Electrification of transport: Major drivers and barriers

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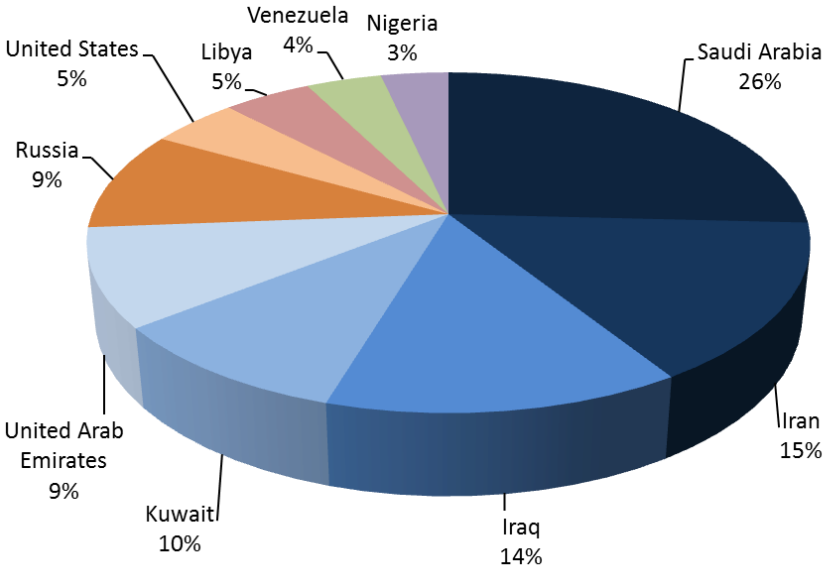
Content

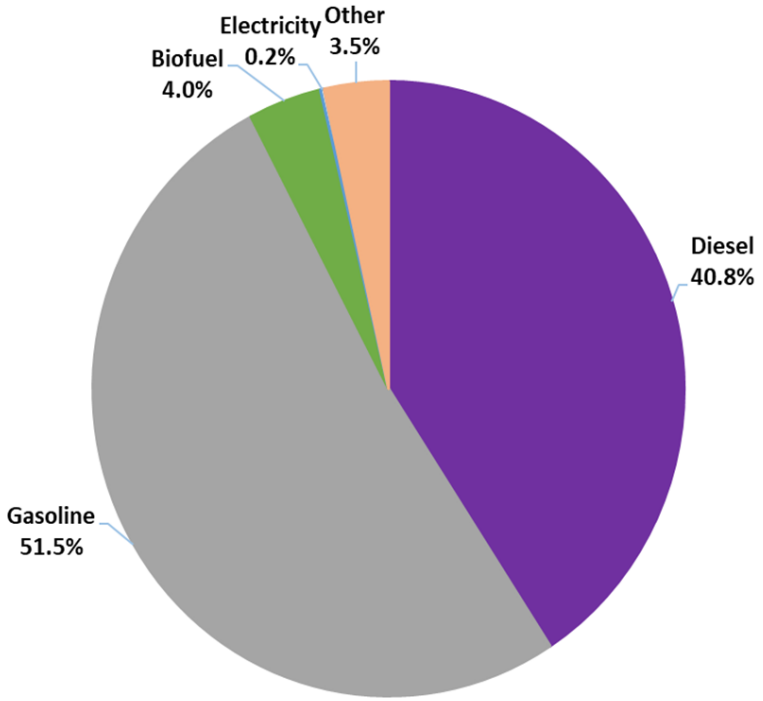
- ✓ Introduction
- ✓ Policy framework
- ✓ Recent developments and challenges
  - ✓ Electrification of the road transport
- ✓ Economic and environmental assessment
- ✓ Conclusion

Transport sector

- oil products
- least-diversified
- energy import dependency



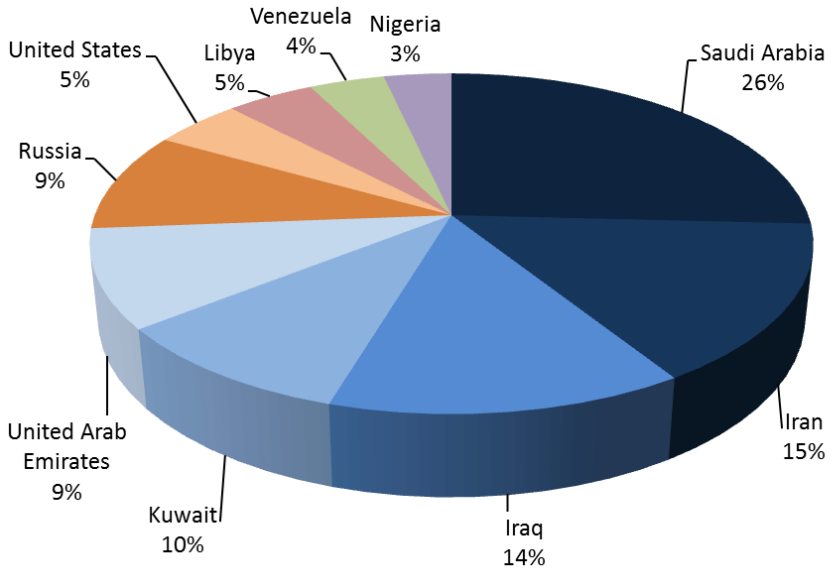
Countries with largest conventional oil reserves



