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Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Modelling low-emission mobility

Ruth Blanck

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Introduction

Modelling low emission mobility

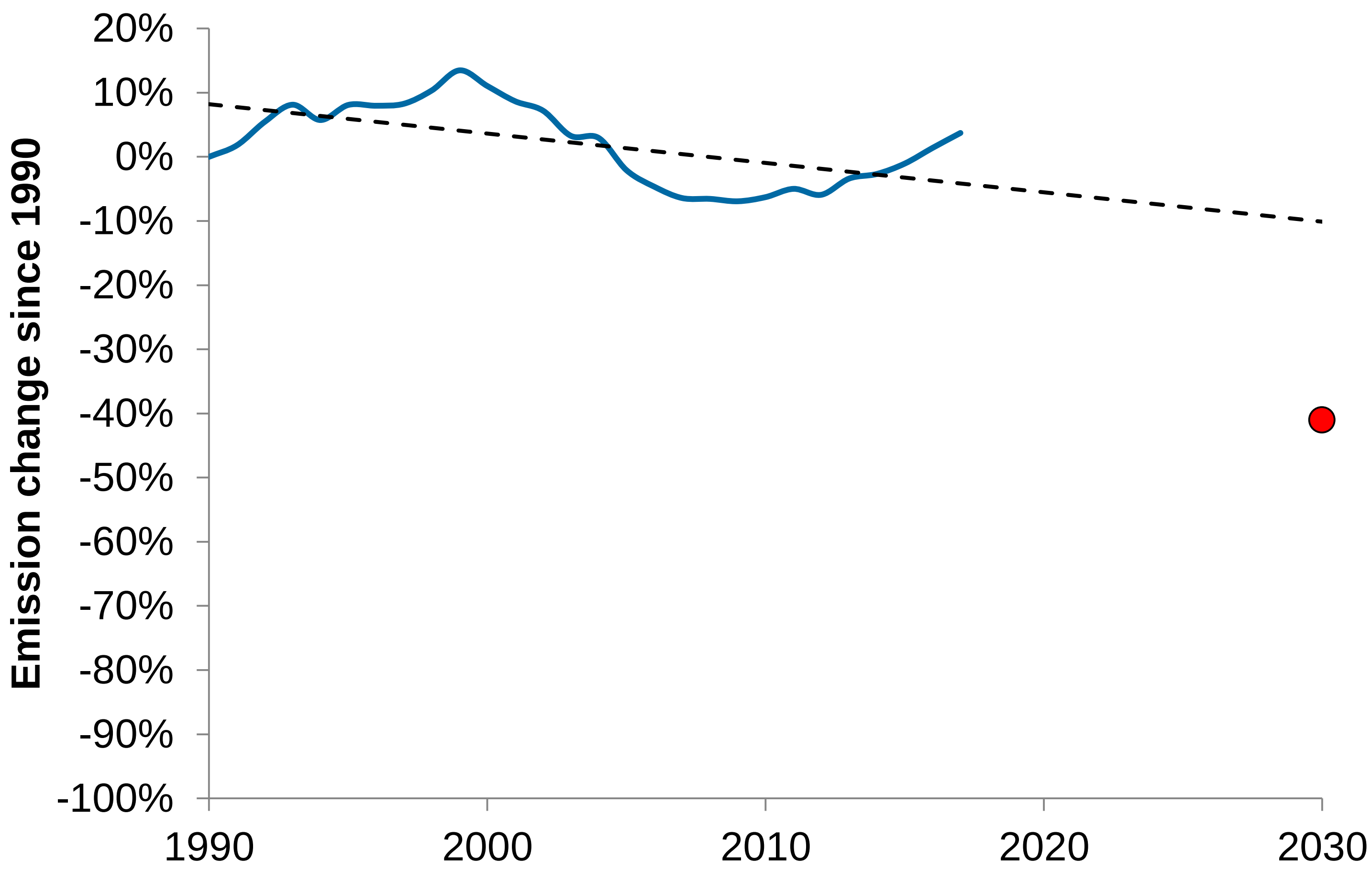
Main strategies for low emission mobility

