On the future relevance of electric vehicles: pro's and con's

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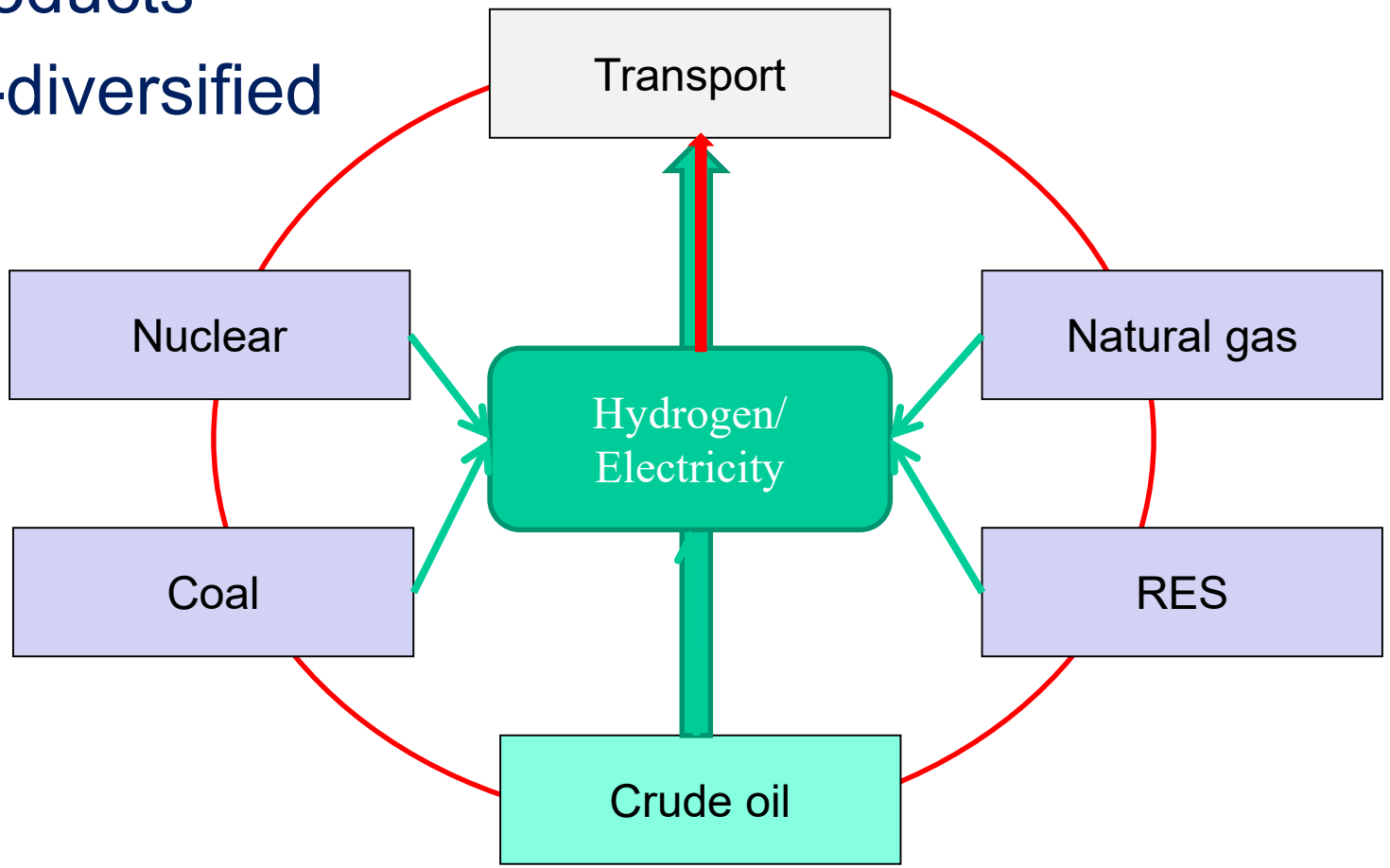
Content

- ✓ Introduction
- ✓ Policy framework
- ✓ Recent developments and challenges
- ✓ Economic and environmental aspects
- ✓ Conclusion

