Green truck technologies wanted!

A cost-optimised drive train portfolio for Germany

EVS35 | Oslo | 13/06/2022

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Agenda

1. Introduction
2. Method
3. Results
4. Discussion and conclusions

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1. Introduction

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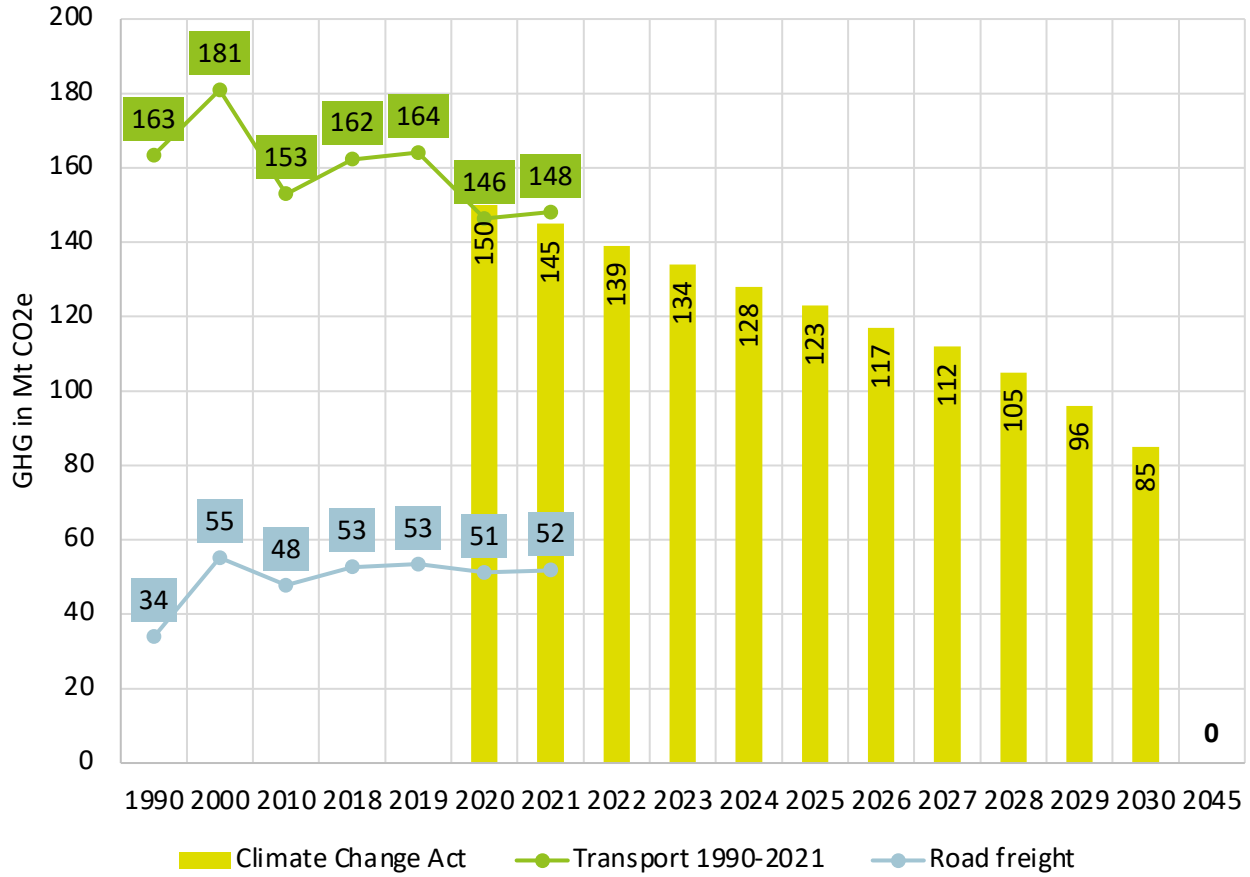
Status quo in Germany

- Transport emissions stagnate
- Road freight accounts for ~1/3
- 2021: 982 electric truck[1] registrations (+ 16 %)
- 1.3 % of all MHDV registrations
- 2030 target: 1/3 of road freight mileage with alternative drive trains

Subsidies for market ramp-up in place:
- 80 % of additional vehicle costs
- Toll exemption for ZEV



[1]full battery electric vehicles, fuel-cell electric vehicles, extended-range vehicles and plug-in hybrids

Sources: Umweltbundesamt, ACEA

1. Introduction

Comparing drive technologies for trucks – TCO Analysis

Battery-electric trucks (BEV)

Overhead-catenary trucks

Battery-electric (OC-BEV) or diesel hybrid (OC-HEV)

Fuel-cell electric vehicles (FCEV)

- Year of analysis: 2030
- Scope: Domestic German truck trips > 3.5 t GVWR

1. What share of fleet-wide mileage can be cost-competitive for each respective technology compared to diesel trucks?
2. How does a cost-optimized technology mix look like?