- Transport demand, modal split
- Vehicle technology & efficiency
- Fuels

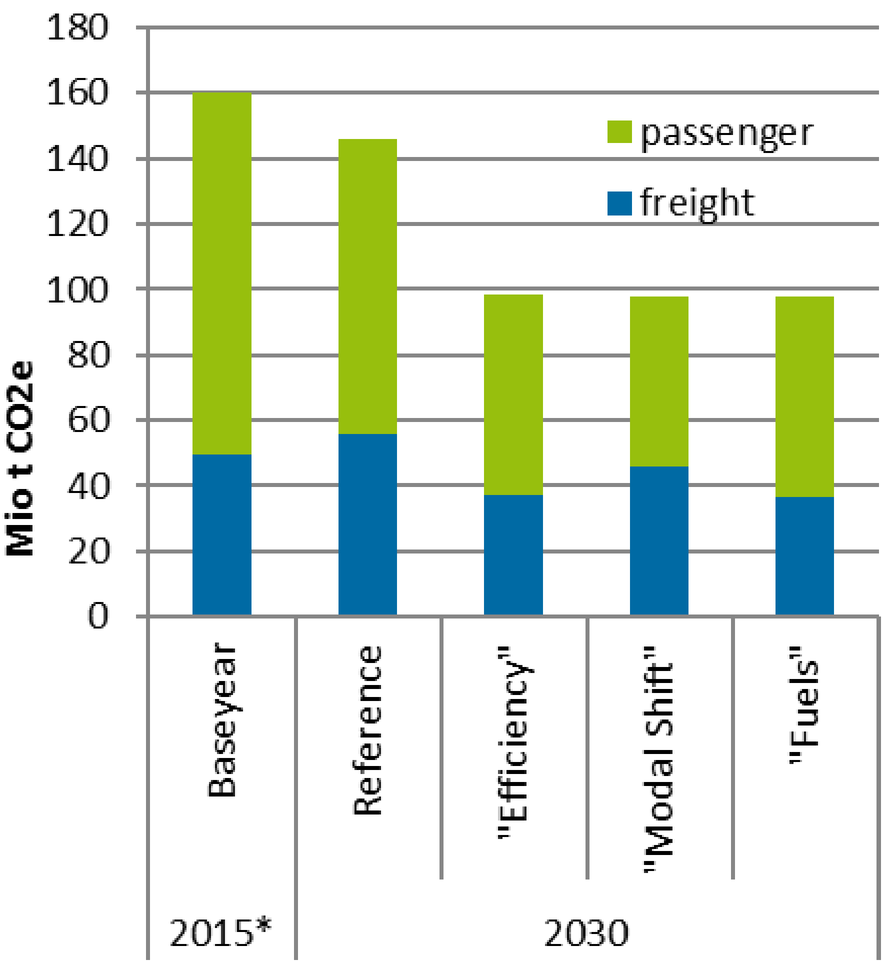
In most mitigation scenarios (especially global IAM scenarios), reductions are mostly achieved through fuel switching and further enhancements in energy efficiency.

Limiting demand growth by shifting to more efficient modes and reducing the distance traveled has limited application in global IAM scenarios and emissions could be further reduced than currently suggested.

Transport sector in Germany has not reduced emissions since 1990



Decarbonisation scenarios for transport



Results from recent modelling project (for „Agora Verkehrswende“) with Öko-Instituts model TEMPS

- Reference scenario: Emission reduction less than 10%, share of freight transport increases (31%=>38%)
- 3 scenarios show different pathways to achieve a -40 percent CO2 reduction

