

Transitioning to zero-emission heavy-duty freight vehicles

A system perspective on zero-emission heavy-duty road freight transport and challenges for a successful market entry

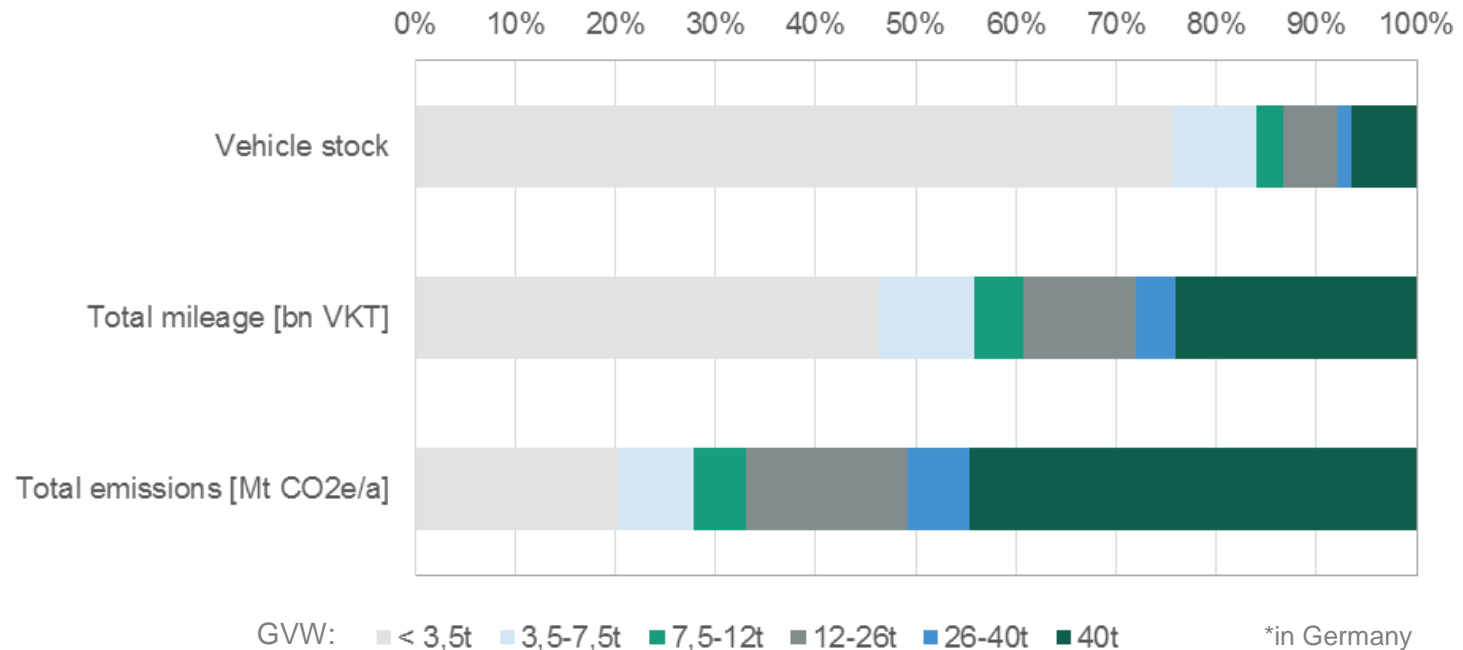
Florian Hacker

Brussels, 04.12.2018

Decarbonisation of road freight transport: Long-haul transport of particular importance

- Light & heavy-duty vehicles responsible for about 35 % of EU transport GHG emissions
- Long-distance trucks particularly relevant in terms of GHG emissions due to high annual mileage and high fuel consumption