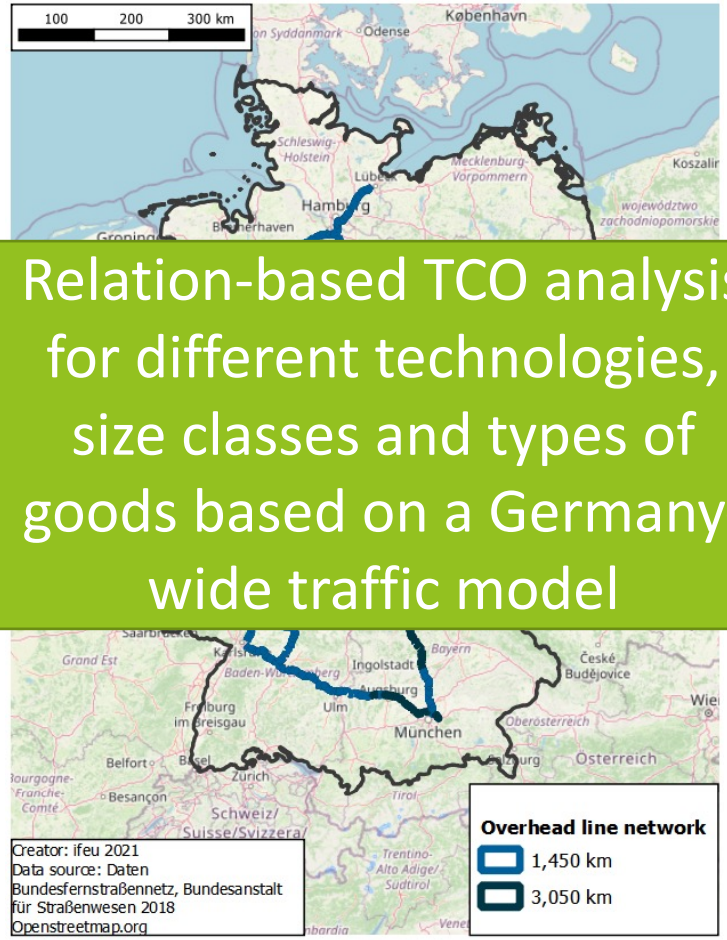
2. Method

2. Method
Data basis

Model network

- Traffic model PTV Validate
- Domestic truck trips in Germany in 2030
- 1.2 million origin-destination relations
- 16 types of goods (e.g. food, vehicles, mail, …)
- 5 vehicle size classes[1]
- Typical daily mission profiles based on official statistics
- Charging during mandatory driver breaks (45 min after 4.5 h of driving), at loading bays and company depots
- 3,050 km overhead line network

Relation-based TCO analysis for different technologies, size classes and types of goods based on a Germany-wide traffic model



https://www.ptvgroup.com/en/solutions/products/ptv-maps-data/traffic/validate/

[1] 3.5 t – 7.5 t, 7.5 t – 12 t, 12 t – 18 t, 18 t – 26 t, > 26 t

3. Results

3. Results 2030
Economic potential of each technology

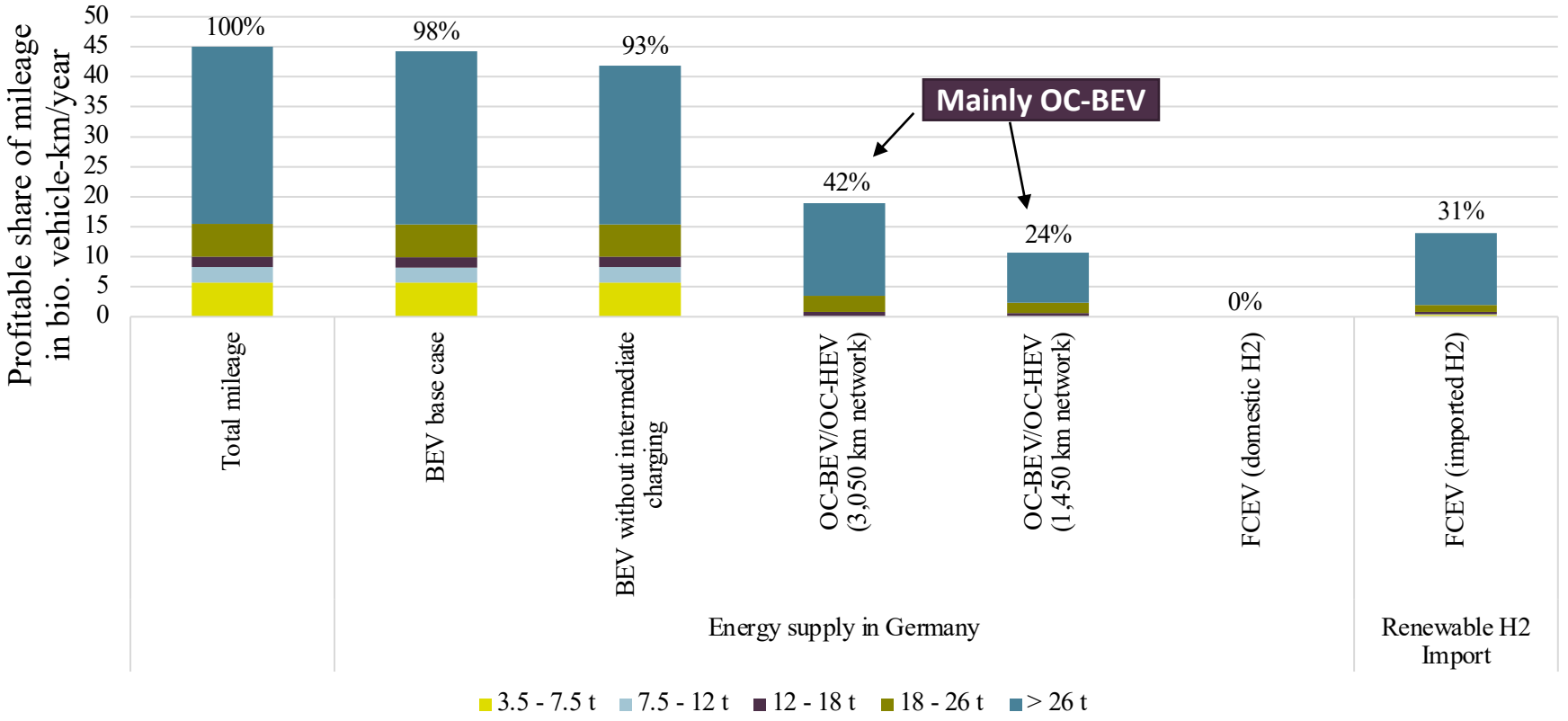
1. What share of fleet-wide mileage can be cost-competitive for each respective technology compared to diesel trucks?

1.36 €/l diesel[1]

16.6 ct/kWh[2]

9.45 €/kg H2 (domestic)

4.57 €/kg H2 (import)



- Economies of scale for vehicle prices
- No subsidies
- No toll exemptions

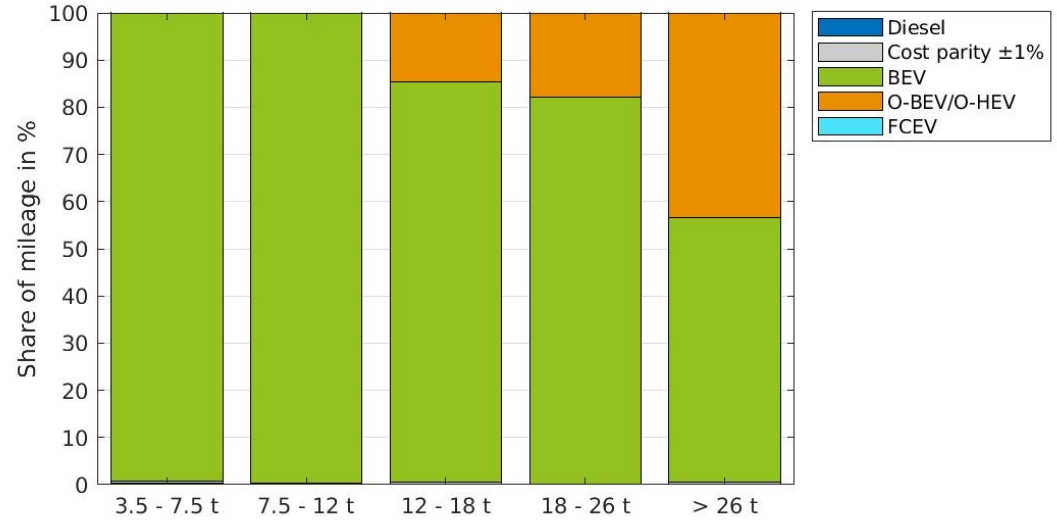
[1]including 100 €/tCO_2 carbon price

[2]energy costs do not include costs for charging/refueling infrastructure installation/operation