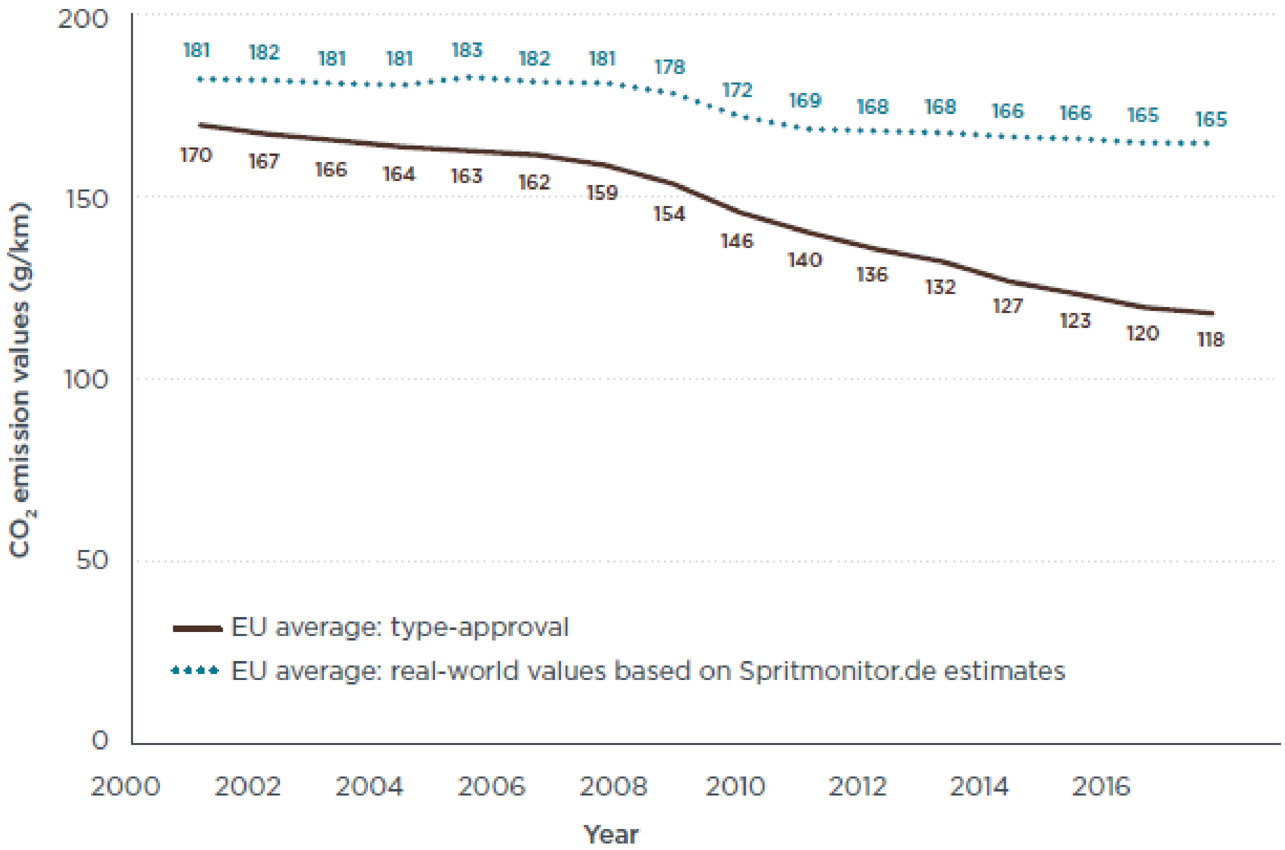
Modelling real-world policies in transport: challenges

Modelling real-world policies can be a tough task…

- Lack of detailed information on policies (especially true for ex-ante modelling)
- Translating real-world policies into modelling often needs a lot of assumptions – especially if the model was not designed for this purpose
- Real world interference: Unexpected user behaviour, loopholes, changes in underlying trends (e.g. oil price etc…)

Example: EU Regulation on CO2 emissions from cars

Ex-ante (expected) reduction was much higher than ex-post evaluation



Travel demand modelling

Evolution of travel demand modelling

- Macro-level strategic models
- Four-step model
  - Trip-based
  - 4 steps: Trip generation, trip distribution, mode choice, route assignment
- Activity-based models
  - Developed in 1990s
  - Based on individual users‘ activity
- Integrating big data (e.g. mobile data such as telephone calls, twitter..)

