operations research
QUANTITATIVE INFRASTRUKTURSYSTEMMODELLIERUNG

OR-MSM

Transport planning and transport modeling

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Who I am

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How does transport sufficiency support fast decarbonisation of the energy system?

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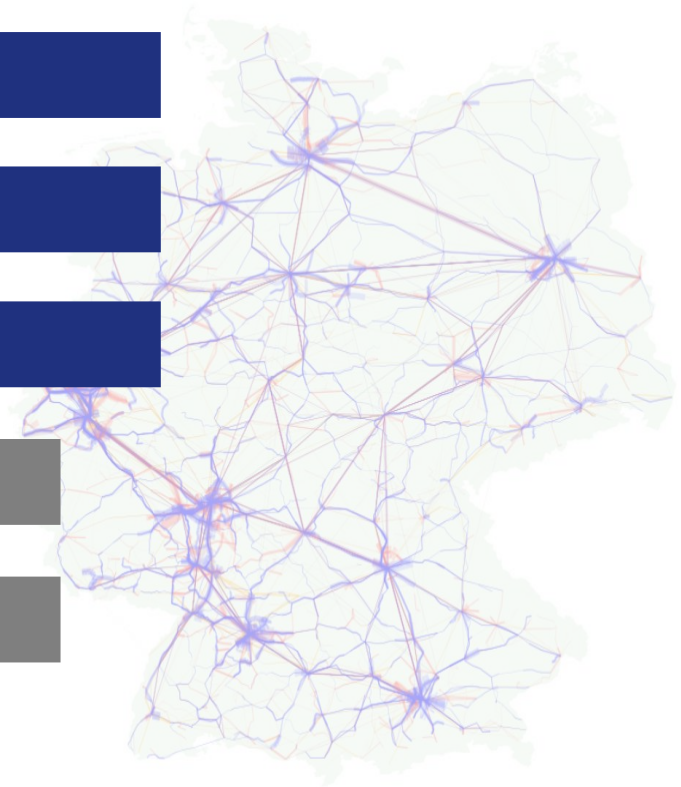
Agenda

- Introduction
  - Transport systems and externalities
  - Transport decarbonization
  - Transport modeling
- Transport supply modeling
- Transport demand modeling

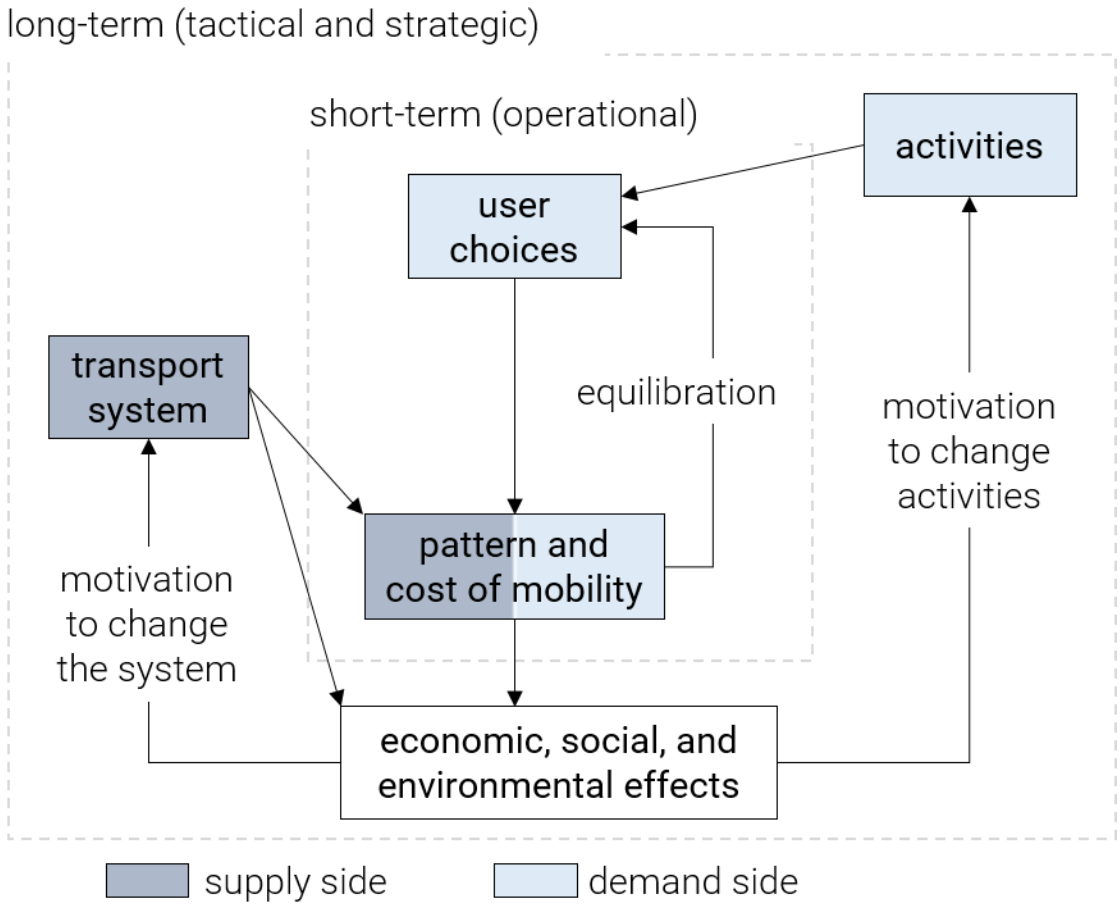


Transport systems and externalities

What are relevant differentiations in transport?