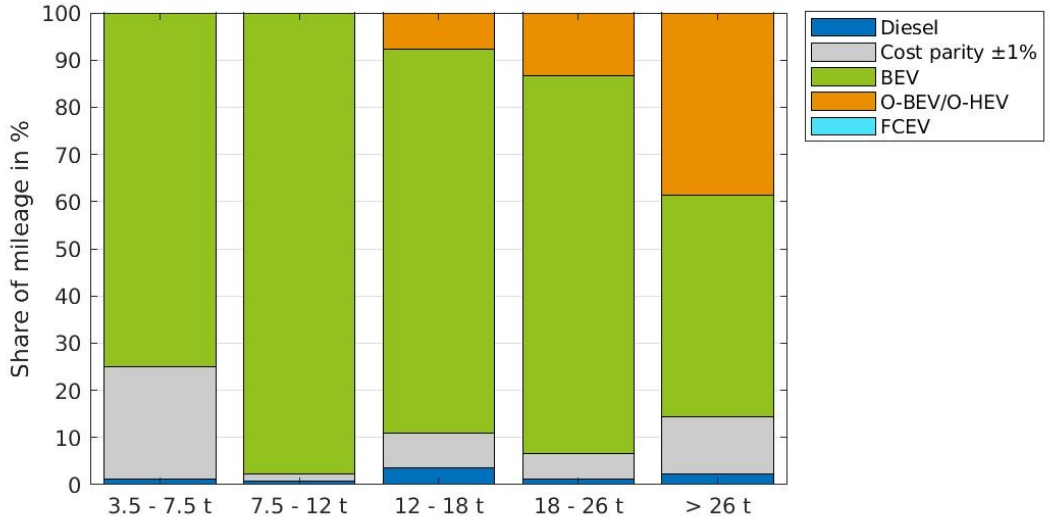
3. Results 2030
Cost-optimised drive train portfolio

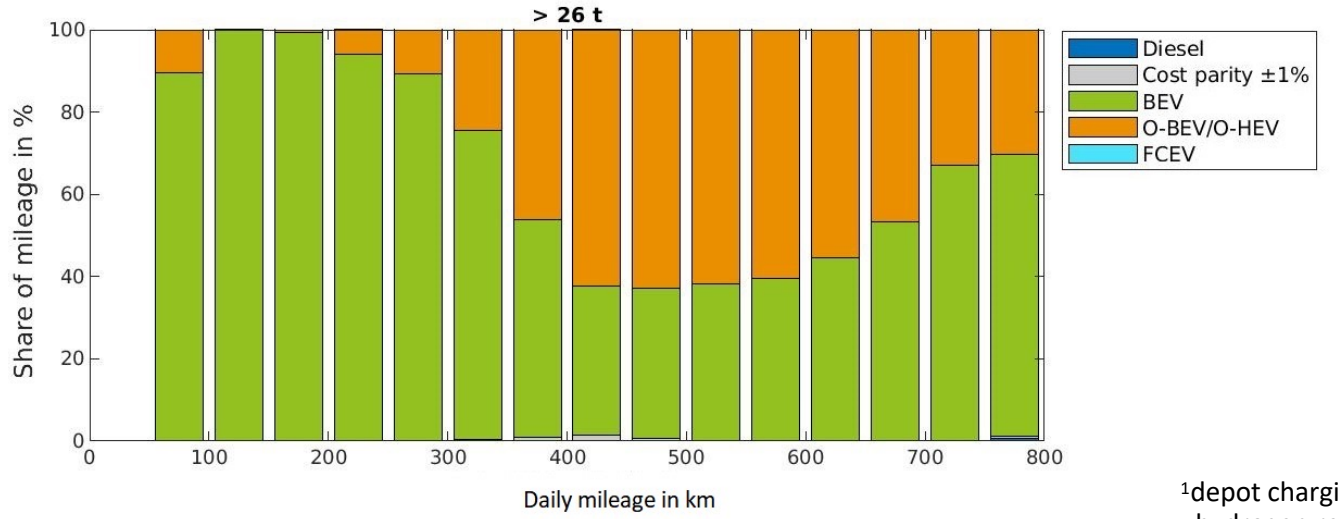
2. How does a cost-optimized technology mix look like?

infrastructure costs **not considered**



infrastructure costs **considered**[1]





- Economic potential is reduced by ~ 15 % when infrastructure costs are considered in TCO
- Infrastructure accounts for 6-23 % of energy costs

[1]depot charging: 2.5 ct/kWh | public fast charging 1.1 ct/kWh | hydrogen refueling: 80 ct/kg | overhead line: 5 ct/kWh

4. Discussion and conclusion

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- Battery electric trucks are likely to form the backbone of cost-efficient road freight transport in the future
- With public high-power chargers, the use of battery electric trucks for long-distance transport is generally possible, even on longer distances
- Slight cost advantages of OC trucks over BEV for some applications. System costs (and GHG emissions) are relatively close. => Other important aspects:
  - Operational feasibility and scalability of public charging infrastructure
  - Impact on the energy system and provision of flexibility options
- FCEV trucks will only play a minor role in the domestic German transport market
- Results are robust with respect to the economic differences between BEV (and OC-BEV) and FCEV applications
- High sensitivity of electric truck potential (BEV and OC-BEV) on electricity prices

Thank you!

