Climate protection and mobility – an economic optimisation problem!

Baden-Baden Engine Congress 2020

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Frontier is an economic consultancy working across sectors…

Regulation | **Strategy** | **Competition** | **Dispute support** | **Public policy**

- **Energy**
- **Transport**
- **Financial services**
- **Health**
- **Retail**
- **Media**
- **Telecoms**
- **Water**

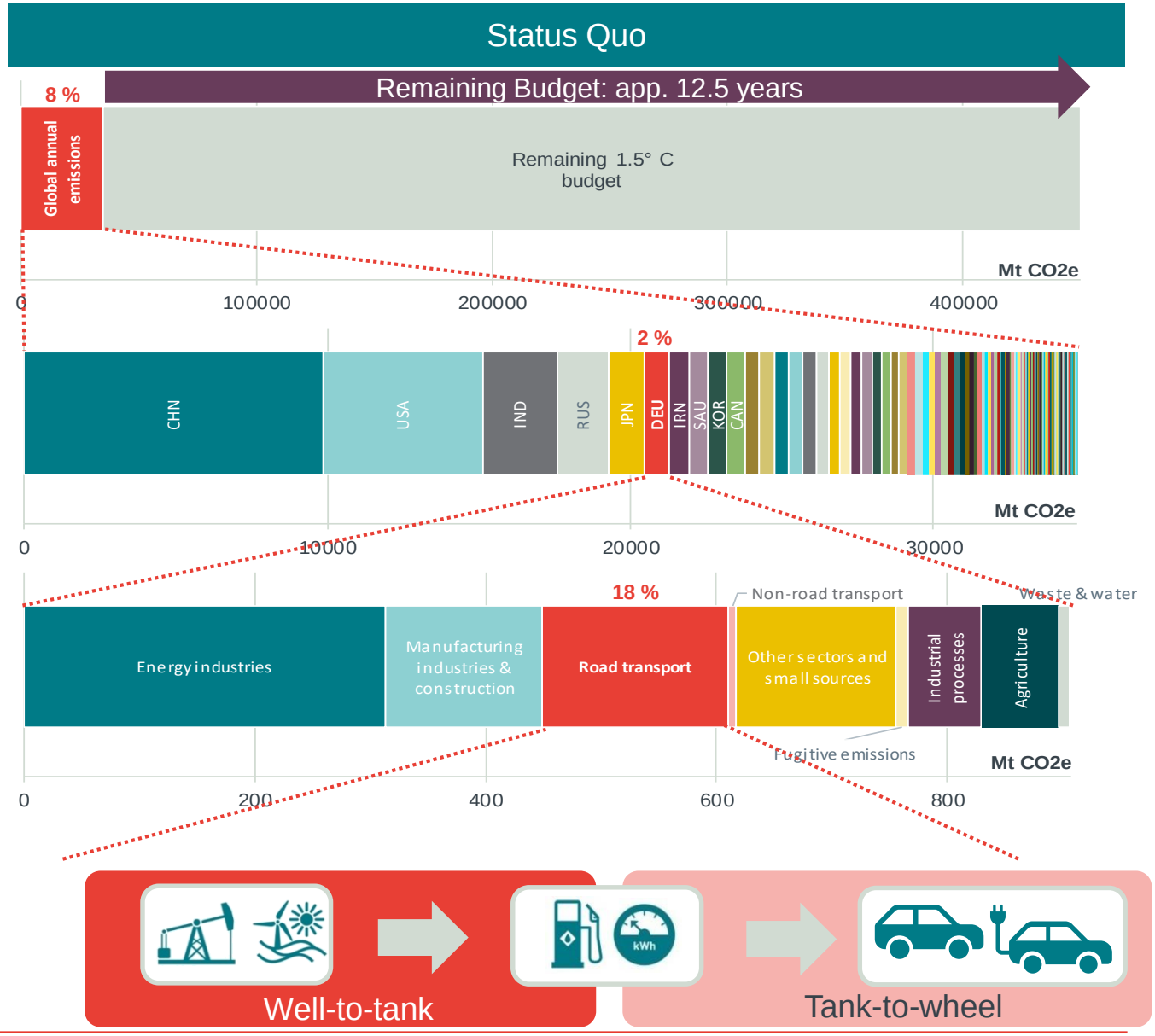
- Frontier has over **200 consulting staff across** its offices Berlin, Brussels, Cologne, Dublin, Paris, London and Madrid
- **Energy** is our largest sector specialisation, also expertise in many other infrastructure sectors, particularly **mobility / transport.**
- Regular work on a wide range of topics in the **power, gas and fuel market**
- One recent focus: **Market for alternative fuels -** Design, Economics, Business Cases
- Broad **customer portfolio** of companies, associations, authorities and government organizations
- **Global, European and German speaking** expertise
  - Projects in all major EU countries

… but energy / mobility are one of our core expertises!

A **sector specific approach** is not suitable to manage the global climate problem!