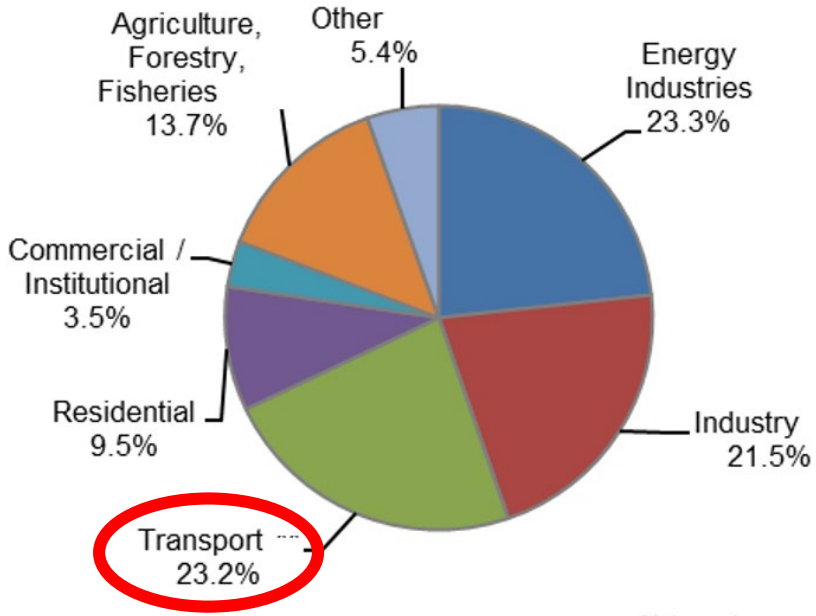
Transport sector

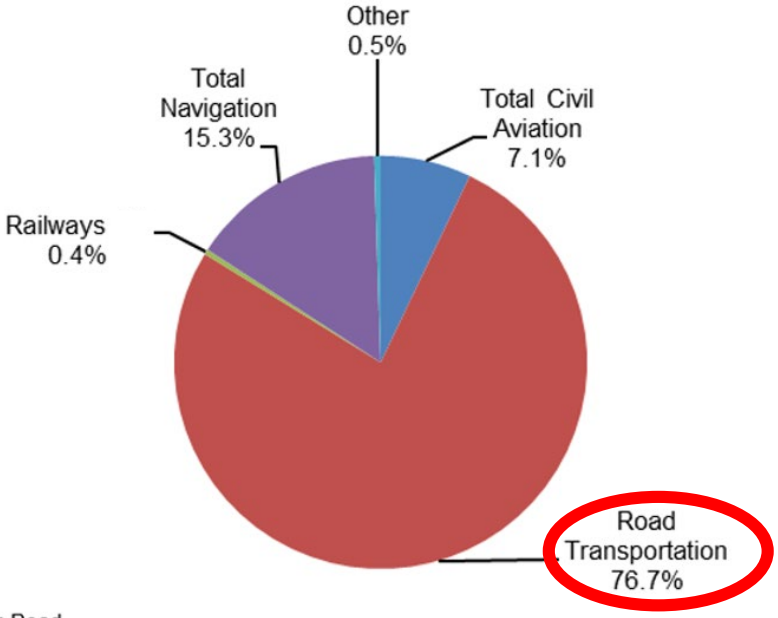
- oil products
- least-diversified

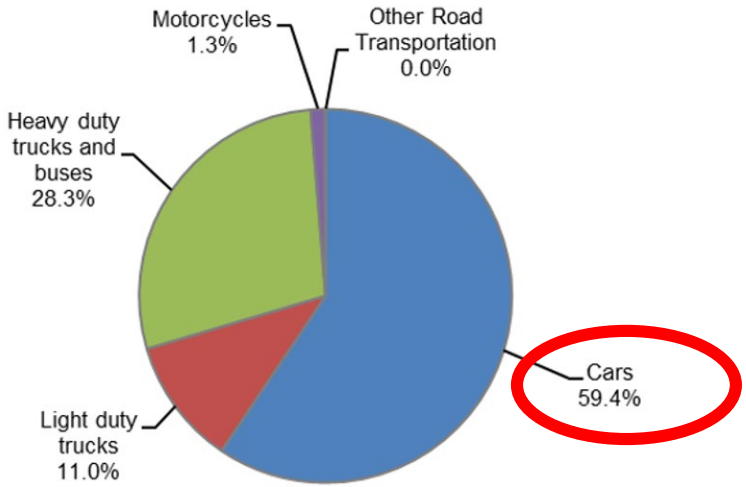


- energy import dependency

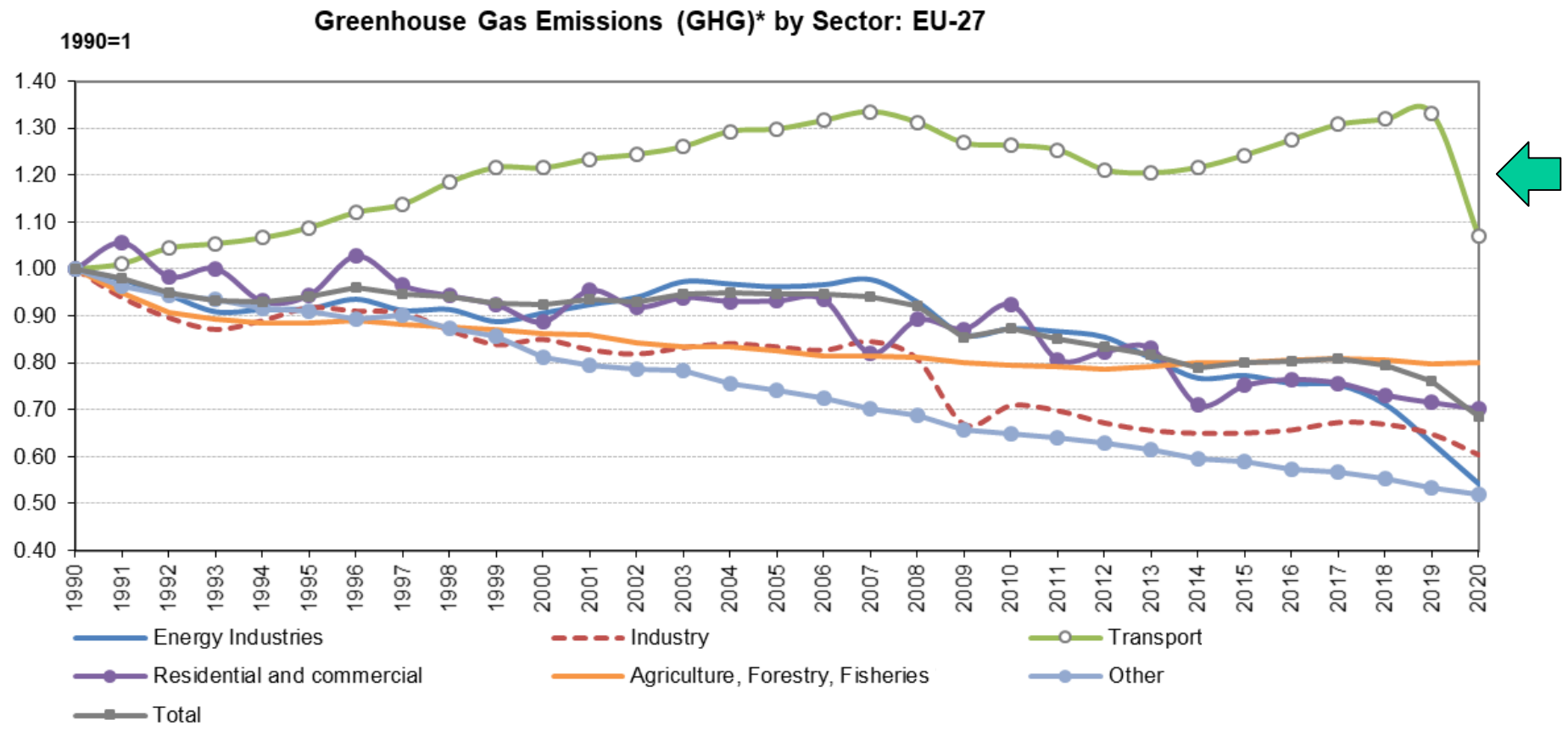
GHG, EU-27


Agriculture, Forestry, Fisheries 13.7%
Other 5.4%
Energy Industries 23.3%
Commercial / Institutional 3.5%
Residential 9.5%
Industry 21.5%
Transport 23.2%


Other 0.5%
Total Navigation 15.3%
Total Civil Aviation 7.1%
Railways 0.4%
Road Transportation 76.7%


Motorcycles 1.3%
Other Road Transportation 0.0%
Heavy duty trucks and buses 28.3%
Cars 59.4%
Light duty trucks 11.0%

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
2019
2020
Energy Industries
Industry
Transport
Residential and commercial
Agriculture, Forestry, Fisheries
Other
Total

EU targets

EU - the first climate-neutral continent by 2050

European Green Deal

2030 climate & energy framework

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.

2010 2020 2030 2050

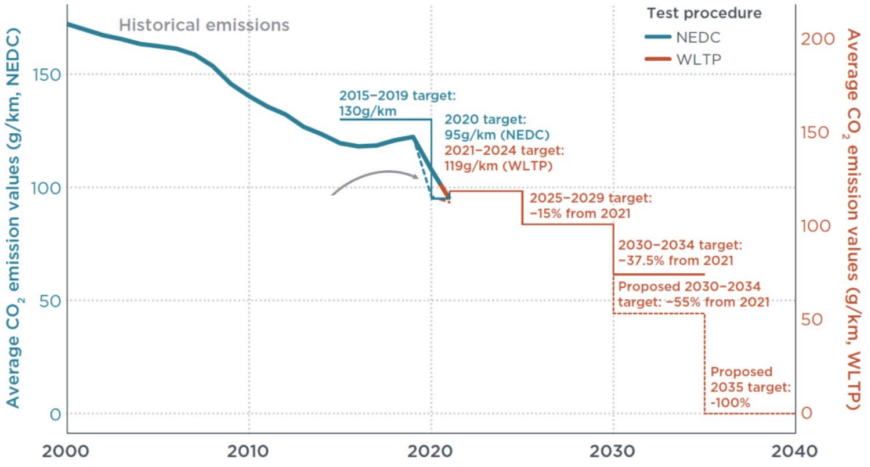
ICE -50% in city

20% GHG (2008)

No ICE in city

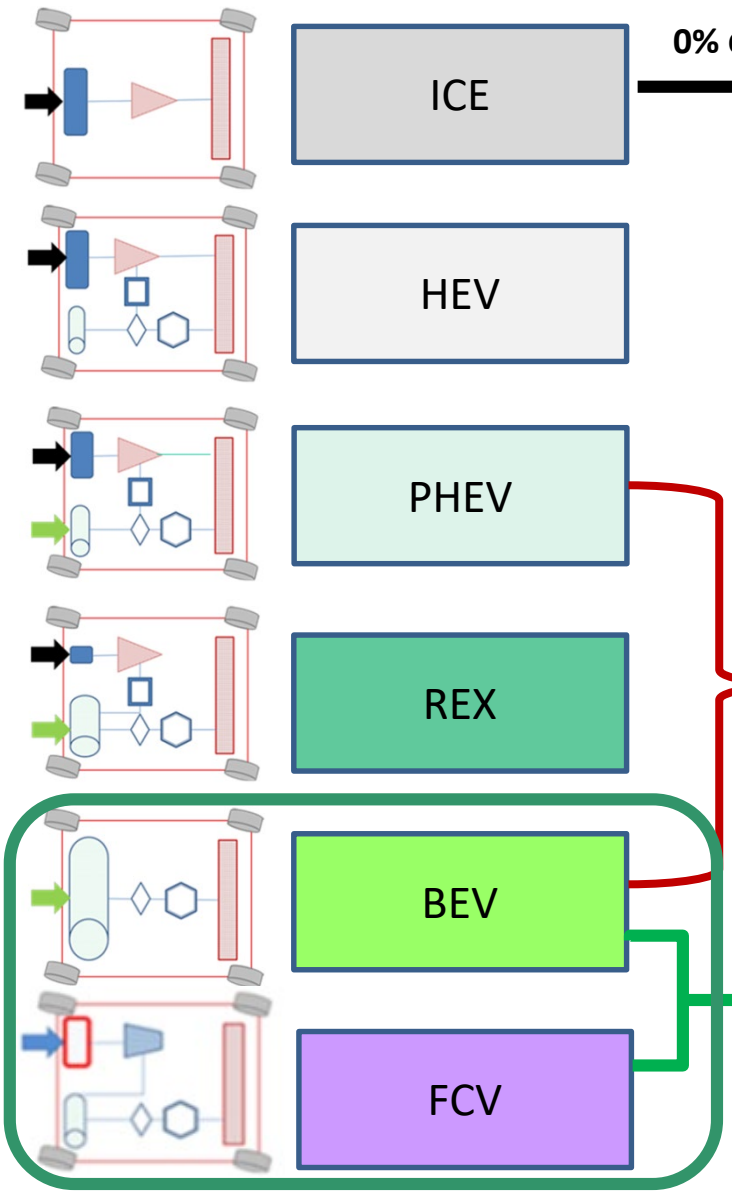
60% GHG (1990)