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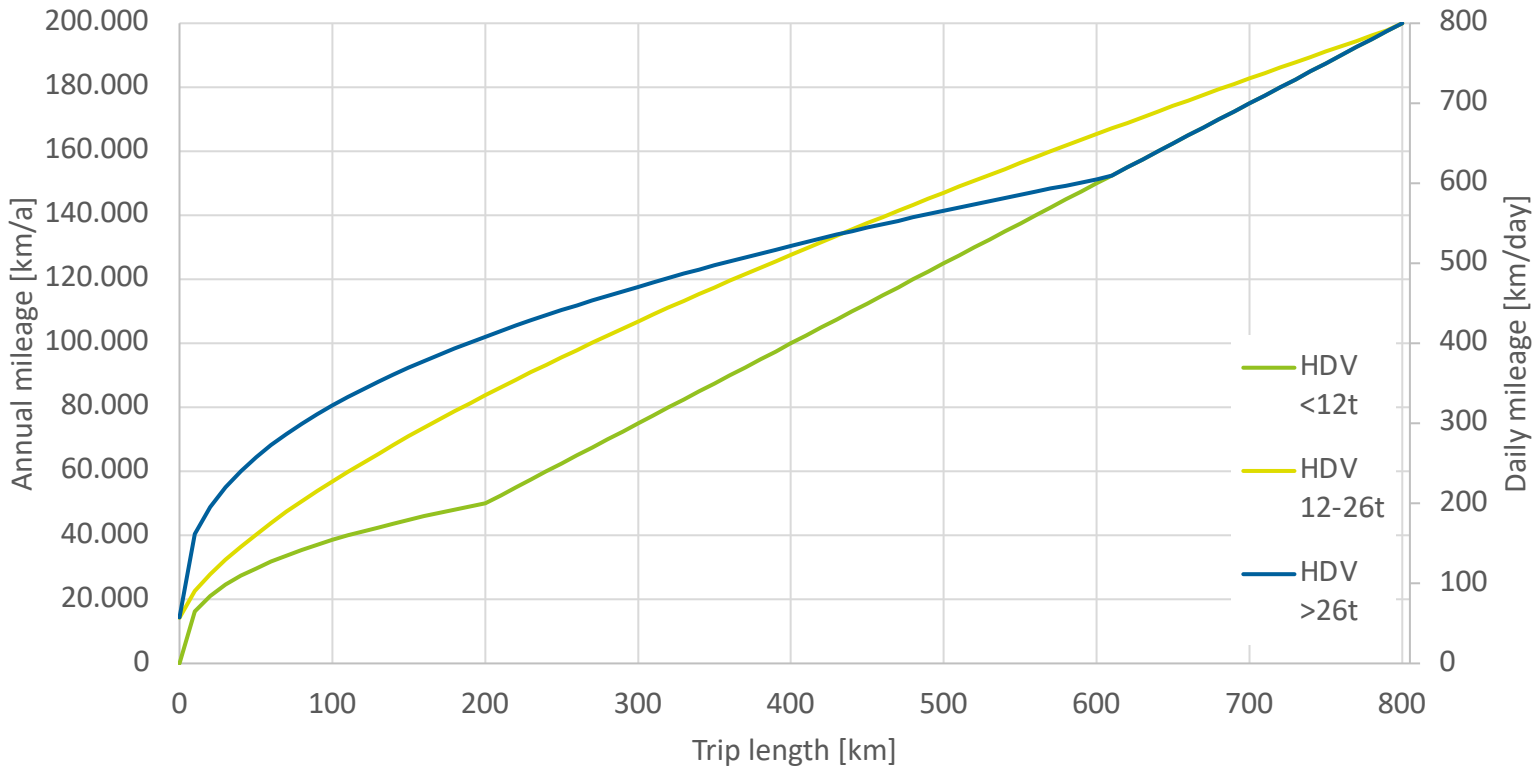
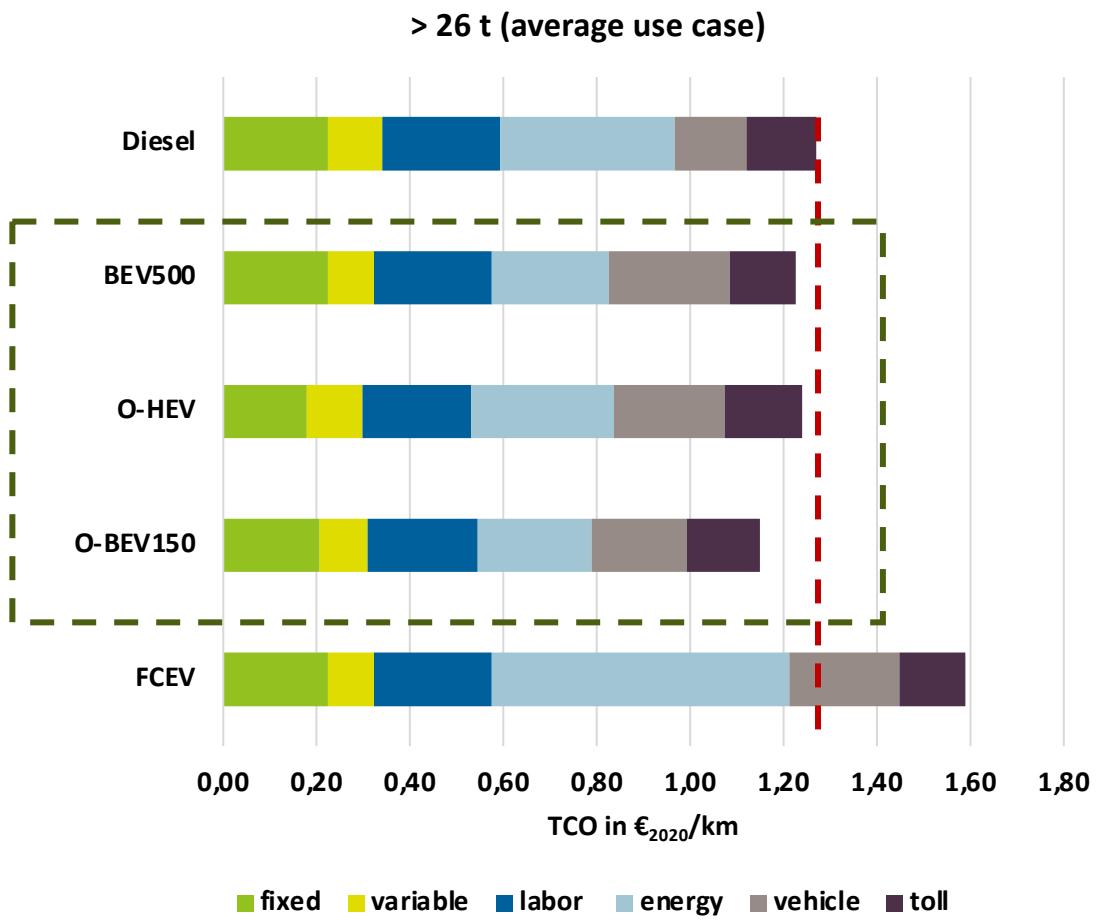
Backup: Daily distance