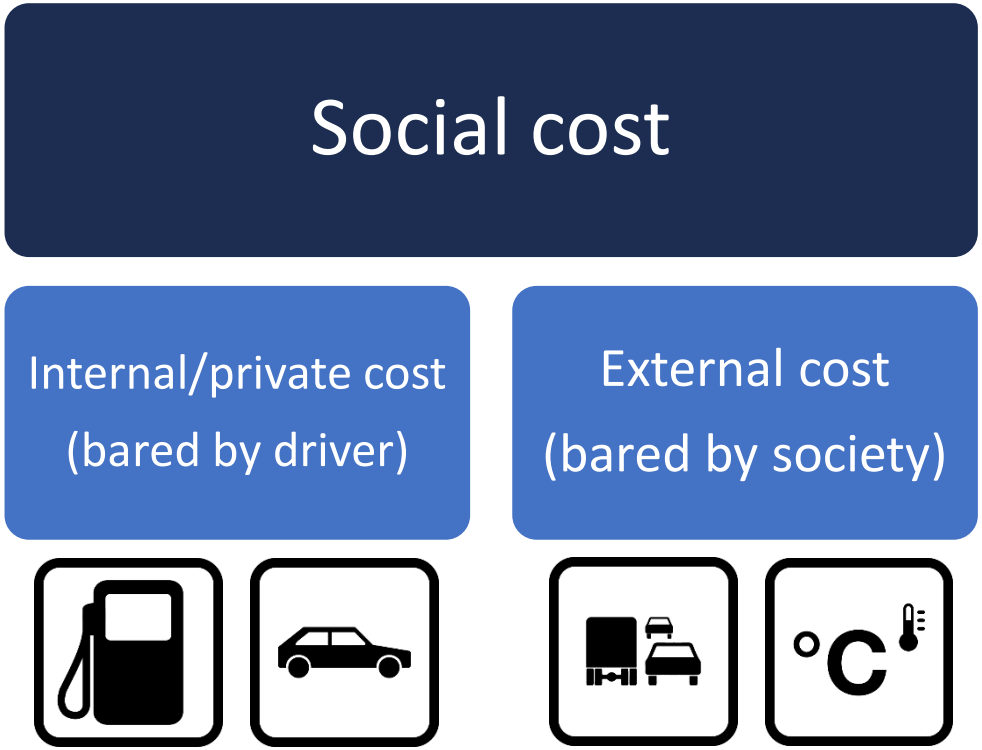
- Freight / passenger transport
- …

Transport system analysis framework

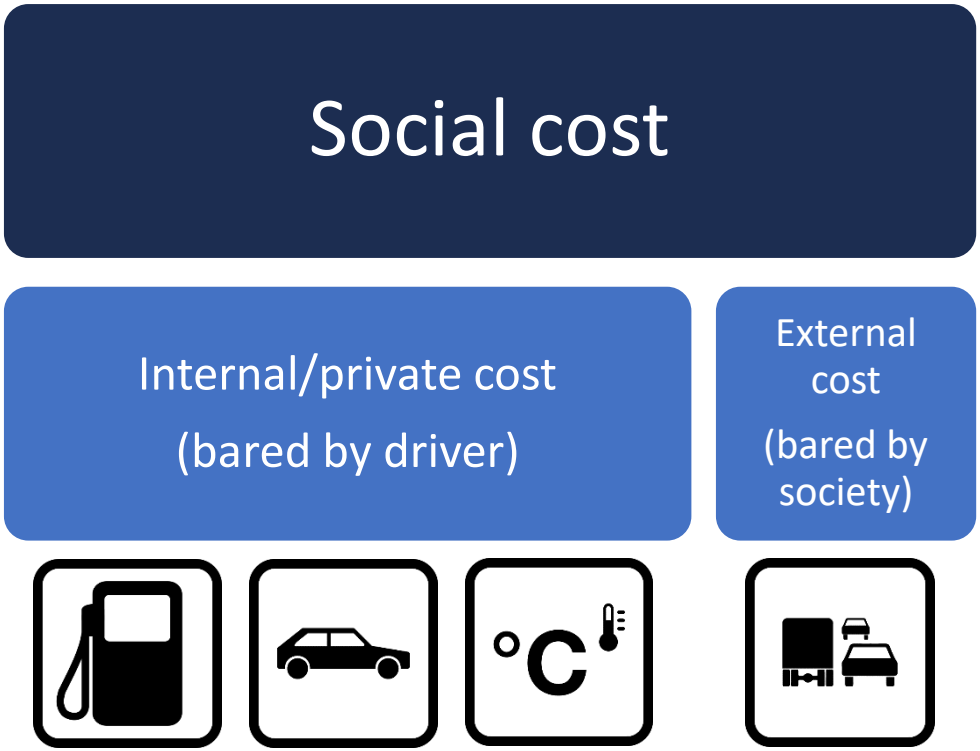


Source: Own illustration based on Allsop (2008): Transport networks and their use: how real can modelling get?. Philosophical Transactions of the Royal Society A, 366, 1879-1892