1 http://humnetlab.mit.edu/wordpress/wp-content/uploads/2010/10/ThePath_TRC.pdf

Modelling for policy

Givoni / Beyazit (2015)

- A complex model is not always needed to achieve better results in a decision-making process. What is more important is to ask the right questions; develop models that answer those questions
- There is a gap between what can be considered good, or the best model from a modelling perspective and what can be considered the most useful, or useful from a policy perspective.
- Models may share with other knowledge technologies the fate of being used politically rather than analytically

Souce: Givoni/ beyazit (2015): The use of state-of-the-art models by policy makers to address global energy and environment challenges: The case of transport policy .

Modelling travel demand & low emission mobility: The project „Renewbility III“

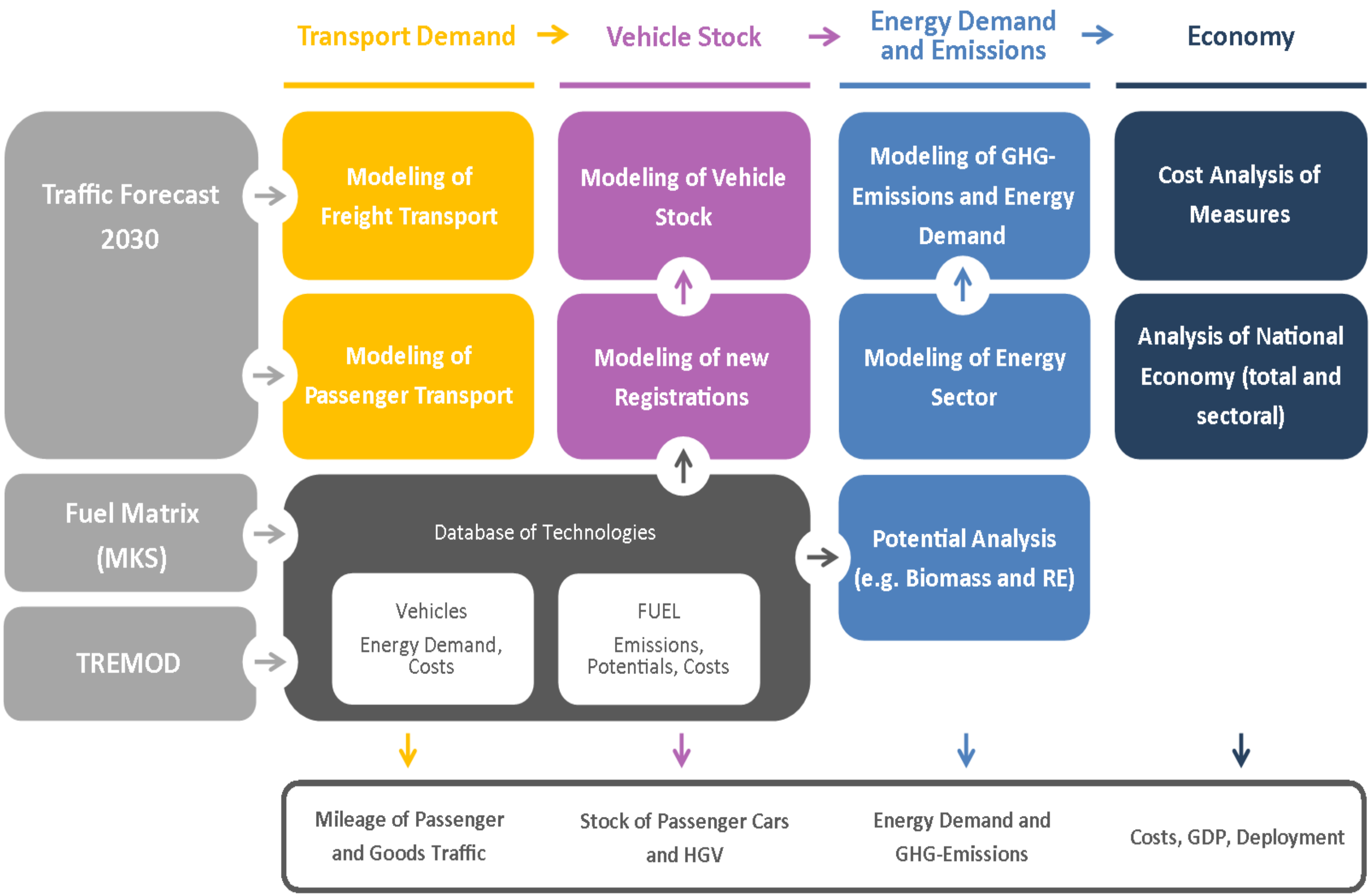
The project „Renewbility” (funded by the German Ministry for the Environment) presents several climate protection scenarios for the transport sector in Germany.

