choice is only one of a number of standardization issues in the introduction of EVs. Technical issues regarding harmonization are:

- **Standardization** (plug, data protocol)
- **Cross-national compatibility**
- **Data protection** (personal, business)
- **Safety** requirements
- Charging **cable**
- **Technical approval** body for recharging places
- Periodic **inspections & maintenance** of recharging places
- Convenient **billing systems**



# *Infrastructures for e-Mobility*









All countries face challenges in this, not only emerging countries!



Typical case: renovated buildings but unchanged electrical installations



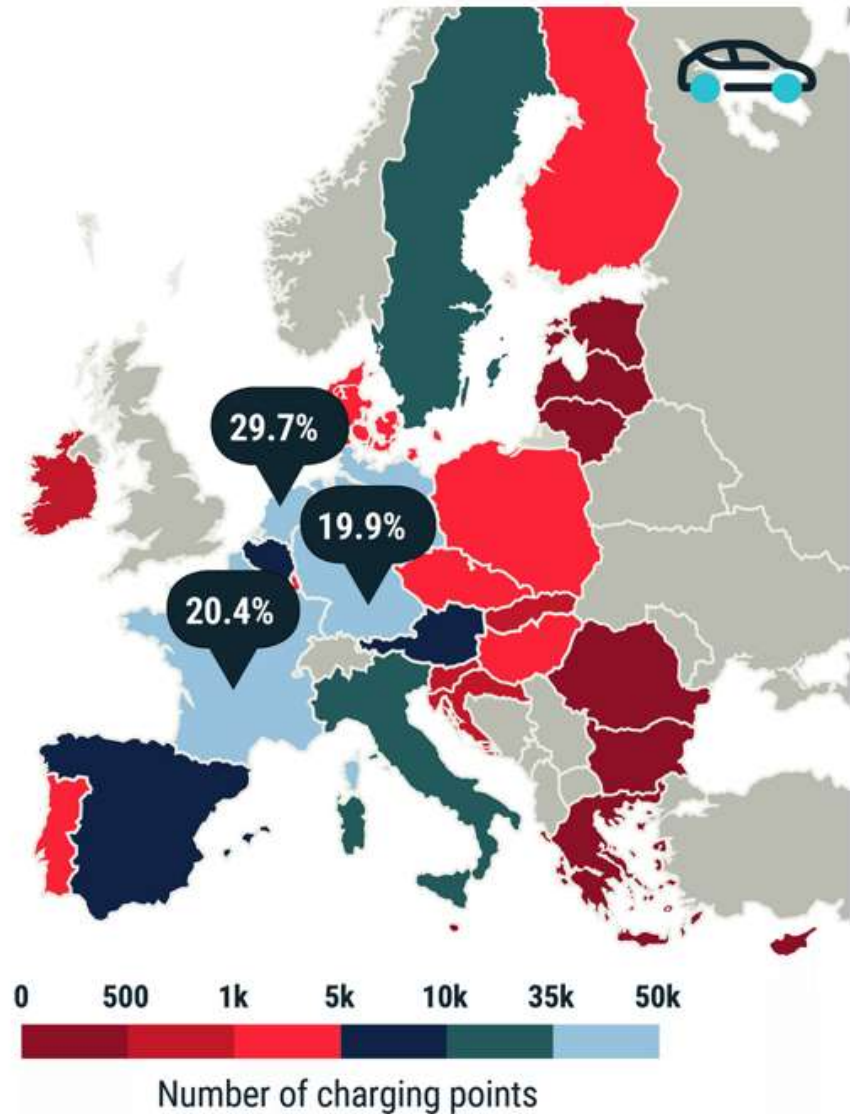
Images: ZVEI



Number of housing units in Germany: 40 Million,  
 thereof built between 1919 and 1948: 11 Million units,  
 total units built before 1978: 28 Million.