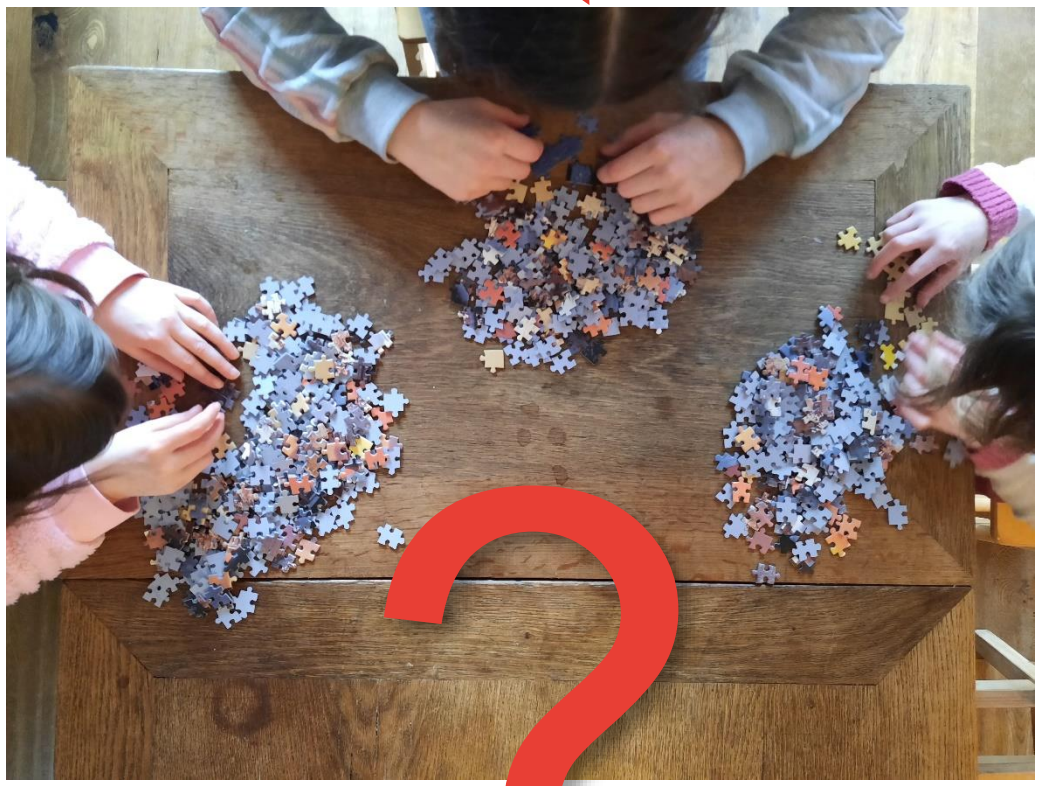
Climate Policy – our current approach: Breaking down the problem in manageable tasks …

Global Climate Target	▪ IPCC models remaining budget (12.5 years!)
National Commitments	▪ Kyoto Protocol 1997 ▪ Doha 2011 ▪ Paris 2015 (INDC)
Sector Targets	▪ DE: Binding sector targets for Energy / Industry / Transport / Buildings / Agri-culture / Waste
Stakeholder specific obligations	▪ Quota for fuel providers (Well-to-tank) ▪ Fleet targets for OEMs (Tank-to-wheel)



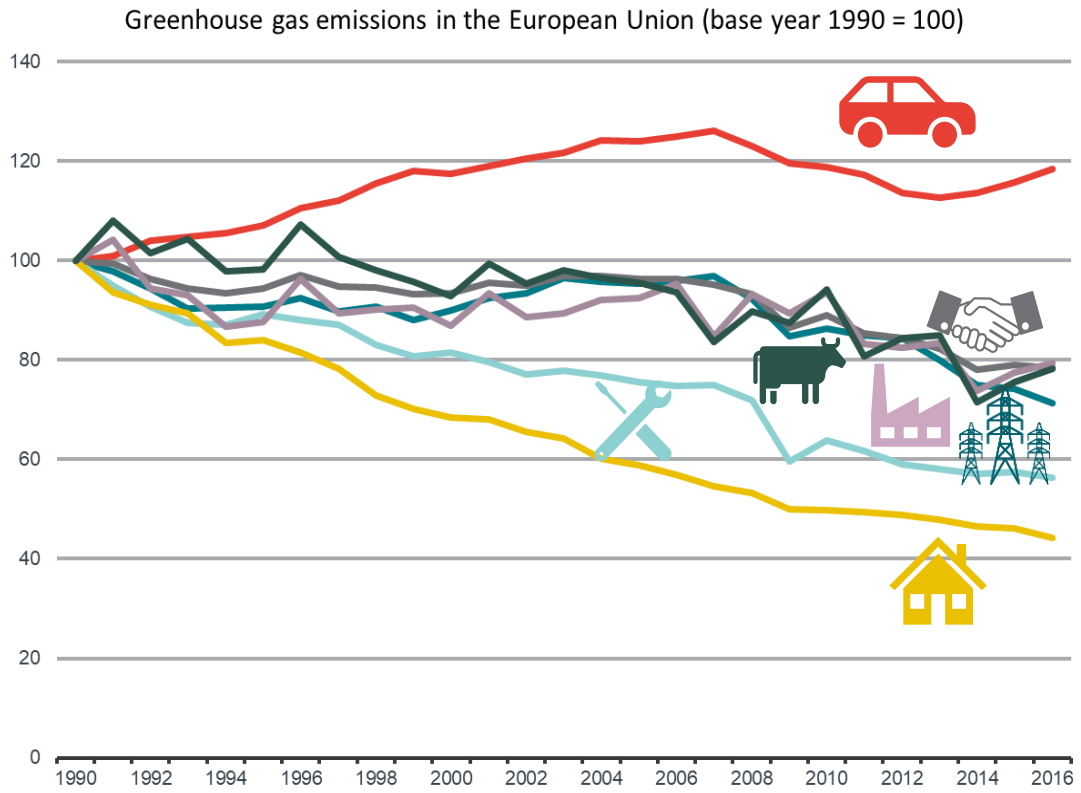
Source: UNFCCC country reports, BP energy statistics