Social cost

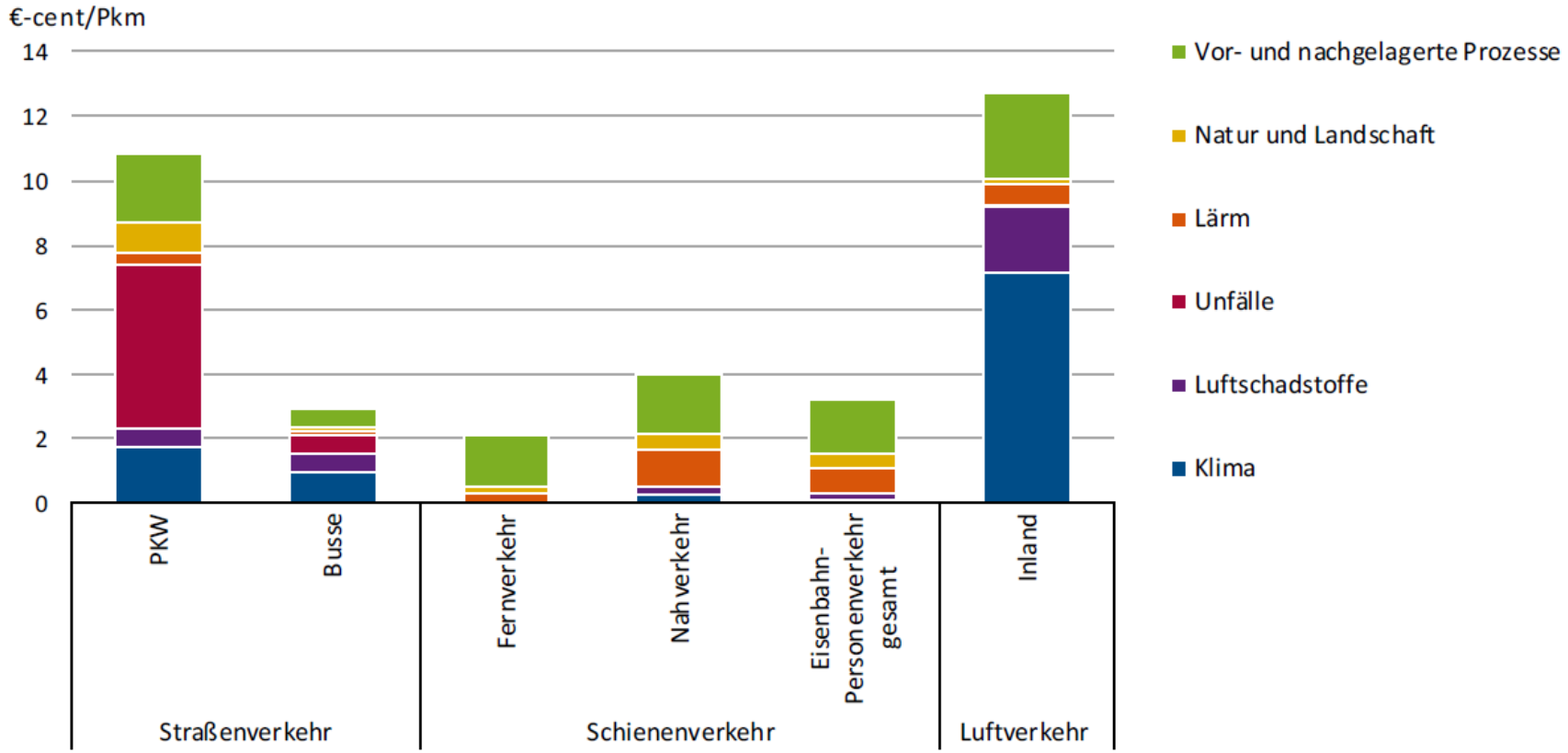

Social cost
Internal/private cost
(bared by driver)
External cost
(bared by society)
°C

Social cost - regulated



Transport externalities

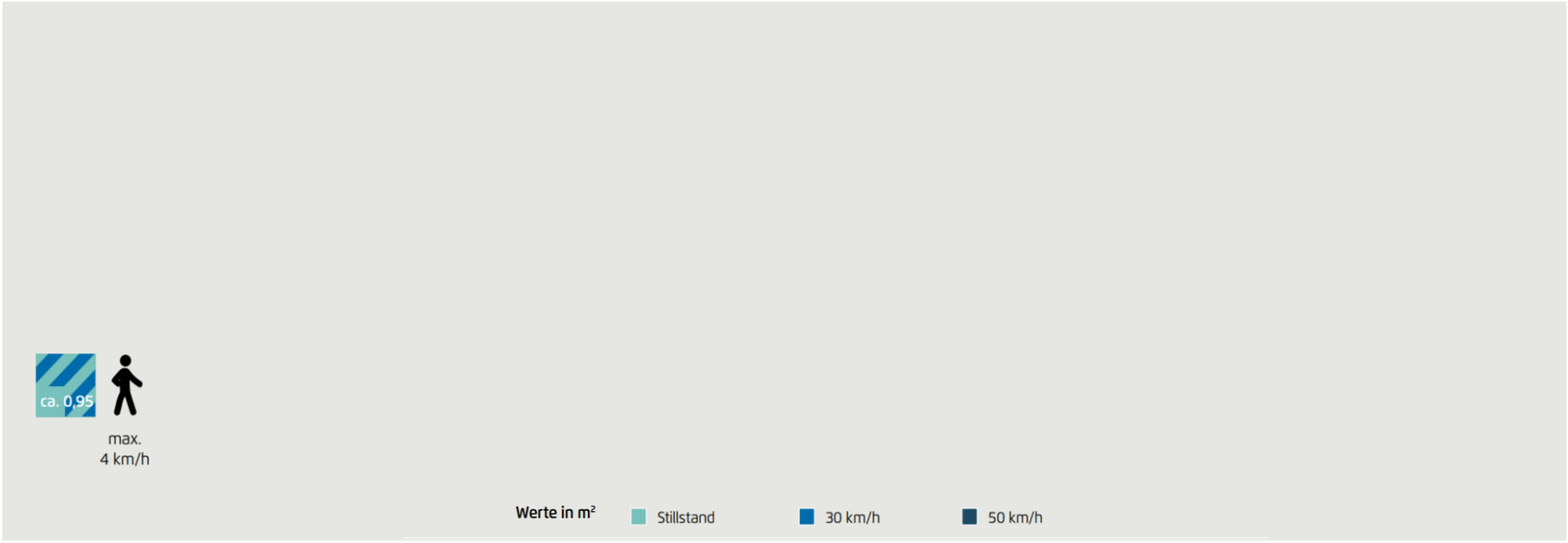
Average external cost of passenger transport in Germany 2017



