# On Economic and Environmental Prospects of Electric Vehicles

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*EnInnov, 15.02.2018*

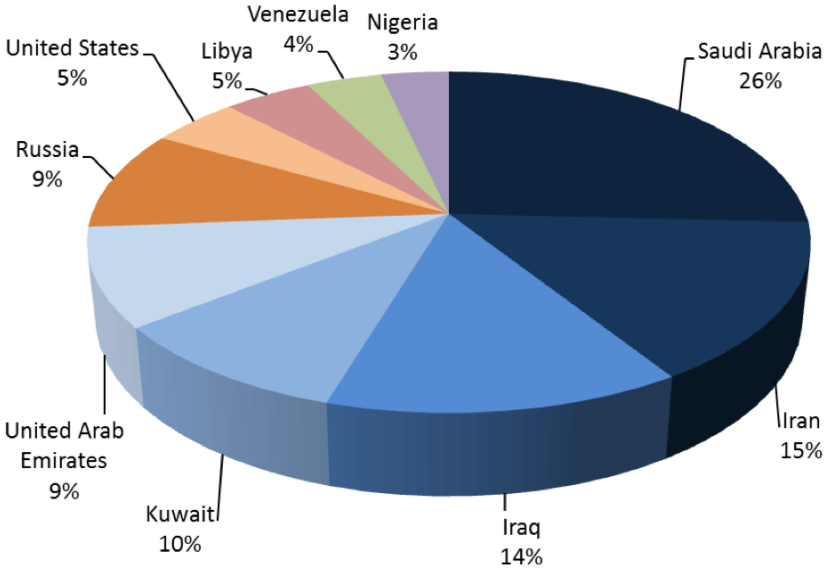
# Content

- ✓ Introduction
- ✓ Electric vehicles
- ✓ Economic assessment
- ✓ Environmental assessment
- ✓ Conclusions

# Introduction

- **93%**

oil products' share of final energy consumption for transport, making the sector the least-diversified