… doesn‘t always work!

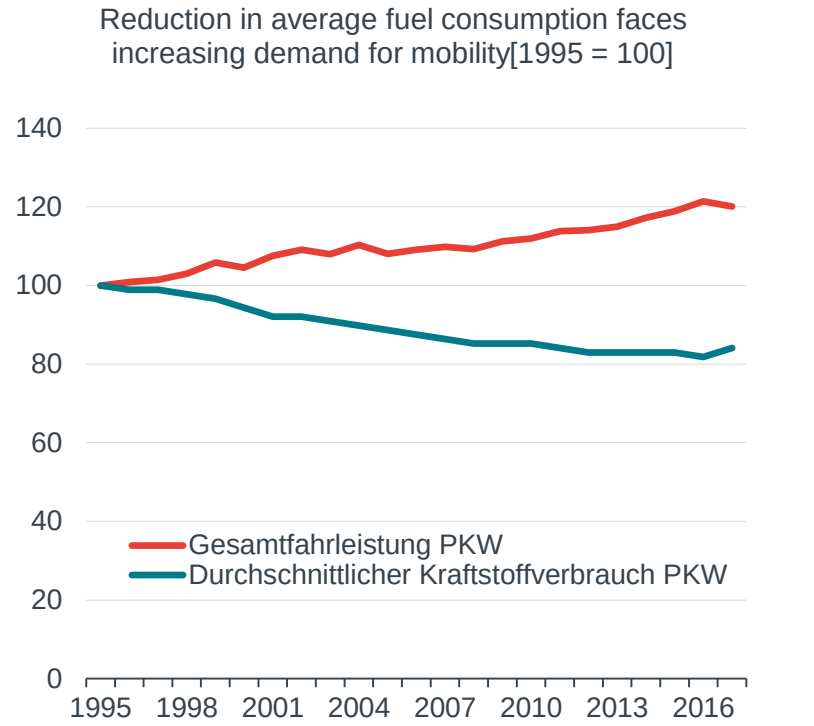


Because of this narrow approach mobility often seems to be the „troubled child“ of climate policy!

Mobility the only sector with increasing emissions since 1990…



… despite efficiency gains, driven by increasing mileages!



Source: Frontier Economics based on data from the Umweltbundesamt

Thesis: The exact impact of the mobility sector is yet unknown!

- Possible GHG-reducing effects of increasing mobility in other sectors (e.g. industry by improved logistic, energy by (raw material-) transport of renewable energies…) have not been taken into account so far!!