Transport White Paper



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

Electric vehicles



Advantages

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

Disadvantages

- – Costs
- – Infrastructure
- – Driving range
- – Charging time

Electric vehicles

Monetary measures

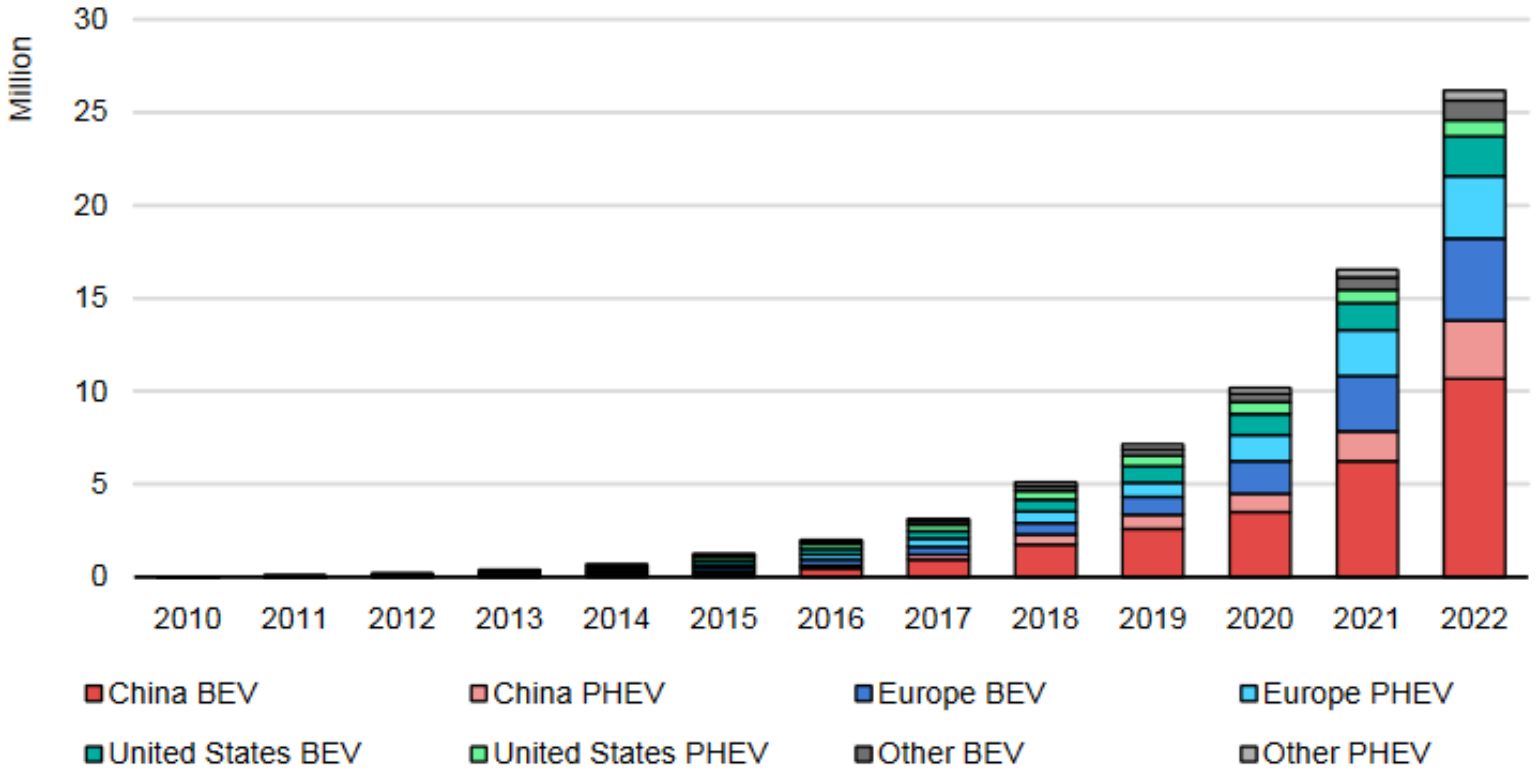
- road taxes
- annual circulation tax
- company car tax
- registration tax
- fuel consumption tax
- congestion charges

Non-monetary measures

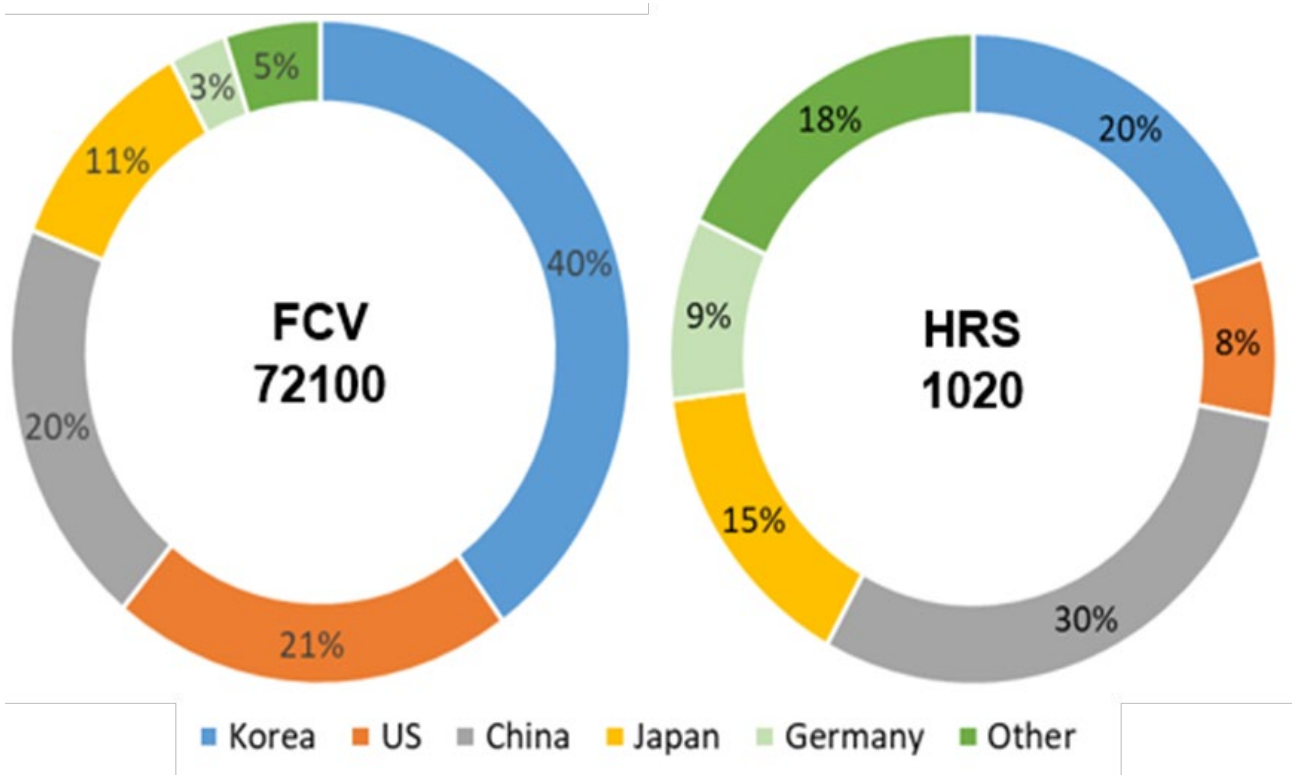
- free parking spaces
- possibility for EVs drivers to use bus lanes
- wide availability of charging stations
- permission for EVs to enter city centers and zero emission zones