Vehicle stock, total mileage and CO₂ emissions of commercial vehicles*

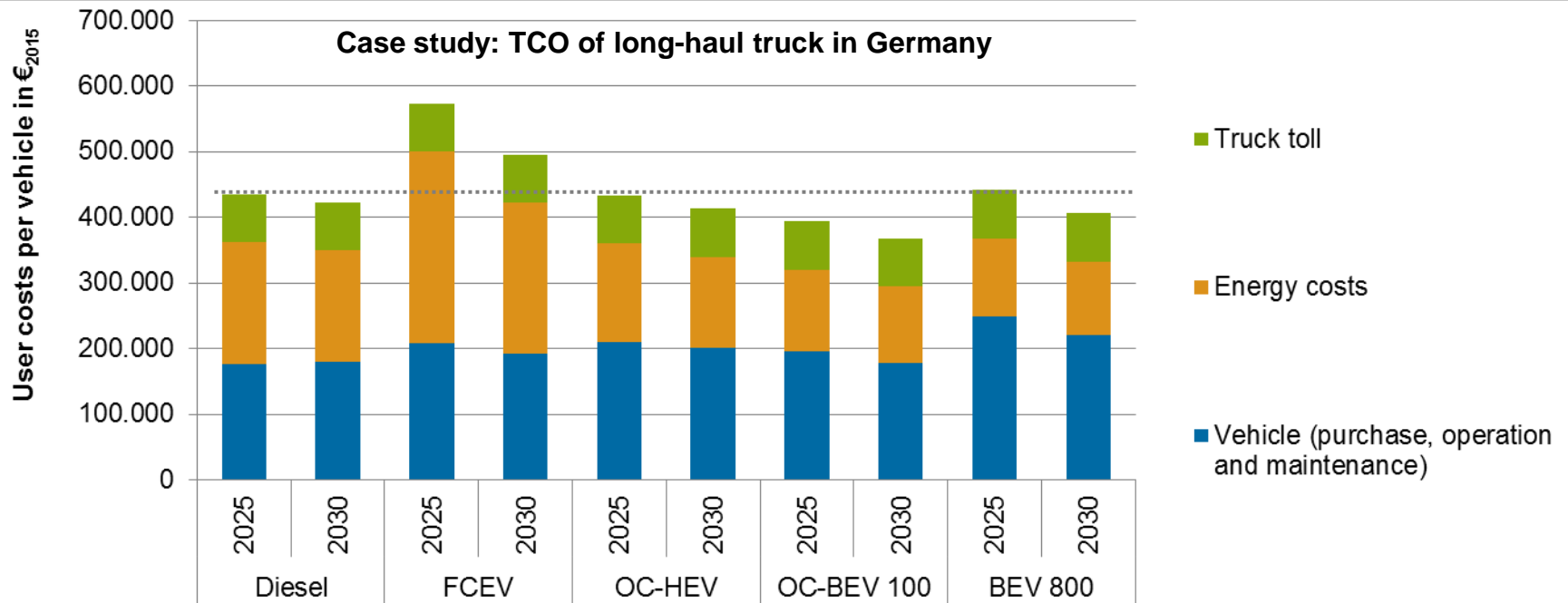


The challenge of zero emissions freight transport has a number of dimensions

- GHG emissions from road freight transport continue to rise in the EU
- In regional freight transport the battery electric drive is emerging as a possible solution
- Among the possible powertrain alternatives in long-haul transport, there is no clear favourite yet
- In particular long-distance transport requires cross-border solutions
- New propulsion technologies must enable zero-emission road freight transport in the long term – at the lowest possible economic cost

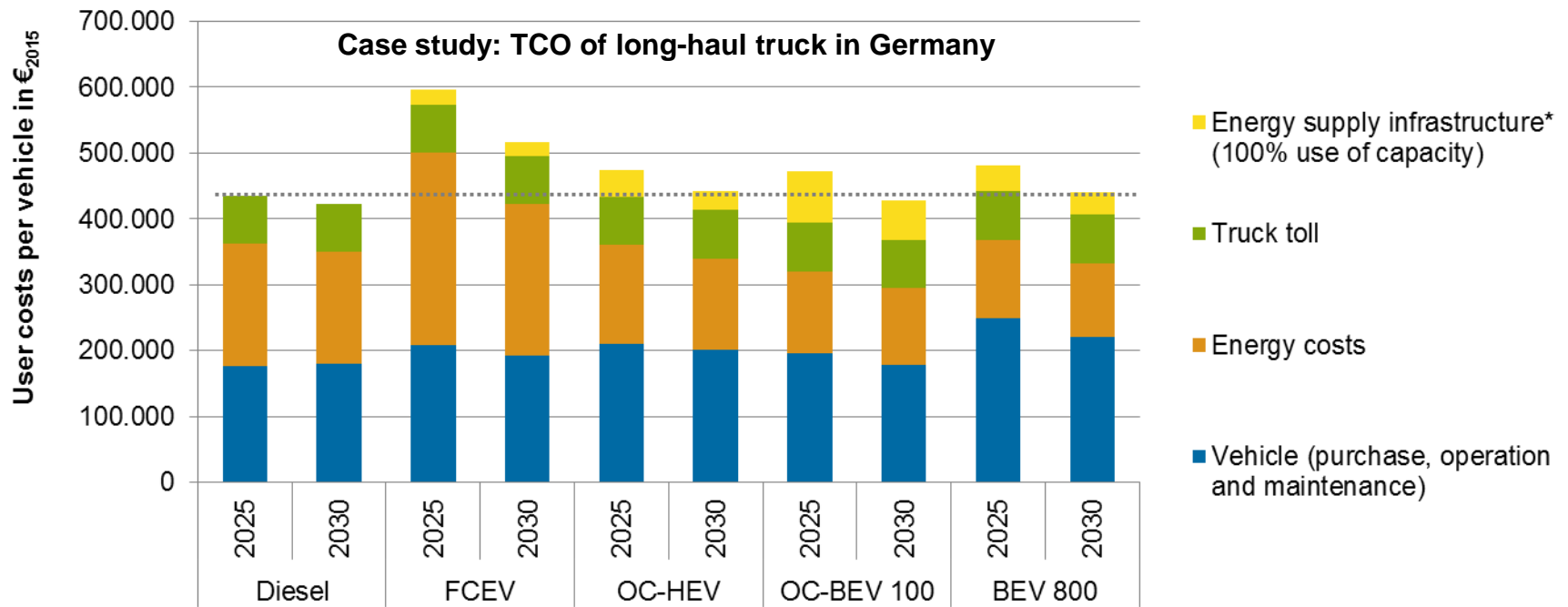
Electric propulsion systems in long-haul transport offer near-term cost advantages