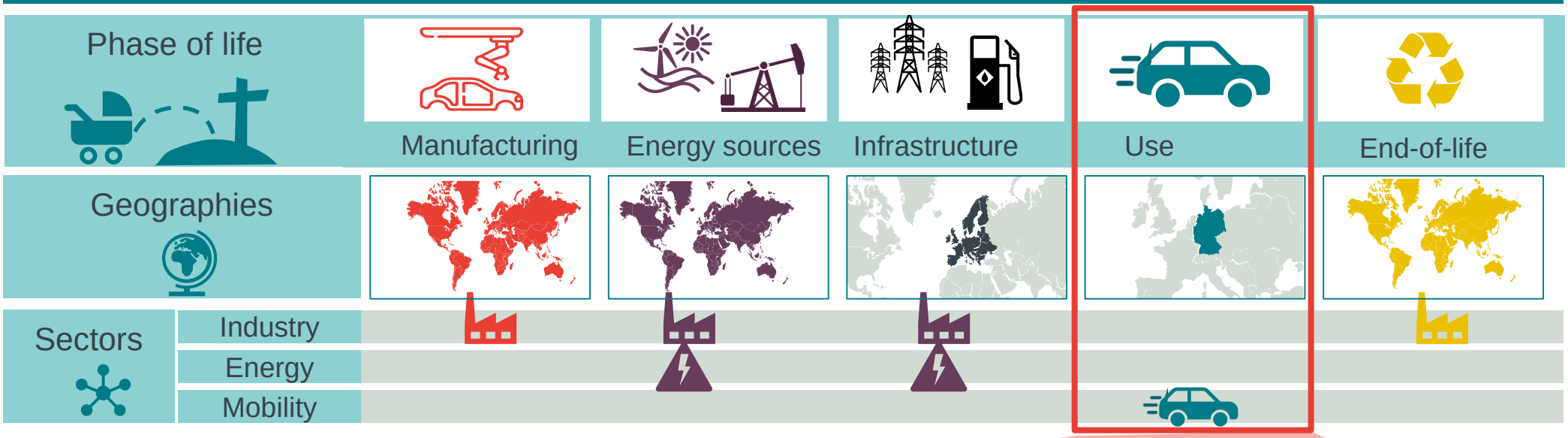
Question – what do we see here?
Additional transport emissions or emission reductions in energy?

Foto: Patrick Findeiß

A comprehensive **cross-sector**, **global**, **intertemporal life cycle analysis** is a prerequisite for a sustainable choice of technologies!

National, sector-specific considerations give only little insight into the effects of one technology!

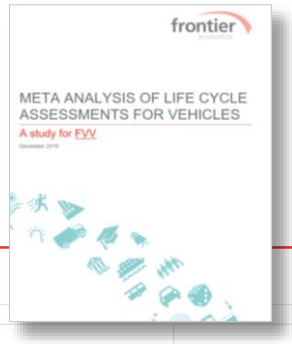
The emissions of a vehicle are globally distributed and comprise many different sectors, e.g.