Global energy consumption in road transport

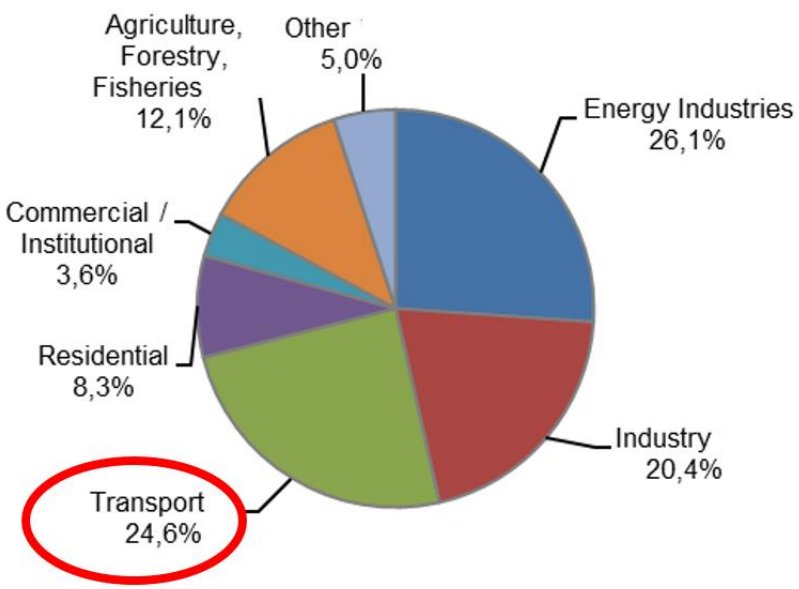
Transport sector

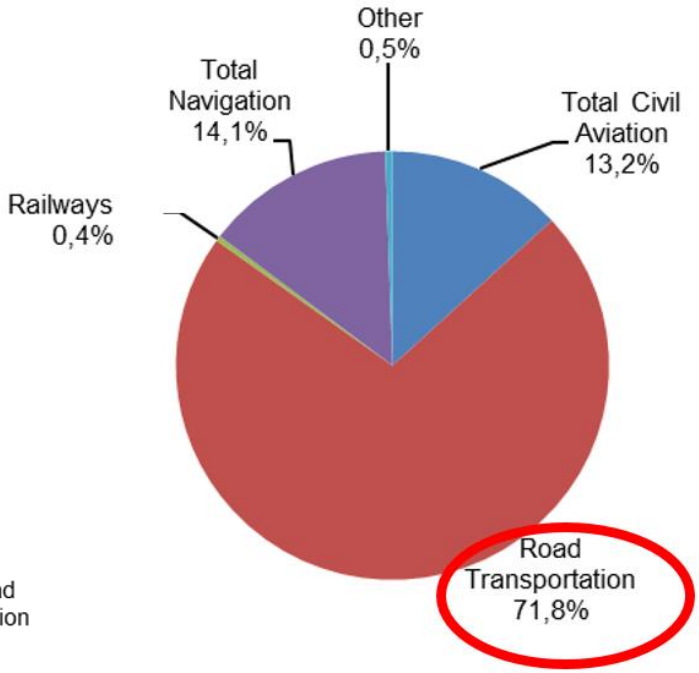
- oil products
- least-diversified
- energy import dependency

