

Passenger cars and the 1.5 °C climate target: the role of propulsion technologies, CO₂ limits and real-world energy demand

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(Professor K. Boulouchos)

- ESMOBIL-RED (BFE)

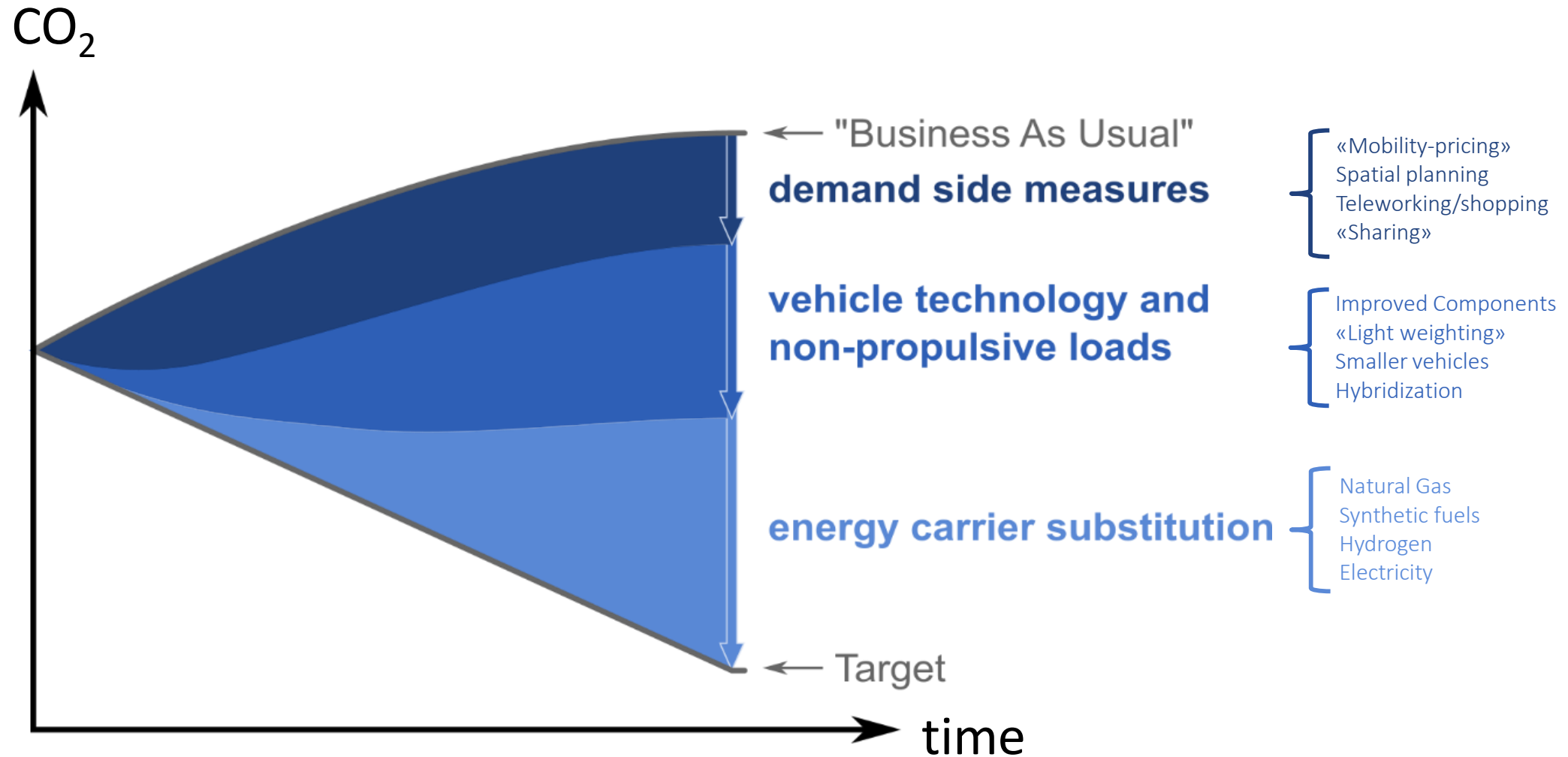


(Professor K. Boulouchos)

- CA A3: minimizing vehicular energy demand
- Strategic Guidance Project
- Vision Development Report
- JA: P2X whitepaper

