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Modelling market uptake of ERS in Germany

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Summary

Freight transport accounts for around 6-7% of Germany's GHG emissions. In the context of GHG reduction targets, the questions arise as to a) what contribution ERS can make to climate protection by 2030 and 2050, b) how the political framework conditions are to be designed in order to advance the market uptake of electric road systems (ERS) as effectively and efficiently as possible.

To answer these questions, a model for heavy duty vehicles was developed, which simulates the possible market uptake taking into account available infrastructure, political framework conditions and user profiles. The scenario calculations show that 1) risk aversion of vehicle buyers (payback period) can be decisive for the market uptake, 2) the toll exemption of electric trucks has the highest effect on the TCO.

1 Research Questions

Recent scenarios and studies on ERS estimate the GHG reduction potential at 2-4 million tonnes in 2030 [1,2]. Significantly higher reductions (of up to 10 million tonnes) might be possible in the long term. However, the market uptake of ERS can hardly be be prescribed by the government. As a minimum prerequisite for a successful market uptake, industry stakeholders state that the vehicles must have a significant cost advantage over their diesel counterparts.

The cost competitiveness of electric trucks on ERS depends on the one hand on the individual application profile of the vehicle (How many vehicle-km can be driven electrically? How much flexiblitiy is required?), but also depend on the political and economic framework conditions (How high is the price of electricity or diesel? How high are the additional costs? What requirements have to be met at EU level? Is there a toll cost advantage?).

Against this background, the question arises as to how different political and economic conditions could influence the market uptake of electric trucks on ERS in Germany and how this would affect final energy demand and GHG emissions.

2 Methodology

As part of the "StratON" project, an agent-based vehicle registration and stock model for heavy trucks was developed as an integral part of Oeko-institutes' existing "TEMPS" model. The procedure was as follows: User profiles ("agents") were defined and the purchase decision was modelled for each of these agents. The group of agents shall represent the entirety of all decision-makers. The aim is to take sufficient account of the heterogeneity of user profiles - without, however, modeling each decision maker individually.

It is assumed that by 2025, 70% of the motorways Hamburg-Kassel and Dortmund-Berlin (around 750 km) will be equipped with overhead catenary lines. The network will be successively expanded until 2035, when a network of around 4,200 km of motorway will be covered, 70% of which will be equipped with overhead catenary lines. These 4.200 km correspond to a network with a high share of heavy goods traffic and are in line with results of previous studies.

In a first step, vehicle profiles were defined, which are characterized by annual mileage, share of driving on electrified routes as well as the requirement for electrical range. Vehicle profiles were derived based on traffic analyses of the length and frequency of journeys under different ERS networks. For heavy trucks, a distinction was made between 6 annual mileage classes (40,000 to 170,000 km), 12 different driving shares on an ERS network (0-10%, 10-20%, .. , 70-80%, 80-85%, 85-90%, 90-95%, 95-100%), as well as requirements for the electrical range for the use of O-BEV depending on the trip structure.

Vehicle costs depend on the year of purchase and the vehicle efficiency. For diesel trucks, the cost curves of the EU commission for HDV regulation were implemented into the model. Additional costs for overhead catenary (OC) vehicles were developed within the StratON project. All relevant cost assumptions were discussed with a group of stakeholders. Other relevant economic parameters such as oil prices, electricity prices and tolls vary depending on the scenario (see Table 1). The baseline scenario uses a high oil price, medium power price, and assumes that OC vehicles do not pay any road toll as long as they drive in electric mode.

On this basis, representative vehicle buyers (agents) select the vehicle with the lowest TCO, taking into account requirements for electrical range. This is used to determine the distribution of new vehicle registrations and the share of electric vehicles driven. Vehicle stock is calculated using survival curves, and combining vehicle stock with mileage leads to final energy consumption and GHG emissions.

Starting from the base scenario, sensitivity analysis are carried out by varying input parameters into the model. Scenario S1 models the complete road toll exemption for OC trucks (non regarding whether they drive mainly in electric mode or not), which corresponds to current framework conditions in Germany. S2 assumes that there is no road toll exemption for electric trucks. S3 is characterized by lower oil price and higher power prices; thus reducing the comparative advantage of fuelcosts.