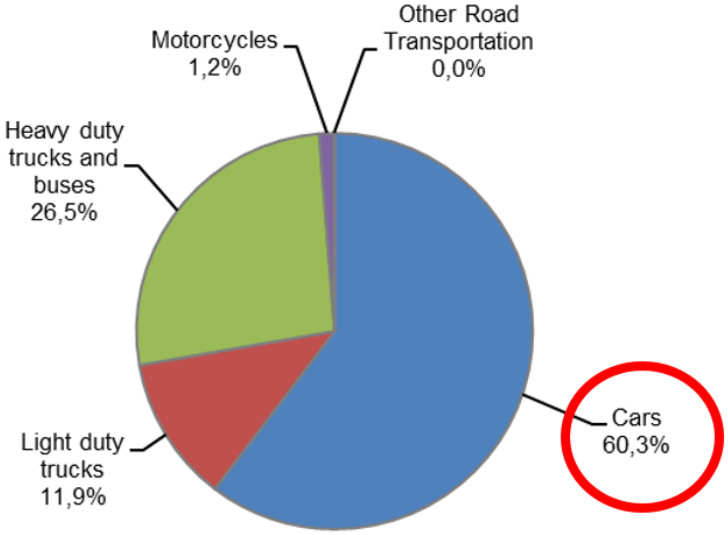


Countries with largest conventional oil reserves

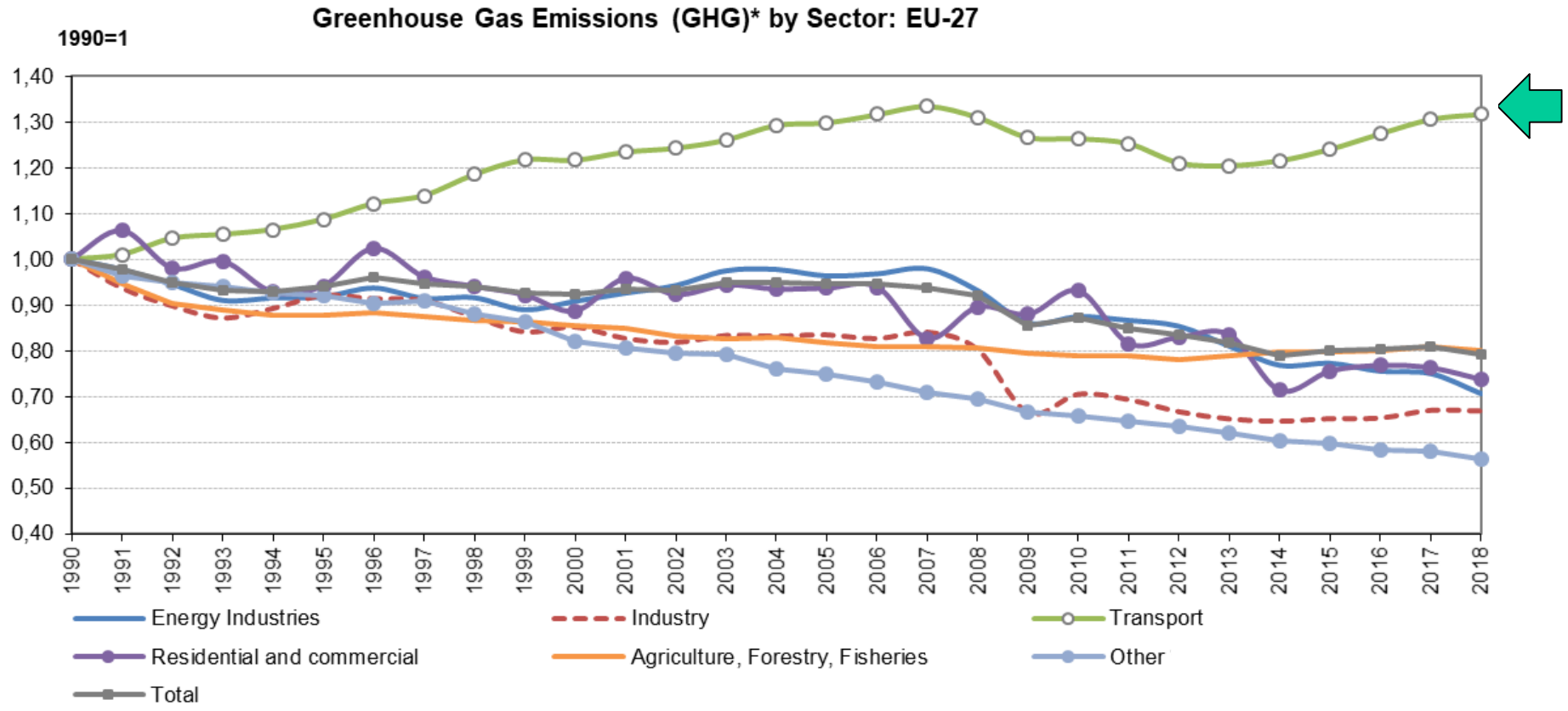
GHG - EU 27


Agriculture, Forestry, Fisheries 12,1%
Other 5,0%
Energy Industries 26,1%
Commercial / Institutional 3,6%
Residential 8,3%
Industry 20,4%
Transport 24,6%


Other 0,5%
Total Navigation 14,1%
Total Civil Aviation 13,2%
Railways 0,4%
Road Transportation 71,8%


Motorcycles 1,2%
Other Road Transportation 0,0%
Heavy duty trucks and buses 26,5%
Cars 60,3%
Light duty trucks 11,9%

GHG


Greenhouse Gas Emissions (GHG)* by Sector: EU-27
1990=1
1,40
1,30
1,20
1,10
1,00
0,90
0,80
0,70
0,60
0,50
0,40
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Energy Industries
Industry
Transport
Residential and commercial
Agriculture, Forestry, Fisheries
Other
Total

EU targets

Climate & energy package

GHG:40-RES:32-EE:32.5

TRA:14%

2009 2010 2015 2020 2025 2030 2050

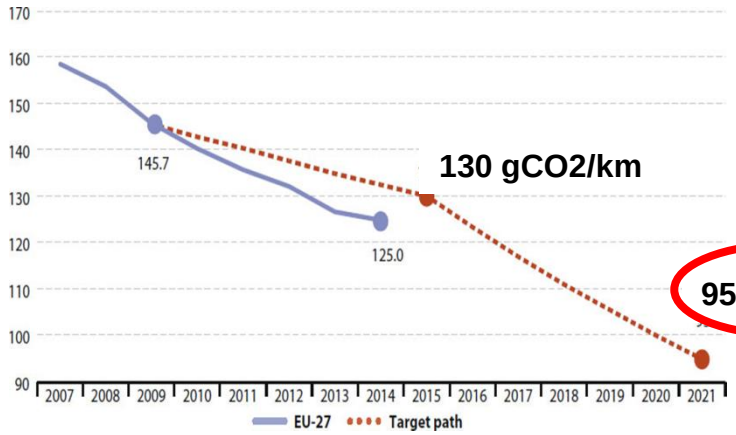
ICE -50% in city

20% GHG (2008)

No ICE in city

60% GHG (1990)

Transport White Paper



-15%

-37,5%

Targets and average CO_2 emissions from new passenger cars in EU countries

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

	2025	2030	2035	2040	2045	2050
Costa Rica						●
Denmark		●				
France				●		
Iceland		●				
Ireland		●				
Israel*		●		●		
Netherlands		●			●	
Norway	●					
Portugal				●		
Slovenia		●				
Spain				●		●
Sri Lanka				●		
United Kingdom				●		