- Lower operating costs compensate for higher vehicle costs
- **BUT:** uncertainties remain regarding the development of technology costs, energy prices and regulatory / fiscal framework



Assumptions of TCO: operation of a long-haul truck in Germany, user costs excl. VAT, 3,5% discount rate, 5 years of vehicle operation, annual mileage of 120.000 km
 FCEV – fuel cell electric vehicle, OC – overhead catenary, HEV – hybrid electric vehicle, BEV 100 – battery electric vehicle 100 km electric range

The roll-out of alternative energy supply infrastructure needs to be pre-financed

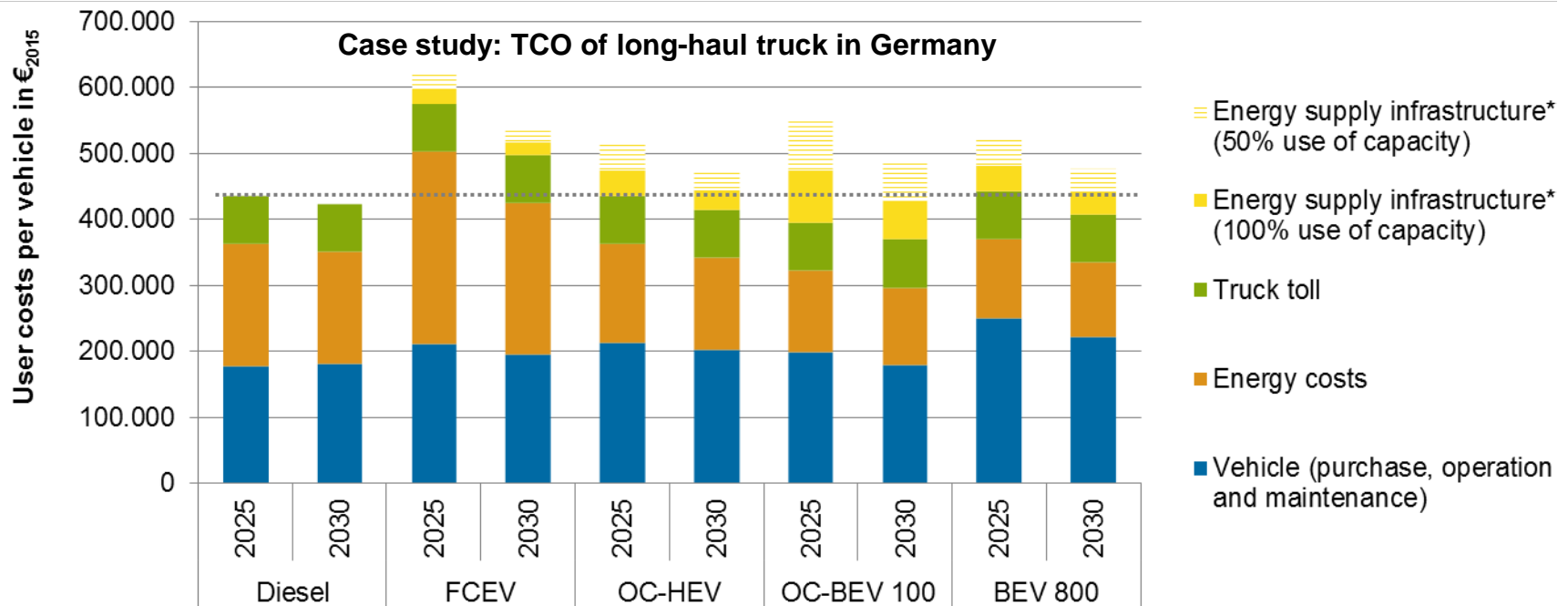