Backup: Method
Key assumptions

Technology	Vehicle price 2030 in €$_{2020}$ for > 26 t semi trailer
Diesel truck	103,000 €
BEV (500 km range)	142,200 € (83 €/kWh battery)
FCEV	144,800 €
OC-BEV (150 km range)	112,600 €
OC-HEV	158,300 €

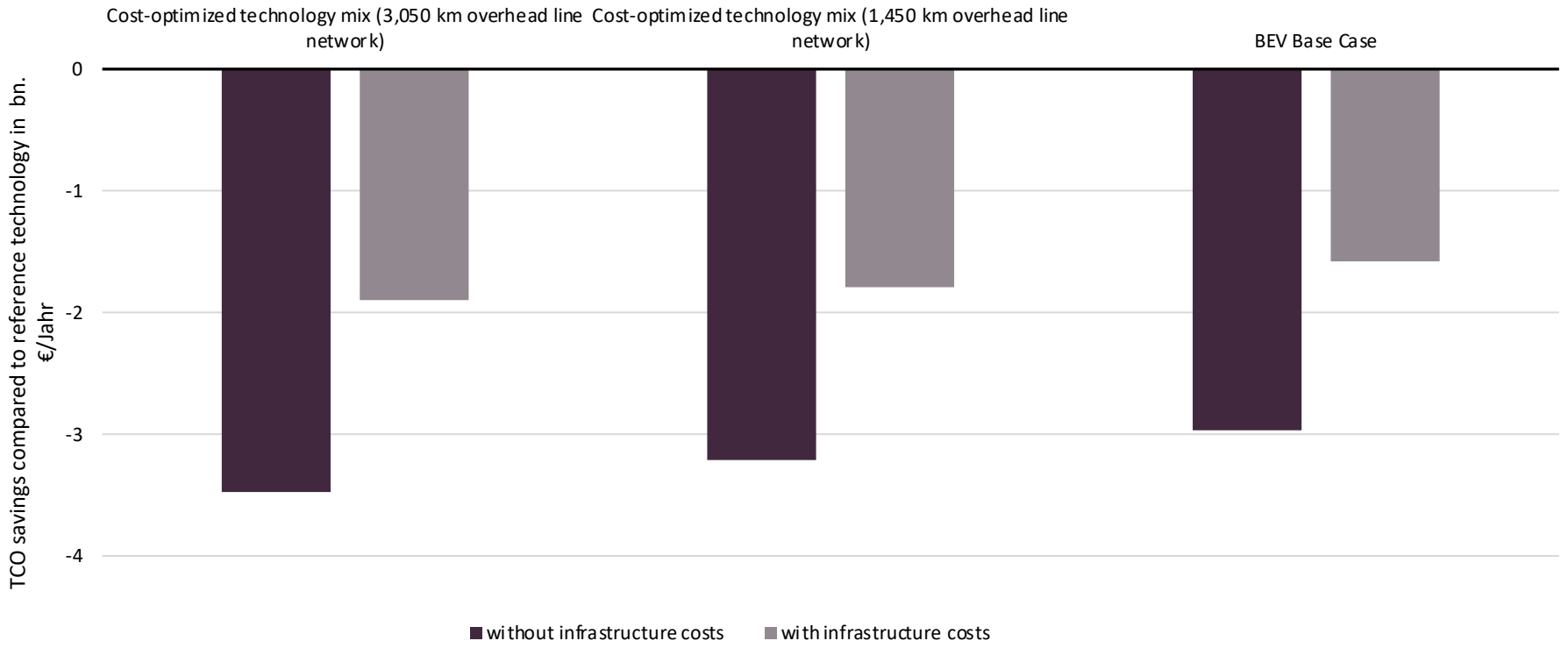
	Energy price in €$_{2020}$
Diesel fuel	1.36 €/l[1]
Electricity[2]	0.166 €/kWh
Hydrogen (domestic electrolysis)	9.45 €/kg
Hydrogen (import)	4.57 €/kg



[1]including 100 €/tCO_2 carbon price

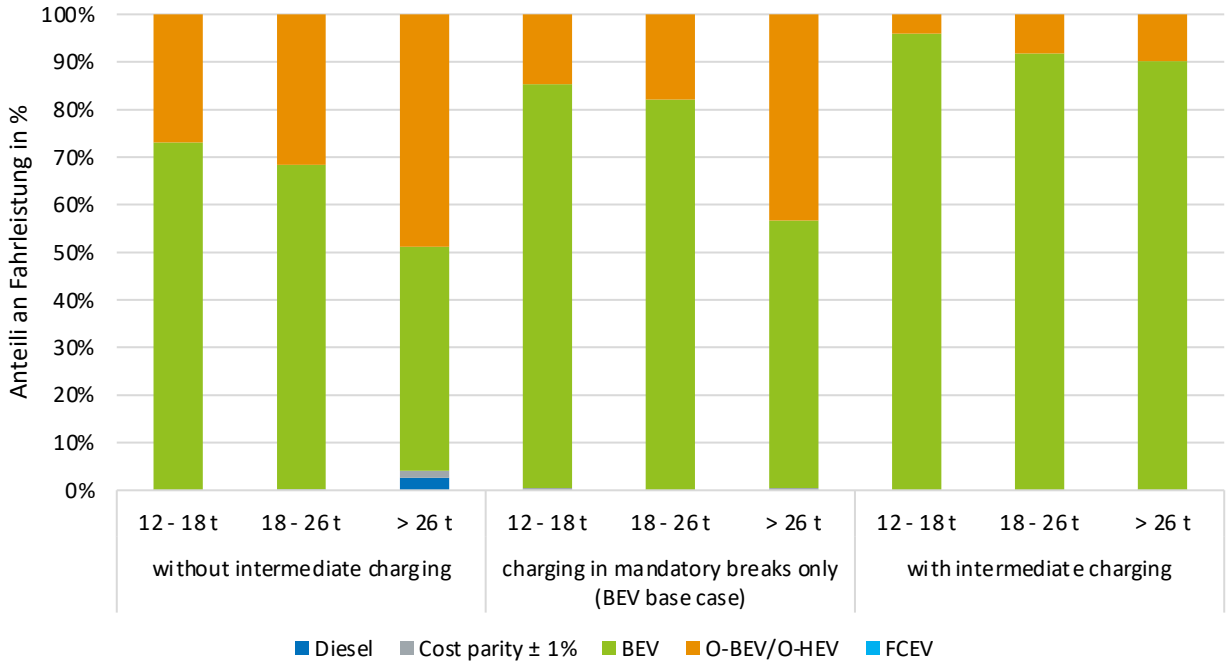
[2]energy costs do not include costs for charging/refueling infrastructure installation/operation