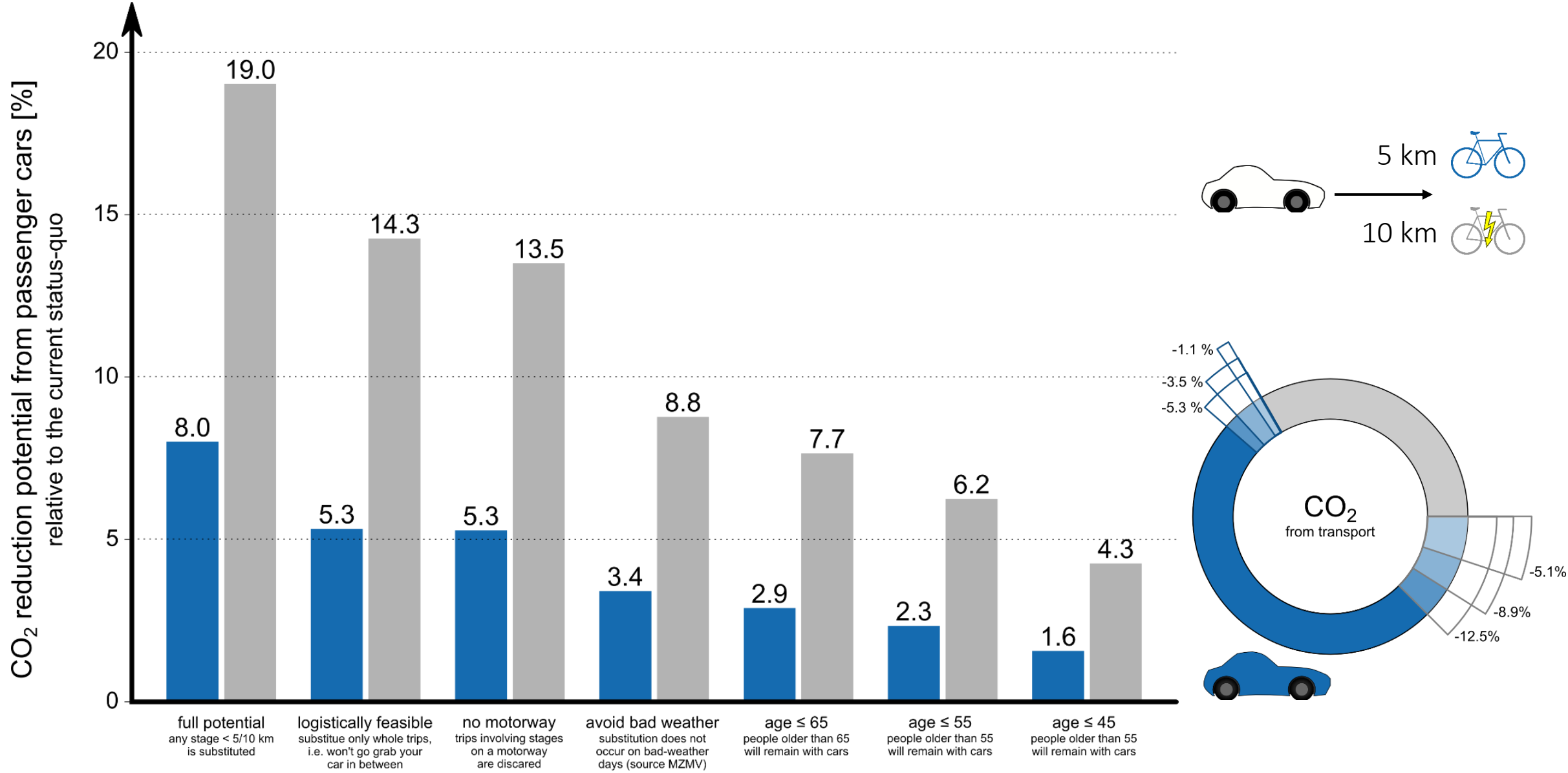
Decarbonizing transportation

The 3 levers (access points) to reduce CO₂

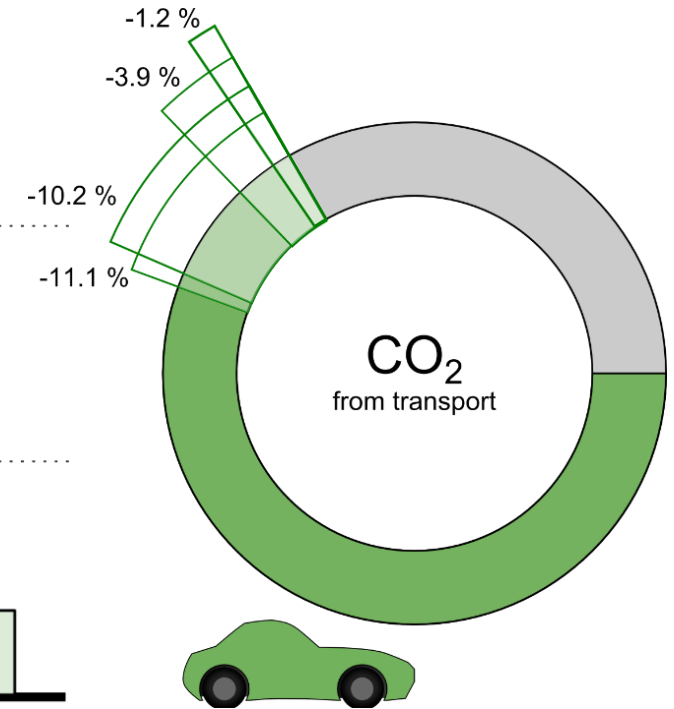
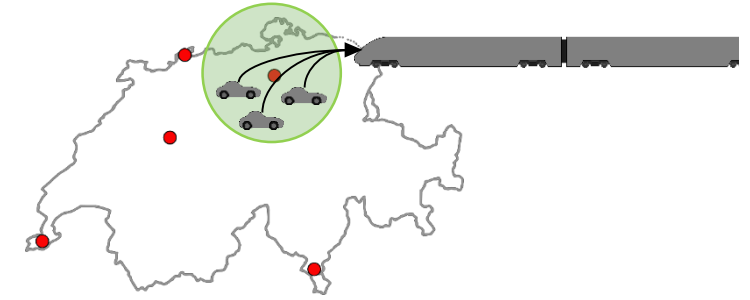
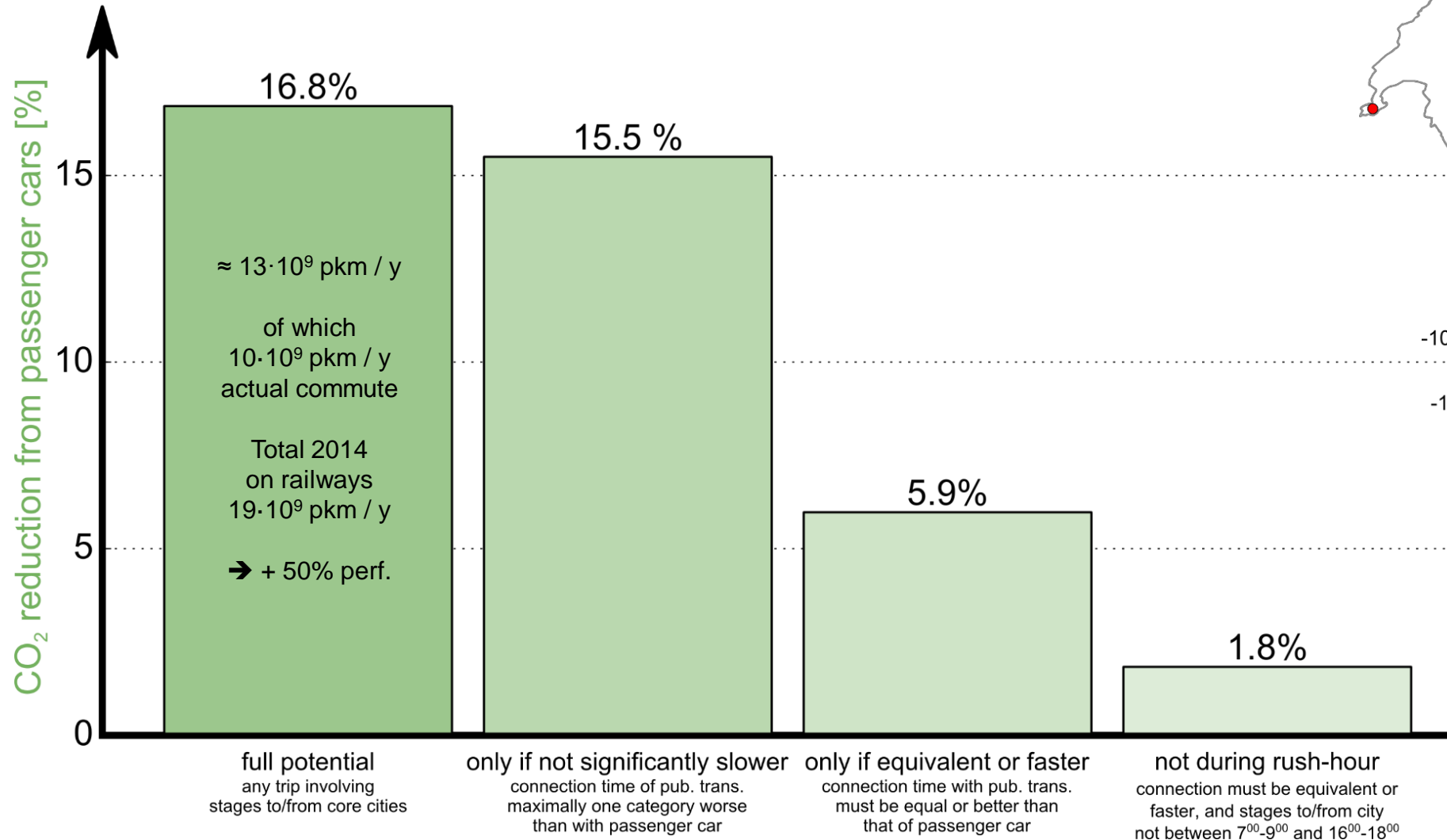


Reduction potential from demand measures

Shift short distances to bicycles



Commute by trains



Demand measures are great, they...

- can significantly reduce CO₂ emissions
- can be realized quickly

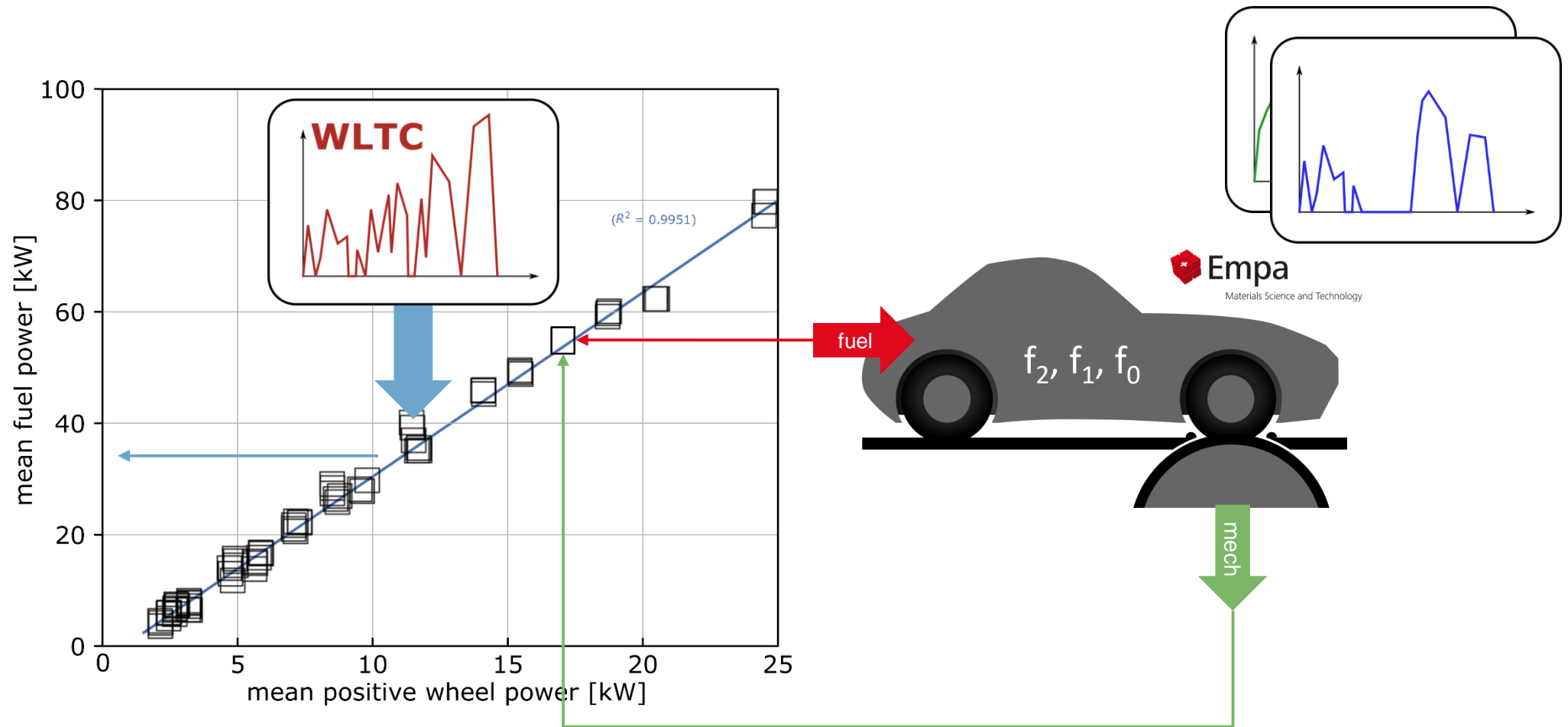
but...