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*Energy supply infrastructure: hydrogen filling station, overhead line system or station-based charging infrastructure

The roll-out of alternative energy supply infrastructure needs to be pre-financed

- Availability of energy supply infrastructure is key to market ramp-up of alternative drives
- If early users fully carry infrastructure cost, this will hinder economic operation

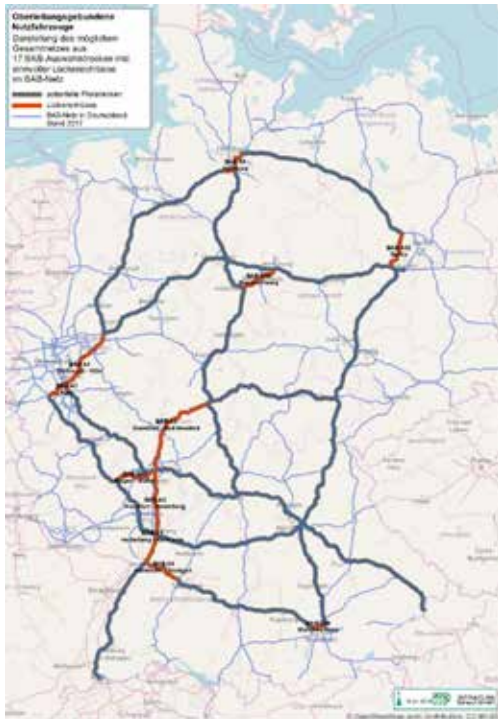


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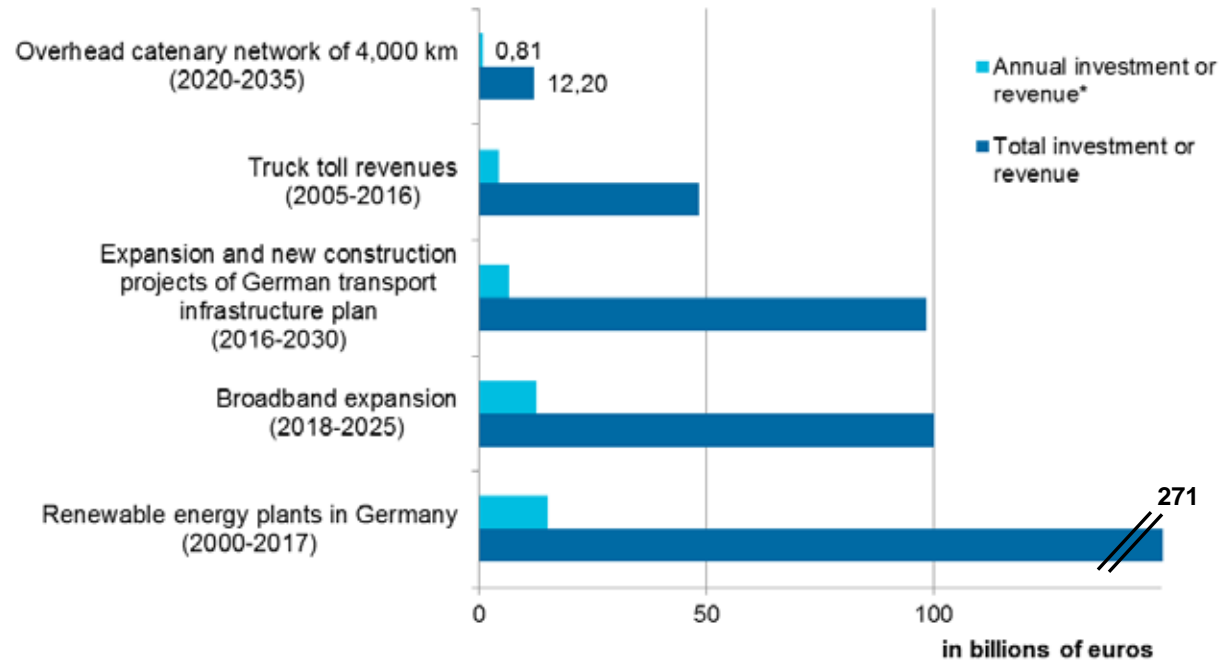
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Example of overhead catenary core network (4.000 km) in Germany: relatively low investment required