● ICE sales ban or 100% ZEV sales target ● Fleet without ICEs

Electric vehicles

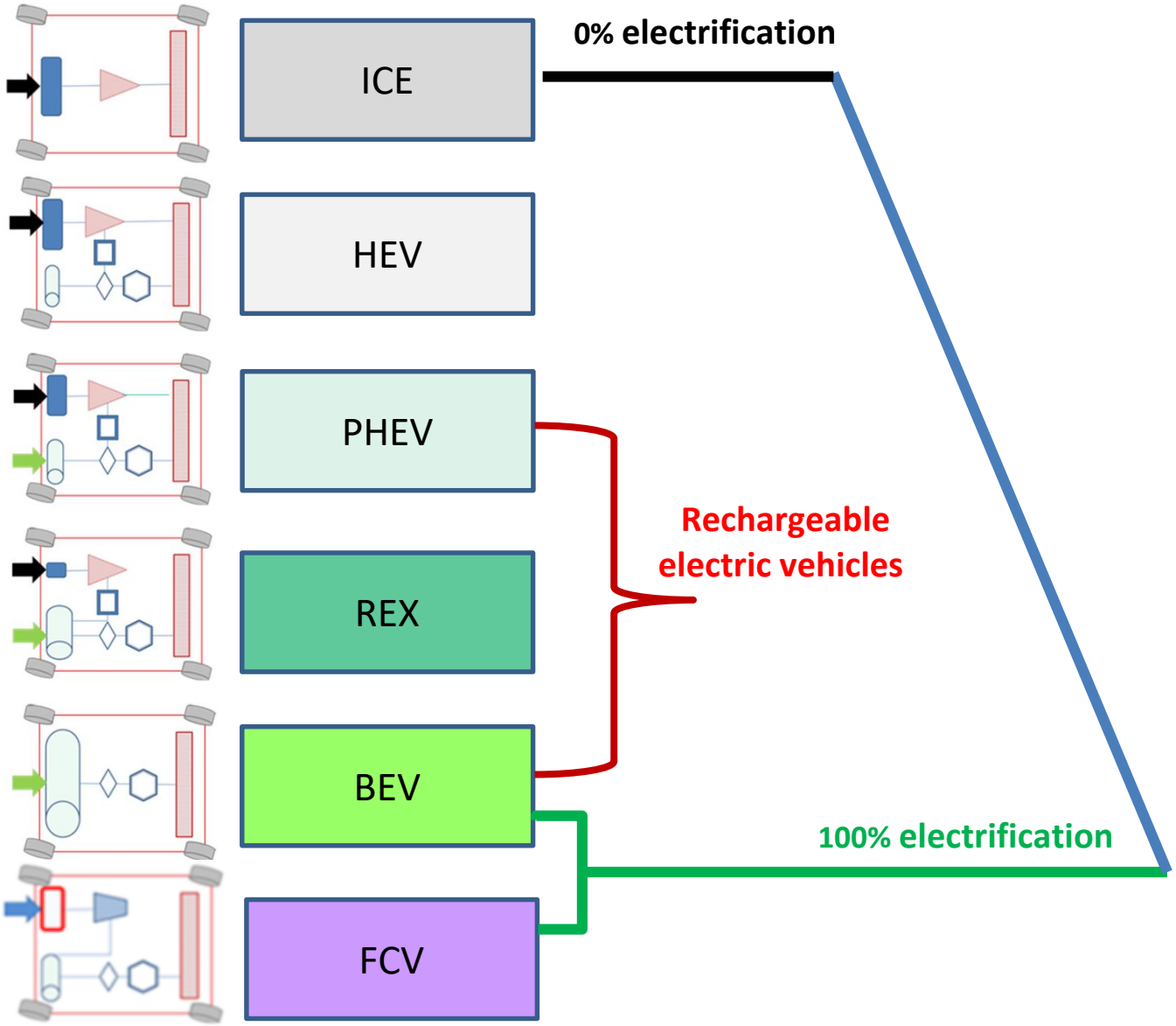
Monetary measures

- 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

Electric vehicles



Electric vehicles

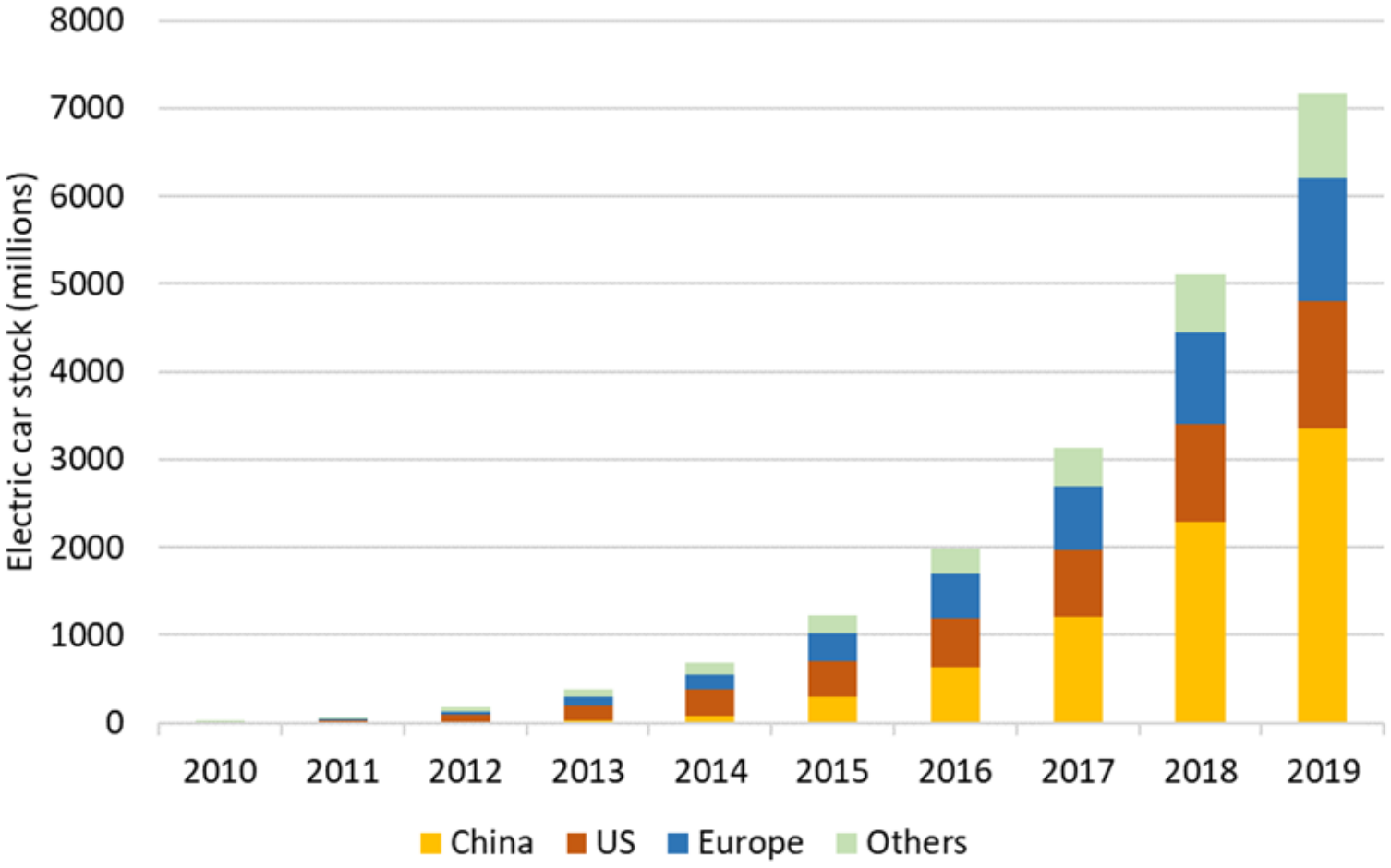
Advantages

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

Disadvantages

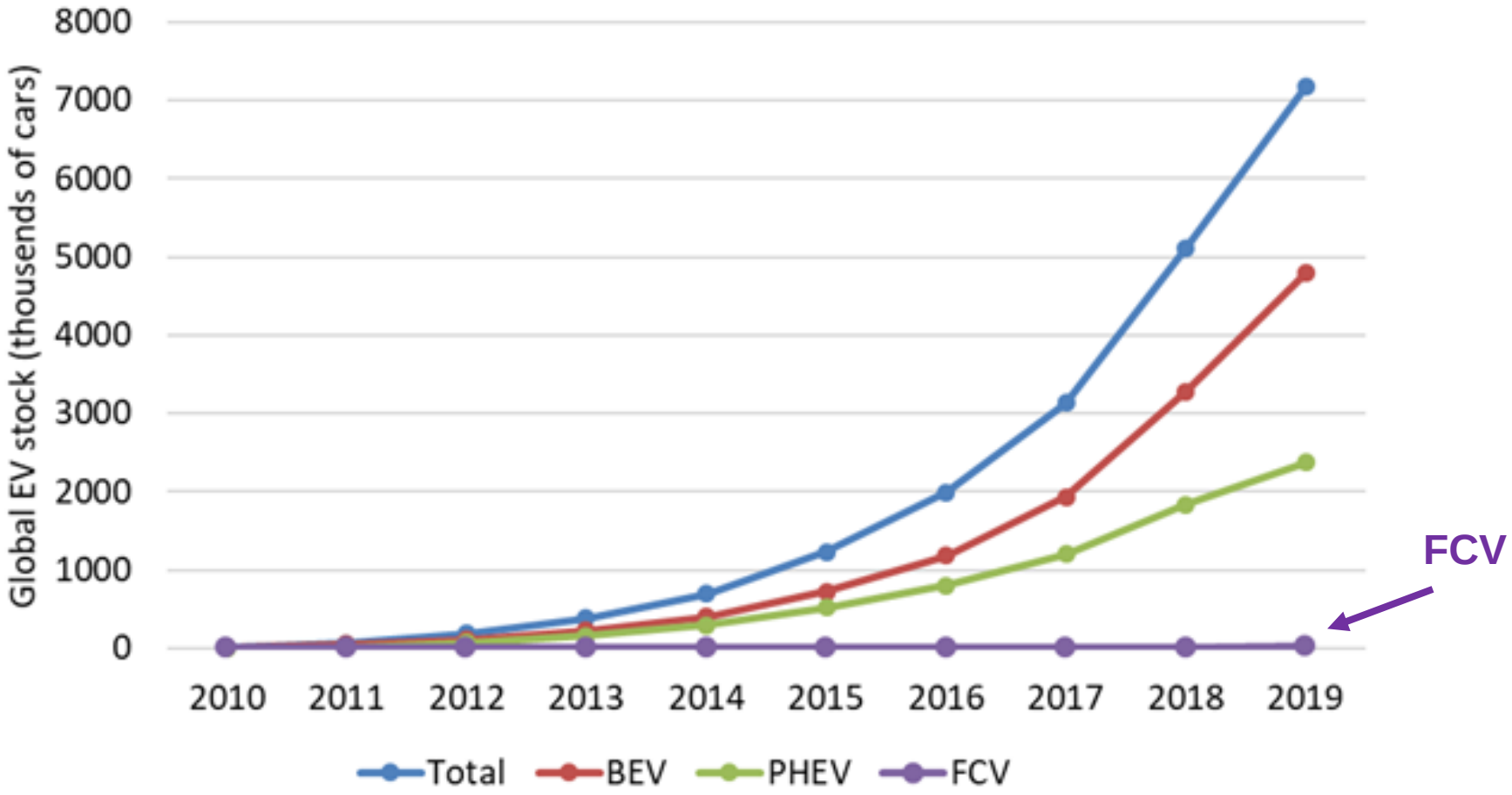
- – Costs
- – Driving range
- – Charging time