Common objective of all scenarios is the full decarbonisation of the transport sector by 2050.

The project involved a broad range of stakeholders of the transport sector and thus included different positions and interest in the design of the scenarios.

The project was conducted by the Öko-Institut, Institute of Transport Research at DLR, INFRAS and ifeu-Institut

Renewbility III: Integrating different models



Renewbility III: Main models used

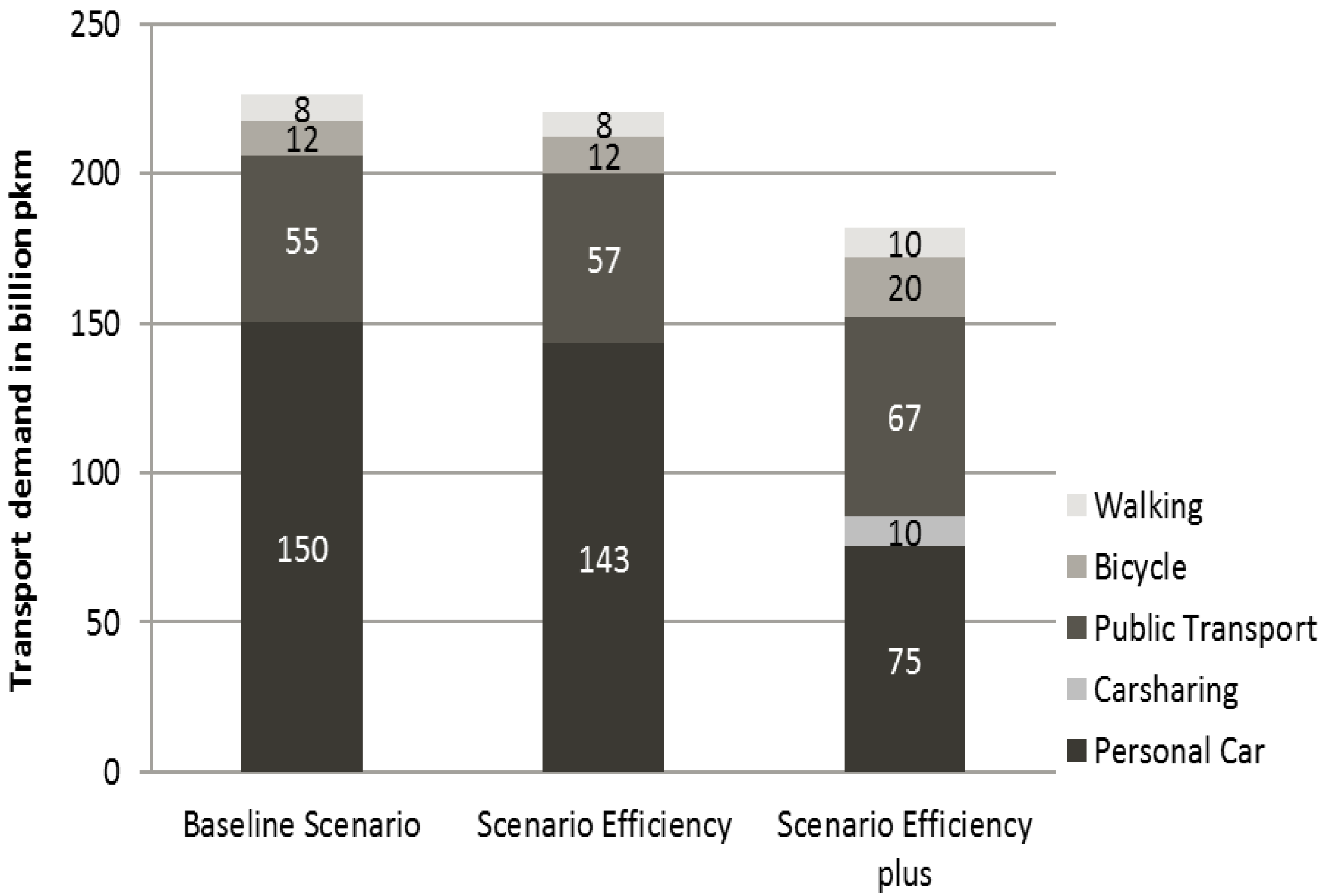
- **Passenger transport**: Use of several demand models, each focussing on specific travel markets: a macroscopic daily travel model, a macroscopic long distance travel model and a microscopic (activity-based) model for selected areas (TAPAS).
- **Freight transport**: The model “FRIDAY” consists of a discrete choice model for the modes rail, road and inland waterway transport, and factor approaches to convert flows into vehicle trips with nine different transport means (vehicle size/train class). The model reflects changes to costs and travel times.
- **New registrations of cars and trucks** (efficiency & powertrain choice): TCO-based model “TEMPS”, taking into account user profiles, restrictions due to long trips, fuel and vehicle prices and CO2 emission performance standards for new passenger cars.
- **Economy**: economic simulation model that builds on differentiated input-output-tables covering the main transport sectors in Germany (VEDIOM).