70% of all charging points:  
Located in just 3 EU countries

29.7%	Netherlands	20.4%	France
19.9%	Germany		

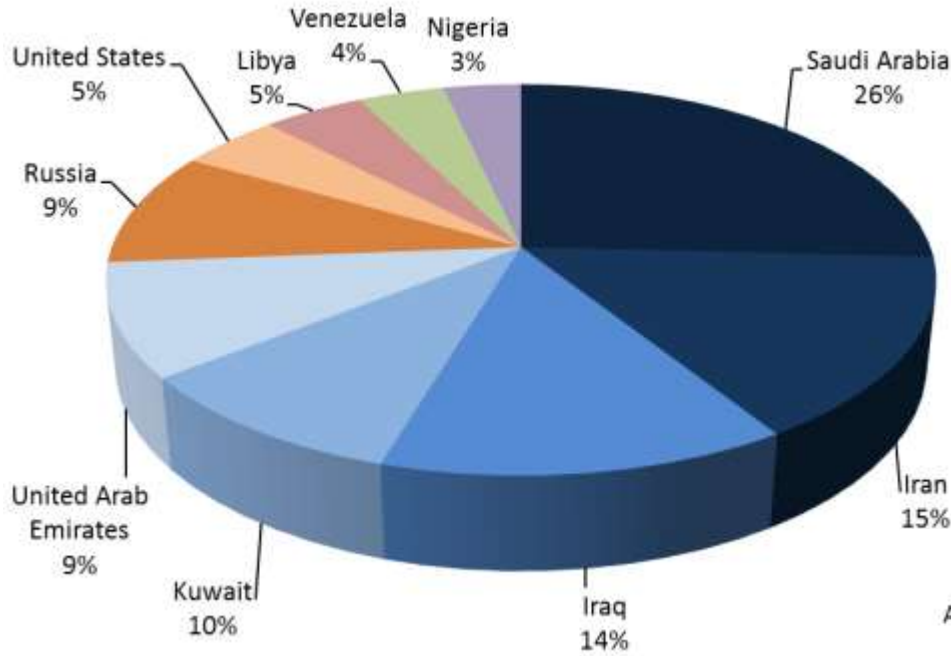




## *Major barriers to EV adoption*

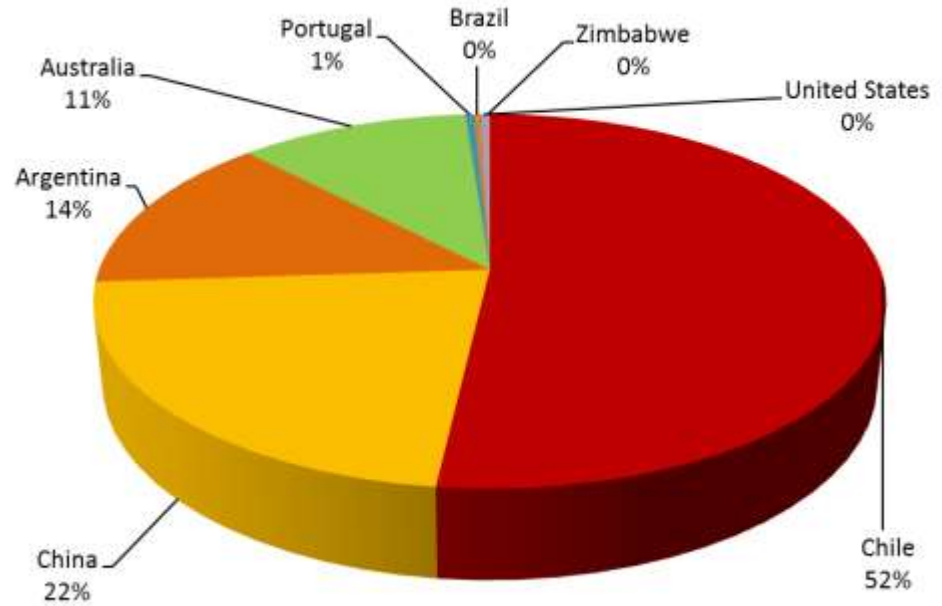


- ✓ Costs
- ✓ Lack of charging infrastructure
- ✓ Charging time
- ✓ Uncertain/underdeveloped/changeable policy framework for EVs