- – Charging infrastructure

Electric vehicles



IEA, 2020

The global stock of electric vehicles, 2010-2019



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]

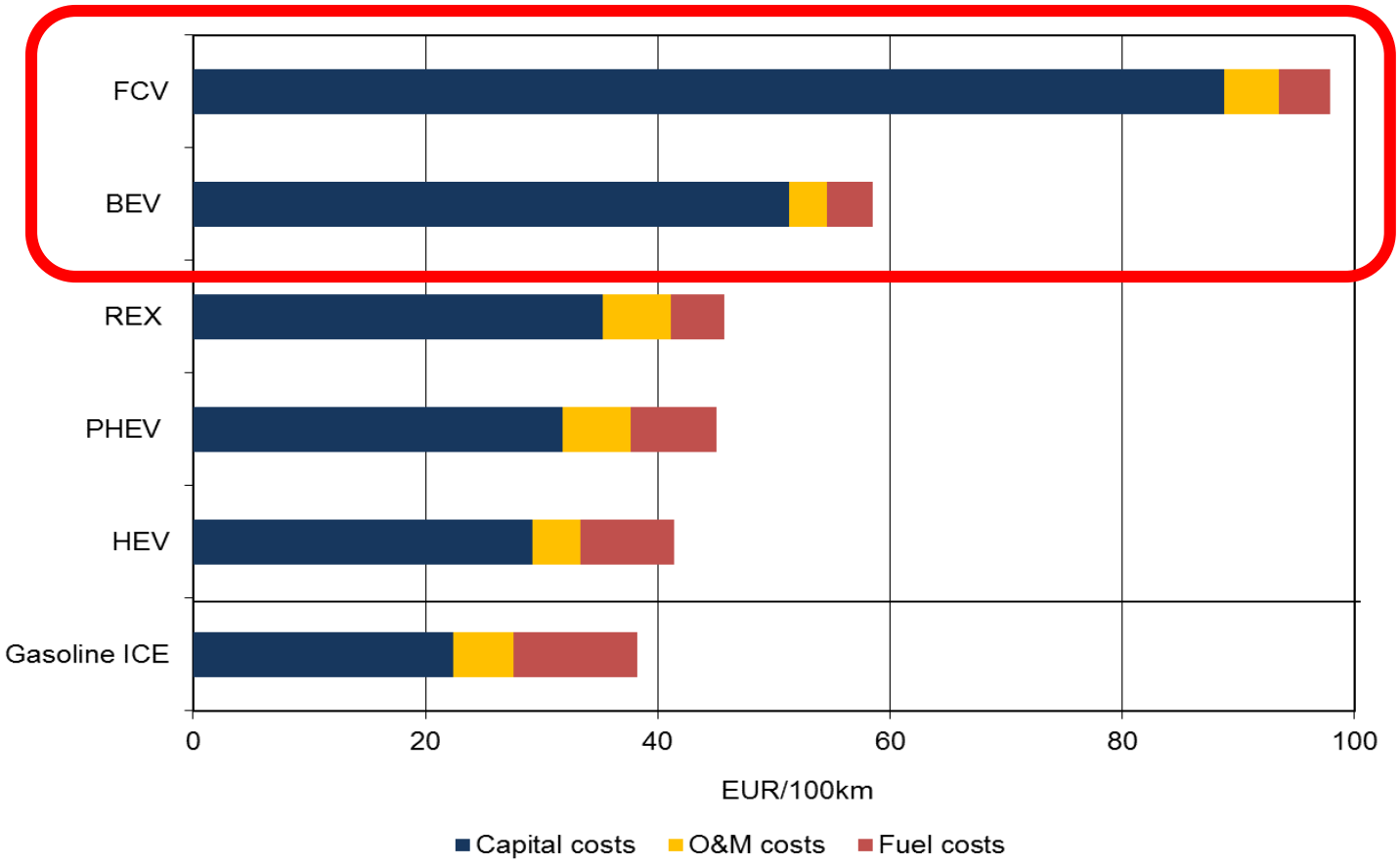
IC……investment costs [€/car]
α……..capital recovery factor
skm…..specific km driven per car per year [km/(car.yr)]
Pf……fuel price incl. taxes [€/litre]
$C_{O\&M}$…operating and maintenance costs
FI……..fuel/energy intensity [litre/100 km; kWh/100 km]