- imply behavioral change (need to convince people)
- are limited. As long as there is motorized mobility demand, the only way to achieve zero CO₂ emissions is through technology

Reduction potentials of different technologies

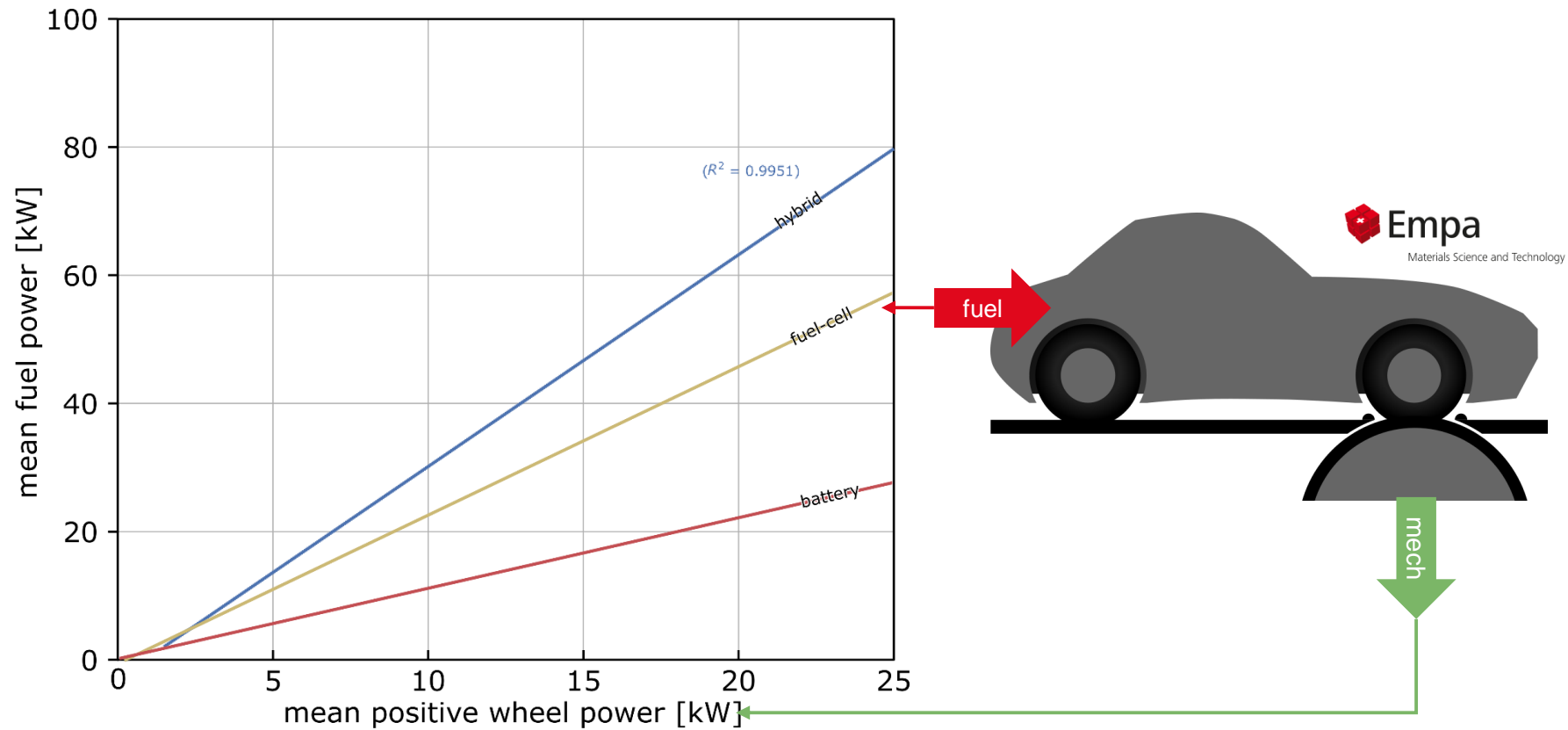
How to describe different powertrain technologies