- All alternative propulsion systems require a reliable energy supply infrastructure
- In road freight transport, a relatively low network density along corridors could already be attractive for a variety of applications
- Investment needed is moderate compared to other expenditures for future technologies



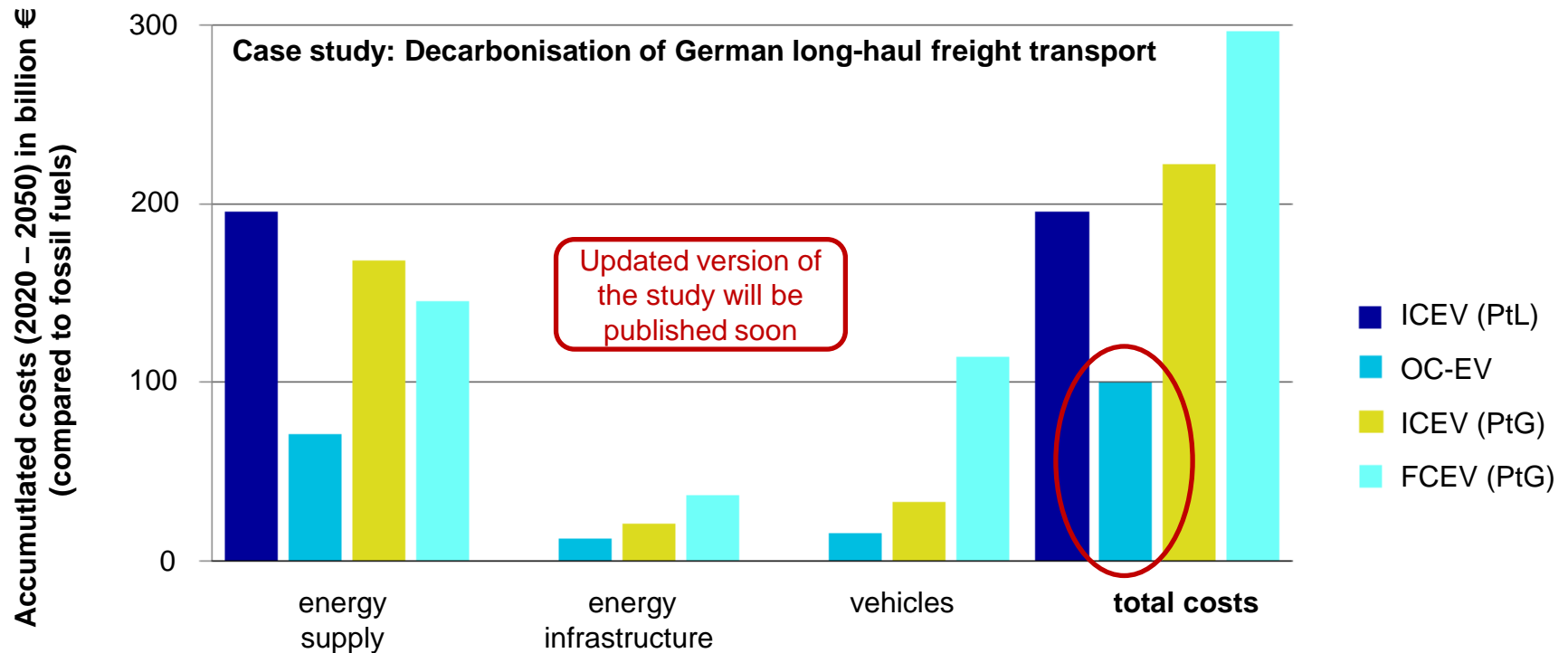
Overhead catenary network of 4,000 km (2020-2035)



*Average annual toll revenues or infrastructure investments during the indicated period

Overall costs of carbon neutral road freight transport until 2050: energy costs of particular importance