Global electric car stock

Over 26 million electric cars were on the road in 2022



FCV


FCV
72100
40%
21%
20%
11%
3%
5%
HRS
1020
20%
8%
30%
15%
9%
18%
Korea
US
China
Japan
Germany
Other

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]

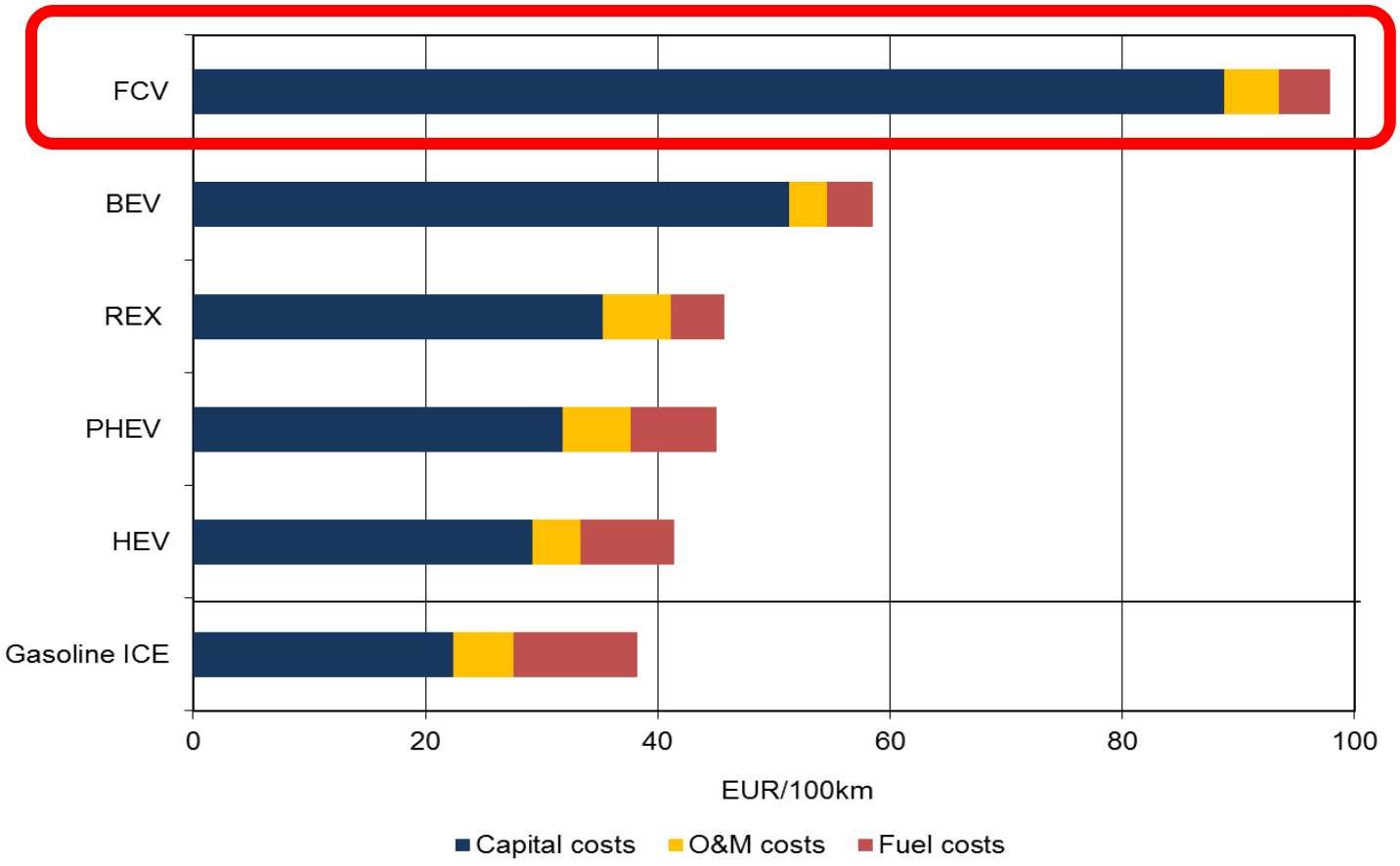
IC……investment costs [€/car]
α……..capital recovery factor
skm…..specific km driven per car per year [km/(car.yr)]
Pf……fuel price incl. taxes [€/litre]
$C_{O\&M}$…operating and maintenance costs
FI……..fuel/energy intensity [litre/100 km; kWh/100 km]

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:

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

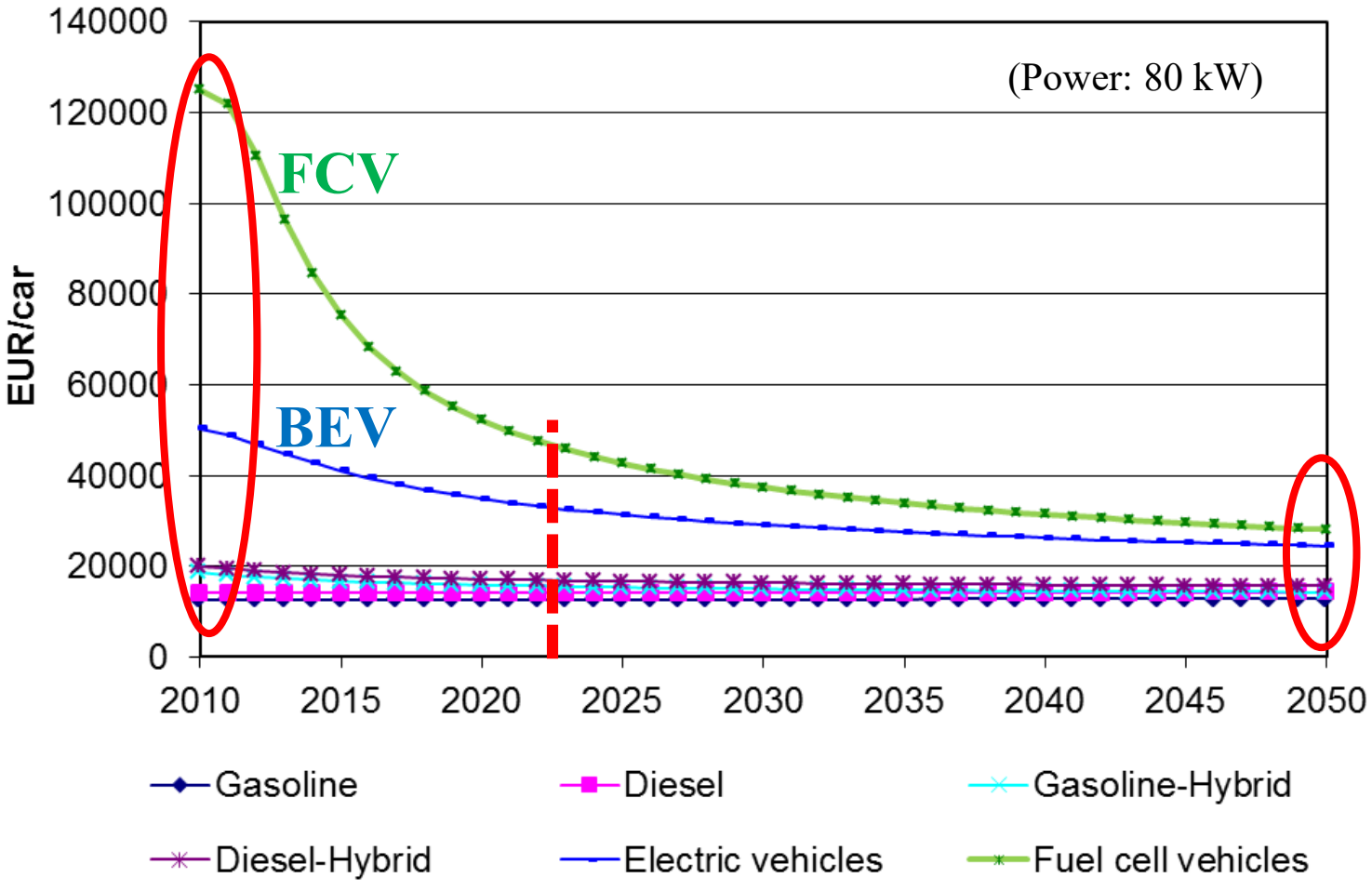
n…..the number of annuities received.