Backup: System costs



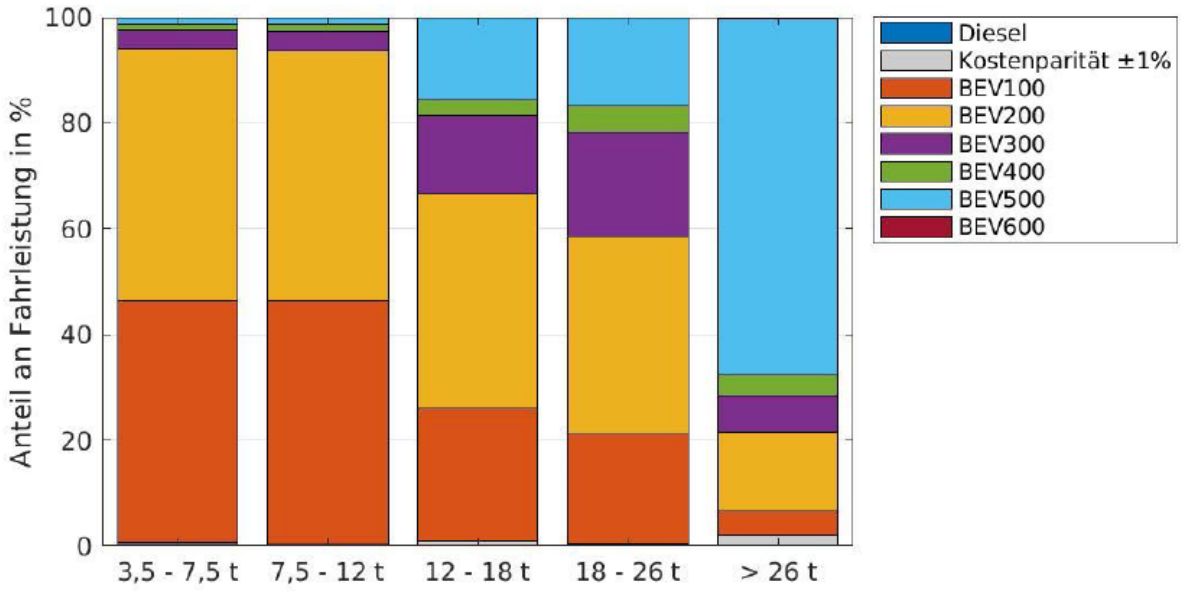
Backup: Results

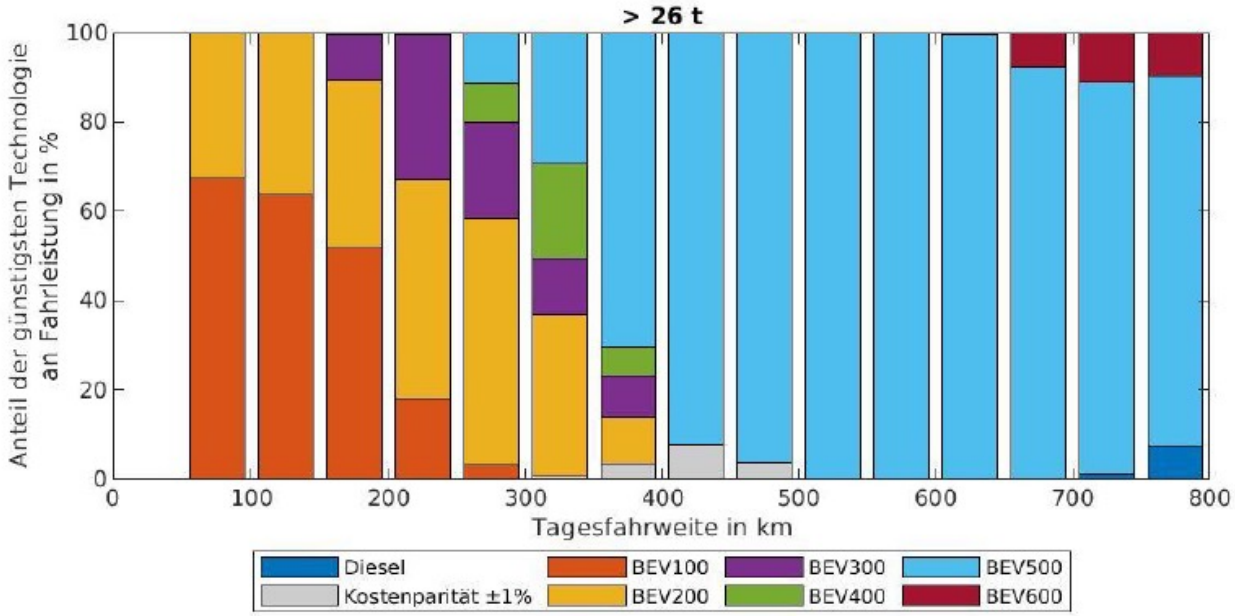
Cost-optimised drive train portfolio: Charging availability



Charging availability and flexibility have a significant influence on the economic potential of BEV and OC trucks