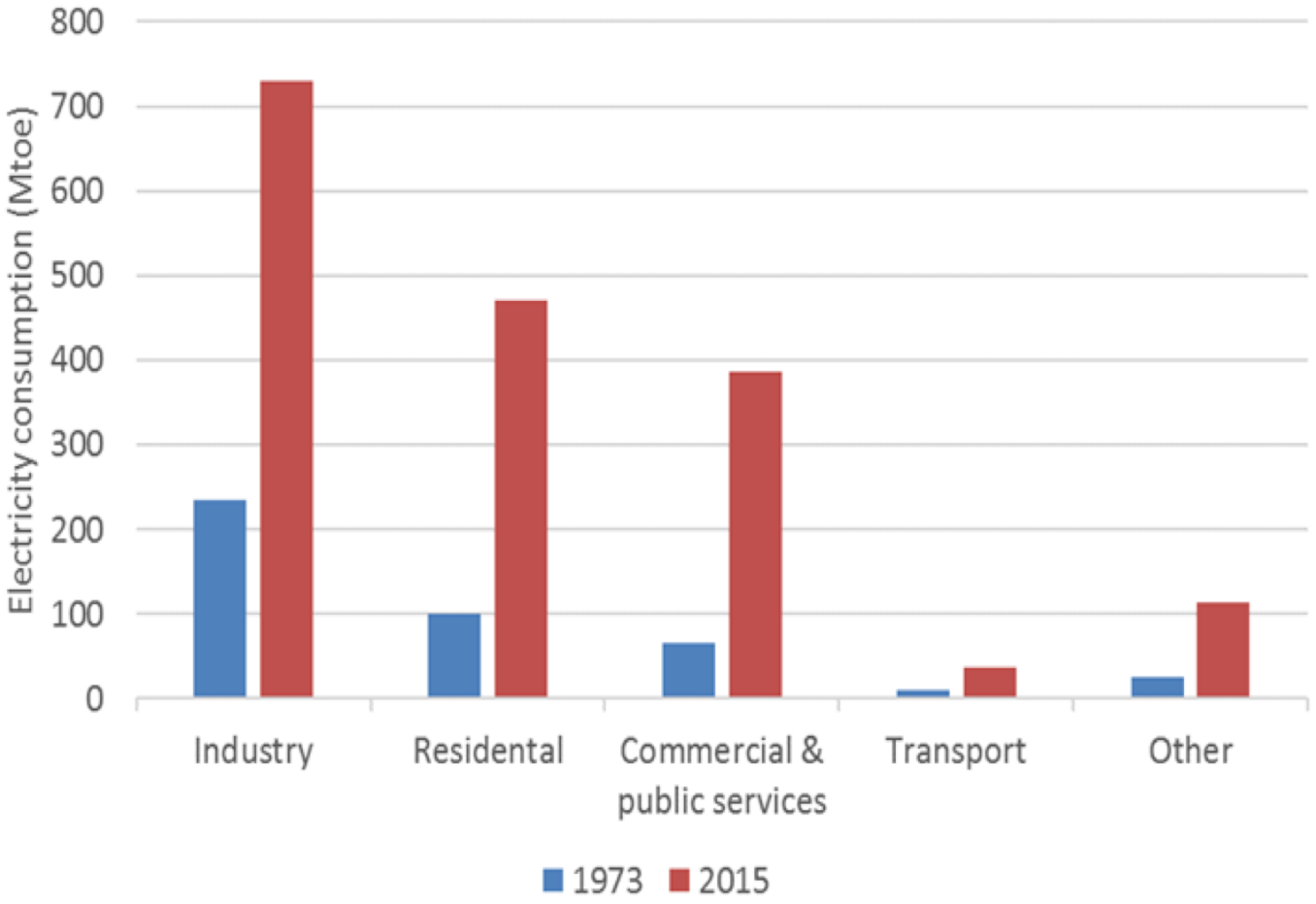



Countries with largest conventional oil reserves

- **28%**

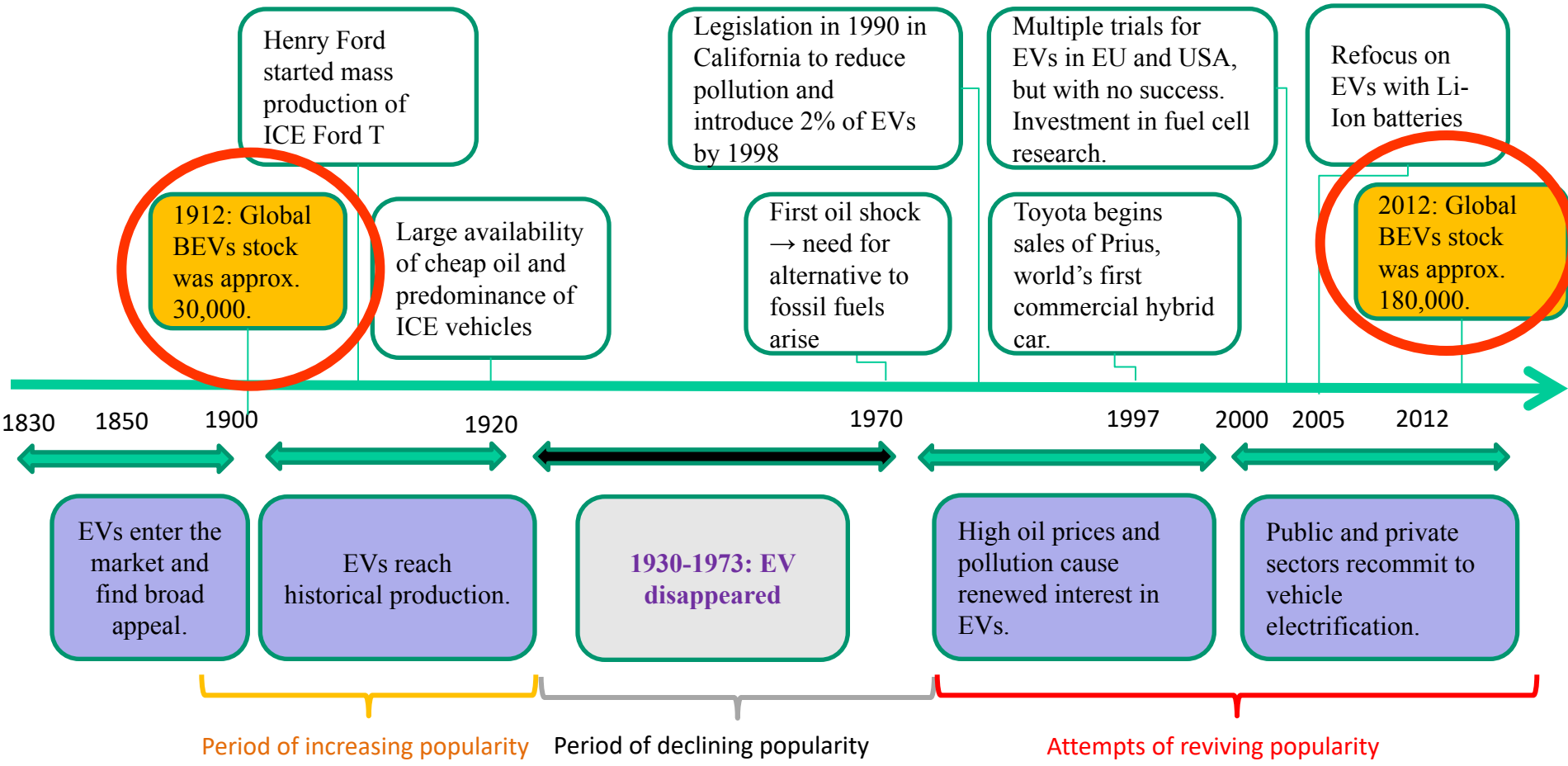
the amount that transport energy and CO2 emissions have increased since 2000

# Total final electricity consumption by sector




440 Mtoe →1737 Mtoe

# Electric vehicles



# Paris Declaration

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

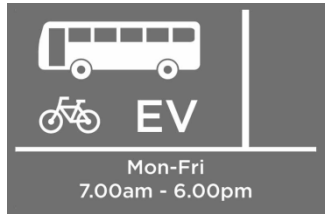
- more than 100 million EVs
- 400 million two and three-wheelers

# Monetary measures

The most commonly used monetary measures are subsidies and exemptions (or reductions) from:

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

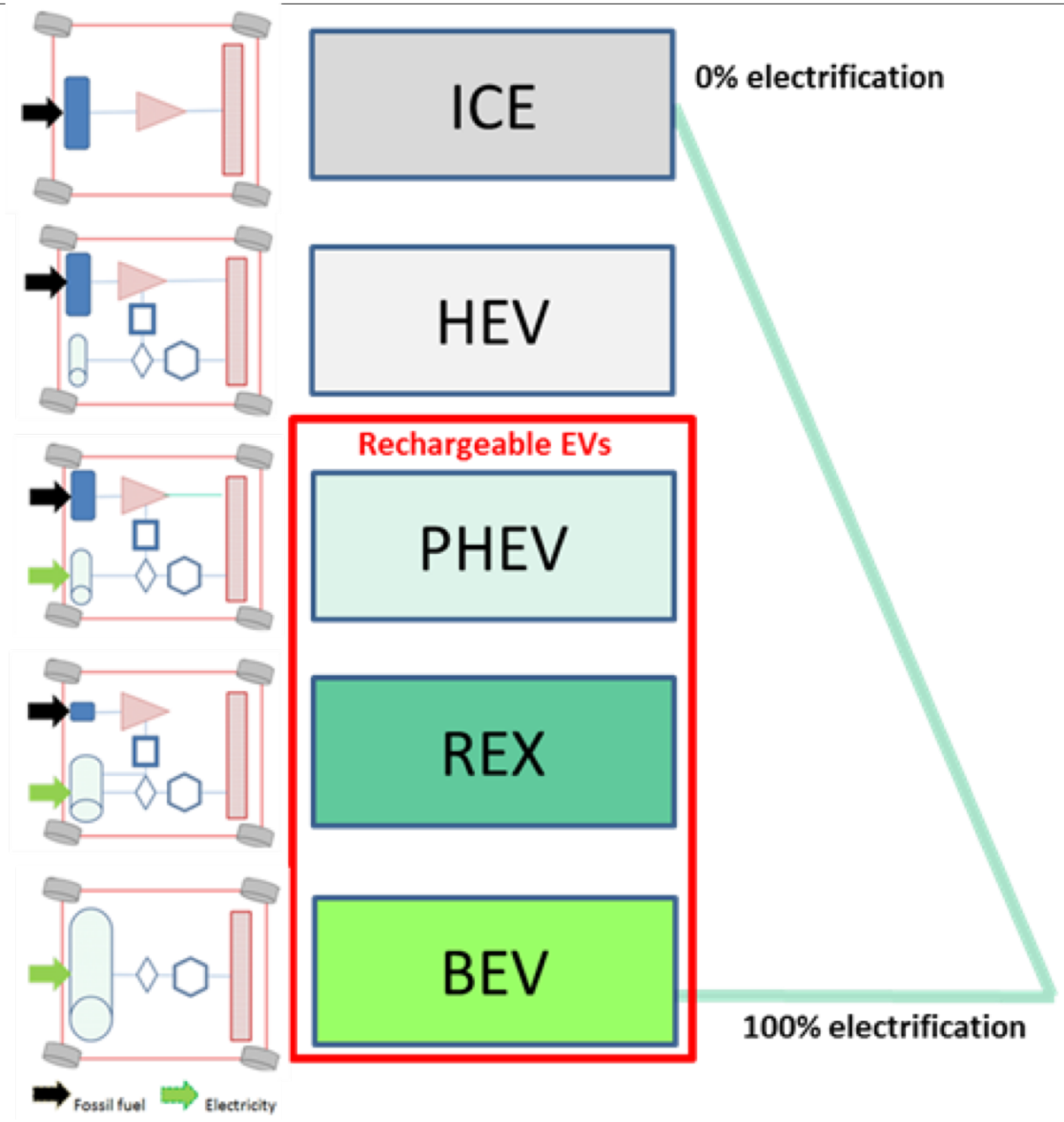
# Non-monetary measures

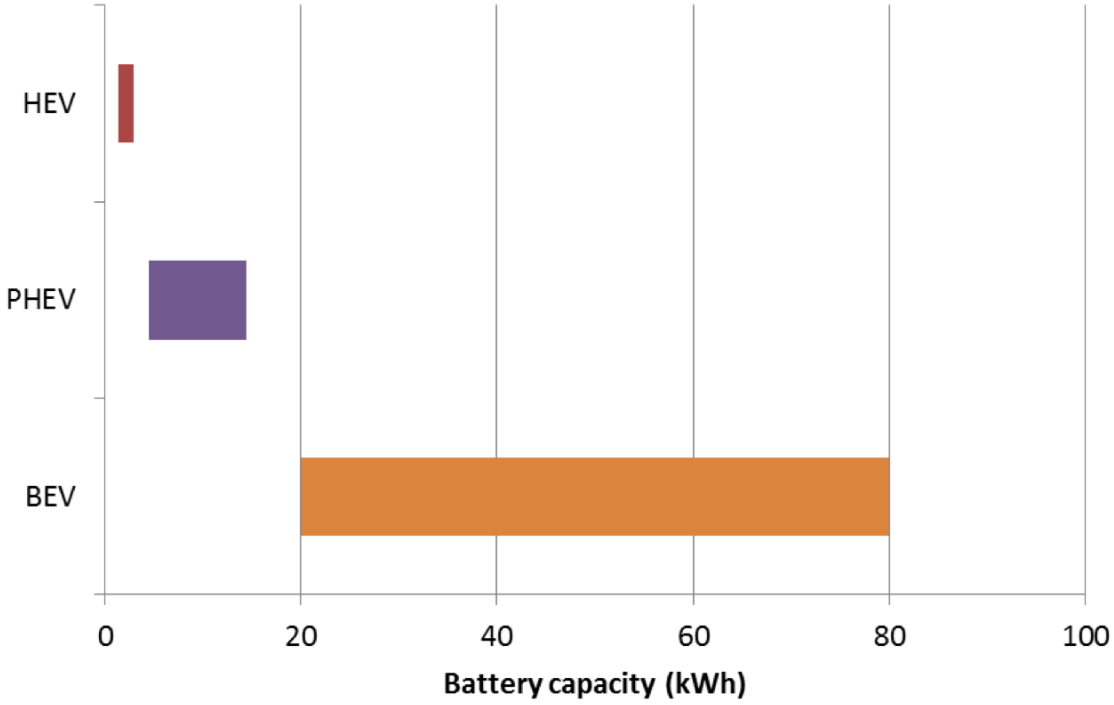

- free parking spaces,
- possibility for EVs drivers to use bus lanes,
- wide availability of charging stations,


- permission for EVs to enter city centers and zero emission zones.