Source: infras (2019): Externe Kosten des Verkehrs in Deutschland

Transport externalities - space

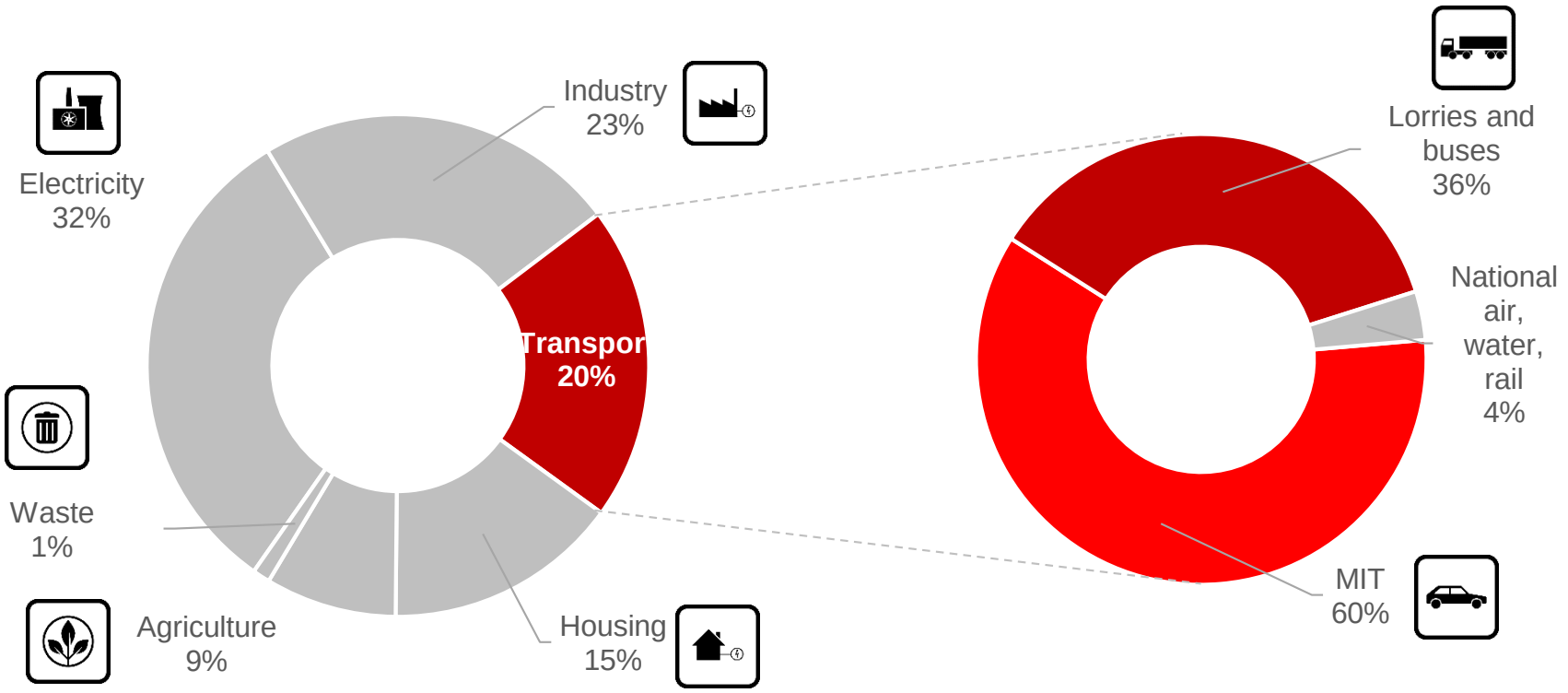
Space demand of different transport modes