Scenario analysis: Policies & measures for liveable cities

Scenario “Efficiency plus” contains a set of measures meant to promote a modal shift and to improve quality of life in (inner) cities:

- stronger land-use mix in the spirit of the "city of short distances" planning concept, improved local area supply
- country-wide introduction of car sharing in cities over 50,000 inhabitants
- inner-city access restrictions for polluting vehicles in cities over 200,000 inhabitants
- large-scale expansion of parking space management with a substantial increase in prices
- 30 km/h speed limit for all urban secondary roads
- increase in the attractiveness of cycling and public transport

Renewbility III results: Passenger transport demand in cities



Travel demand modelling in long-term scenarios

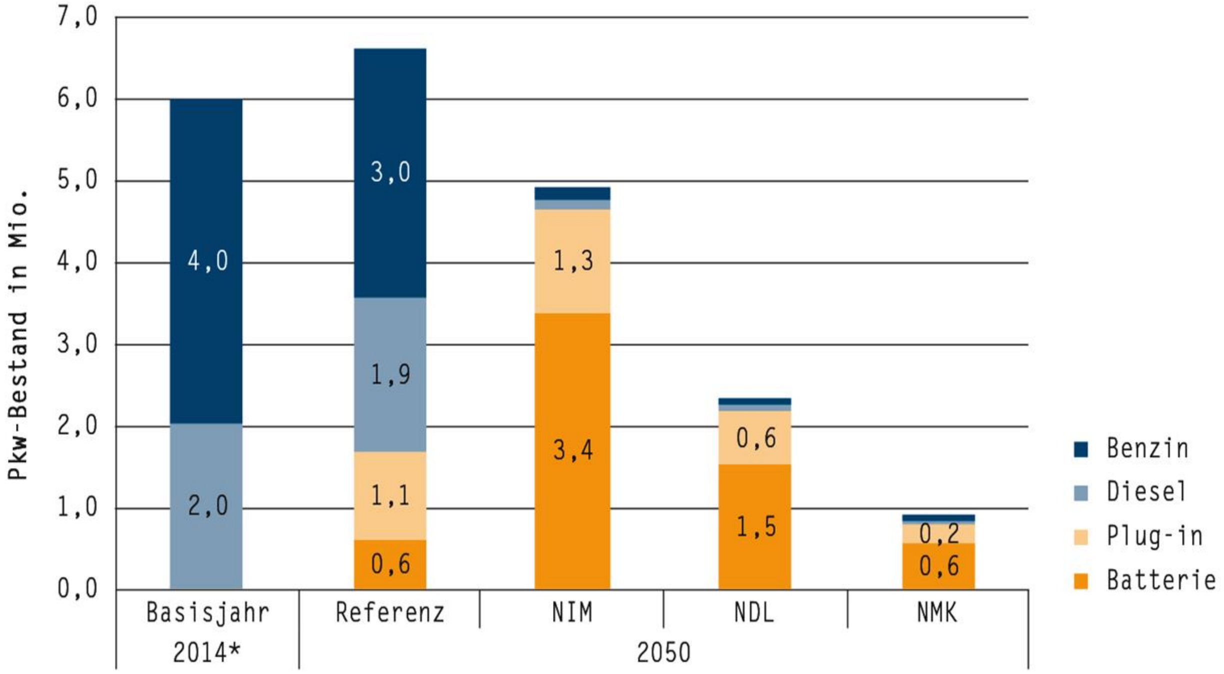
State-of-the-art travel demand models deliver detailed and good analysis of travel behaviour.

Main limitations when using travel demand models for long-term scenarios:

- Predicting the effect of future trends (e.g. autonomous vehicles, high level of digitalisation) is difficult
- Usually, no changes in user preferences and attitudes are assumed
- High level of uncertainty

Long-term travel demand scenarios: Explorative scenarios based on stakeholder involvement

Project „Mobiles Baden-Württemberg“: Car stock reduces to less than 15% compared to baseline



Sustainability of decarbonisation scenarios

	Indikator	Neue Individual-mobilität (NIM)	Neue Dienst-leistungen (NDL)	Neue Mobilitäts-kultur (NMK)
ökologisch	THG-Emissionen	yellow	yellow	green