Willans-line based on chassis dynamometer testing

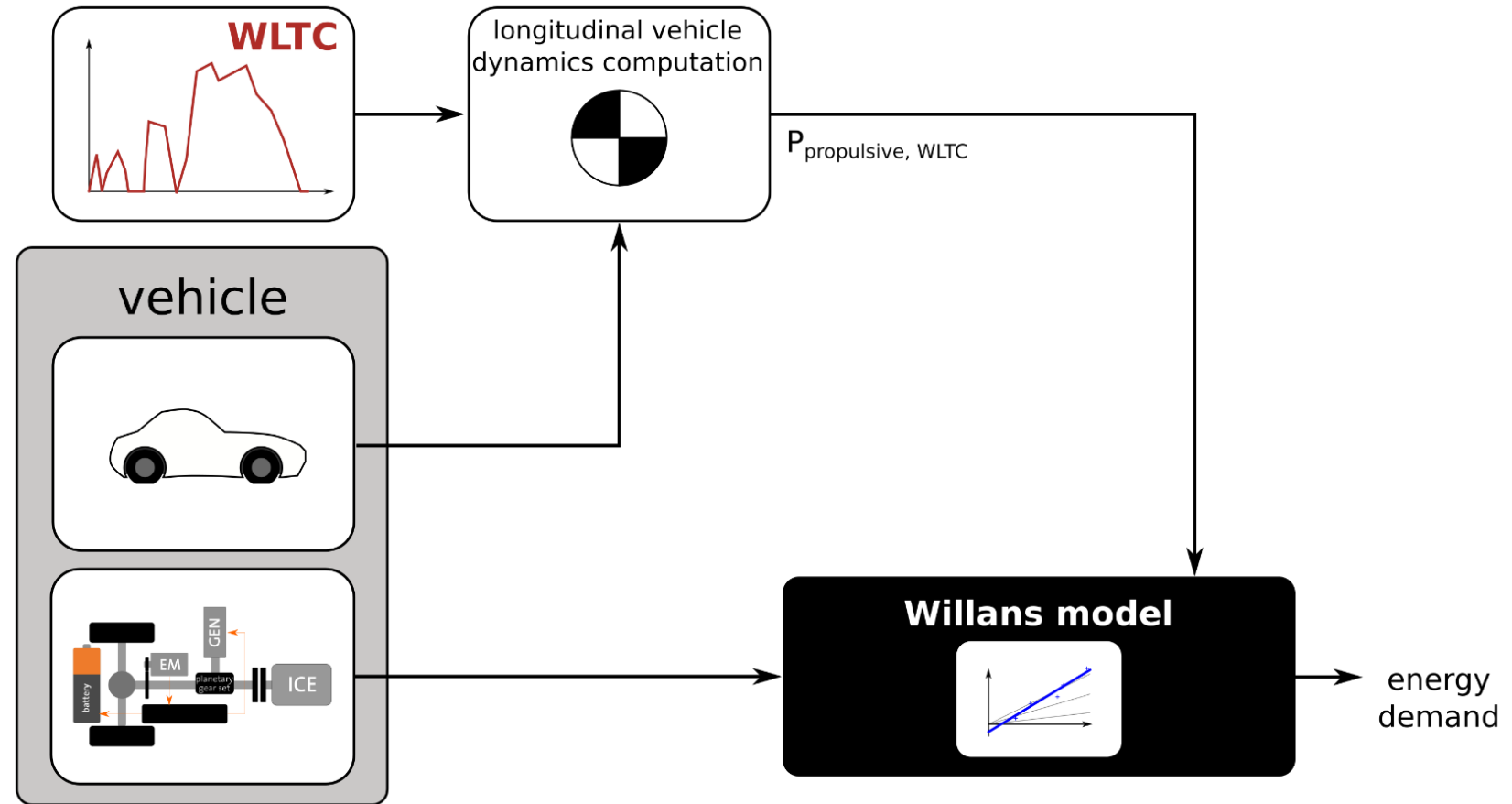


Energy demand modeling of various technologies

Willans-lines exist for all powertrain technologies

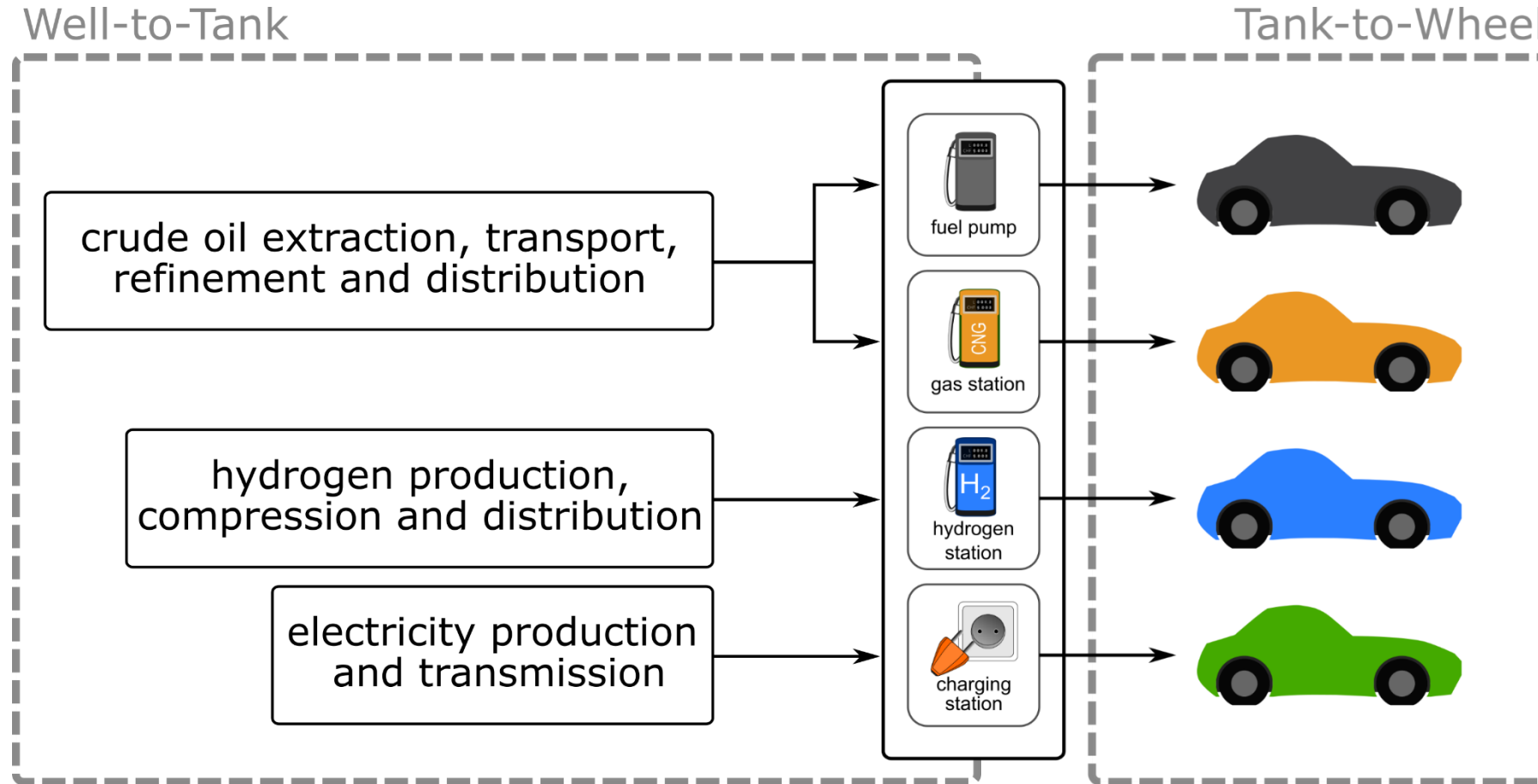


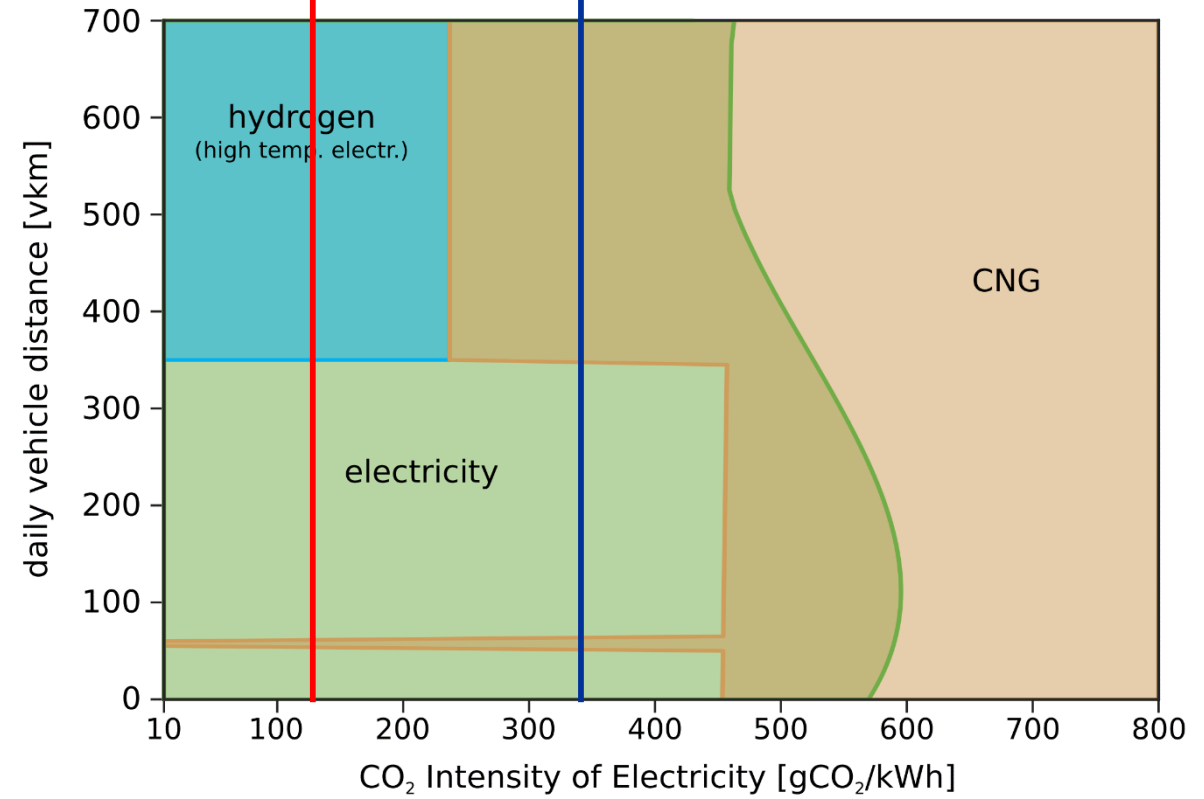
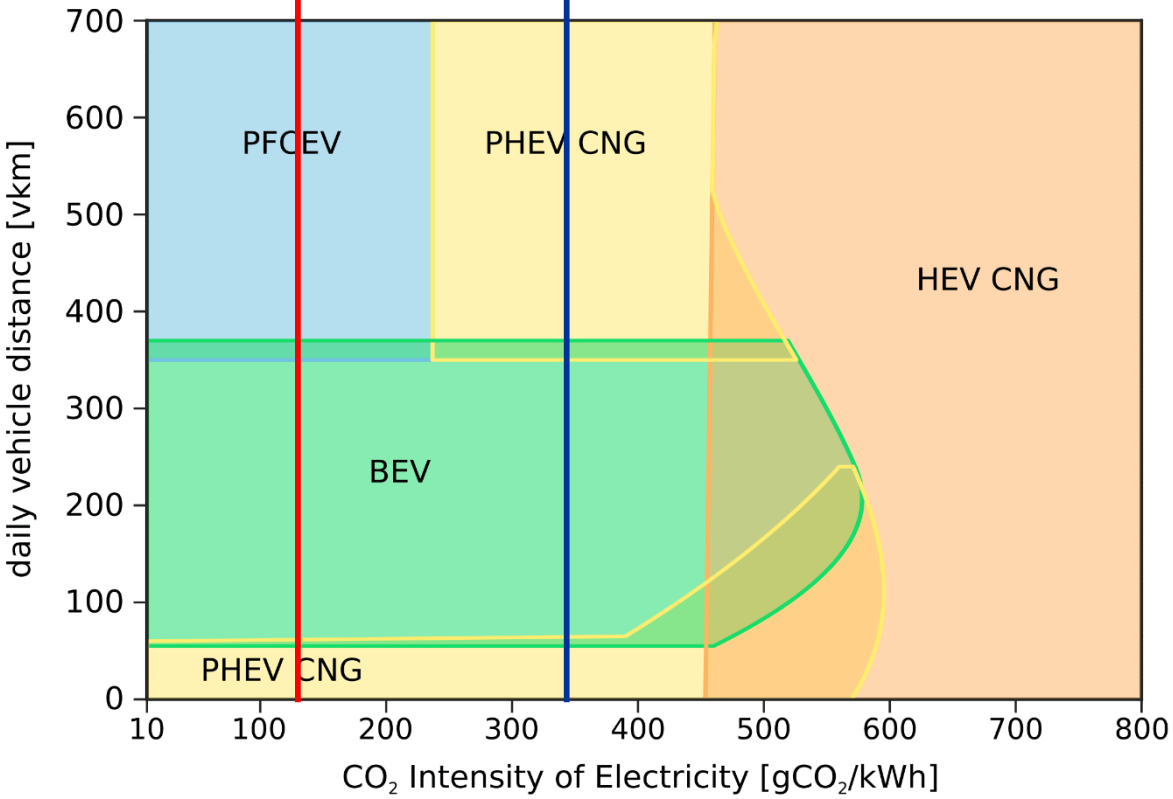
Willans-lines enable us to model different technologies

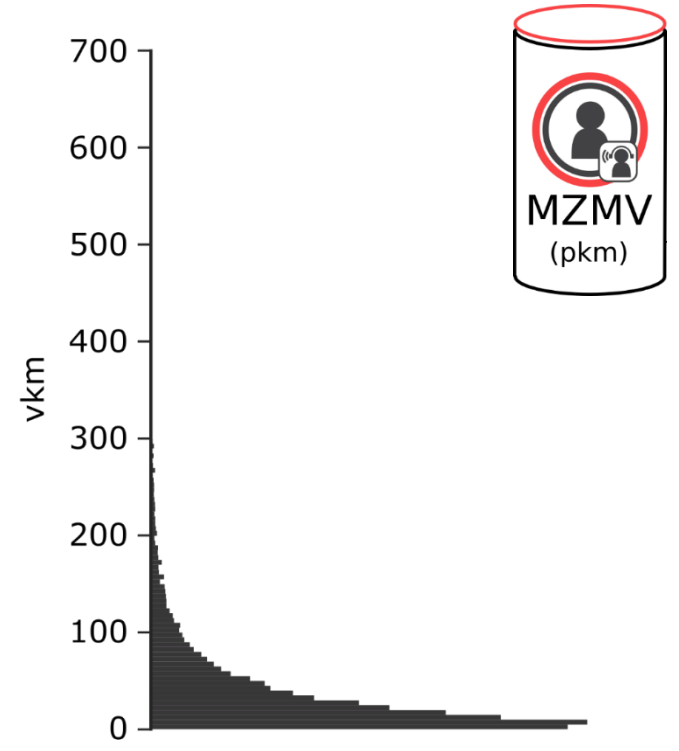
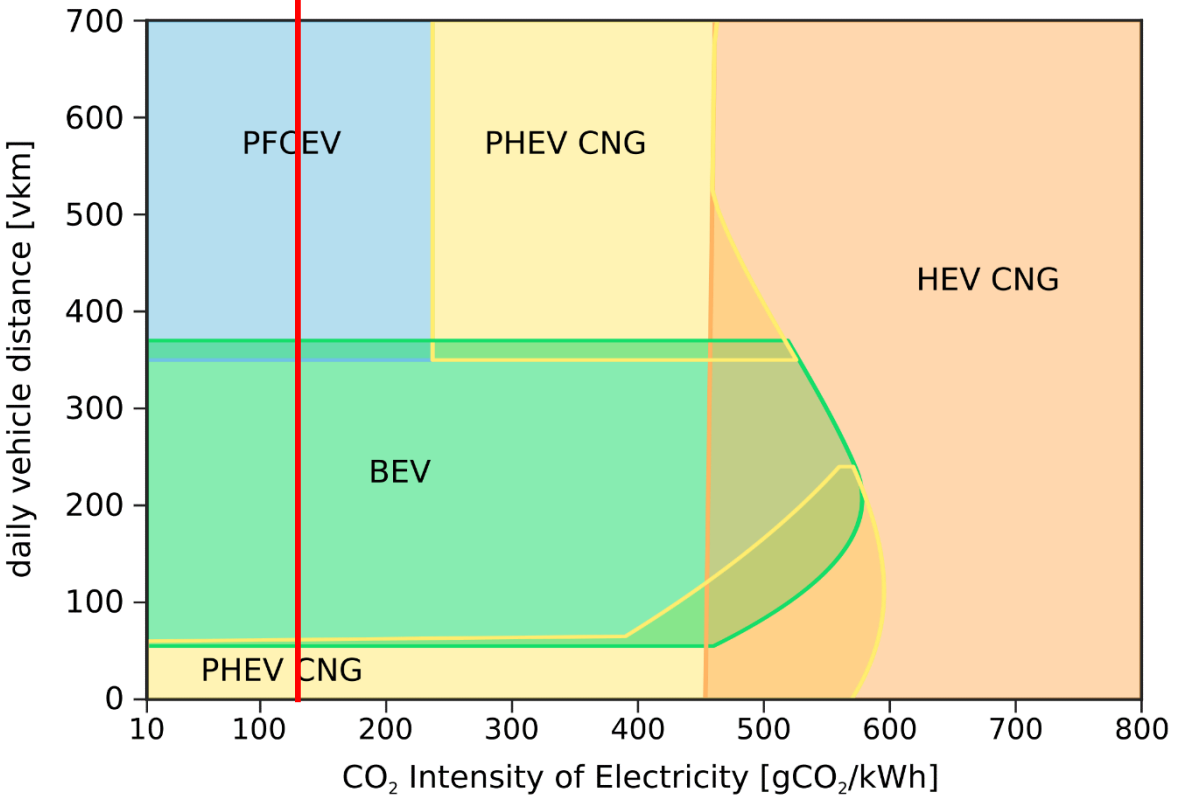