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:

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

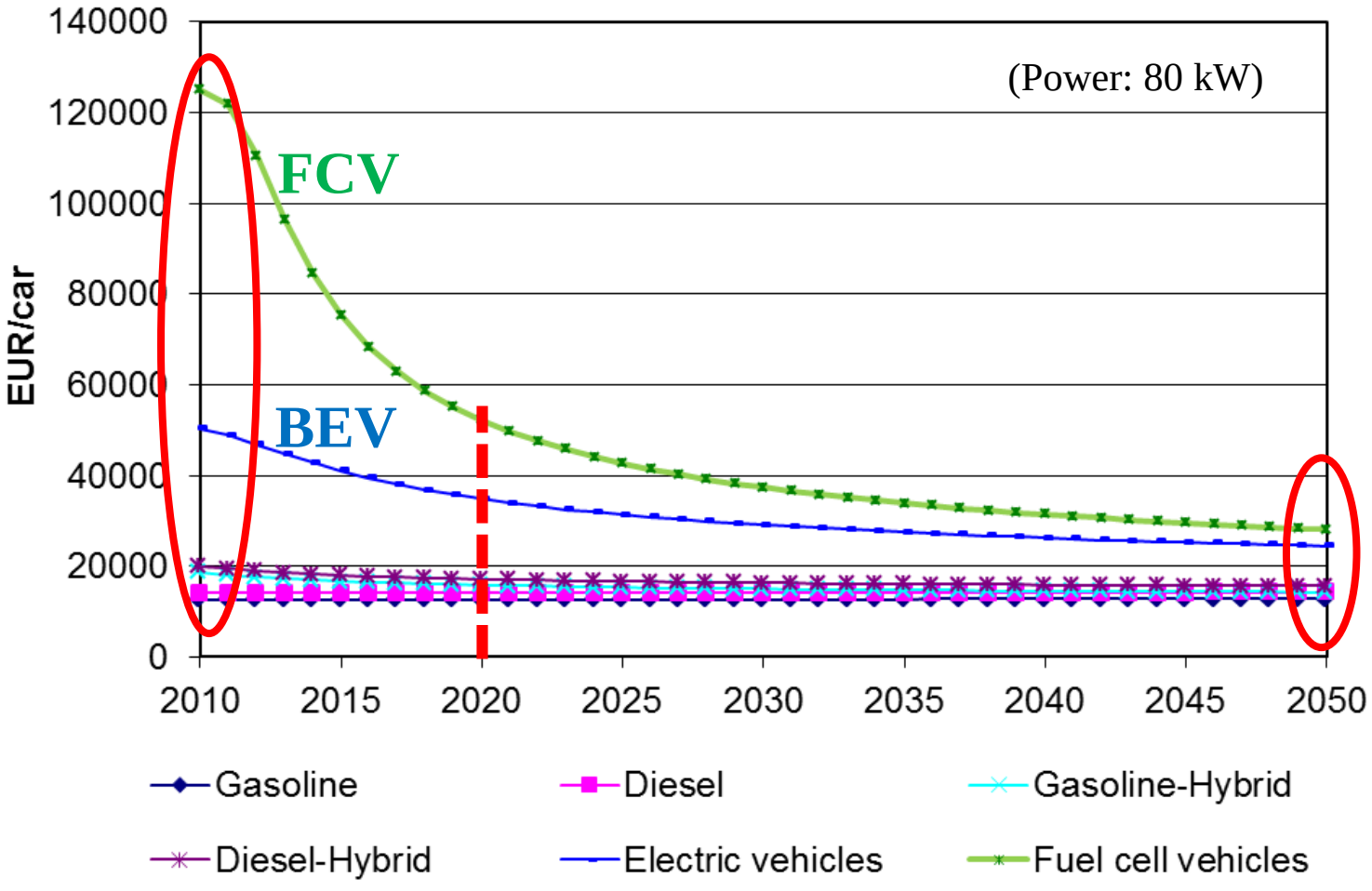
n…..the number of annuities received.