ökologisch	Endenergieverbrauch	yellow	yellow	green
ökologisch	Strombedarf	red	red	yellow
ökologisch	Nutzung nicht-energetischer Rohstoffe	red	red	green
ökologisch	Flächeninanspruchnahme	red	yellow	green
ökologisch	Luftschadstoffemissionen	green	green	green
ökologisch	Lärmemissionen	red	yellow	green
ökologisch	Verkehrsleistung ÖV	yellow	yellow	green
ökologisch	Modal Split Güterverkehr	red	red	green
ökonomisch	Beschäftigung in der Mobilitätswirtschaft	yellow	red	red
ökonomisch	Umsatz in der Mobilitätswirtschaft	yellow	red	red
ökonomisch	Mobilitätskosten	yellow	yellow	green
sozial	Bewegung/aktive Mobilität	yellow	green	green
sozial	Nutzungsmischung	red	green	green
sozial	Erreichbarkeit	red	green	green
sozial	Aufenthaltsqualität öffentl. Raum	red	yellow	green

Visualizing low-emission scenarios

Modelling policies & communication: Suggestions

- Where assumptions are necessary, consider worst case and not only best case to avoid overestimating impact
  - Example: When modelling effect of CO_2 regulation of cars, consider the possibility that real-world gap between test values and real-world driving may increase further
- Specify policies as clearly as possible to avoid mis-interpretation of results by policymakers
  - Example: „From 2020-2030, invest additional 10 Euro per capita and year into cycling infrastructure“ instead of „support cycling“
- Take uncertainties into account by giving a range of possible outcomes depending on uncertain parameters
  - Example: „GHG-reduction 2-3 Mt“ instead of „GHG-reduction 2,54 Mt“

Contact details

Ruth Blanck

r.blanck@oeko.de

Tel ++49(0)30 405085-305