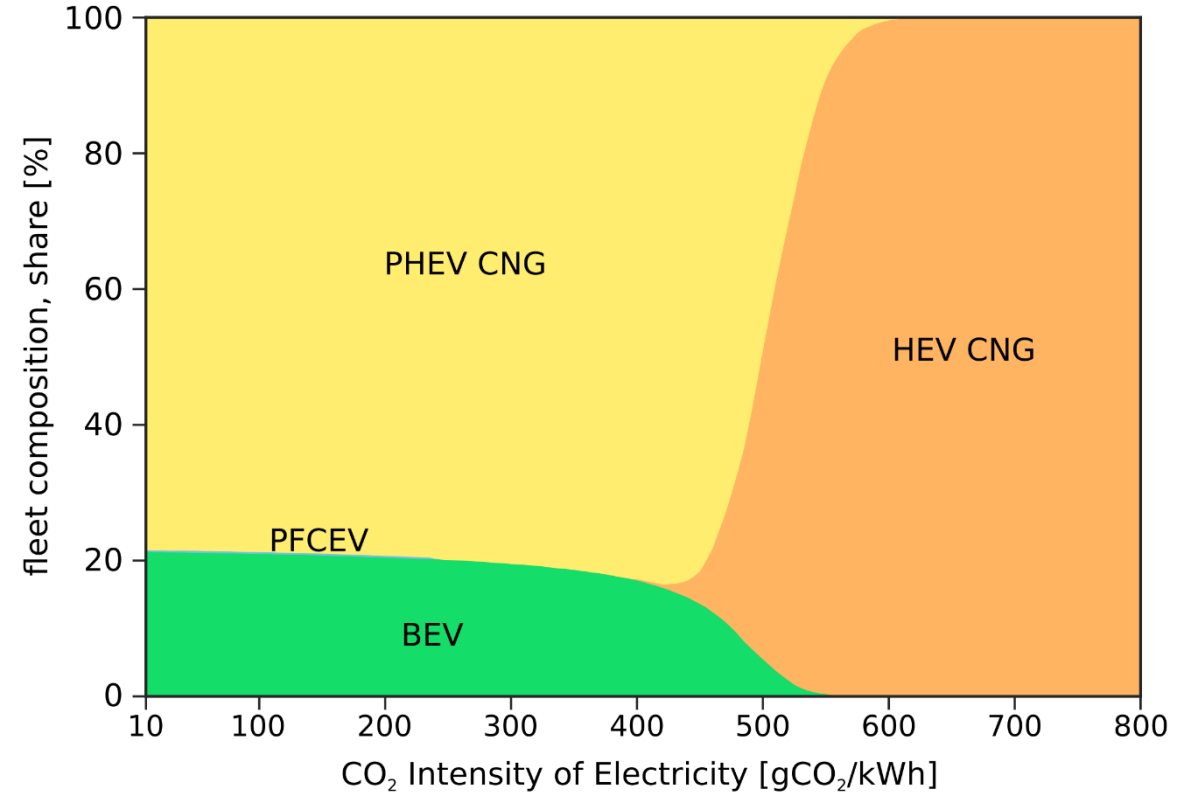
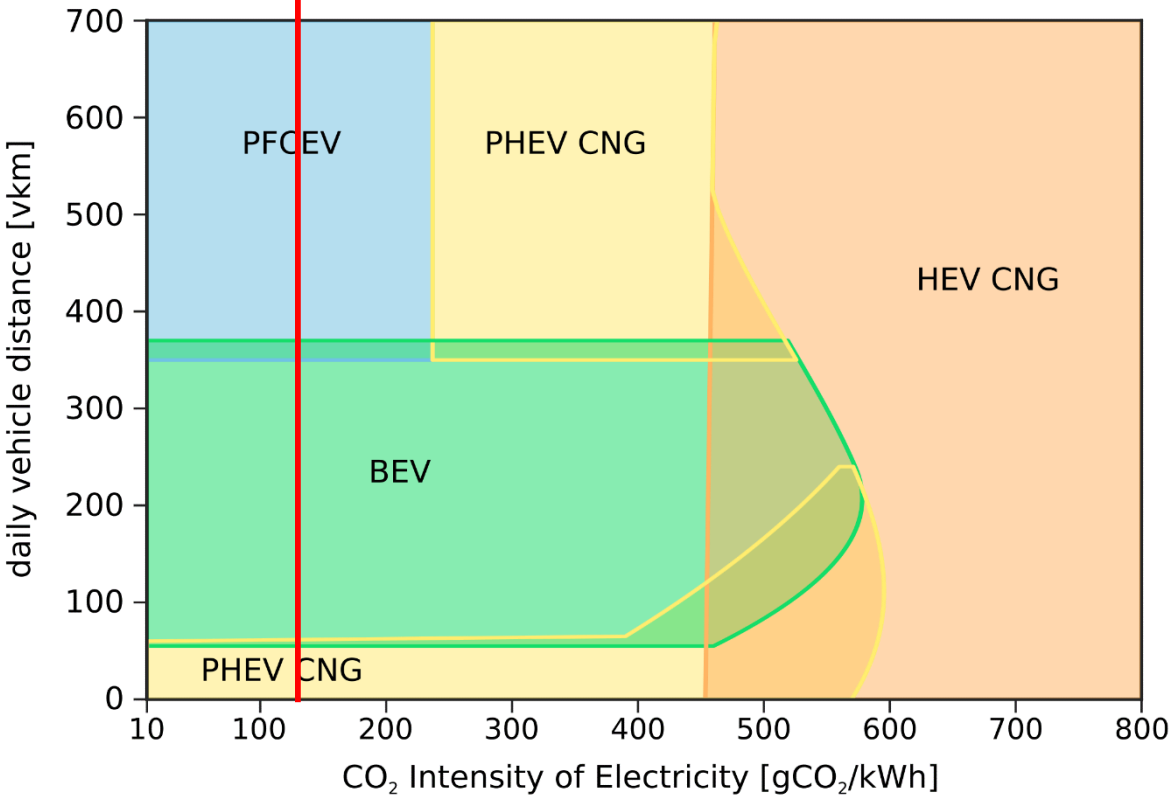
Which technology is the optimal?