Economic aspects

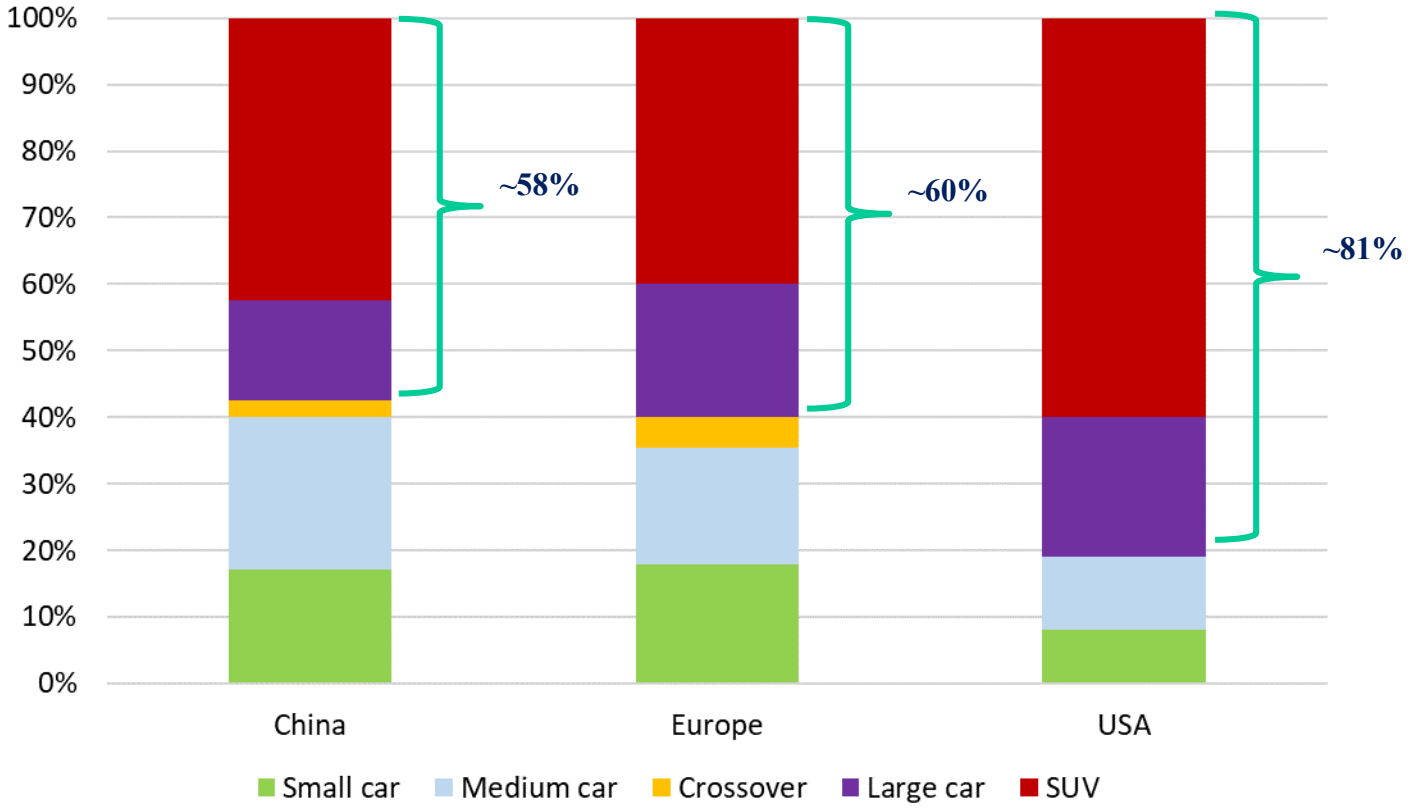


Total costs of service mobility of various types of EV in comparison to ICE cars

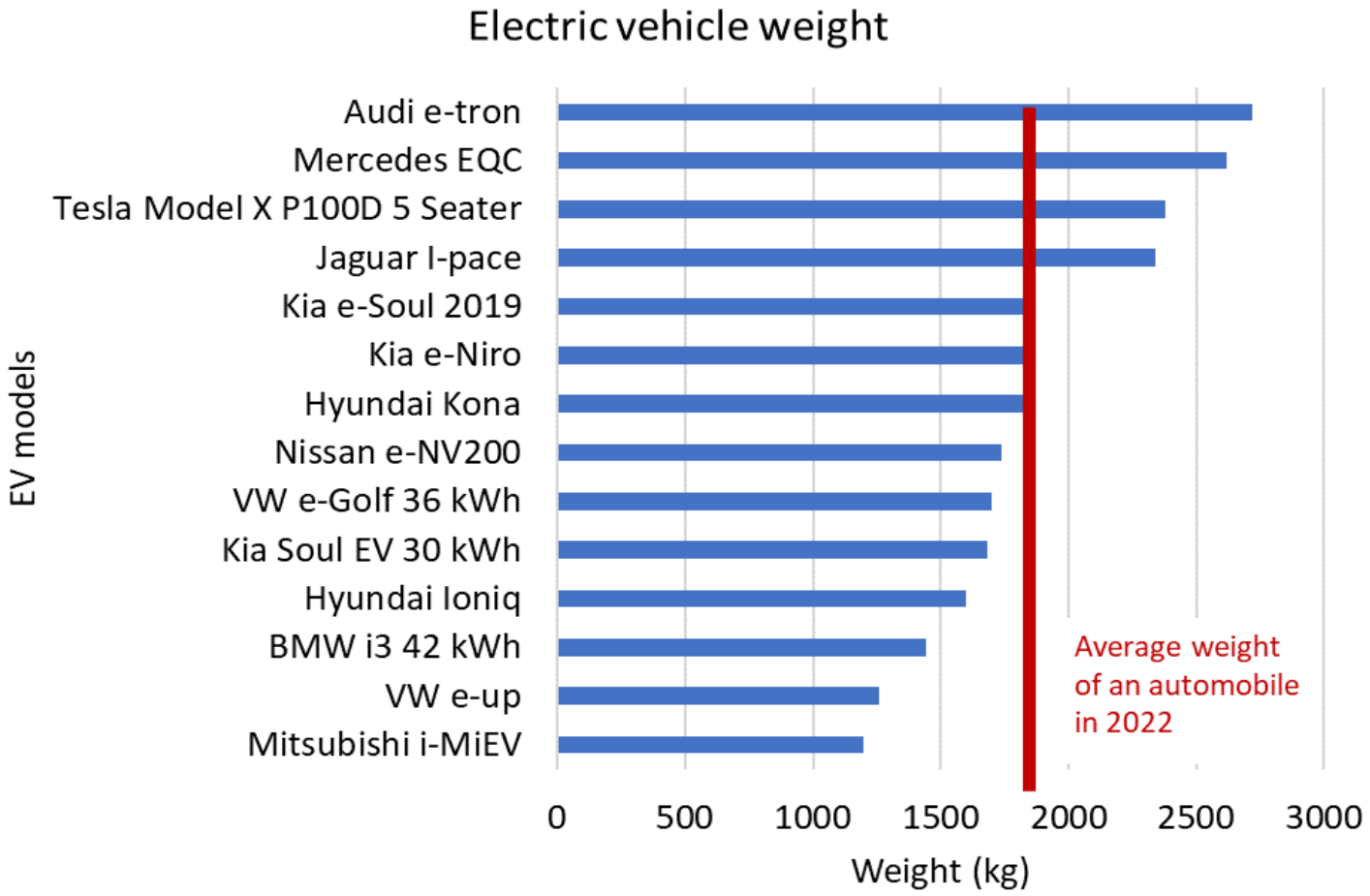
Scenario for development of investment costs