# Electric vehicles

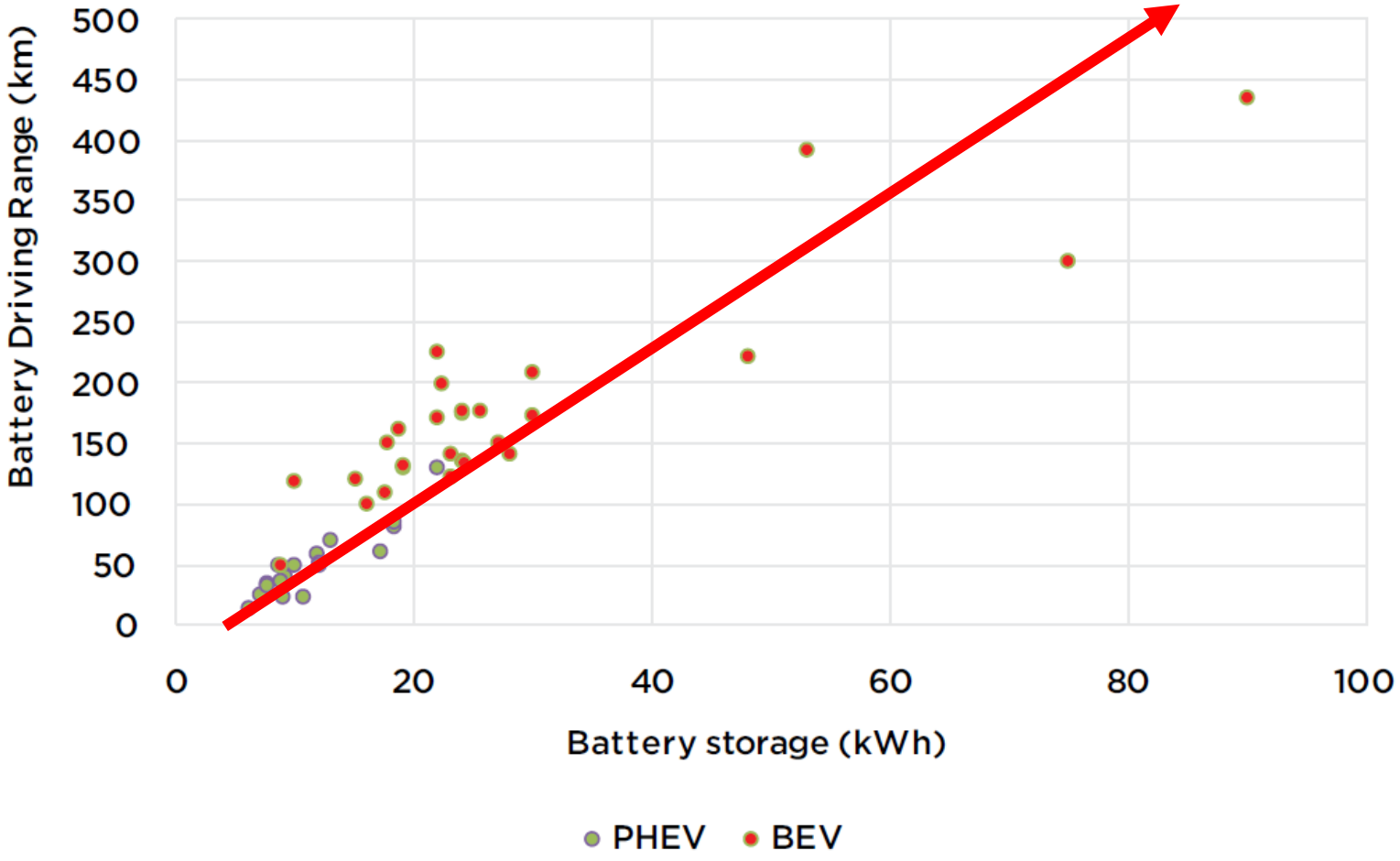


# Battery capacity




Battery capacity for different types of EVs

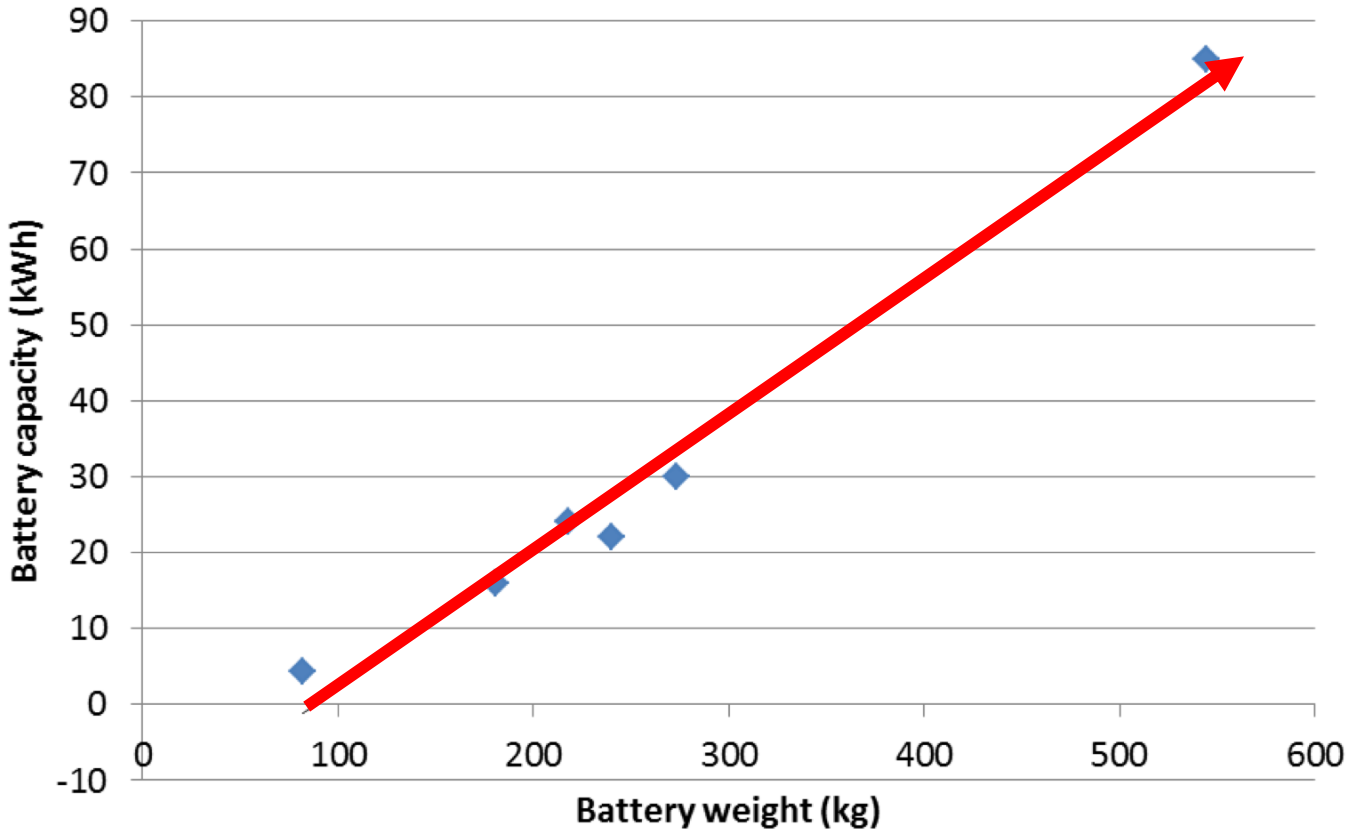
# Capacity vs range




Source: UC Davis market data

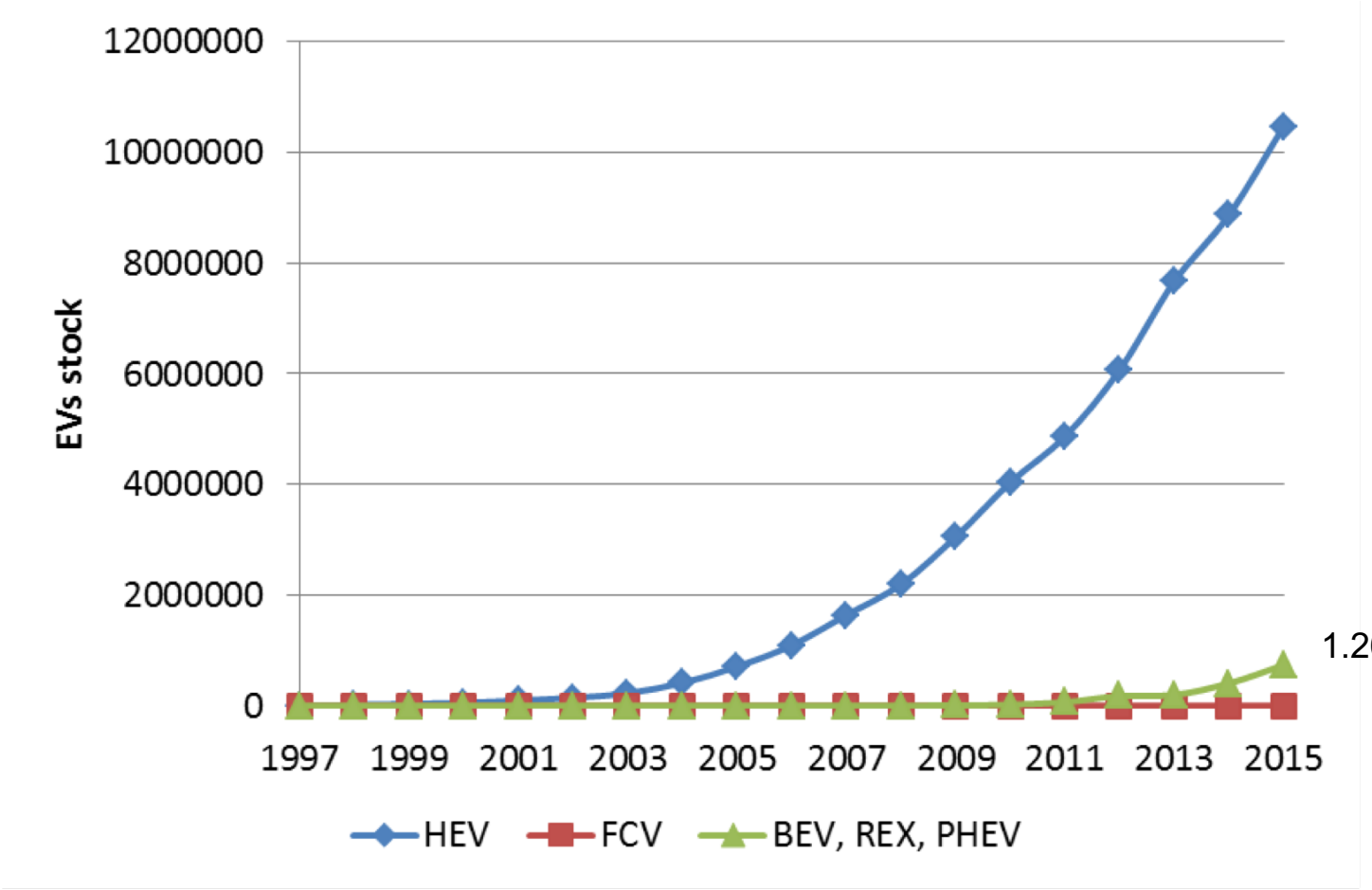
Comparison of battery capacity/driving range for BEVs and PHEVs