Source: Agora Verkehrswende (2017): 12 Thesen für die Verkehrswende

Transport decarbonization

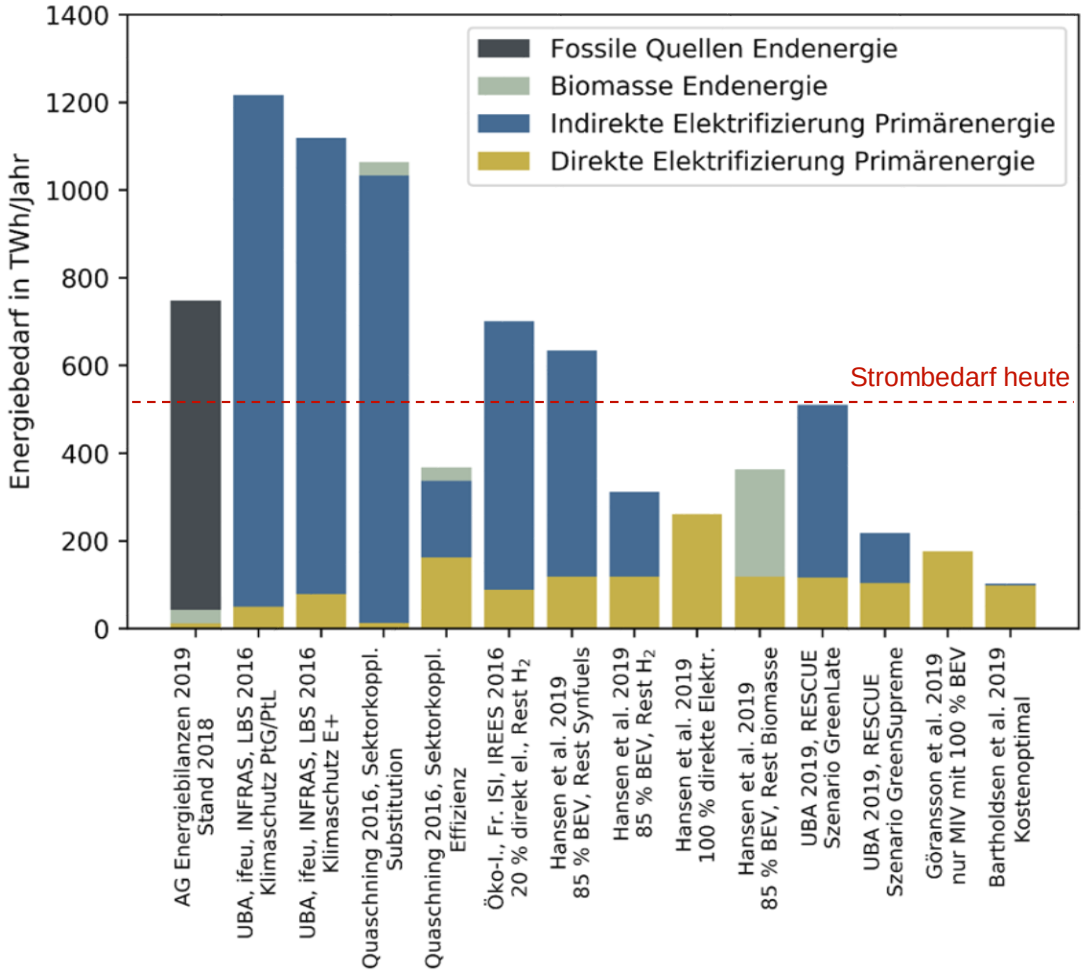
Transport GHG emissions in Germany



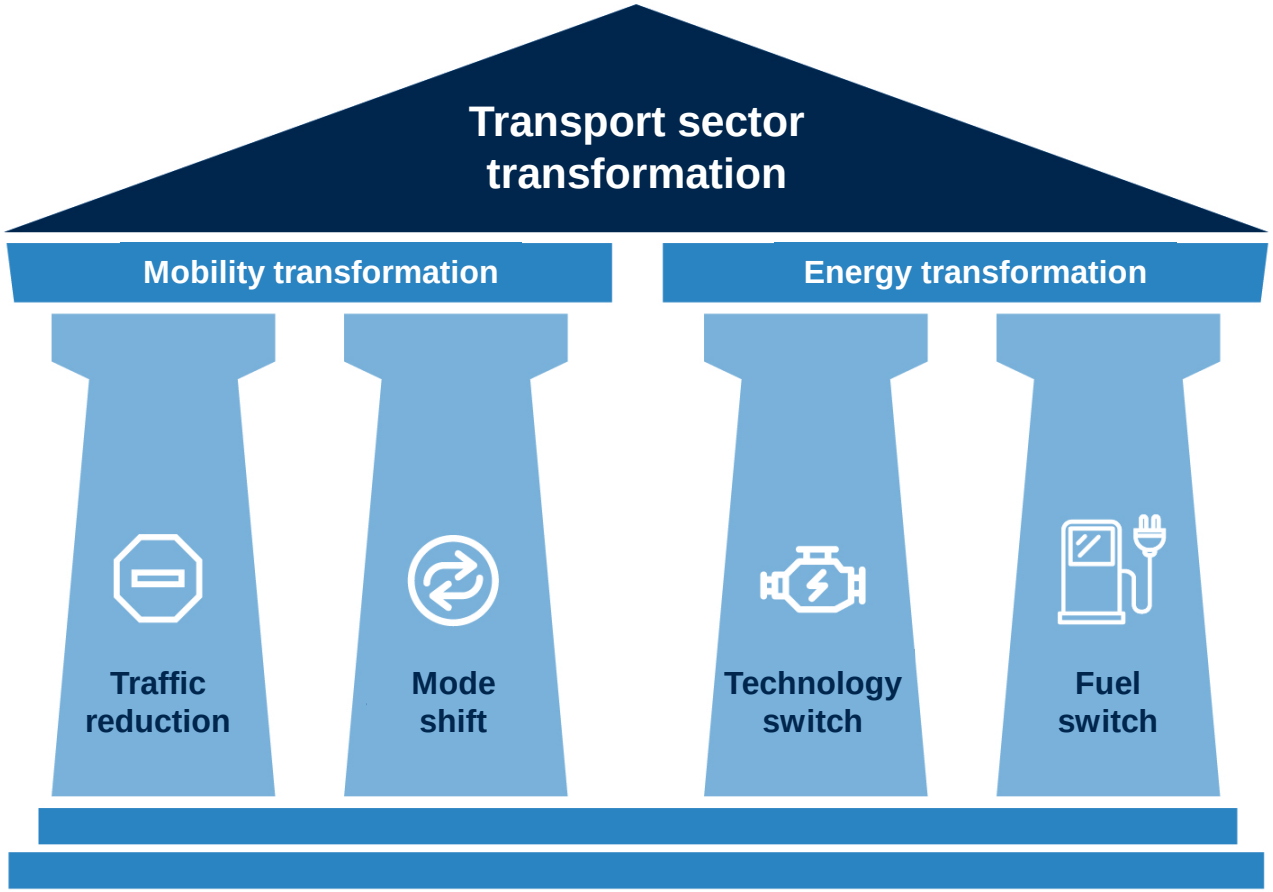
Source: BMU (2020): Klimaschutz in Zahlen

Scenarios for 100% RES in German transport

Outlooks are highly uncertain – why?



Transport and decarbonization



Source: Reiner Lemoine Stiftung (2020): Weichenstellungen ins Erneuerbare Energiesystem. Impulspapier zur EnergieSystemWende im Wahljahr 2021

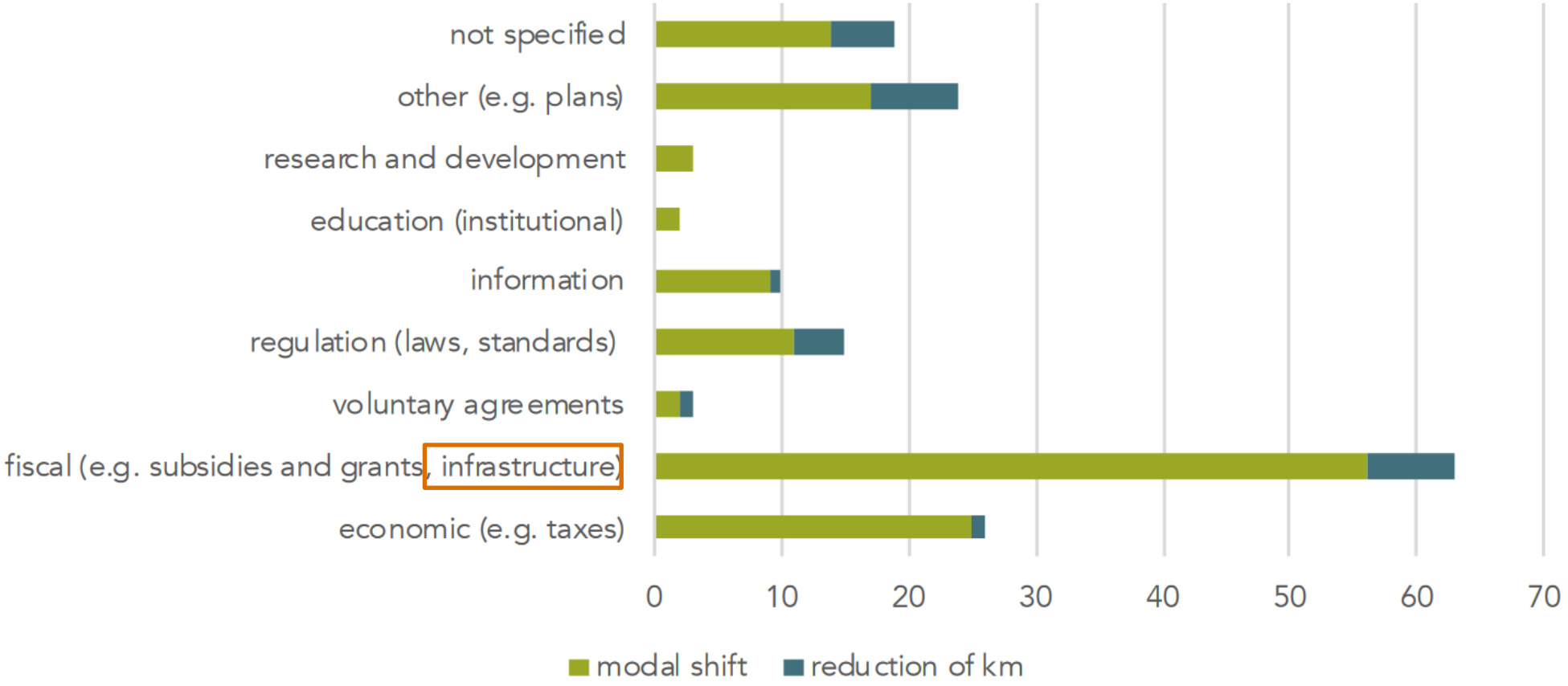
Both dimensions – efficiency and sufficiency – have similar emissions reduction potential