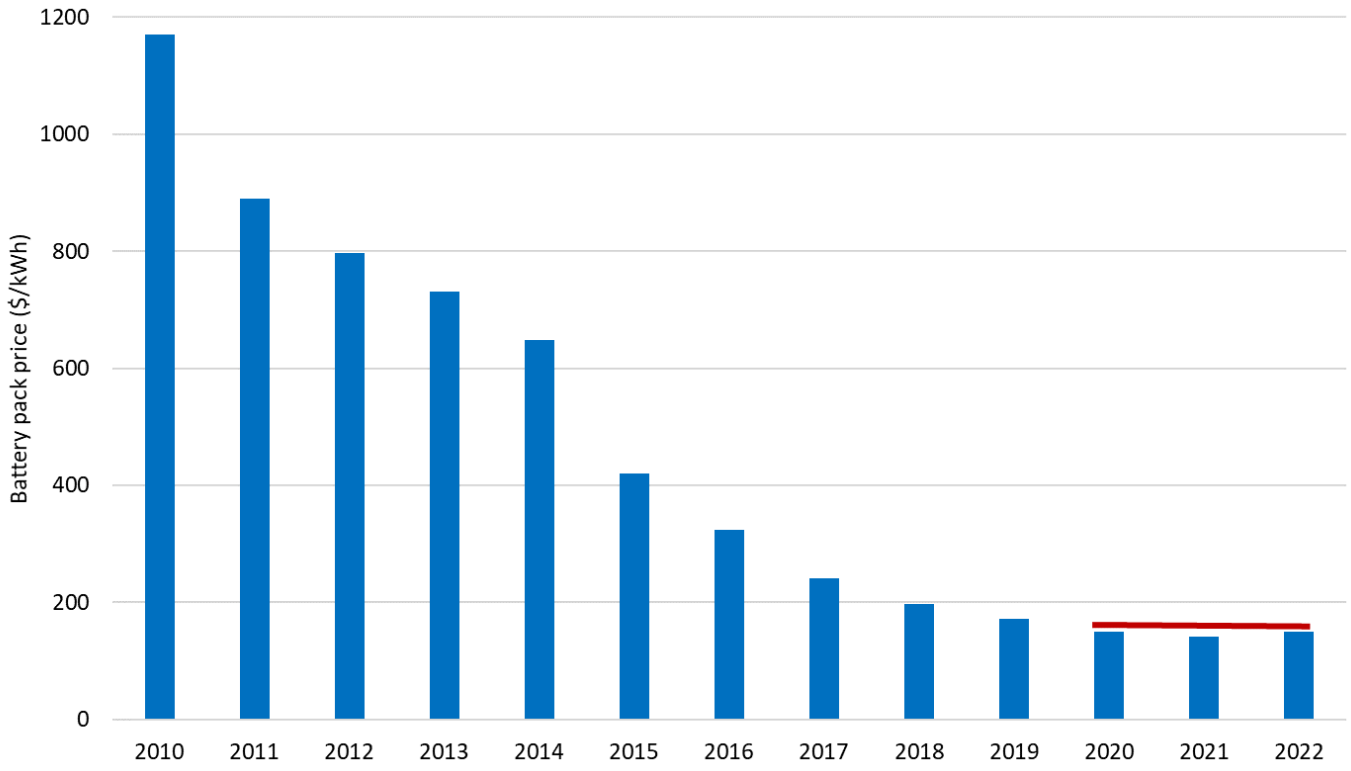
EV models


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
~58%
~60%
~81%
China
Europe
USA
Small car
Medium car
Crossover
Large car
SUV

EV weight


Electric vehicle weight
EV models
Audi e-tron
Mercedes EQC
Tesla Model X P100D 5 Seater
Jaguar I-pace
Kia e-Soul 2019
Kia e-Niro
Hyundai Kona
Nissan e-NV200
VW e-Golf 36 kWh
Kia Soul EV 30 kWh
Hyundai Ioniq
BMW i3 42 kWh
VW e-up
Mitsubishi i-MiEV
Average weight of an automobile in 2022
0
500
1000
1500
2000
2500
3000
Weight (kg)