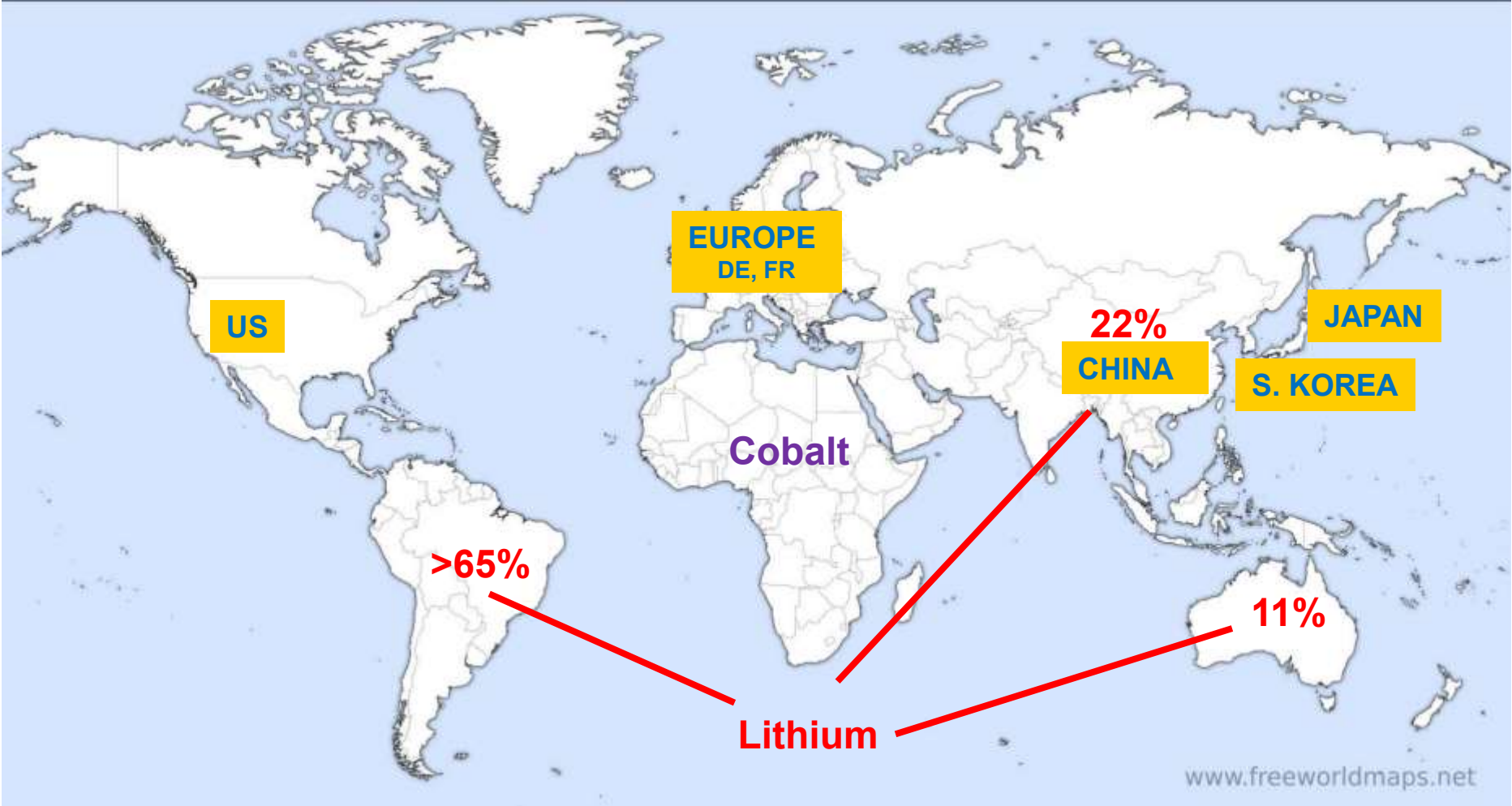


Countries with largest conventional oil reserves

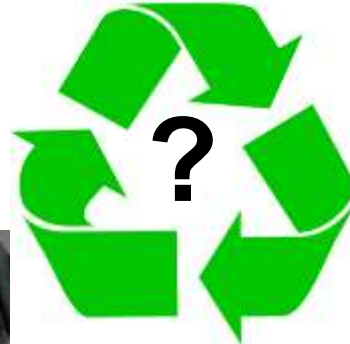
World lithium reserves by country



# Main battery cell manufactures



# Recycling







# ***Towards Sustainable Mobility***



- Decarbonization ...goals and challenges
- EVs ...part of the solution
- New policy design
- Sustainable and resilient supply chains
- Avoid-Shift-Improve strategy



**[ajanovic@eeg.tuwien.ac.at](mailto:ajanovic@eeg.tuwien.ac.at)**