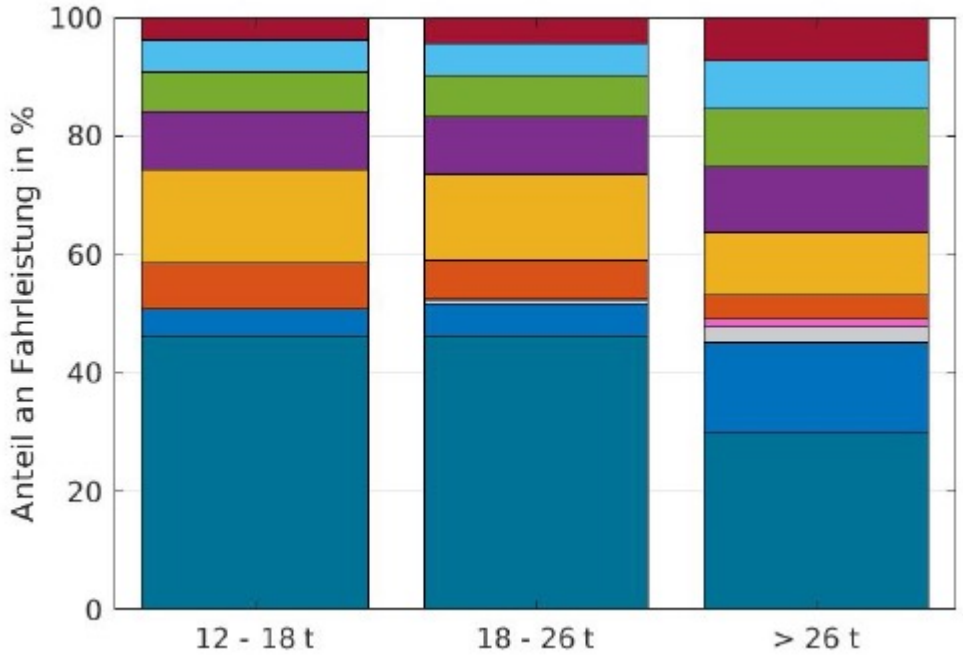
Backup: Results
BEV: Battery sizes

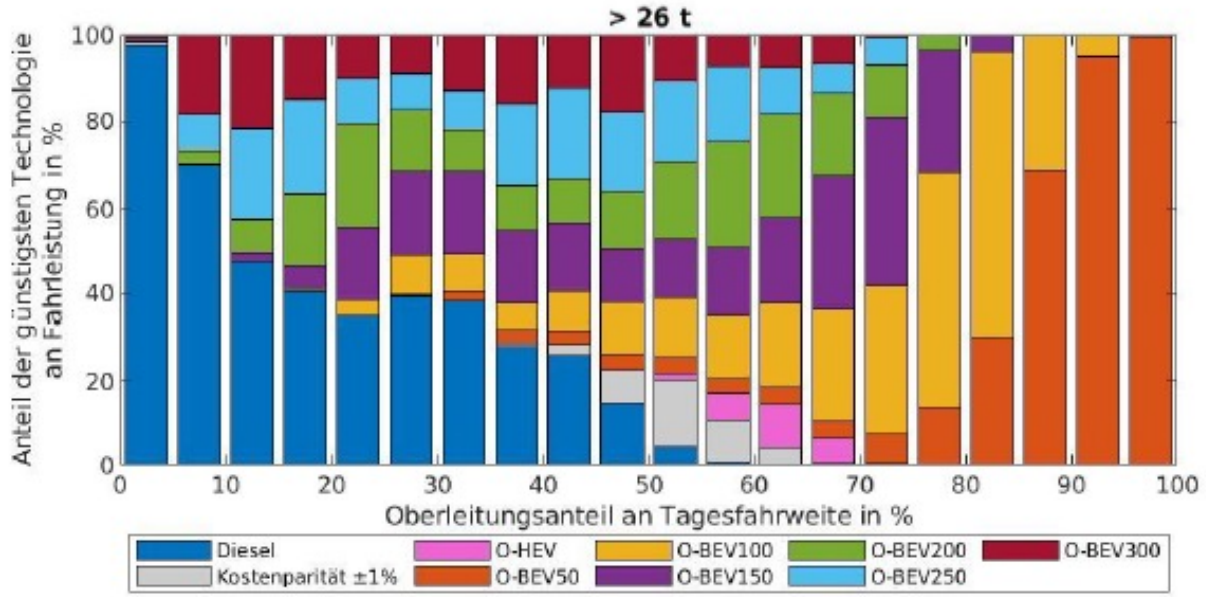




Backup: Results

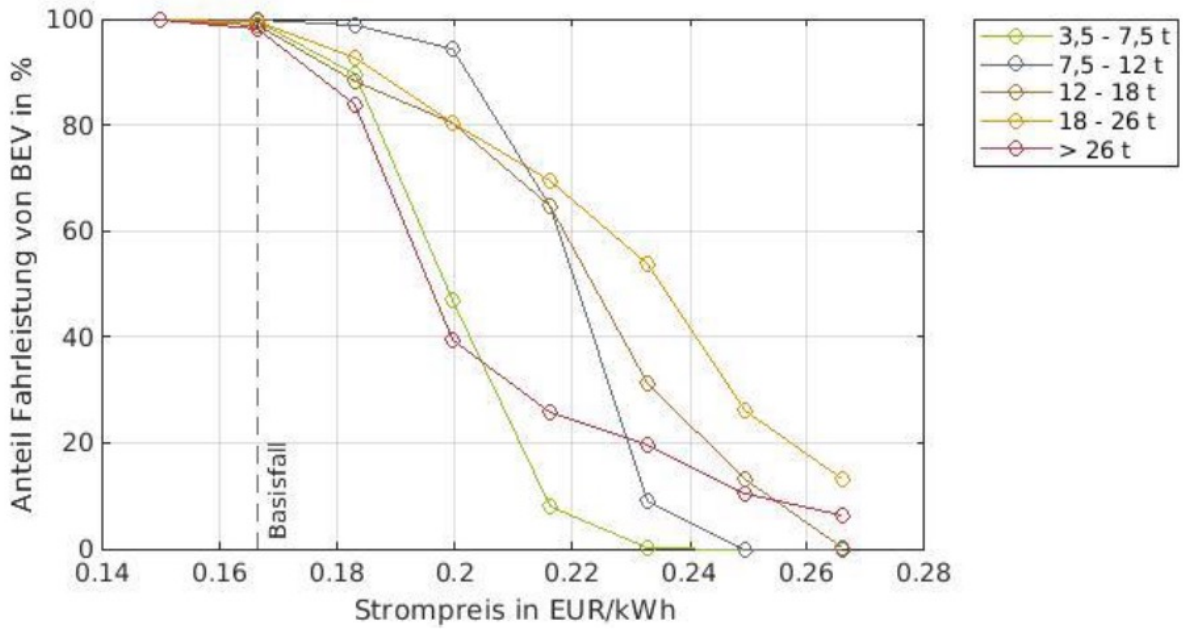
Overhead catenary trucks: battery sizes

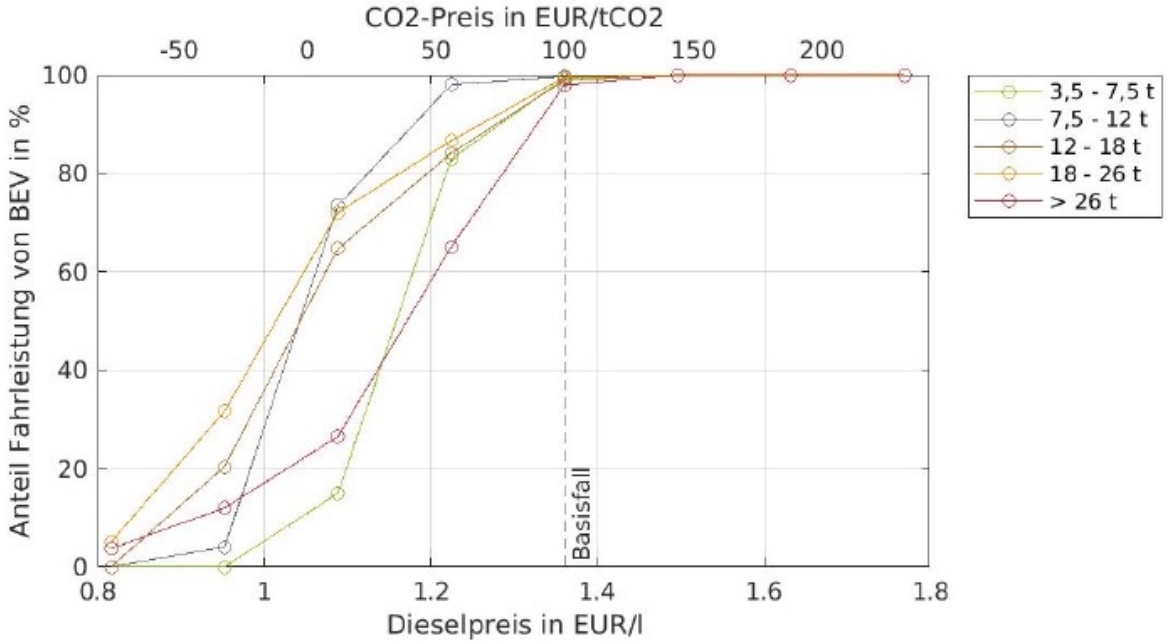