Development of the battery pack prices

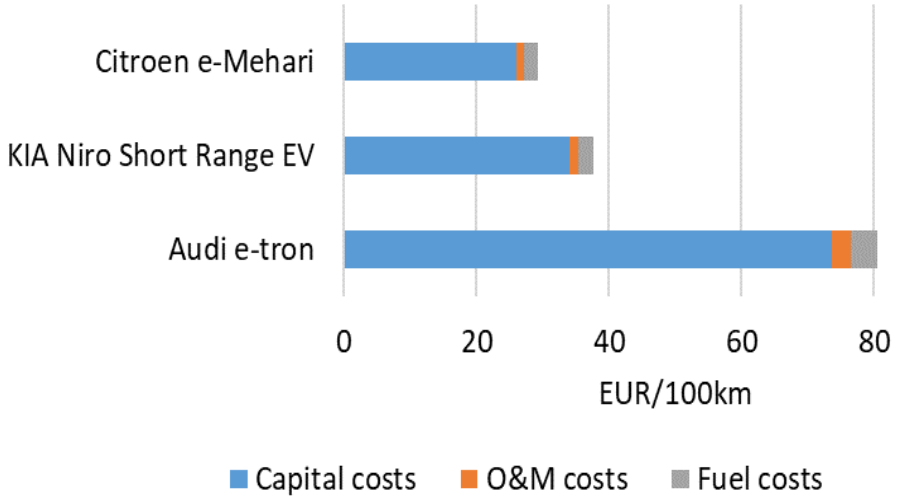


Driving costs

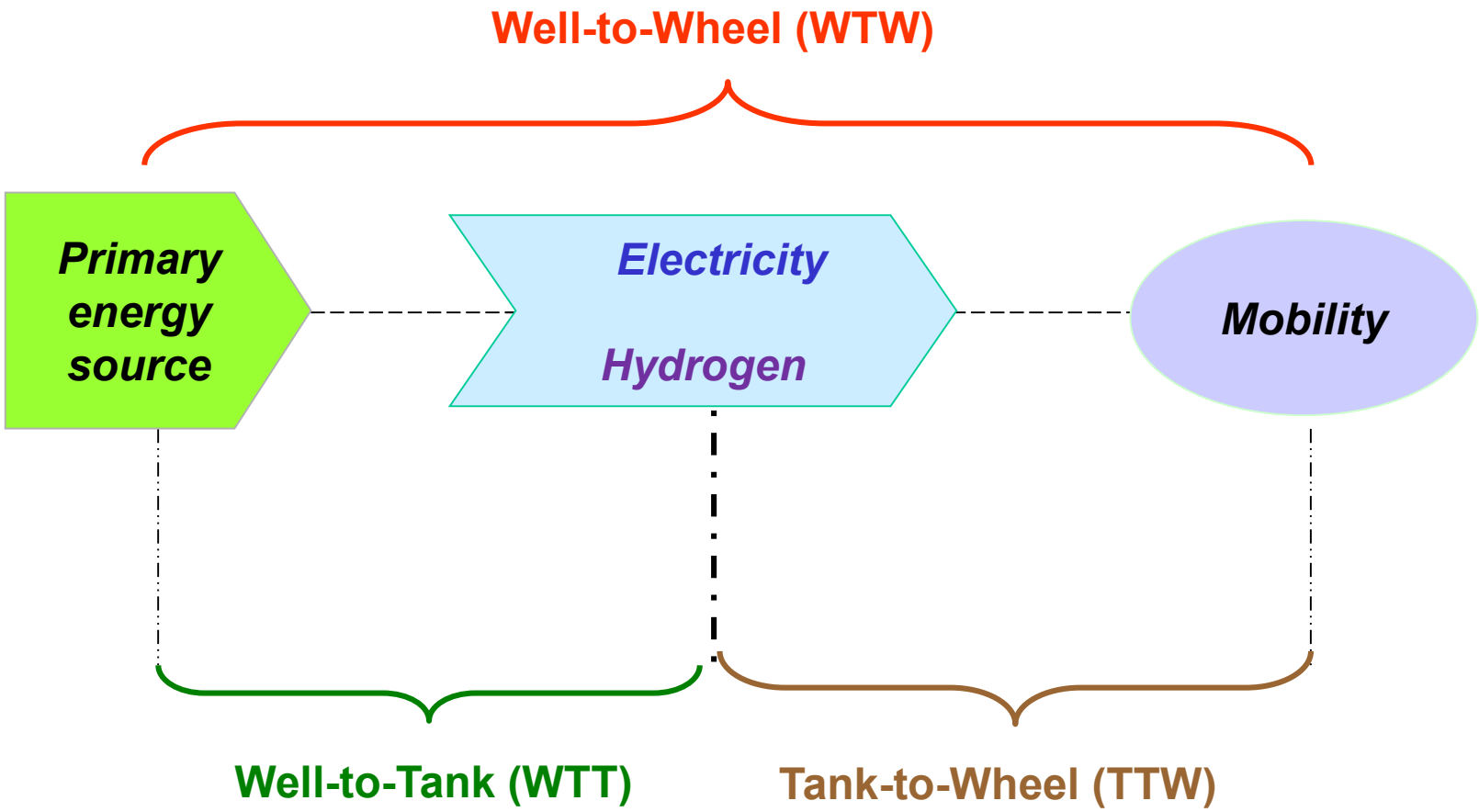
Driving range: ~80 km

Driving range: ~270 km

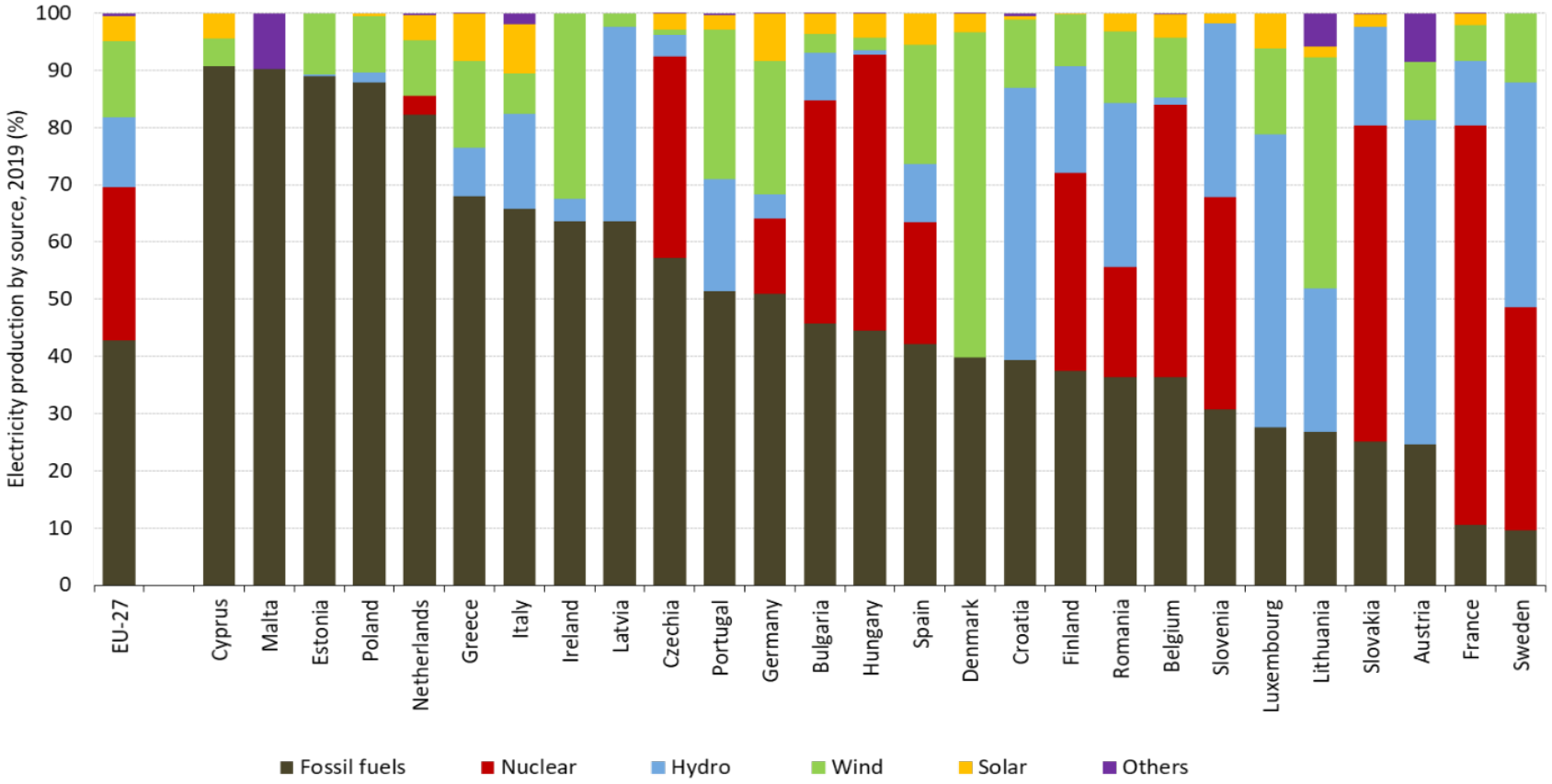
Driving range: ~500 km



Environmental assessment



Electricity production by source



FCVs vs BEVs

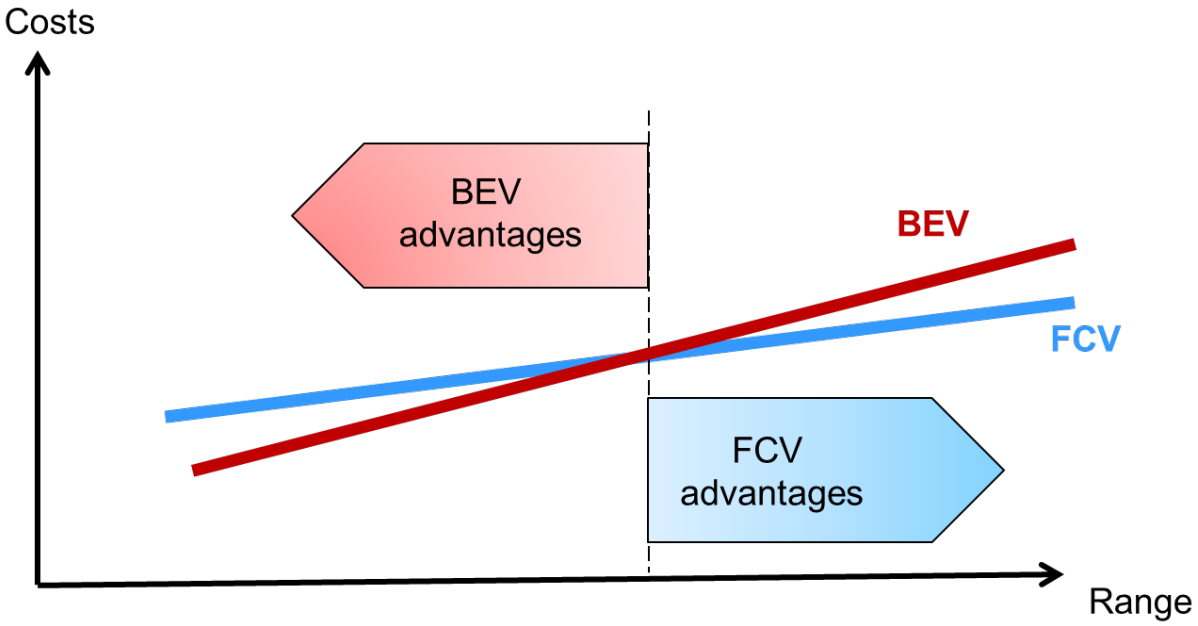
BEV

- Costs
- Infrastructure
- Fuel efficiency

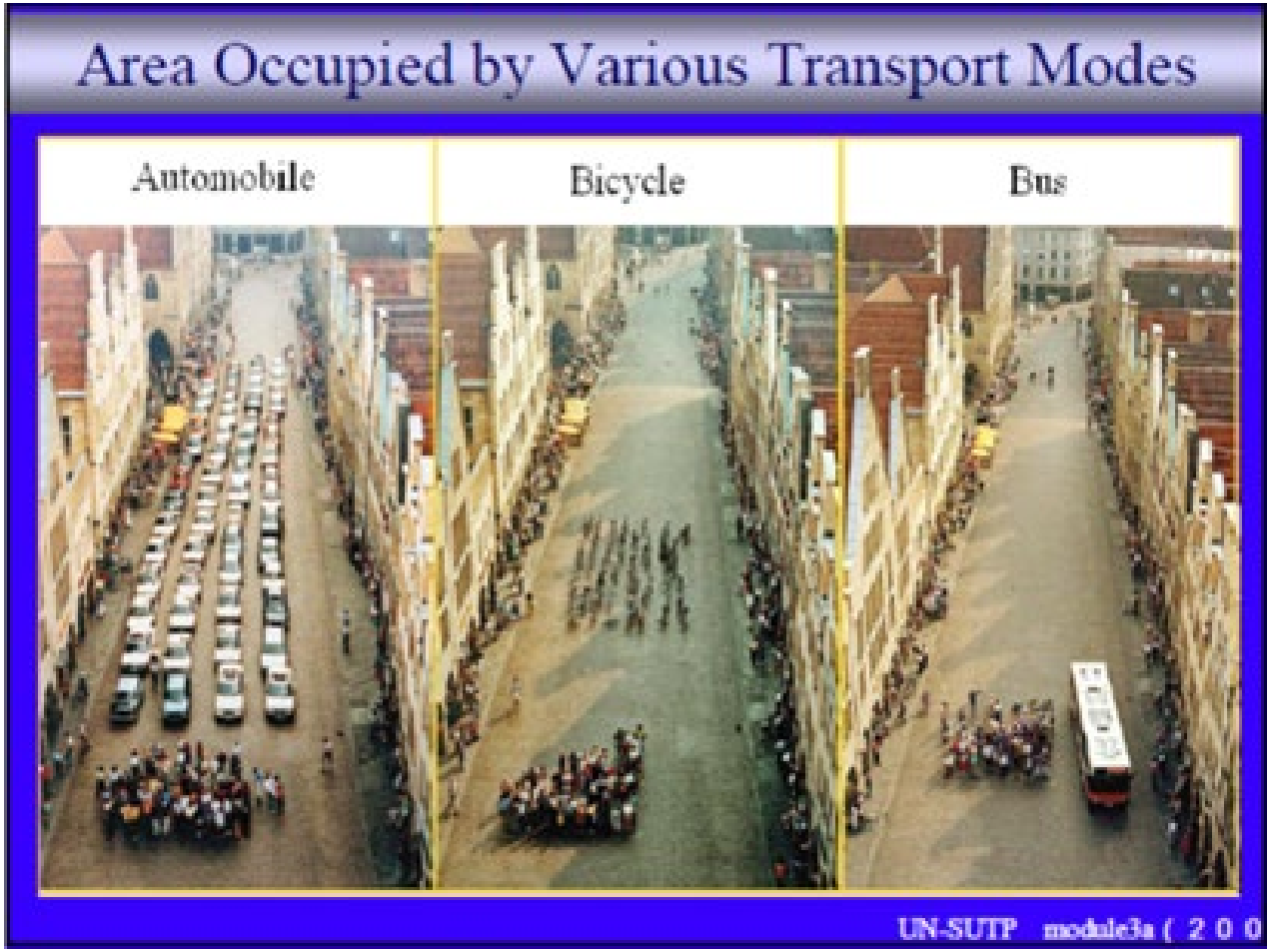
FCV

- Refuelling time
- Driving range
- Weight of energy storage