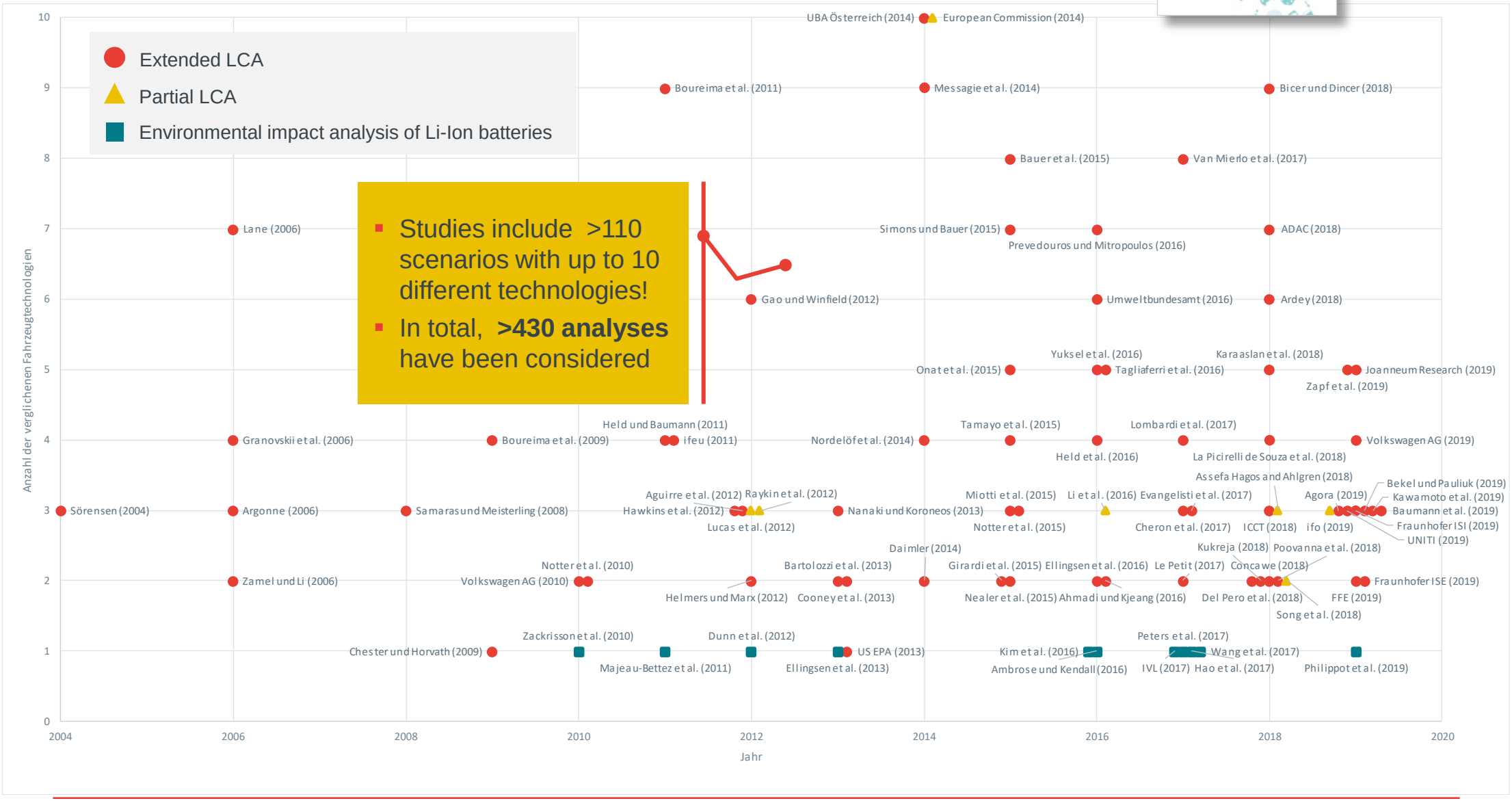


With a narrowed perspective, limited to country borders, sectors and specific periods, the rollout of low-carbon technologies might be ill informed!

- A perspective that is **limited** to the use of a vehicle can put technologies into a better light so that their emission level may seem lower than actually justified
- Instruments with an isolated effect on parts of the entire life cycle of a technology unjustifiably put emission **shifts** on the same level as emission **avoidances.**

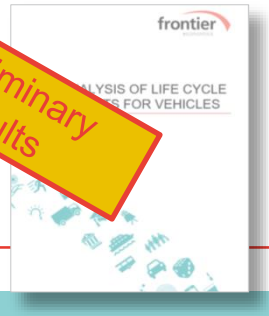
In a meta analysis we evaluated >80 int. LCA studies (focus on drive systems) from over 15 years





A meta analysis of existing LCA studies already allows several conclusions, despite missing data

Preliminary results



Maximum value in all studies

Bandwidth 50% of studies

Median of all studies

Minimum-value of all studies

ICEV (Diesel)

Fossile diesel

E-fuel diesel

New infra-structure required for E-fuels only

?

BEV

Electr. mix

RES-E

New infra-structure required for all BEV

?

FCEV

Fossile H2

E-fuel H2

New infra-structure required for all FCEV

?

t CO2

0

10

20

30

40

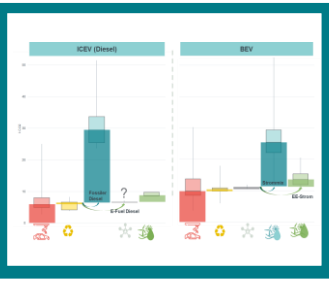
50

60

n=43 n=23 n=39 n=5 n=3 n=71 n=37 n=5 n=70 n=16 n=19 n=4 n=5 n=18 n=10

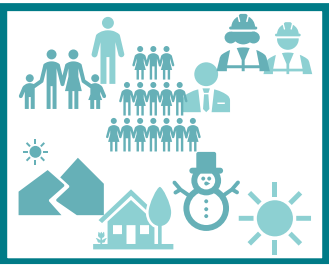
Conclusions: No silver bullet technology – but we are gaining options!
… therefore we shouldn‘t rule out any technology!

Data show no clearly **superior technology,** but location of emissions differ**!**



We have to maintain a portfolio of technology options and don’t let artificial sector targets distort our choice!

Advantages depend highly on the **individual application case**!



Every usecase is unique - no one size fits all! Only users can decide!

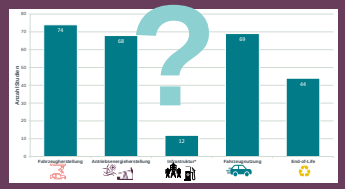
In the long run **all drive-trains** allow for a (almost) GHG neutral mobility!

There is no “dead-end” technology, but required system wide investments might be prohibitive!

Technology-open approaches based on live cycle emissions are most likely to ensure effective savings in GHG emissions

Current **technology/sector specific regulatory approaches** might mislead our technology choice, e.g. **devaluing the ICE without justification**!