# Capacity vs weight



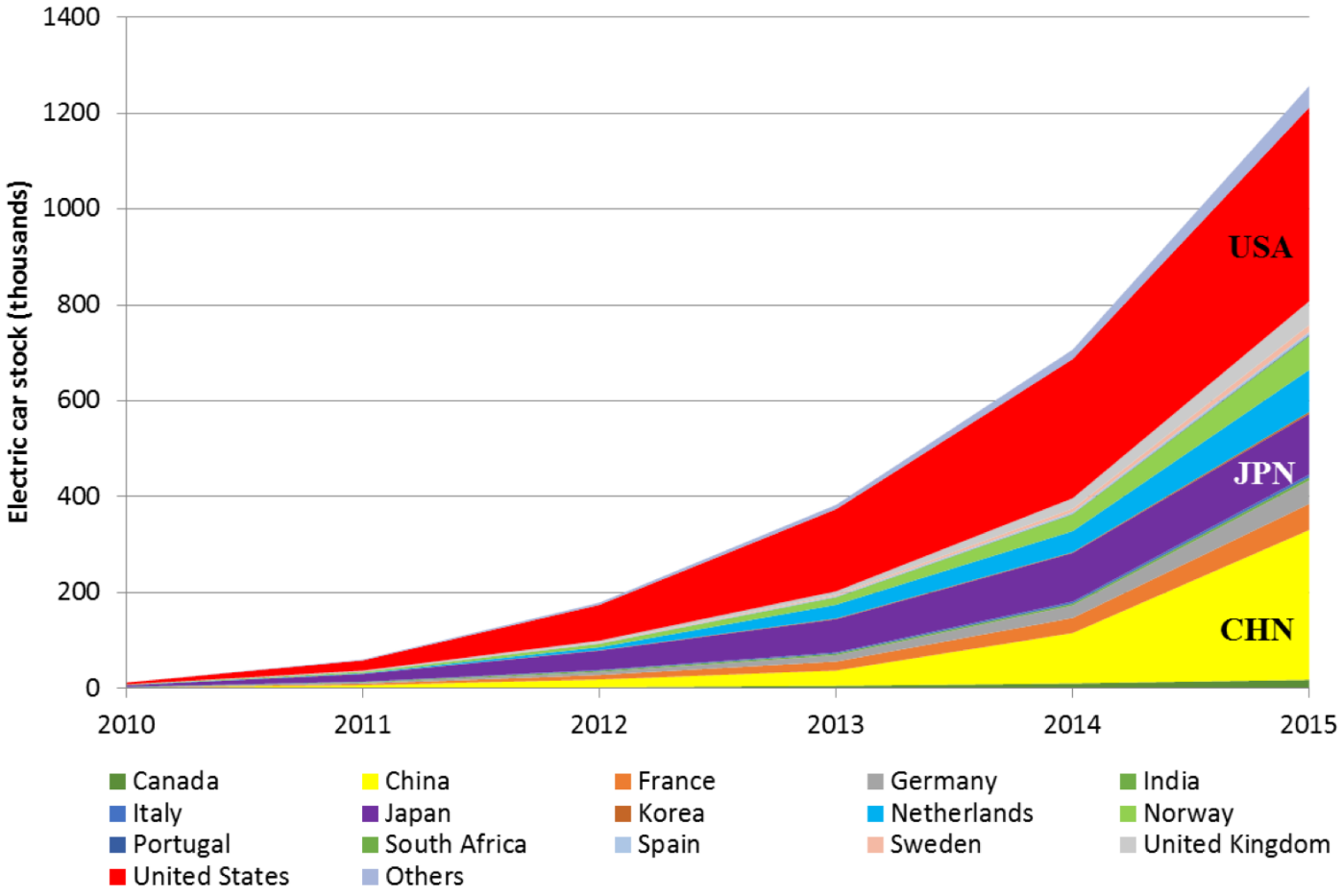

Battery capacity vs battery weight

# Electric vehicles




Development of the global stock of EVs

# Electric vehicles




1.26 milion

Development of the global stock of rechargeable EVs

# Economic assessment

The costs per km driven $C_{km}$ are calculated as:

$$C_{km} = \frac{IC \cdot \alpha}{skm} + P_f \cdot FI + \frac{C_{O\&M}}{skm}$$

[€/100 km driven]

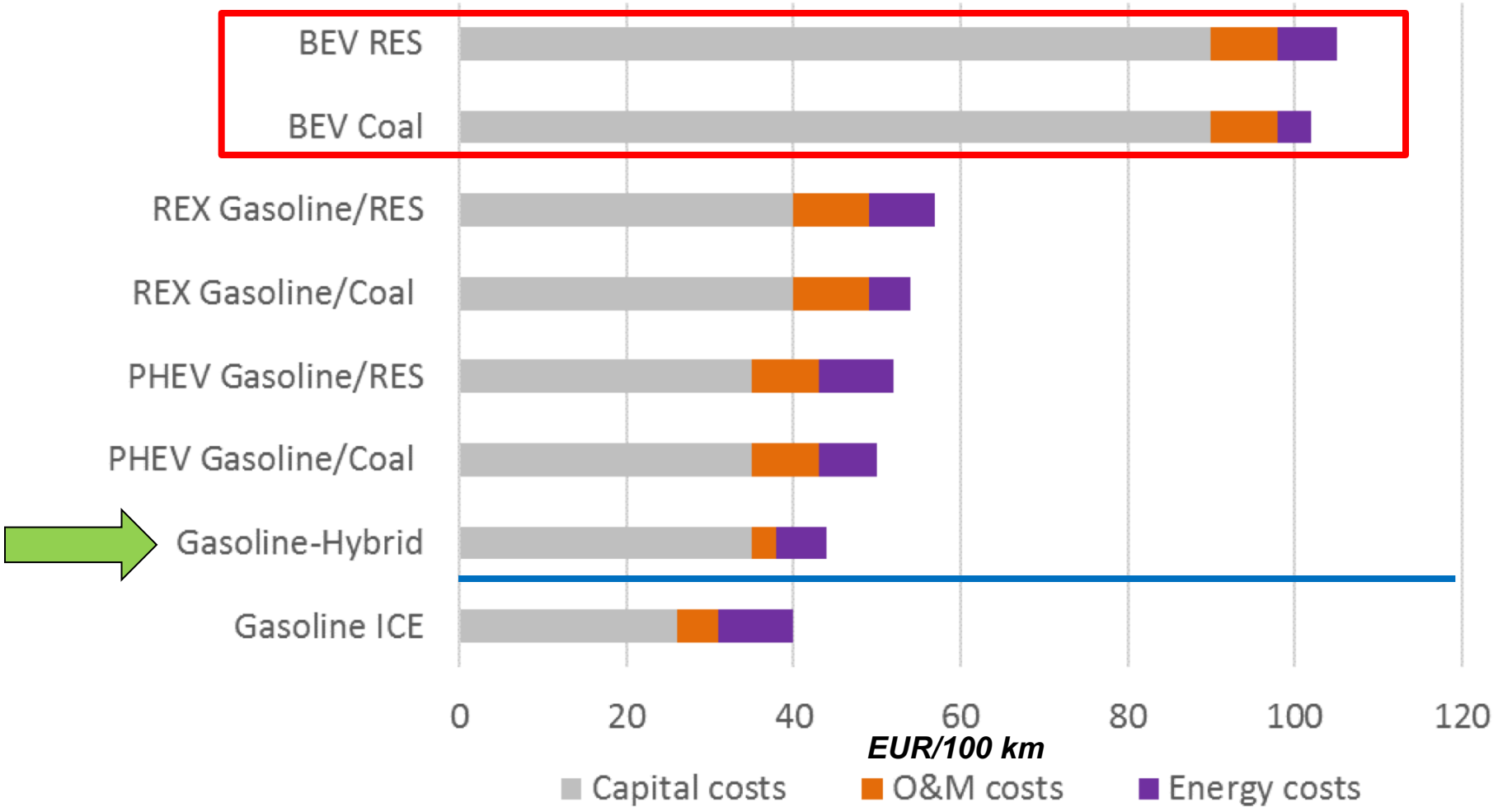
IC……investment costs [€/car]
α……..capital recovery factor
skm…..specific km driven per car per year [km/(car.yr)]
Pf……fuel price incl. taxes [€/litre]
$C_{O\&M}$…operating and maintenance costs
FI……..fuel/energy intensity [litre/100 km; kWh/100 km]

A capital recovery factor (α) is the ratio of a constant annuity to the present value of receiving that annuity for a given length of time. Using an interest rate (z), the capital recovery factor is:

$$\alpha = \frac{z(1+z)^n}{(1+z)^n - 1}$$

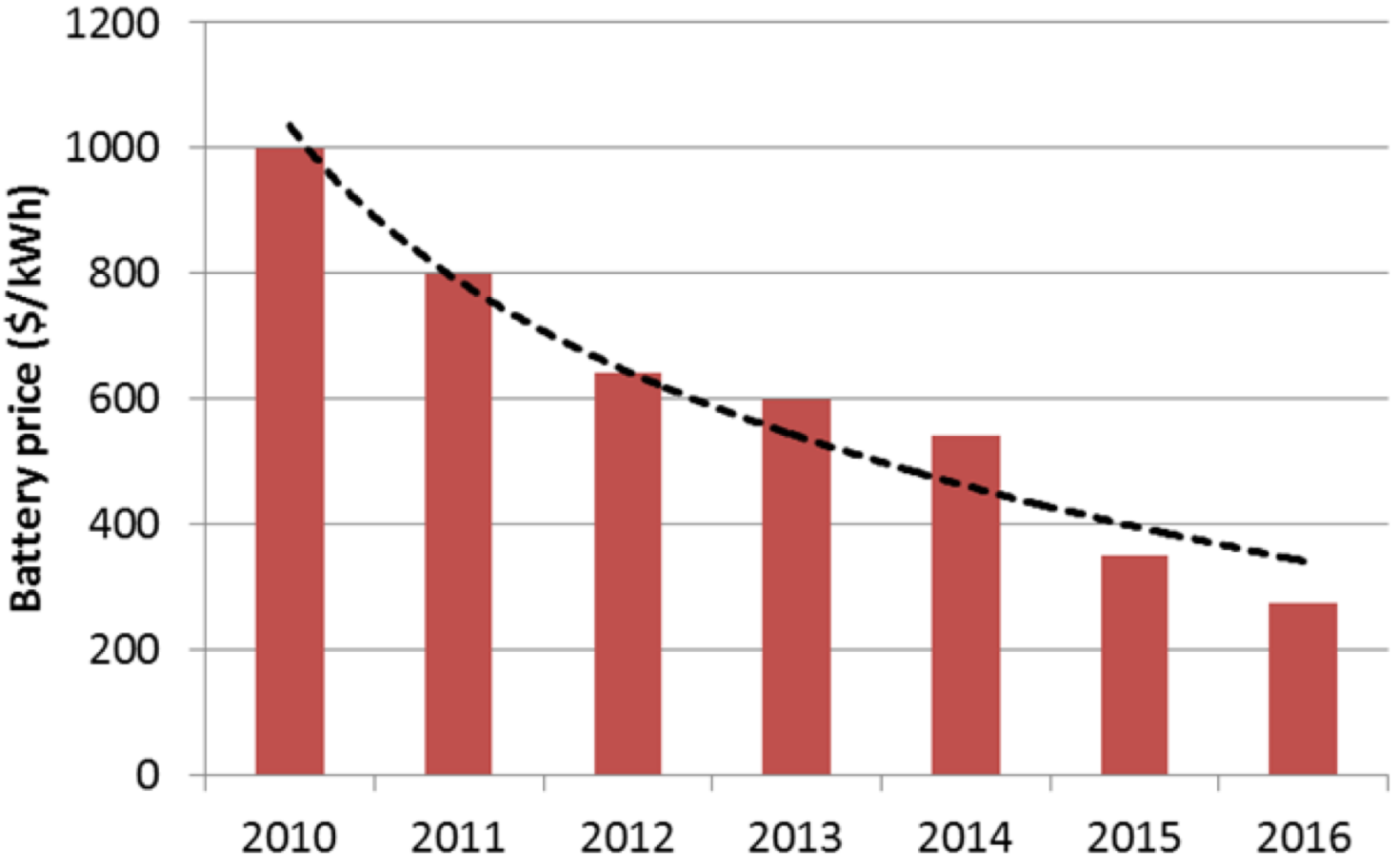
n…..the number of annuities received.

# Total costs of service mobility

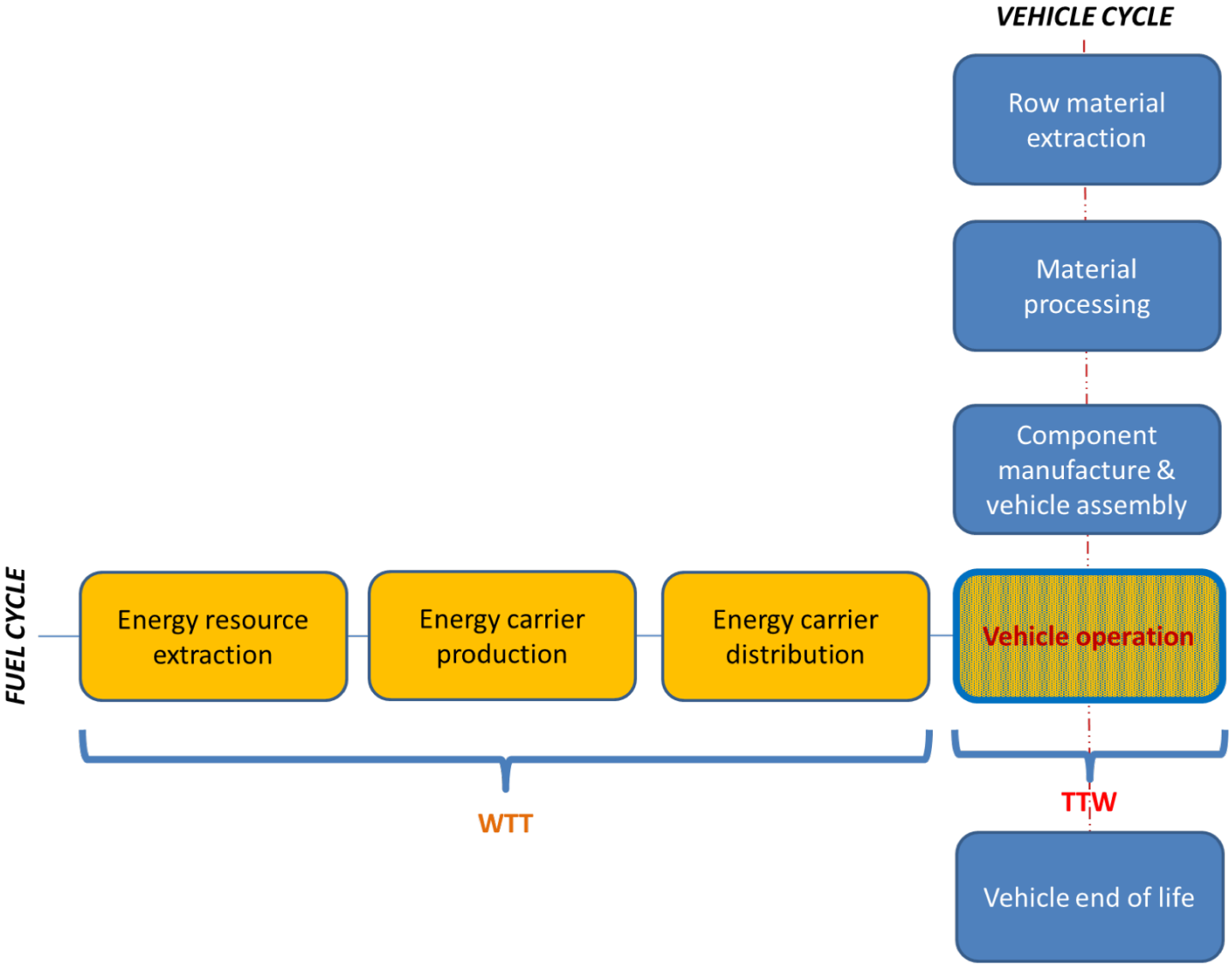



Costs per km driven for various types of EVs in comparison to conventional cars (power of car: 80kW)