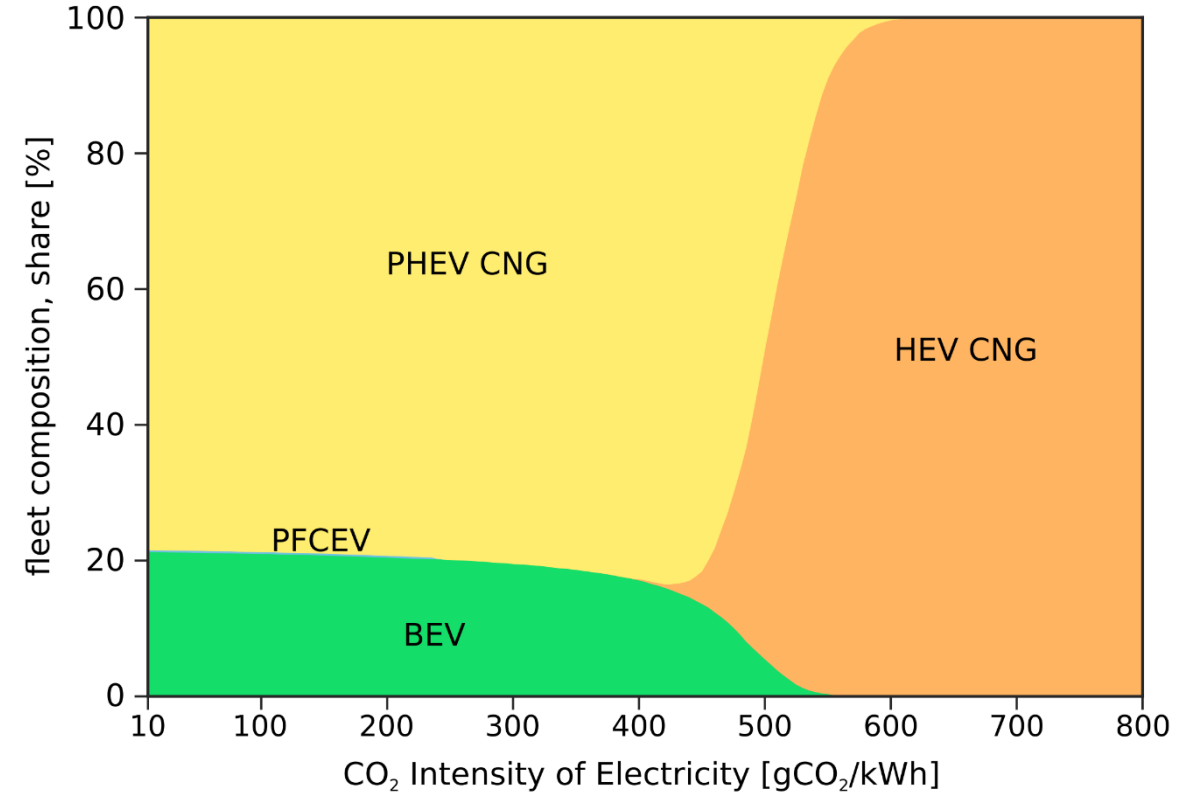
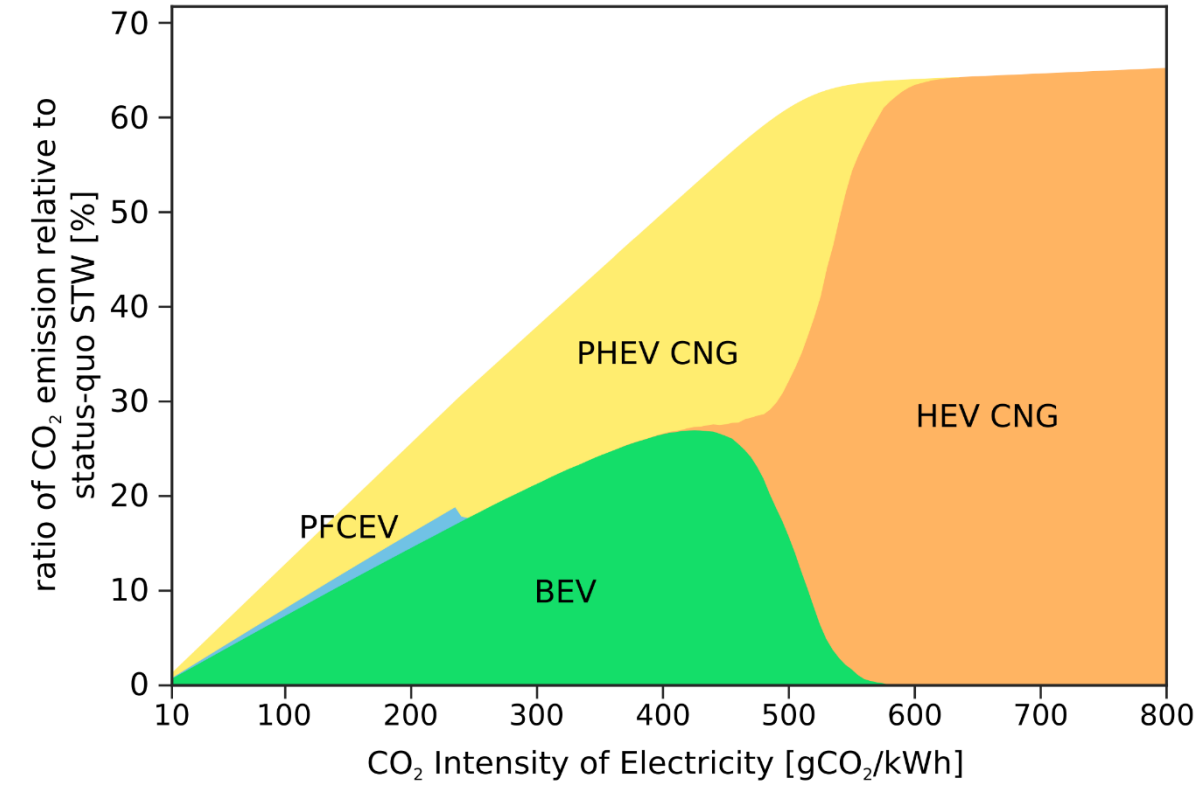
Well-to-Wheel system boundary











Which technology is the optimal?

Conclusions from reduction potential estimation of technologies

- No *one-fit-all* technology
- General trend: electrification is desired!
- With electrification of fleet, CO₂ reduction driven by electricity supply
- Majority of trips could be covered by small(er) battery capacity vehicles

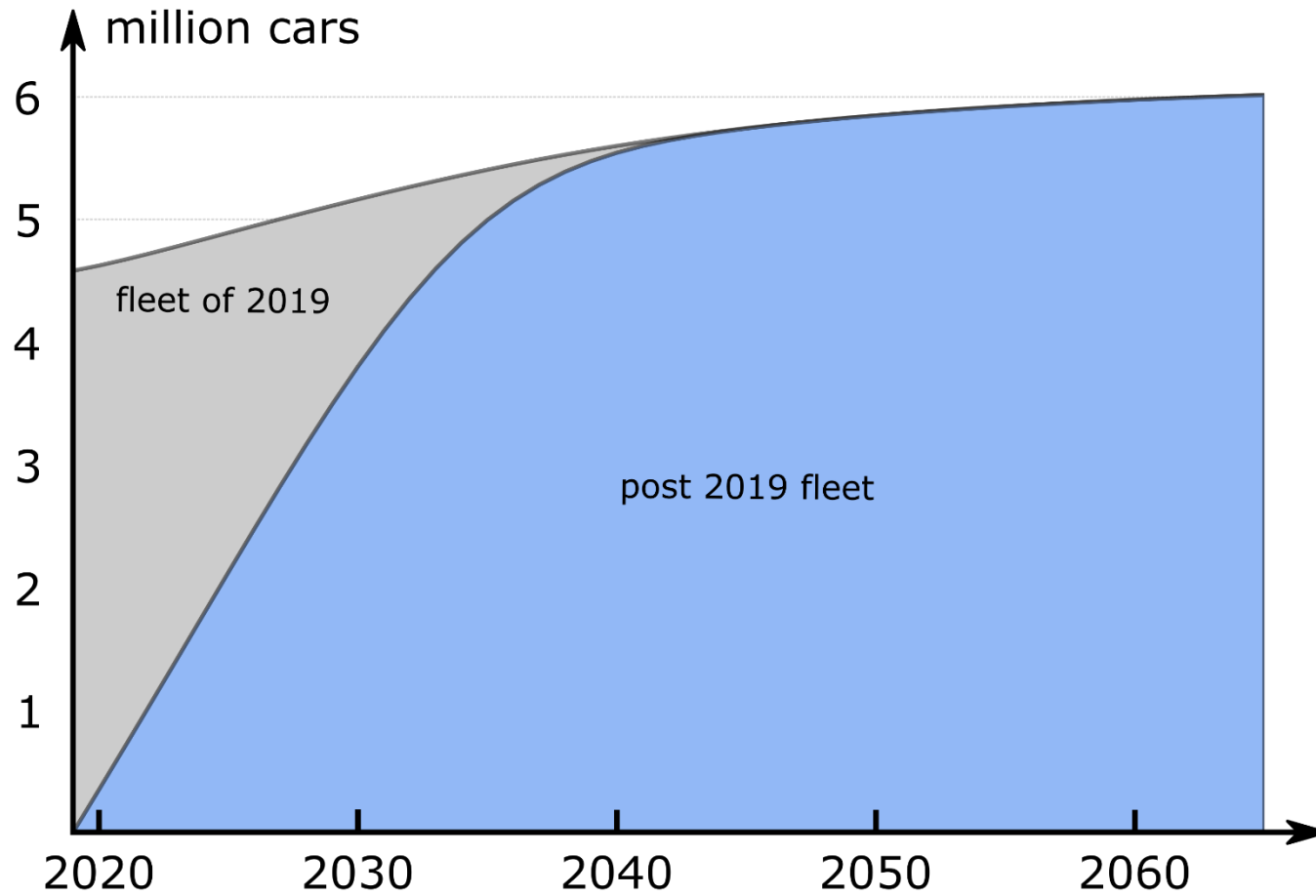
but...