Economic aspects

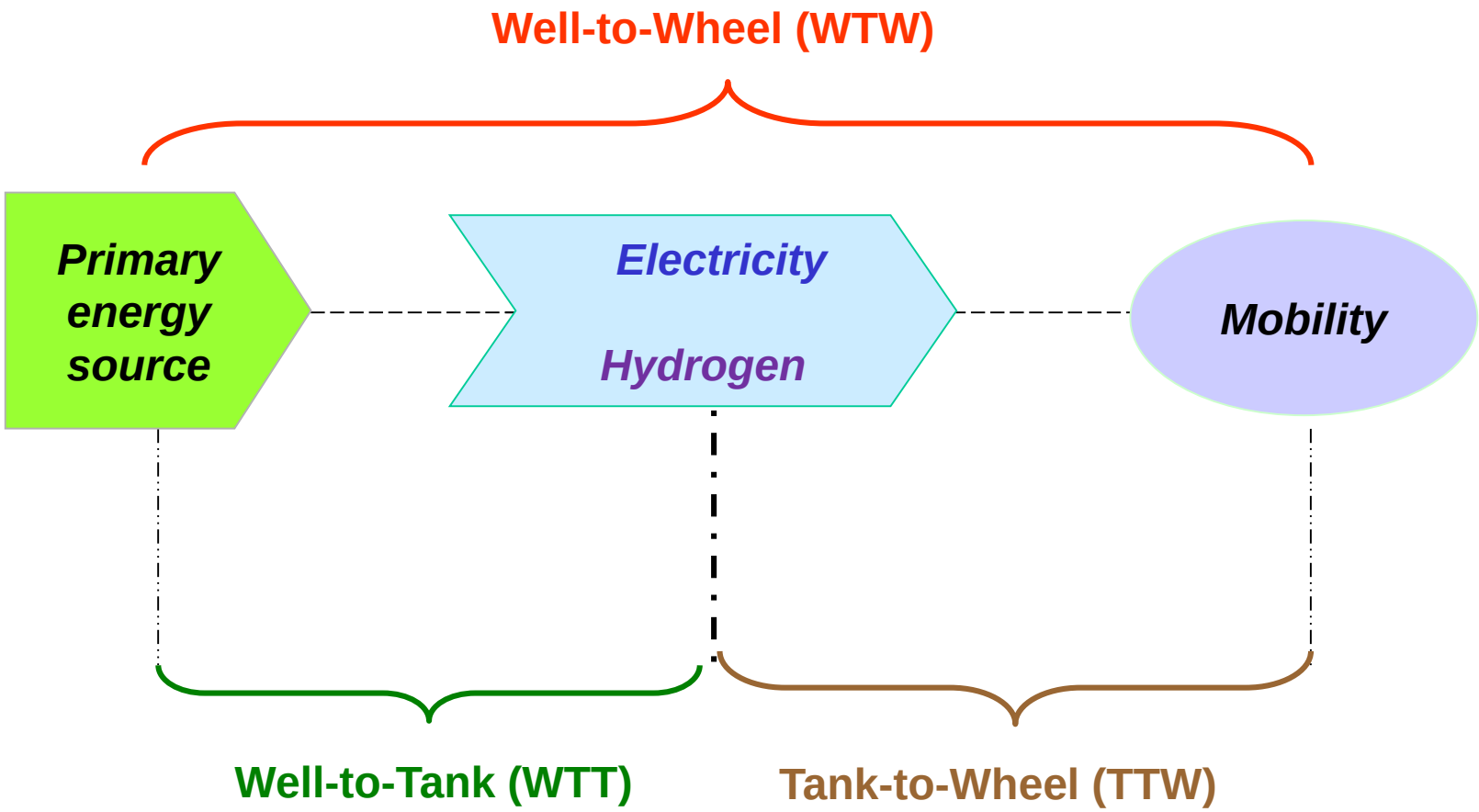


Total costs of service mobility of various types of EV in comparison to ICE cars

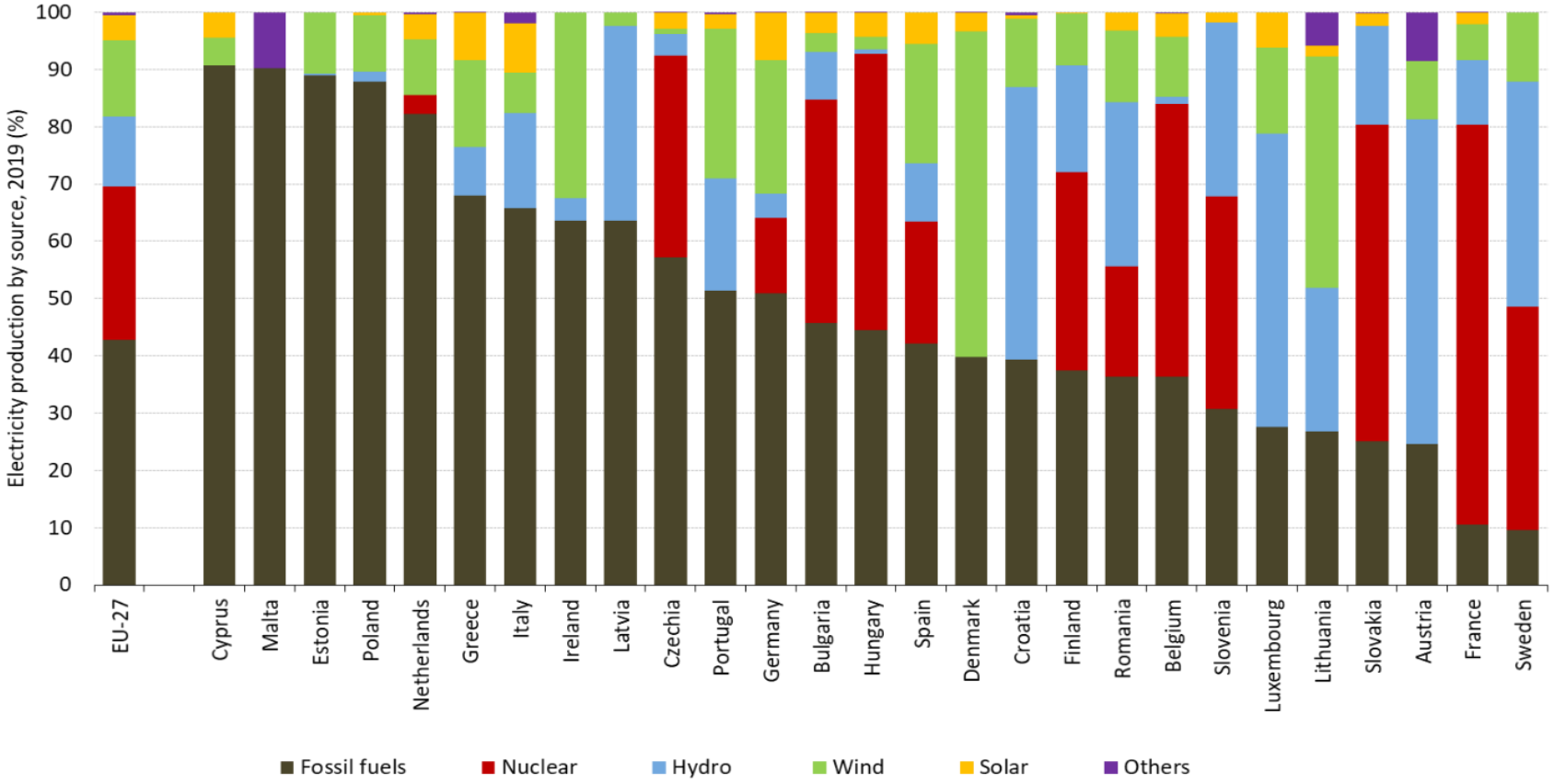
Scenario for development of investment costs