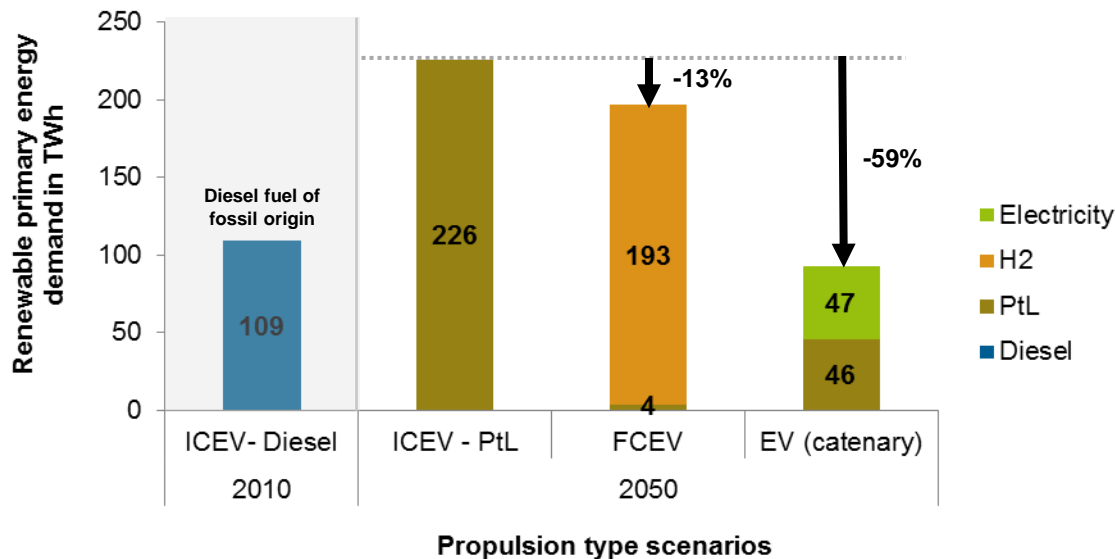
- Decarbonisation of freight transport is related with considerable economic costs
- Total costs are determined by the energy costs
- Costs of infrastructure and vehicles are less important from this perspective
- Direct use of electricity shows economic cost advantages



Decarbonisation of the freight transport sector by 2050: Demand of renewable energy depends on propulsion system

- Decarbonisation of long-haul freight transport requires high amount of renewable energy
- Highest energy efficiency for direct use of electricity results in lowest additional demand
- Use of synthetic fuels (PtL, H₂) requires energy imports
- Use of synthetic fuels must be combined with sustainability criteria at an early stage

Case study: Decarbonisation of German long-haul freight transport



Net electricity generation from renewable energies in Germany 2017: **210 TWh**

Scenario assumptions:

- All scenarios: complete decarbonisation of long-haul freight transport
- **ICEV – PtL:** Diesel replaced by imported synthetic fuel based on renewable energy → WTT efficiency: 49%
- **FCEV:** imported hydrogen (electrolysis, liquefaction and transport) à WTT efficiency: 48%
- **EV (catenary):** OC-vehicles with 75% electric mode and 25 % conventional mode (PtL); WTT efficiency of electricity: 85 %

Long-term framework conditions are needed to encourage the deployment of zero emission HDV in Europe

- Pressure to decarbonise road freight transport is high
- Direct use of electricity, as in passenger transport, also has advantages in road freight transport
- Depending on the application, synergies and various combinations of different drive technologies are also conceivable
- Parties involved need planning security, therefore strong state incentives for alternative drives and infrastructure development are necessary
 - ∅ e.g. CO₂-based truck toll, ambitious efficiency standards

Infrastructure development requires government action and pre-financing

- Competitive alternatives to diesel propulsion require a reliable basic energy supply network
- In the early market phase, the costs can neither be passed on to the (few) users, nor does a privately financed implementation appear realistic
- State initiative and takeover of investment risks related to infrastructure deployment is therefore necessary in this early stage

Large demonstration projects are necessary to gain practical experience and create acceptance

- New drive technologies create numerous practical challenges for all the players involved
- Near-market technologies should therefore be tested on a larger scale as soon as possible
- The aim of the pilot tests should be to develop a long-term strategy for road freight transport on the basis of experience gained
 - ◊ including an infrastructure development strategy for HDV
- Cross-border projects should be taken into account at an early stage

Further reading – recent publications of Oeko-Institut

StratON project report (09/2018) on overhead catenary heavy-duty vehicles



Policy paper (10/2018) on alternative drive trains and fuels for HDV



Available on our website: www.oeko.de

Thank you for your attention!

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