- Large additional share of electricity needed (about 15 TWh/yr)
- We cannot exchange existing fleet “over night”

Transition to alternative propulsion technologies

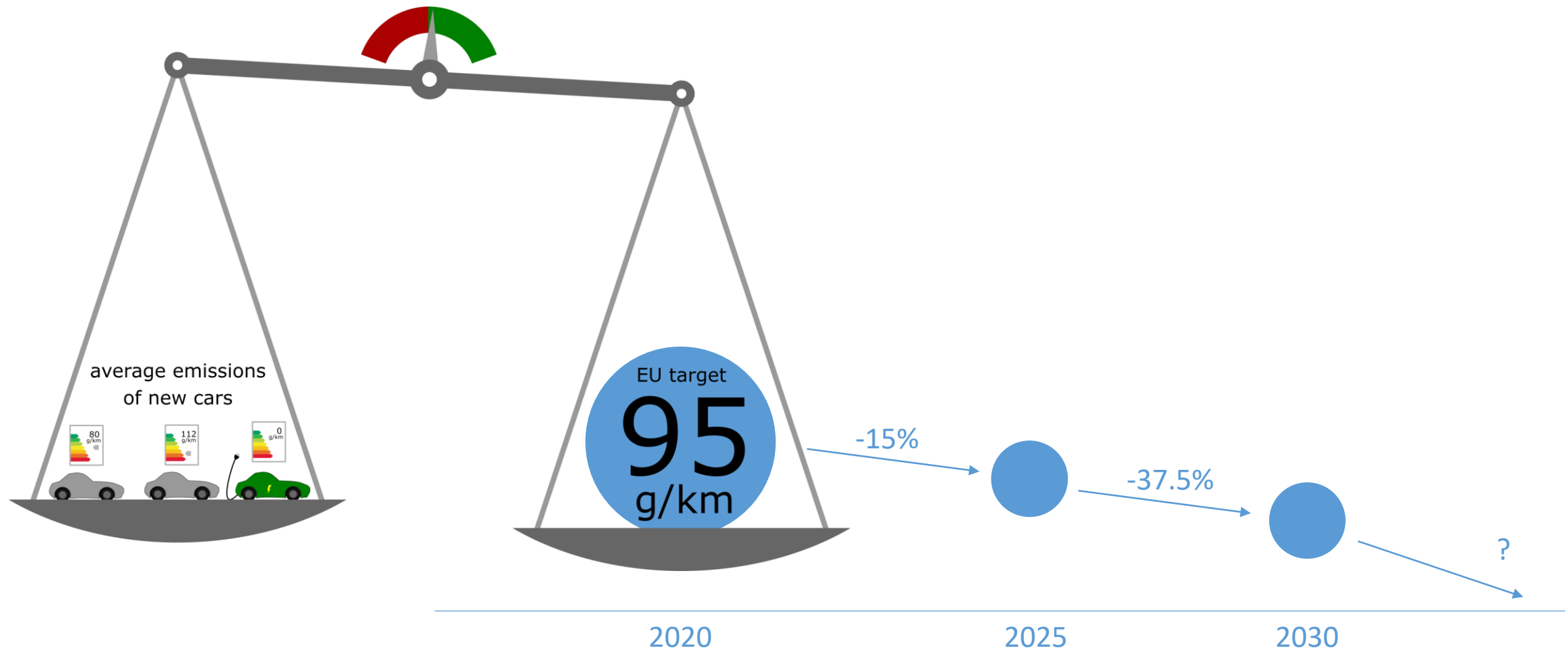
Passenger car fleet renewal

Technology introduction through new vehicle registrations



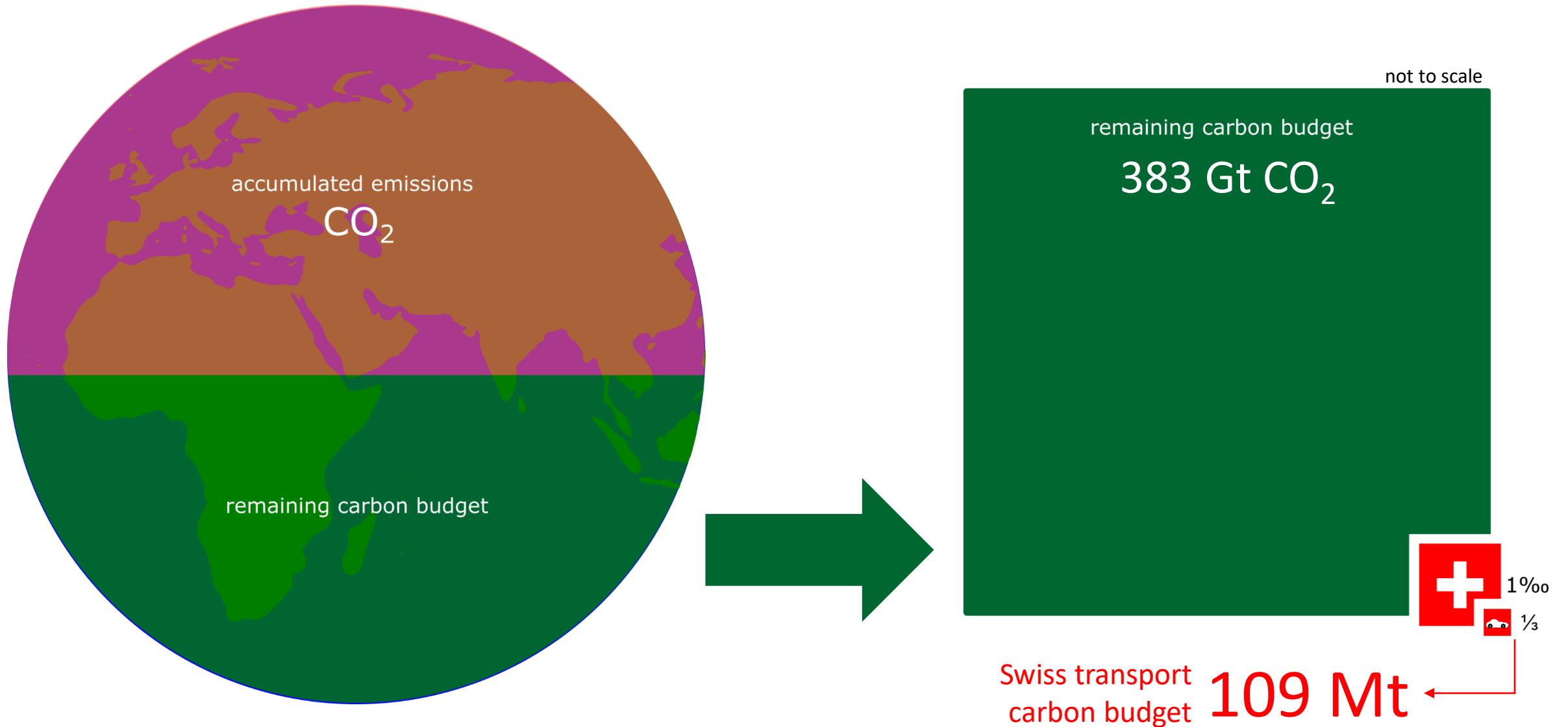
CO₂ targets for cars in the EU (+ Switzerland)

Average emissions of newly registered vehicles need to follow a gradual reduction path