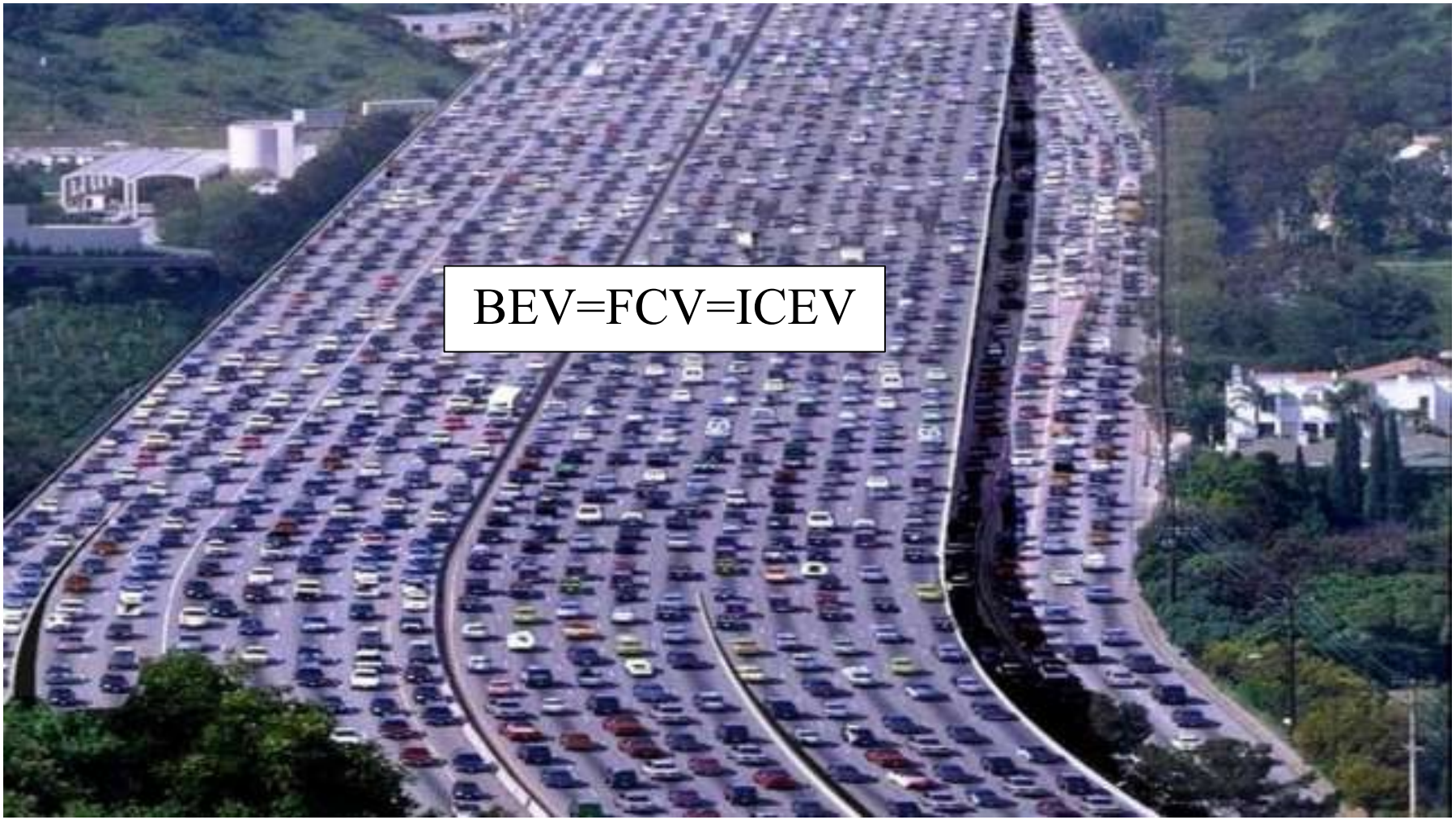
- Environmental benefits



Car-oriented mobility



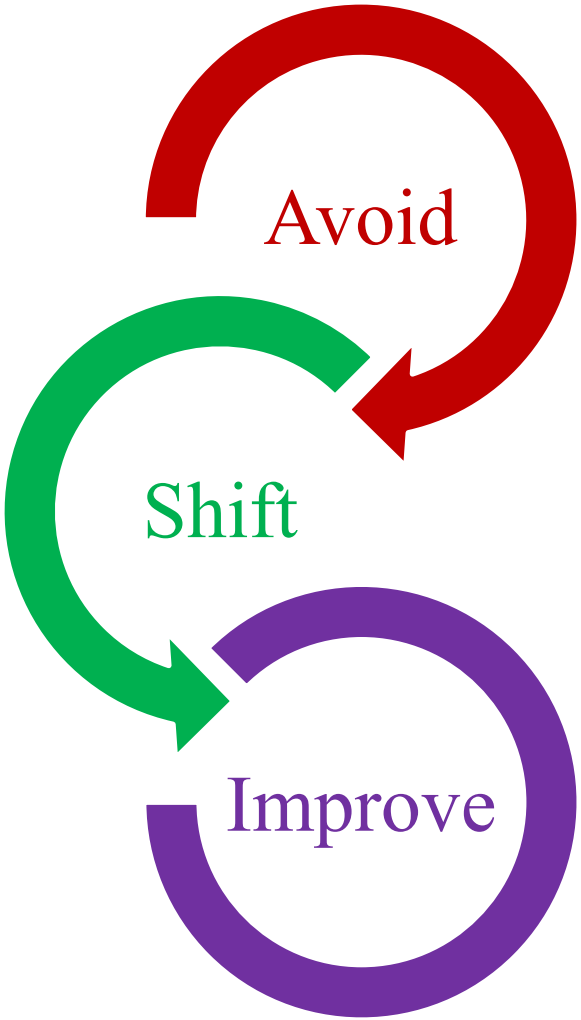
Car-oriented mobility



Car-oriented transport development

https://simotron.files.wordpress.com

Towards Sustainable Mobility



…unnecessary travel and reduce trip distances

….towards more sustainable modes

…transport practices and technologies

Conclusions

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

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