BUT:
Full CO2-LCA not comprehensively available to date

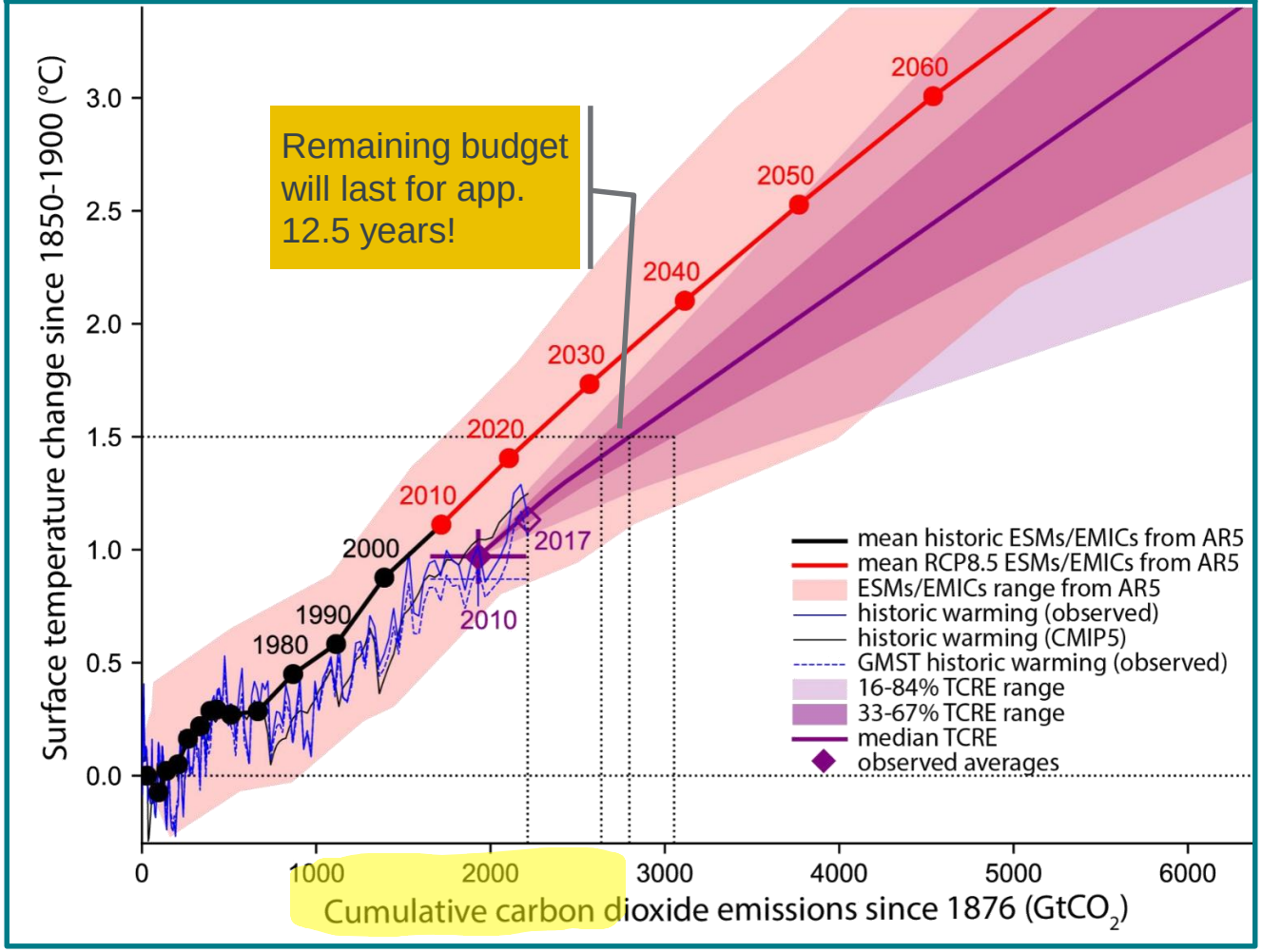


- Especially infrastructure is missing
- Numerous technology options and –combinations (e.g. e-fuels) have not been analysed in detail
- Dynamic development of parameters to be considered

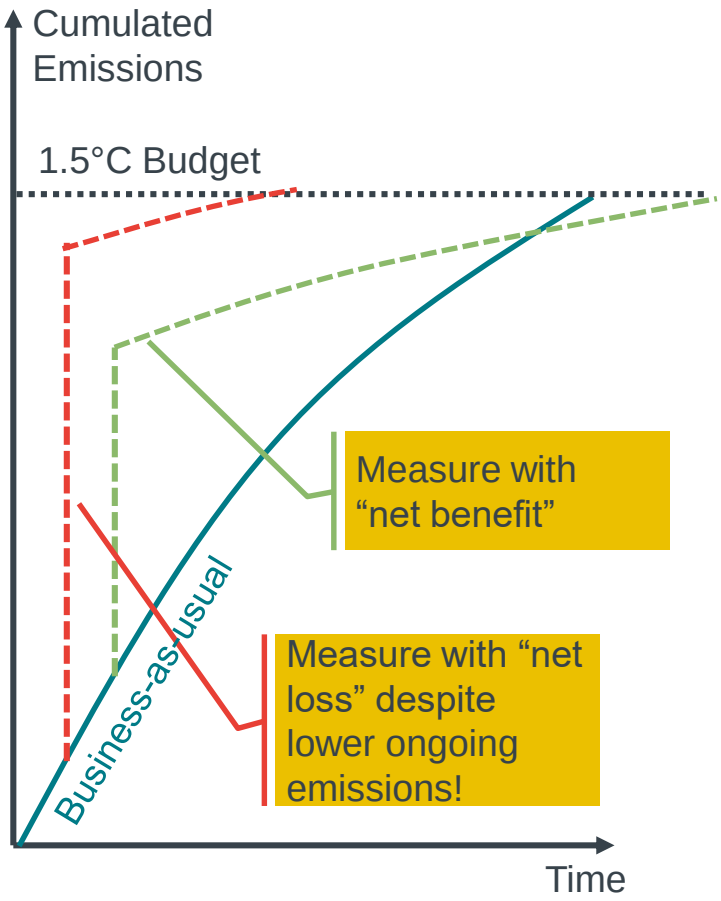
The remaining CO2 budget requires a rigorous „**return on invest**“ thinking!