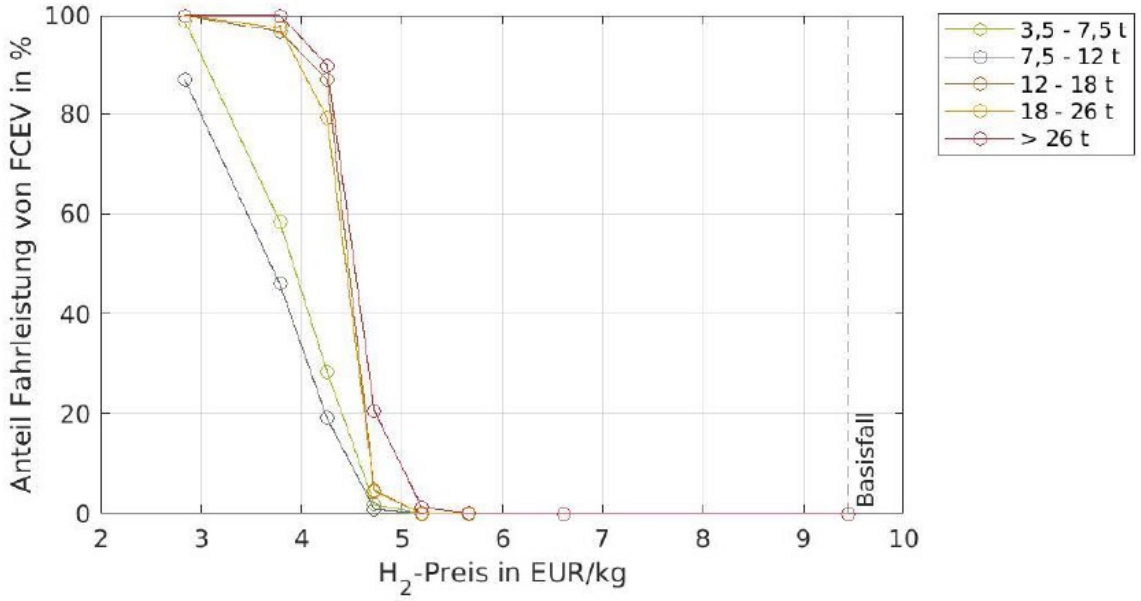
Backup: Results

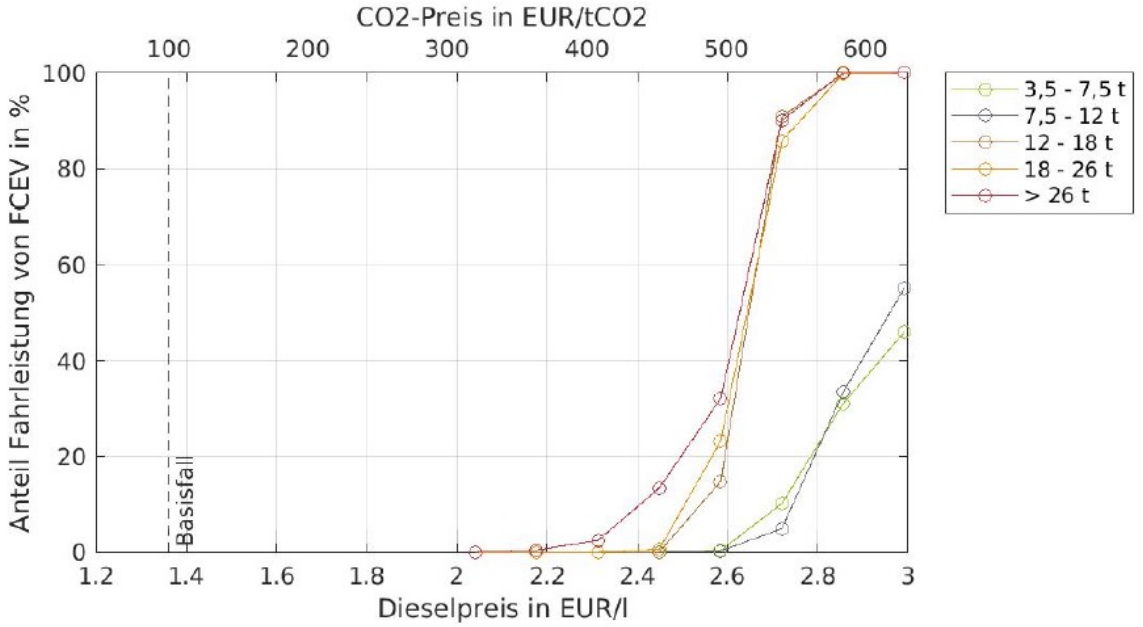
Sensitivity analysis electricity price





Backup: Results
FCEV Sensitivity H2 price





Backup:
Distribution of daily distance