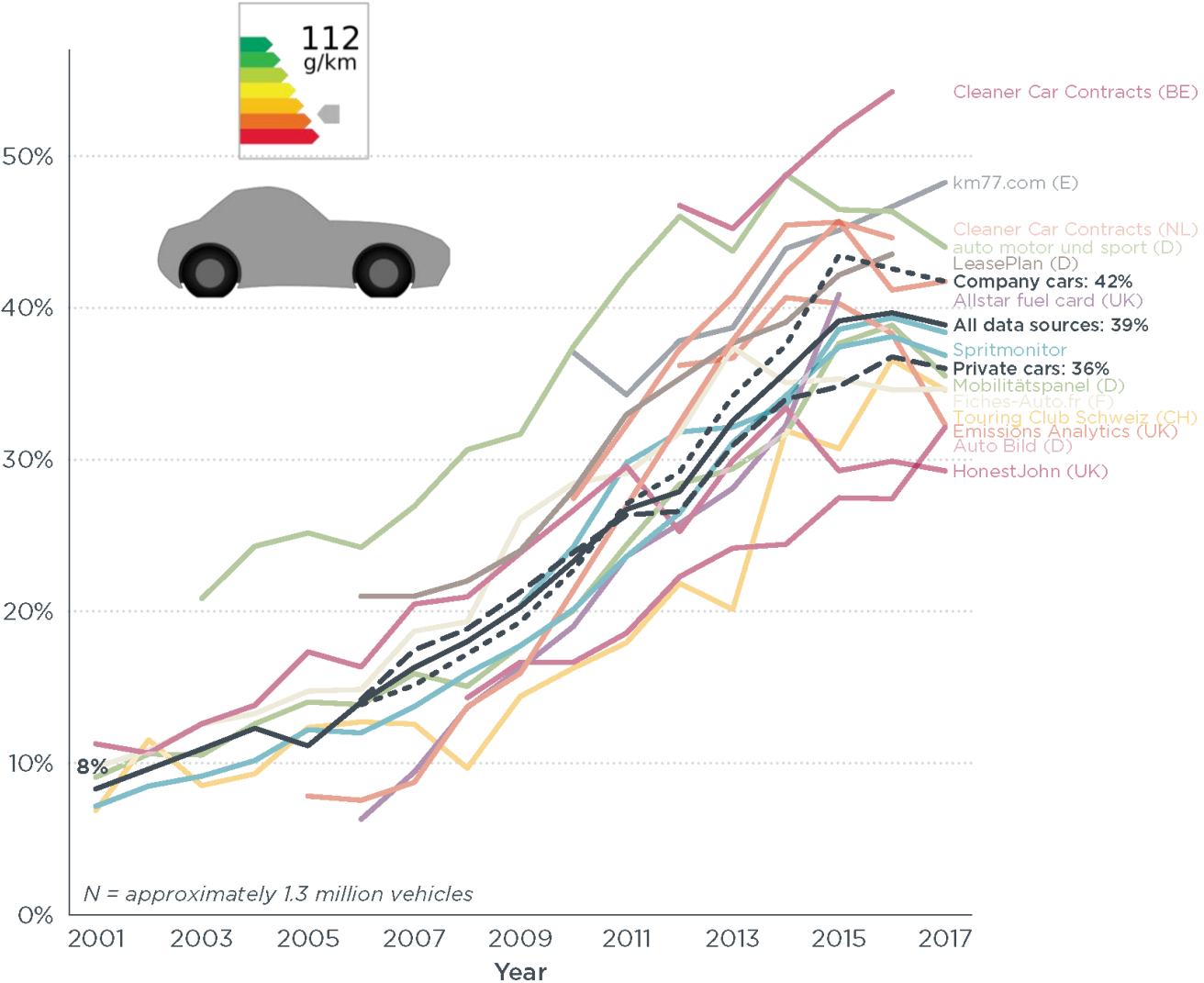


Are current transport policies in accordance
to the 1.5 °C climate target

CO₂ budget as measure for climate targets



Issue: Diverging norm and real-world values



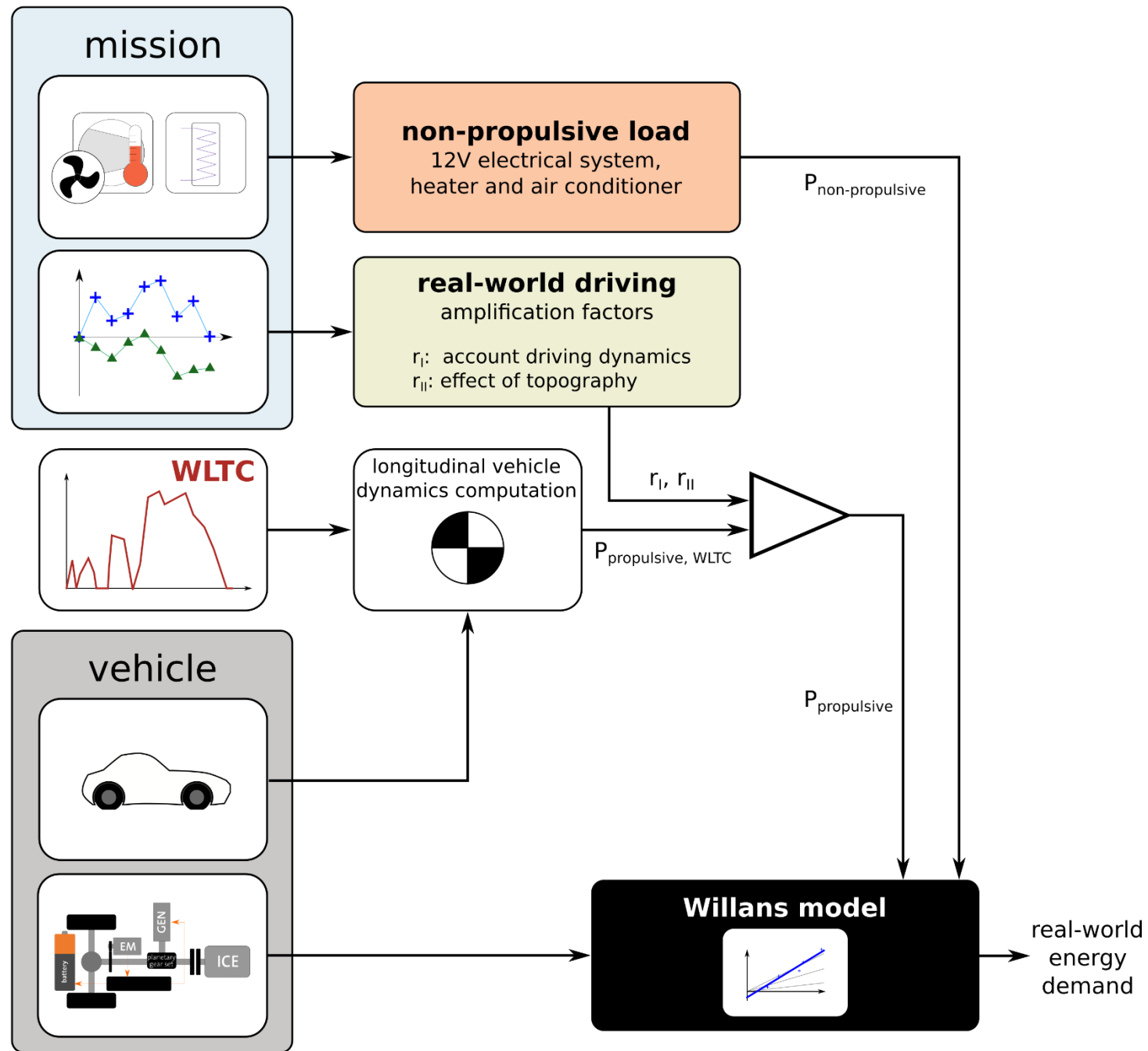
ESMOBIL-RED Project: Real-world energy demand

Alternatively propelled test vehicles: investigated in laboratory and on the road



➔ Technology: Laboratory measurement campaign

➔ Real-World factors: on-road operation as shared fleet



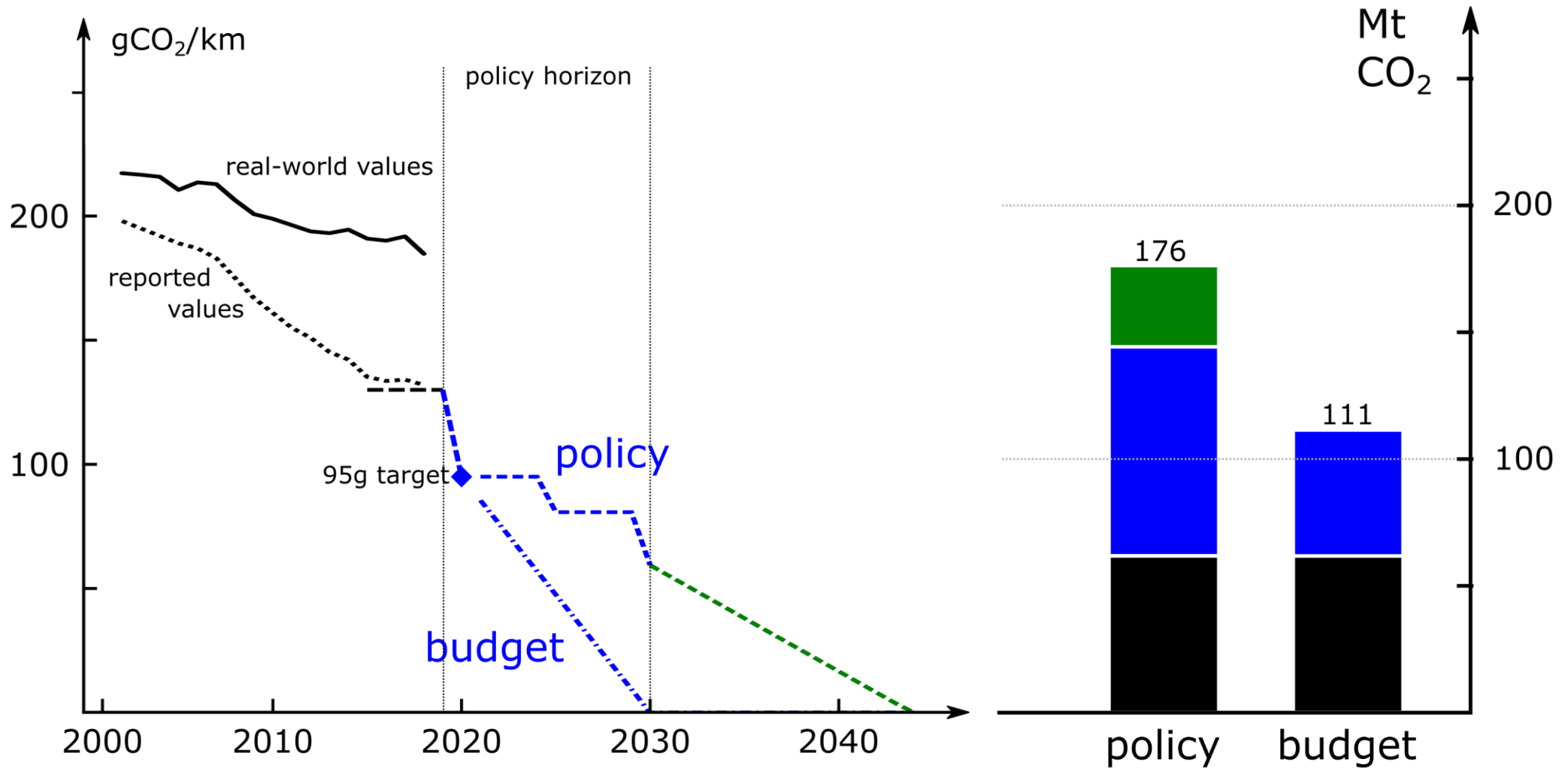
Real-world energy demand factors

Results from the ESMOBIL-RED project

	Energy Ratio (ESMOBIL-RED usage)	Energy Ratio (MZMV 2015 usage)
EURO 6 gasoline	1.17	1.22
EURO 6 diesel	1.16	1.22
EURO 6 CNG	1.13	1.20
EURO 6 HEV gasoline	1.35	1.30
EURO 6 HEV diesel	1.36	1.31
EURO 6 HEV CNG	1.39	1.32
FCEV	1.30	1.28
BEV*	1.31	1.28

* Without battery charging

CO₂ emissions from passenger cars



Conclusions

- The existing transport policies will result in more than 109 Mt CO₂
- Accumulated CO₂ emissions over lifetime of existing fleet is in the order of 60 Mt
- Fast promotion of electrified vehicles needed (preferably pluggable, with small battery capacities)
- Demand measures are important, as they realize fast reductions
- Synthetic fuels can help with decarbonization of existing and future fleet
- Promotion of renewable electricity supply needed, to cover large additional demand from transportation

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