Effective climate protection has to consider the time dimension – a **budget principle** applies to GHG! Therefore …

IPCC determines a remaining GHG budget until the 1.5°C target …



… which we have to invest wisely!



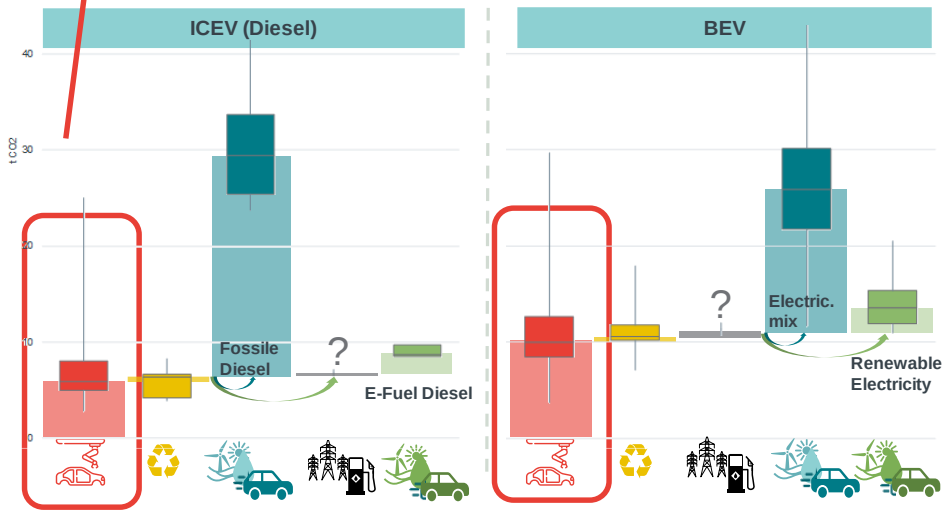
... quicker is not always better!

Src.: IPCC 2018 - Special Report: Global Warming of 1.5°C, Figure 2.3

Significant one-off emissions and a limited budget require a “**Return on invest**” **thinking** for mobility policy measures!

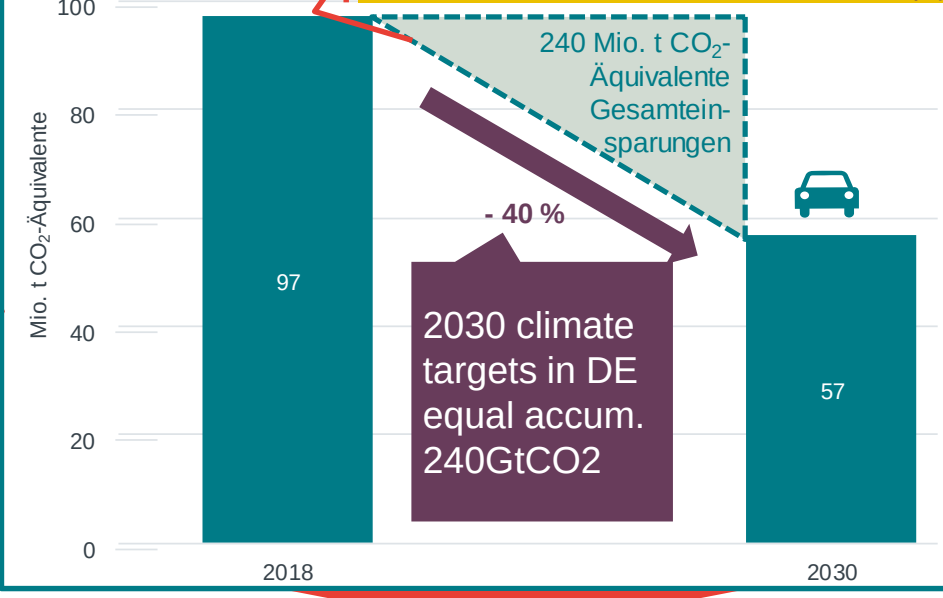
Life-cycle analysis shows:
Large share of emissions during manufacture!

Production emissions are one-off… therefore „long usage“ reduces average emissions per km!



A **premature exchange** of the fleet might therefore inefficiently use up the emission budget

Equals the size of the “invested” manufacturing emissions of the German fleet *)



We have **to maximise the “return”** (GHG savings over lifetime) **“on invest”** (GHG Budget used for new technologies)

Political measures that only aim at a **premature technology change** beyond the usual re-investment cycles may further aggravate the total climate balance!