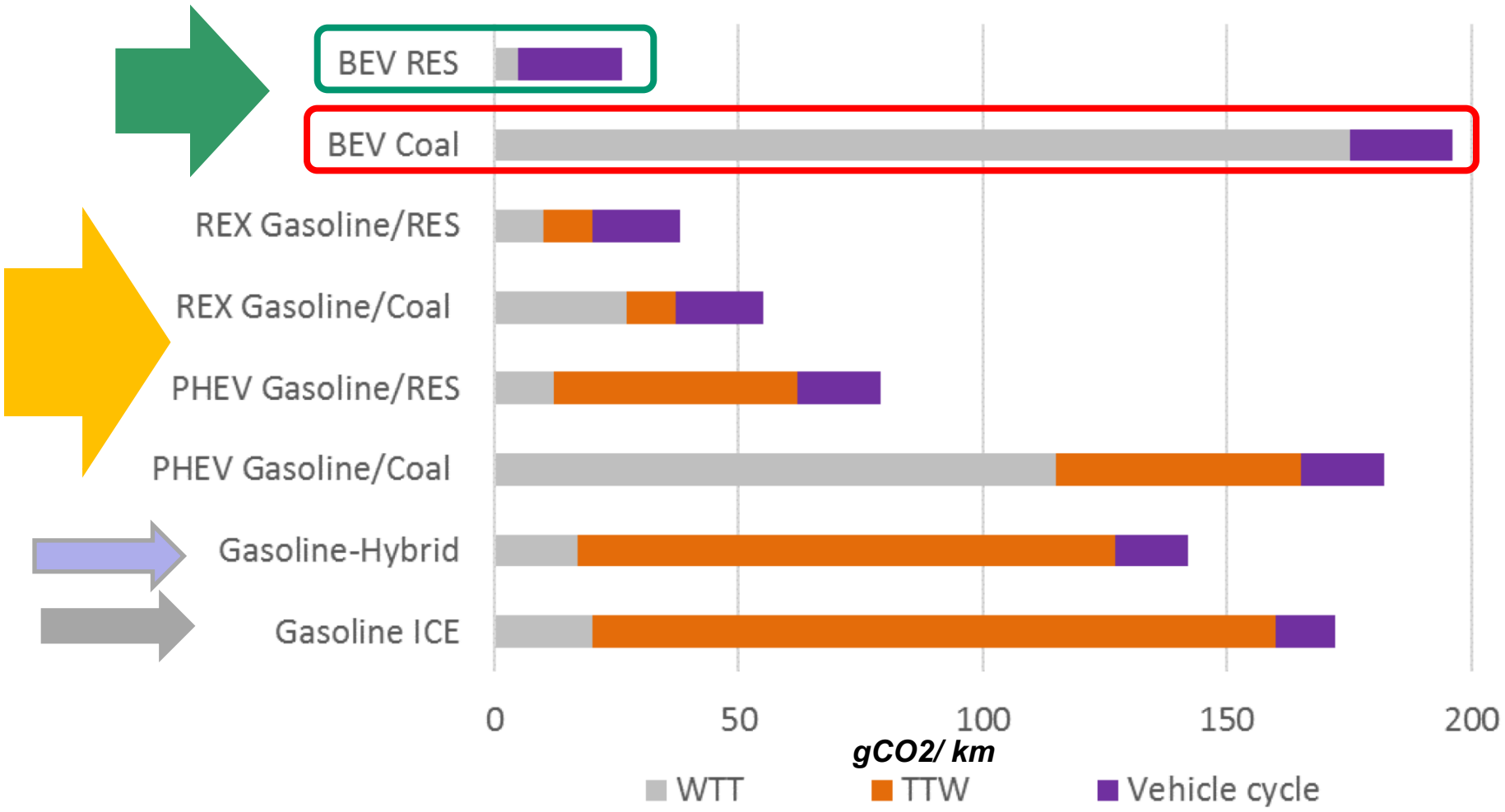
# Technological learning – Battery



# Environmental assessment

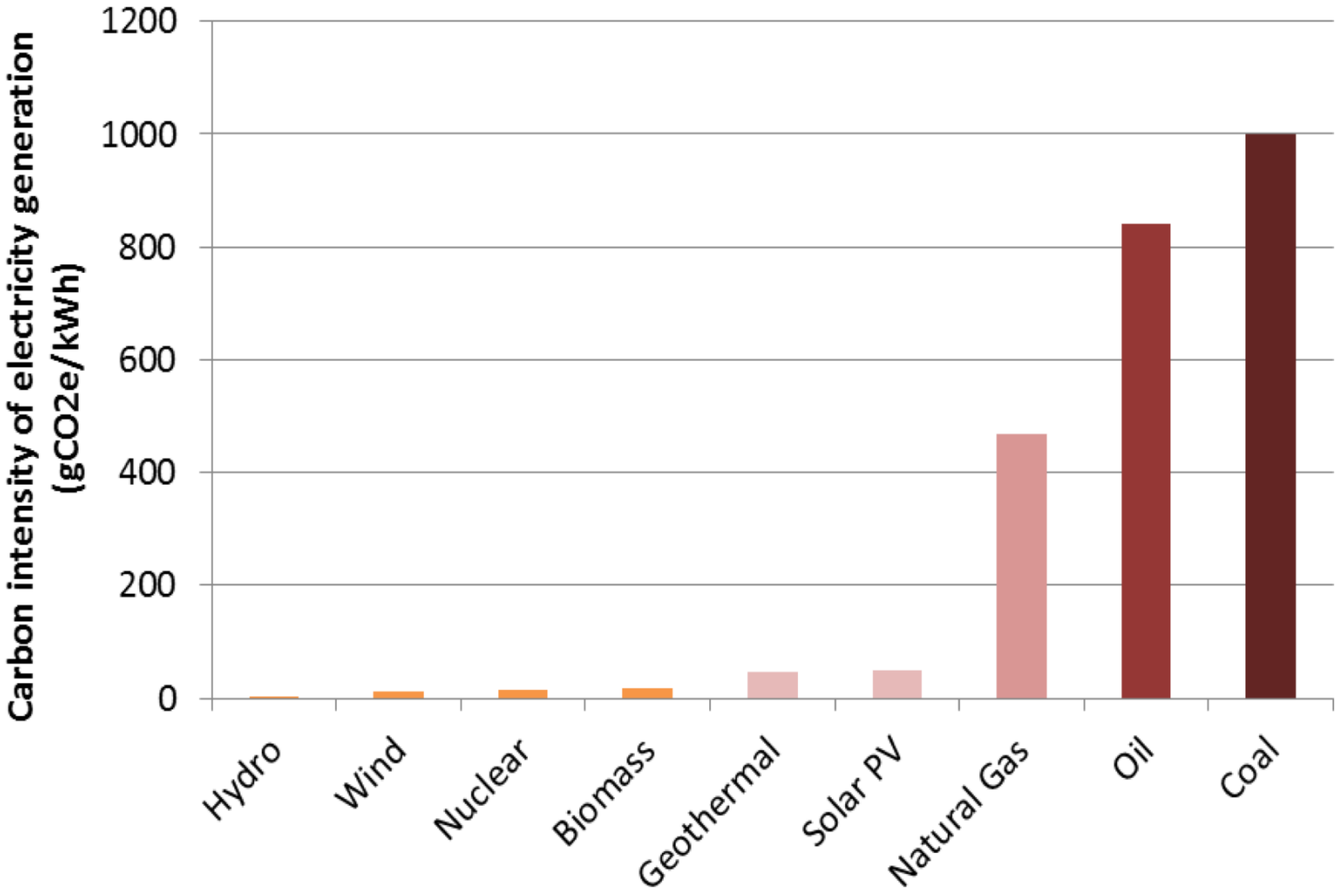


# Environmental assessment

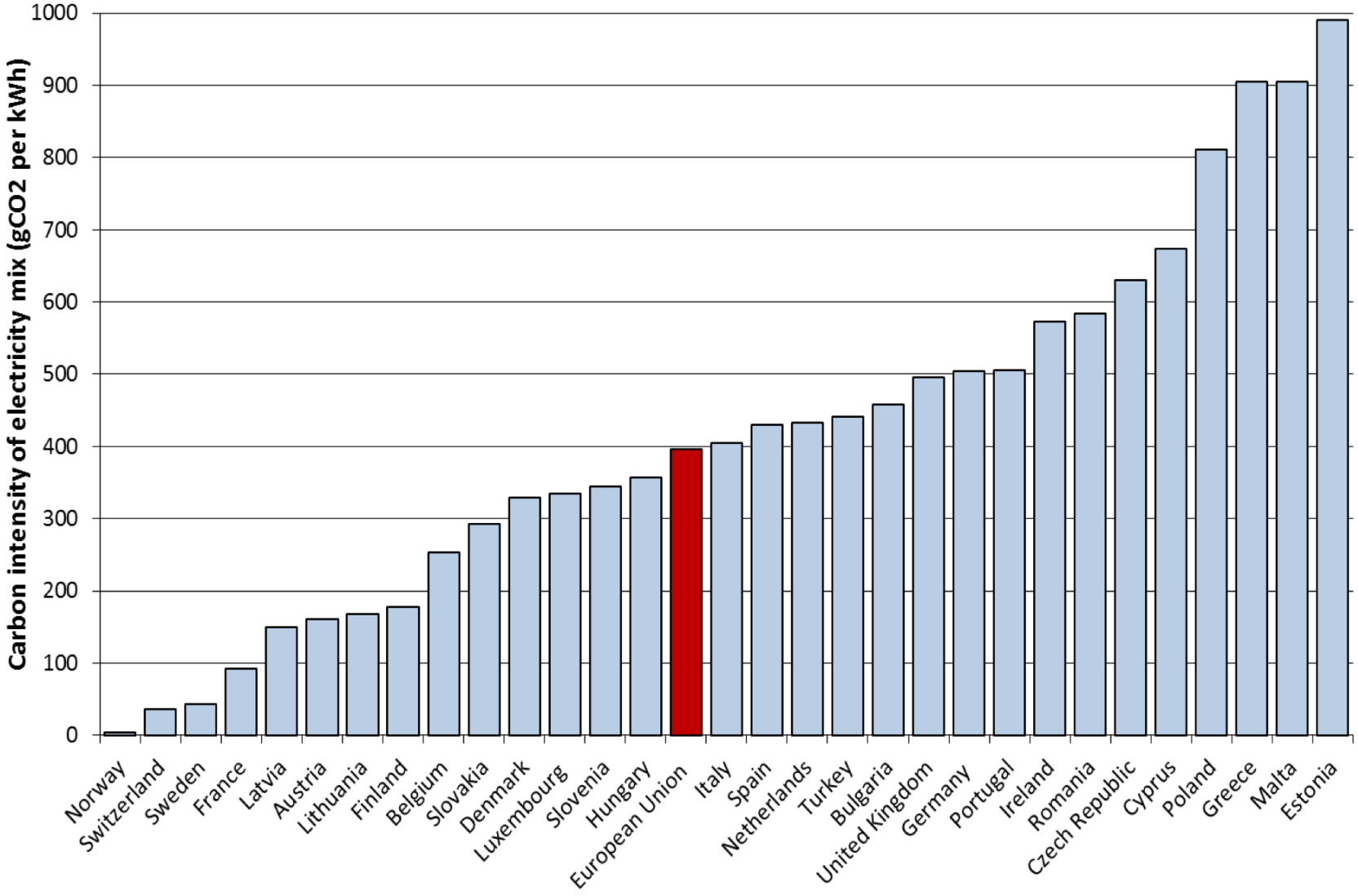



$CO_2$ emissions per km driven for various types of EVs in comparison to conventional cars (power of car: 80kW)

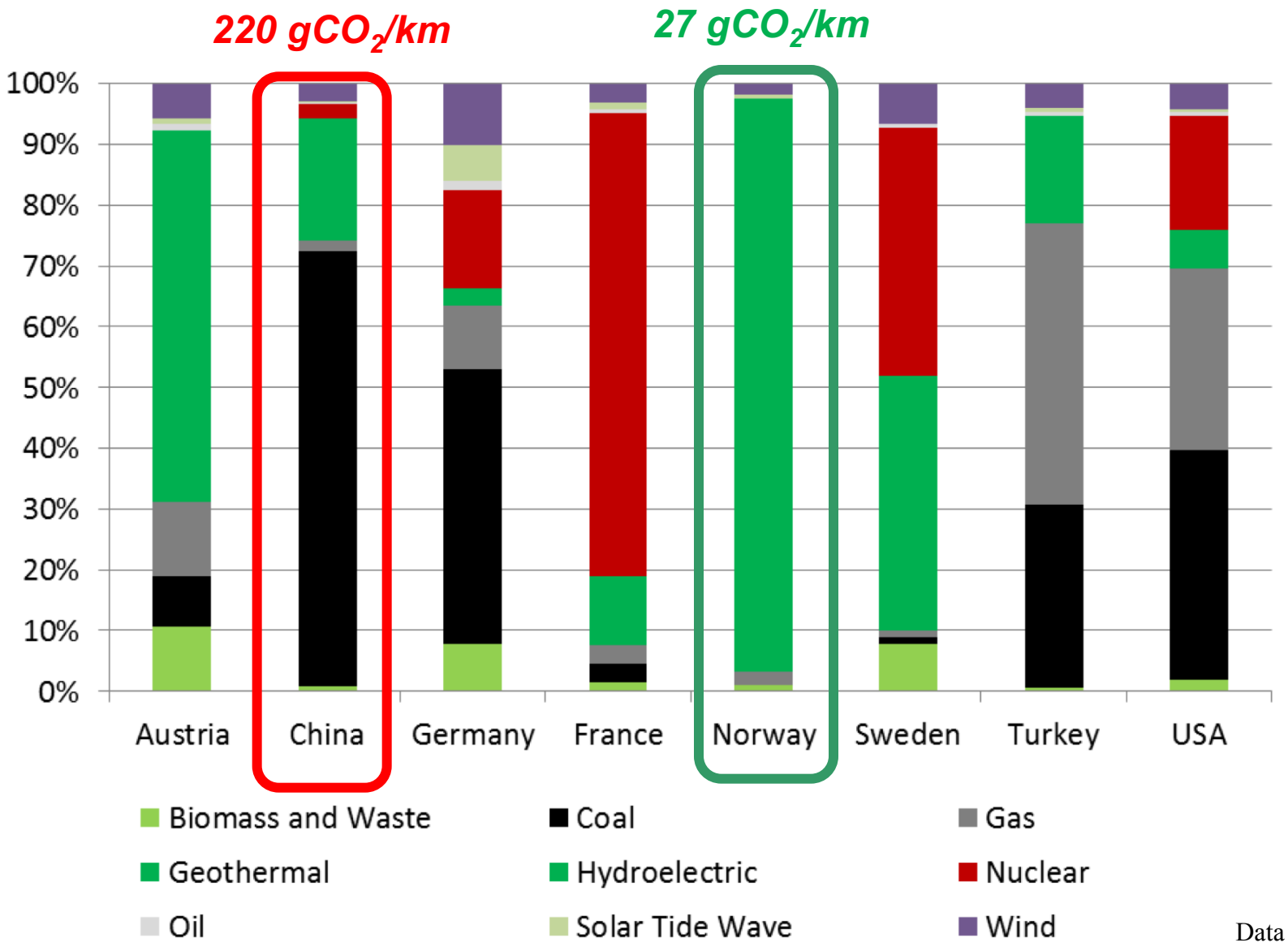
# The carbon intensity of electricity generation



# The carbon intensity of electricity mix



# Electricity mix




Data source: tsp,2014

# Conclusions

- EVs …cost reductions, battery improvement, infrastructure development
- New policy design….most of the policies implemented will be abolished with the increasing number of EVs
- Full environmental benefit – only if EVs are powered by electricity generated from renewable energy sources

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