Transport policies

- Passenger transport:
- …

Transport policy overview (mobility transformation)

Transport policies found in EU-NECPs

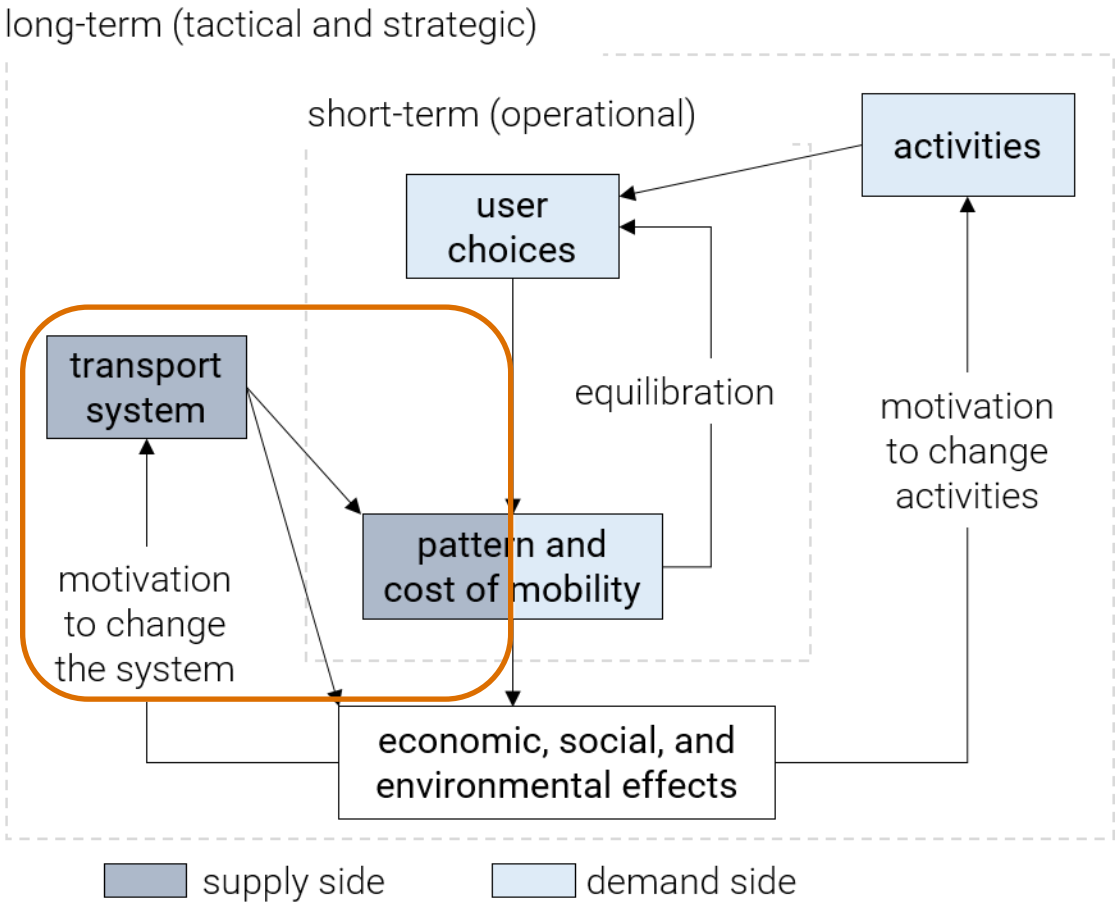


Source: Zell-Ziegler, C., Thema, J., Best, B., Wiese, F., Lage, J., Schmidt, A., Toulouse, E., & Stagl, S.(2021): Enough? The role of sufficiency in energy and climate plans of European countries. Energy Policy, 157, 112483

Why transport planning?

Short-term operation either via free market competition or central planning

Long-term strategic infrastructure planning always centralized



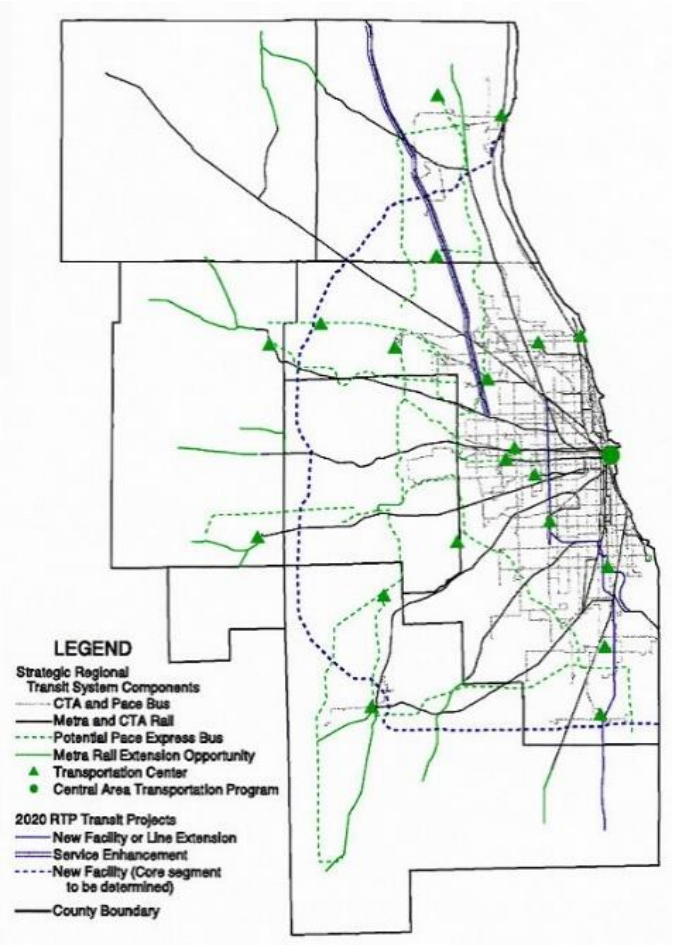
Source: Own illustration based on Allsop (2008): Transport networks and their use: how real can modelling get?. Philosophical Transactions of the Royal Society A, 366, 1879-1892