Advantage for brownfield solutions (e.g. e-fuels) vs. greenfield technologies (e.g. FCEV)!

*) 47 Mio. PKW á 5t CO2/PKW = 235 Mio. t CO2

How are we doing? Current sectoral targets incentivise **emission shifts** instead of **emission avoidances!**

Exemplified calculation based on averages

Example: a key measure within the German climate package (based on NPM, AG1) *):
Introduction of up to 10.5m BEV until 2030 to save approx. 13 Mio. t CO2 by 2030.

Assumption: Linear increase

Sector/geography affected

	Per vehicle	Cumulated until 2030
Reduction „tank-to-wheel“	- 124 gCO2/km*)	- 65.0 Mio t CO2
Additional emissions from the electricity sector **)	+ 98 gCO2/km	+ 51.5 Mio t CO2
Emission savings WtT ICEV	- 17 gCO2/km	- 8.8 Mio t CO2
Additional emissions from infrastructure expansion ***)	+ 7 gCO2/km	+ 3.6 Mio t CO2
Additional emissions from vehicle production and end-of-life ****)	+ 29 gCO2/km	+ 15.2 Mio t CO2
Net avoidance	- 7 g CO2/km	- 3.5 Mio t CO2

Not included: risk of premature exchange

Total emissions from production: + 48 Mio t CO2

Vehicle assumptions:
Yearly mileage: 10.000km;
Consumption (mid-size, WLTP): 21 kWh/100km (BEV), 5.6 l/100km (ICEV)
CO2 power mix 2026: 437g/kWh (incl. 42g/kWh REN-E plants); charging losses 10%;
Manufacturing emissions 8.66 t CO2 (BEV); 4.09 t CO2 (ICEV), purchase in 2025

*) Based on data from the climate protection act (8.10.2019) and from the NPM AG1 report (29.03.2019))
7 – 10.5 Mio vehicles for approx. 6-13 Mio tCO2 savings TtW in 2030

**) Total emissions limited by EU ETS, but crowding-out effects to other consumptions likely (moving of demand outside EU ETS)
***) Estimated with 5% of life-cycle emissions (but will in practice be front-loaded)
****) Pro-rata share of production based on assumed 15years lifetime

The value of mobility is the **big unknown** in almost all analysis!

And not to forget: Sustainability is not only about climate …
… and mobility might contribute to many sustainable development goals!

UN sustainability goals, issued as Agenda 2030 in 2015 …

Climate protection is only one in 17 targets!

Guiding principles: **mankind, planet, wealth, peace** and **partnership**

… adapted in the German sustainability strategy!

- Agreement January 2017, update in 2018

- Selection of relevant indicators:
  - Constant and appropriate economic growth
  - Affordable living space for everybody
  - Preserve species – protect habitats
  - Protect the ecosystems

… but for a sustainable cross-sectoral technology mix, in which individual mobility has a potentially strong role to play …

Individual mobility has a high value …

… for climate protection …

Foto: Patrick Findeiß

… for the sustainability goals …

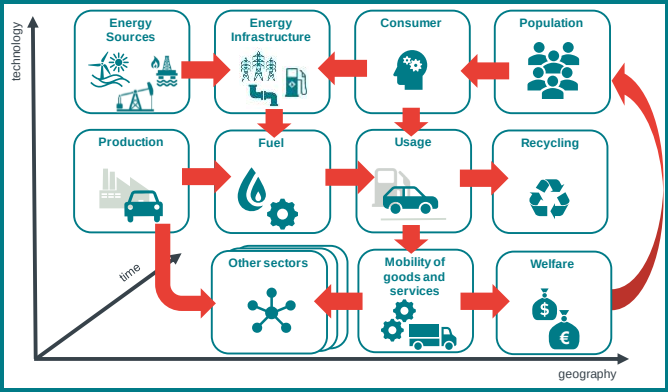
… and ultimately: for economic welfare!

… but who is going to make the case?

Climate protection and mobility – we are facing a massive **economic optimisation problem**!

Conclusion

We need to approach the defossilisation of mobility and the deployment of technologies as a system-wide optimization task …



Always consider feedback-loops and avoid unnecessary constraints, e.g. **sector targets**! Political intervention should happen **on a high level**, e.g. pan-sectoral CO2 prices!

All drive-train technologies allow in the end for a **GHG neutral mobility –** we have to pick the ones with **highest net savings cradle-to-cradle!**

Because of the budget principle we have to apply **a „return on investment**“ thinking! Continued use of existing infrastructure / fleet might have strong benefits compared to new „greenfield“ solutions.

… but we are still lacking critical information!

?

Full comprehensive **cradle-to-grave** (to cradle) analysis of all relevant technologies not yet available.

The **value of mobility** not captured in any analysis, yet.

Ultimately to be determined: What is the **optimal path** to utilize the **remaining CO2 budget**?