Environmental assessment



Electricity production by source, 2019



Colors of hydrogen

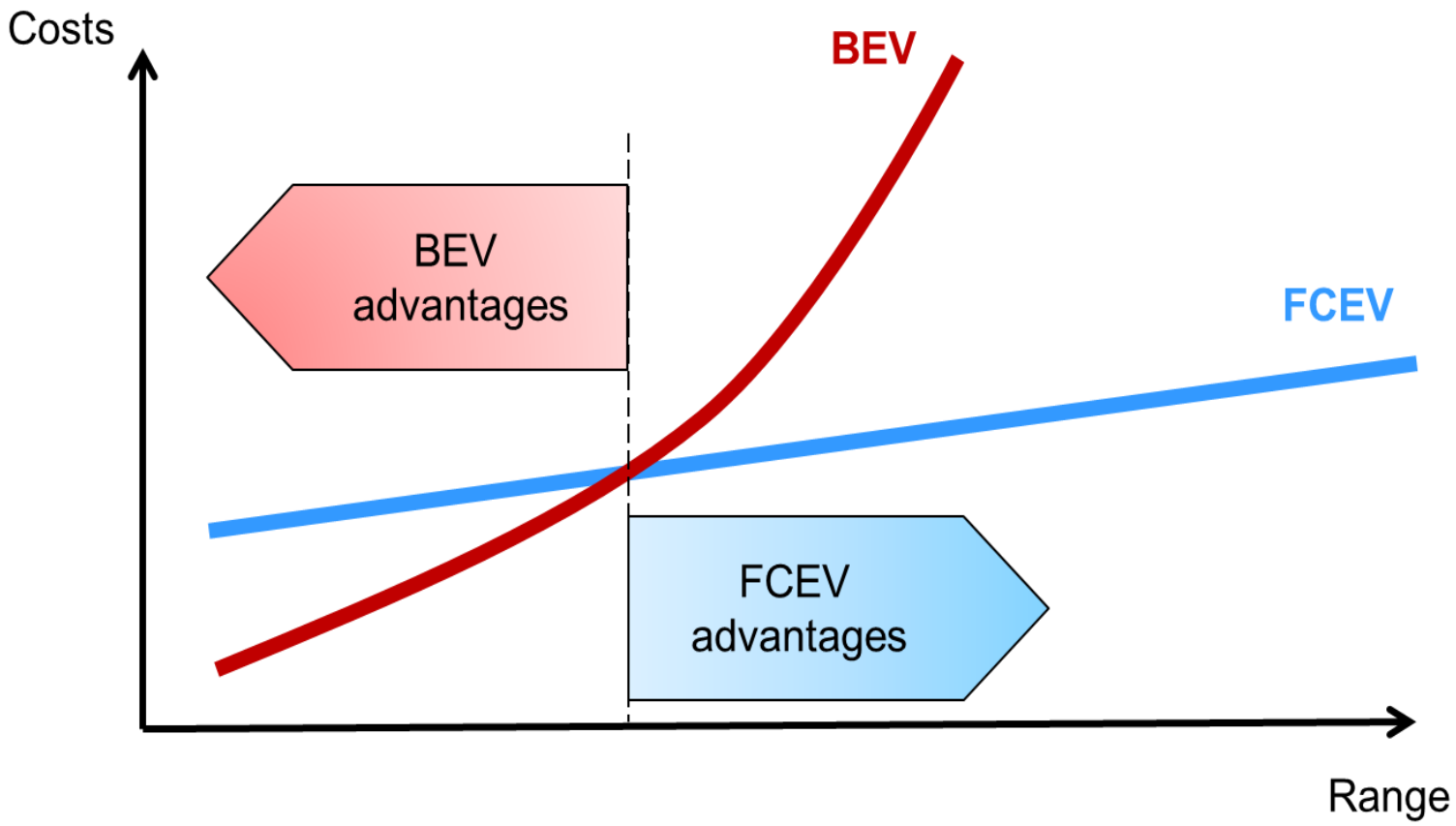
Biomass
Hydro
Wind
Solar

→ Green H2

Oil
Coal
Natural gas

→ Grey H2

Costs vs range, BEV and FEV



Conclusions

- ✓ …decarbonisation of the transport sector...
- ✓ …enhance energy security…
- ✓ major challenge – cost reduction and infrastructure development
- ✓ clear and stable policy framework
- ✓ full environmental benefit – RES

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Ajanovic A., Haas R. (2021), Prospects and impediments for hydrogen and fuel cell vehicles in the transport sector, International Journal of Hydrogen Energy, Volume 46, Issue 16, 3 March 2021, Pages 10049-10058, https://doi.org/10.1016/j.ijhydene.2020.03.122

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