Early transport planning

Transport planning evolved in the 1950s and 1960s:

- Uptake of private motorization
- Fast urbanization
- Need for expanded network capacities
- Not sufficient computational power for complex calculations

→ Focus on expanding network capacities to satisfy demand



Chicago Area Transportation Study (CATS) in the 1950s

Modern transport planning

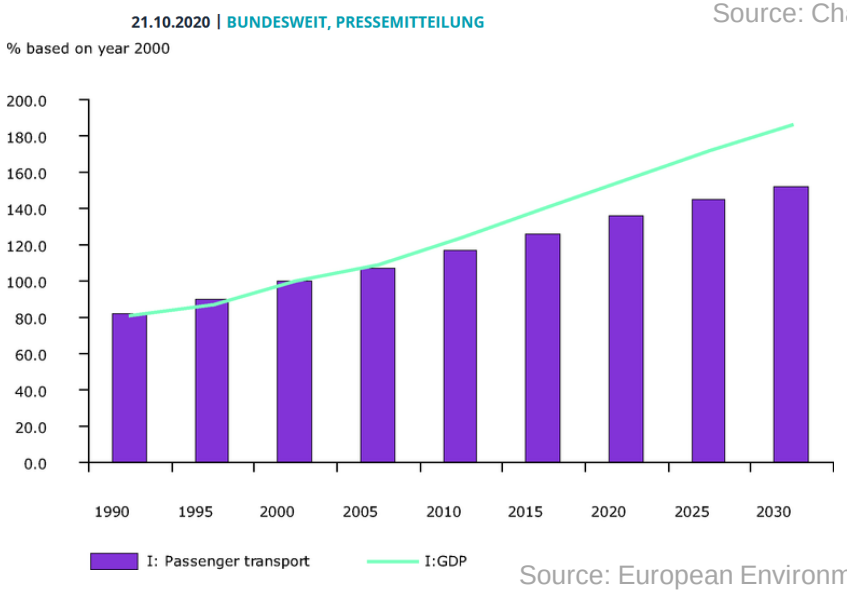
First step: Establish a vision → shape demand

Political and societal objectives

- “Vision Zero”
- Healthy transport
- Just mobility
- Economic development
- Environmental sustainability

Luftverschmutzung in Deutschland kostet jährlich 1.468 Euro pro Stadtbewohner*in

Source: Changing Cities

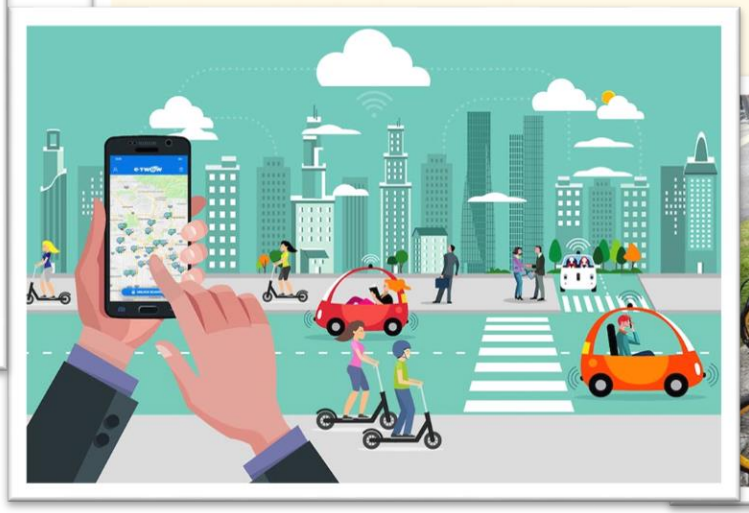


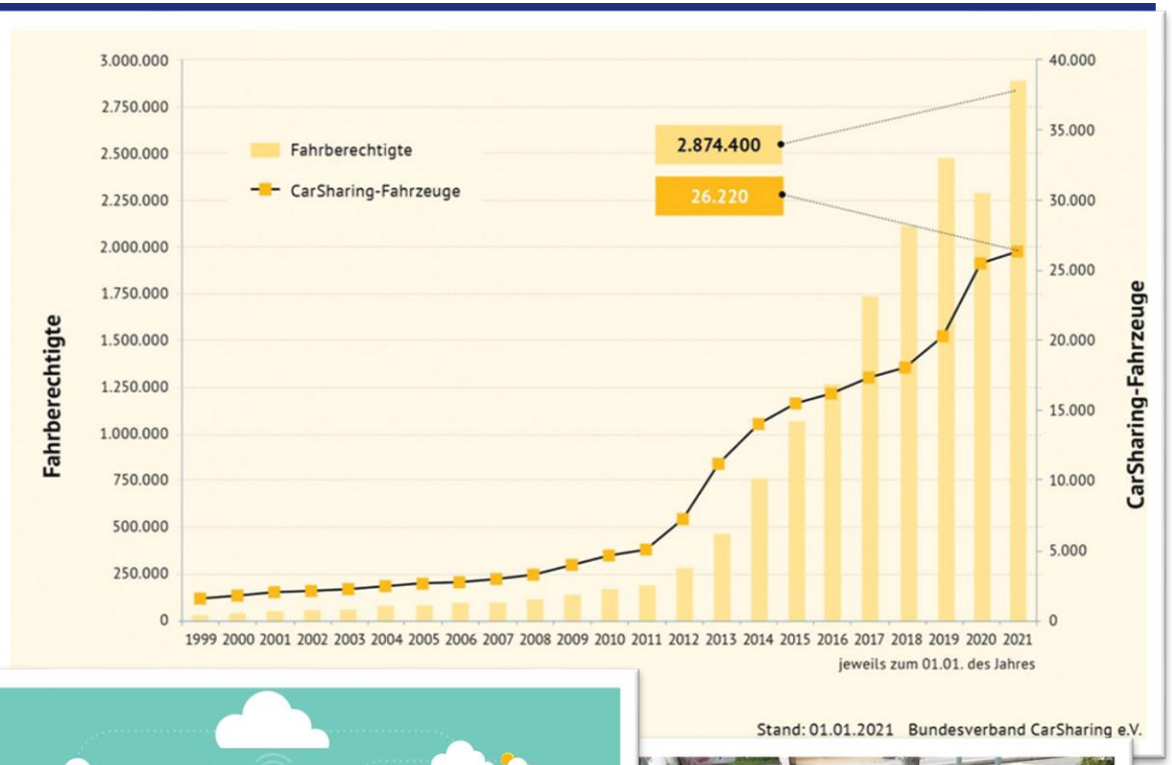
Source: European Environmental Agency

Modern transport planning

Include new trends and modes

- Sharing economy
- Integrated, smart mobility
- Multimodality





Example: German transport planning

Bundesverkehrswegeplan

- Every ~10 years
- Methods are scientific
- Goals are highly political
  See Wer Straßen säht, wird Verkehr ernten – Politische Tricksereien im Bundesverkehrswegeplan

Transport modeling and transport planning

Transport modeling is the scientific underlay of transport planning.