In addition to economic parameters, the influence of different payback periods (S4, S5) are examined to account for risk aversion of decision makers.

Scenario	Oil price	Power price	Payback period	Road toll
Basis	high	Medium	5	No road toll in electric mode
S1	high	medium	5	No road toll for electric vehicles
S2	high	medium	5	Standard road toll
S3	medium	high	5	No road toll in electric mode
S4	high	medium	2	No road toll in electric mode
S5	high	medium	1	No road toll in electric mode

Table 1: Definition of scenario parameters

3 Results

Results to be delivered are:

- market uptake of electric trucks depending on framework conditions and assumptions,

- TCO cost comparisons for different user profiles,

- share of electric mileage, final energy demand, and GHG emissions.

Conclusions will be drawn regarding potentials and uncertainties, recommendations for policymakers will be drawn, and further research topics identified.

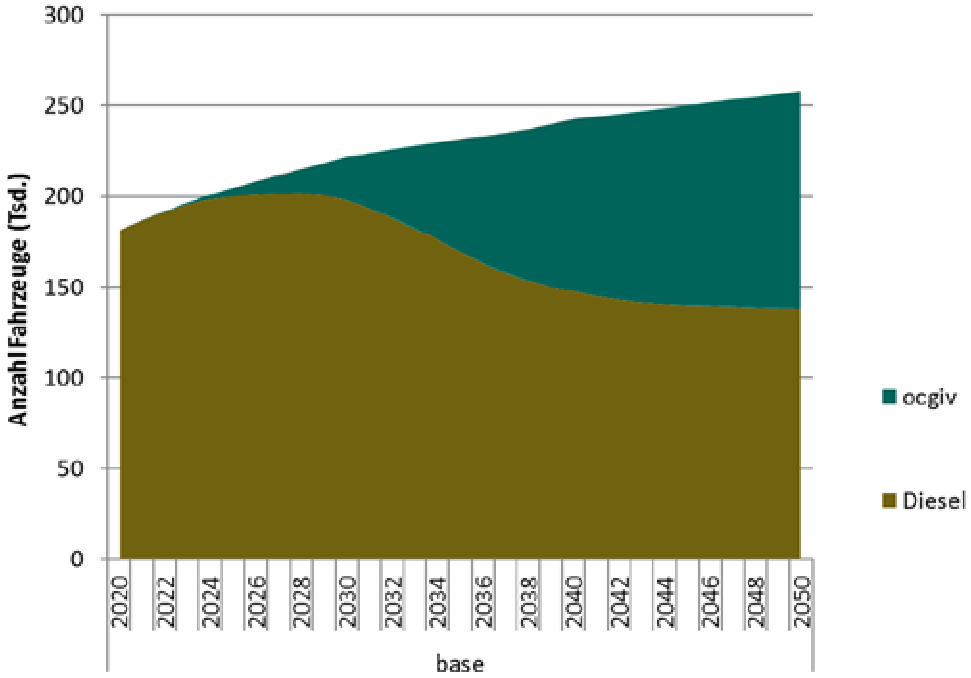

Figure 1: Example for results

References

[1] FH-ISI (2017): Machbarkeitsstudie zur Ermittlung der Potenziale des Hybrid-Oberleitungs-Lkw

[2] IFEU (2018): Roadmap OH-Lkw: Kurzfristig realisierbare Potenziale für den wirtschaftlichen Betrieb von OH-Lkw

Authors

Ruth Blanck has a degree in mathematics. Following the completion of her studies, she worked at DB Mobility Logistics AG in the department for transport modelling and traffic forecasts.

Since February 2011 she has been working at Oeko-Institut as a researcher with a special focus on sustainable mobility. In this context she is involved in the development of the TEMPS model for the determination of long-term transport scenarios. She has broad experience both in scenario development and in quantifying policies & measures to reduce GHG emissions.

Wolf Görz has a bachelor in Transport Science, and a Master in Environmental Science and Technology. Since 2018 he has been working at Oeko-Institut with a focus on electric road systems. He played a major role in developing and implementing the model for market uptake of ERS in Germany.