Classic approach to transport planning (transport economist approach)

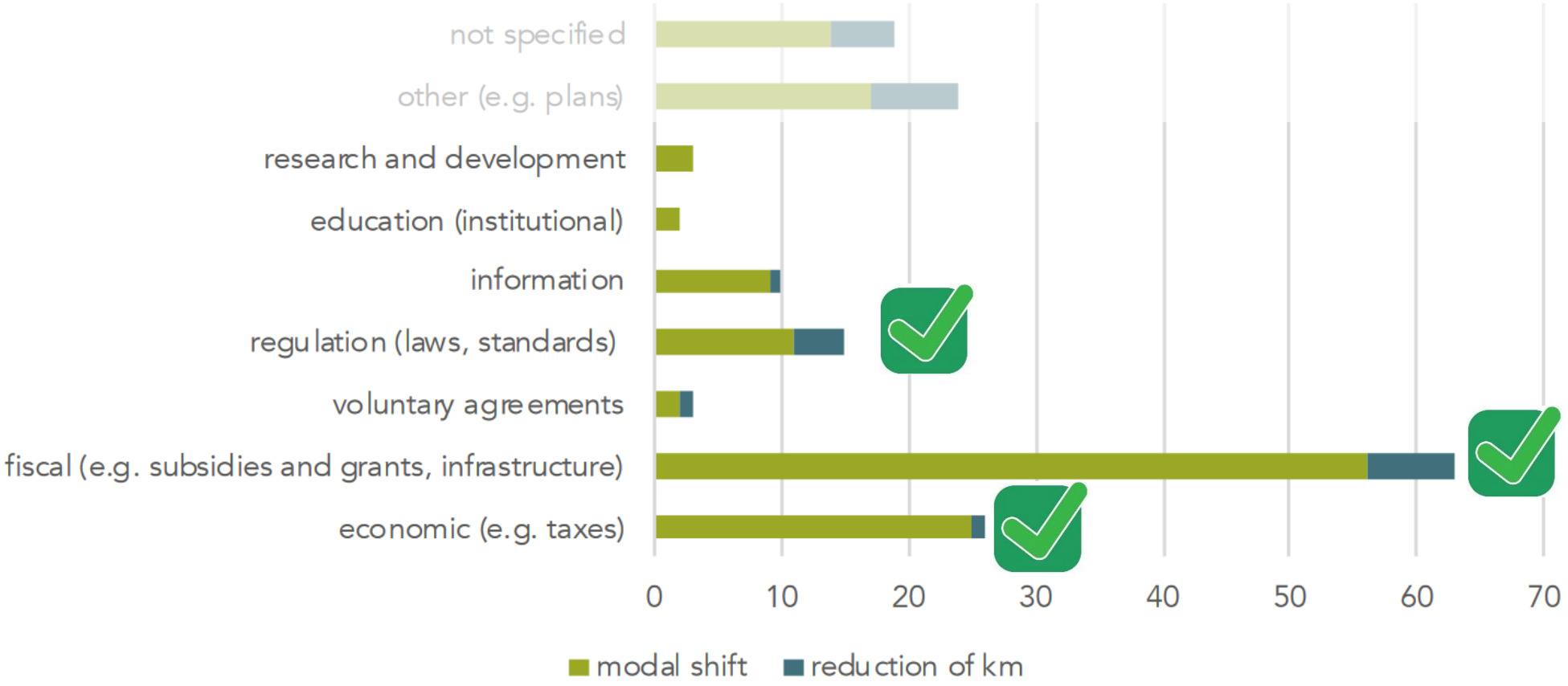
1. Search (future) network bottlenecks via *transport modeling*
2. Identify network expansion alternatives
3. Estimate consequences of alternatives via *transport modeling*
4. Assess alternatives using monetary cost-benefit ratios

Transport planning is only one field of transport policy.

Most transport policies can be assessed through transport modeling.

Transport modeling policy coverage

Transport policies found in EU-NECPs



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Transport modeling

Two schools of transport modeling

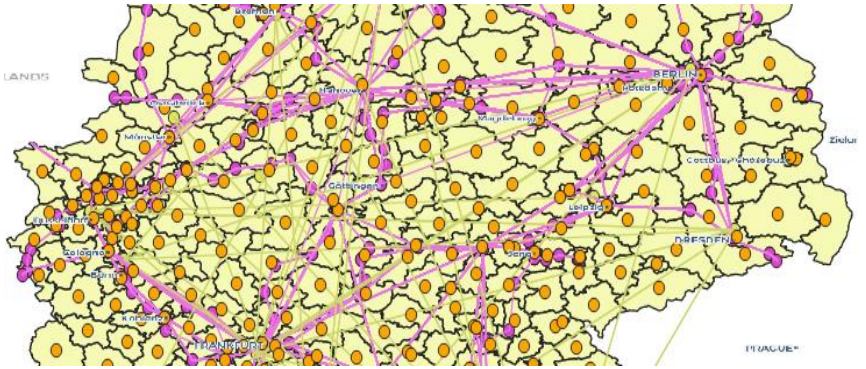
Agent-based (micro)

- Individual travelers with individual schedules
- Temporal: minutes to hours
- Spatial: Cities or regions
- Data: very high requirements

Source: MATSim

Aggregated (macro)

- Aggregated demand groups traveling between aggregated zones
- Temporal: hours to years
- Spatial: regional to international
- Data: lower requirements depending on desired model quality



Source: quetzal_germany

Questions?