

Flexibility marketing options for charging processes of electric medium-duty and heavy-duty commercial vehicles

Sector Coupling and Flexibility; Decarbonisation: Industry Sector

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Motivation and key research question

This feasibility study examines how electrified trucks and busses can provide flexibility to the energy system. The focus is on ancillary services in Germany. For this, the key economical, regulatory, legal and technical aspects along the flexibility segments of balancing power and congestion management (redispatch) are investigated. This study creates awareness regarding possible use cases for and revenues from unidirectional smart charging applications for relevant stakeholders in the energy and automotive sector.

Methodology

The approach taken in this study is twofold: first, expert workshops with relevant experts from Daimler Truck and TenneT were held. Secondly, flexibility and marketing potential were derived for a range of use cases and extrapolated over exemplary market ramp-ups.

Results and conclusions

The results of the expert workshop sessions include three key take-aways:

1. Logistics businesses will not use electrified vehicles if there is no positive business case depending on, e.g., vehicle price, electricity costs, incentives for earning additional revenue by providing flexibility services.
2. Promising flexibility segments are balancing power and congestion management (i.e. redispatch).
 - While for balancing power the asset location (e.g. depot) is less important, it is crucial for congestion management because spatial bottlenecks in the electricity network are to be solved.
 - Technically, trucks and busses can participate in all three balancing types FCR, aFRR and mFRR. However, the “higher quality” balancing types FCR and aFRR are most suitable because charging of batteries can be adjusted quickly, and they have enough capacity that can be shifted.
 - In Germany, the regulatory framework for loads and storages under “Redispatch 3.0” is still to be shaped, while in the Netherlands the GOPACS platform already offers market-based remuneration. Depot operators only provide the redispatch service if they reduce their electricity costs from a market-based remuneration.
3. The Crowd Balancing Platform “Equigy” enables a more efficient provision of balancing power and congestion management from decentral, distributed flexibility sources.
 - The Crowd Balancing Platform is not a marketplace, but it creates the framework conditions for a decentralized prequalification and efficient accounting for the increasing amount of small and distributed asset. This ultimately lowers market entry barriers.

Results of the flexibility and market modelling are as follows. The positive and negative flexibility potential [MW] for TenneT’s grid operation is illustrated in Table 1. The flexibility potential is substantial for the line haul and retail truck use cases and also large bus depots play a substantial role in the early morning hours. With a theoretical potential of over 4 GW of positive and negative flexibility from 4 pm to 4 am (peaking at over 23 GW of negative flexibility in the 4-hour-block 20:00-24:00 and at over 7 GW of positive flexibility in 00:00-04:00), all examined use cases combined could have a significant impact on, for example, the balancing power market in 2040. For context, the current demand in 2022 for positive and negative balancing power in Germany is around 7.1 GW.

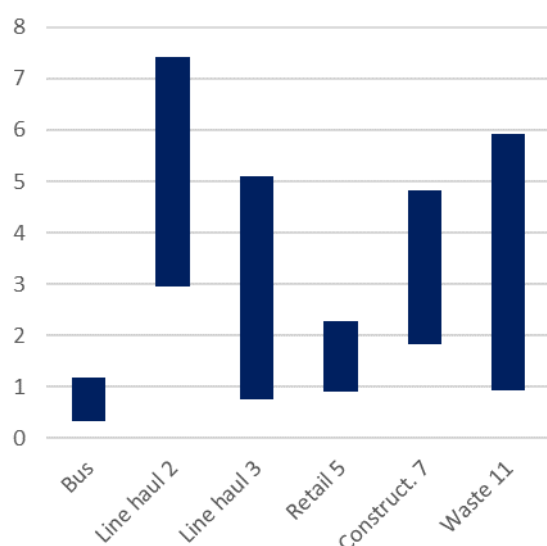
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Table 1: Maximum positive (+) and negative (-) flexibility potential for Germany in 2025, 2030 and 2040 [MW]

	00:00-04:00	04:00-08:00	08:00-12:00	12:00-16:00	16:00-20:00	20:00-24:00
2025	529	13	4	0	266	354
	-1,146	-26	-13	-47	-659	-1,048
2030	2,210	46	13	0	1,238	1,613
	-5,960	-77	-39	-138	-3,981	-5,765
2040	7,066	154	23	0	4,183	5,542
	-22,593	-137	-70	-245	-16,095	-23,113

Figure 1 illustrates the potential revenue from flexibility provision and therefore the reduction potential for the total cost of ownership [EURct/kWh] for truck customers. In practice, depot operators may have electricity contracts with flexibility aggregators who grant remuneration or rebates on electricity price in exchange for flexibility. The revenue potential is larger on the aFRR market, and the largest revenue results for truck use cases line haul 2 and waste 11, while the bus use case and truck use case retail 5 have the lowest potential. For aFRR the revenue potential can be very significant given average electricity prices for German industry at around 20 EURct/kWh. If transport companies could facilitate flexibility marketing reliably, significant rebates on their electricity costs would be possible.

a) aFRR (capacity & energy)



b) FCR

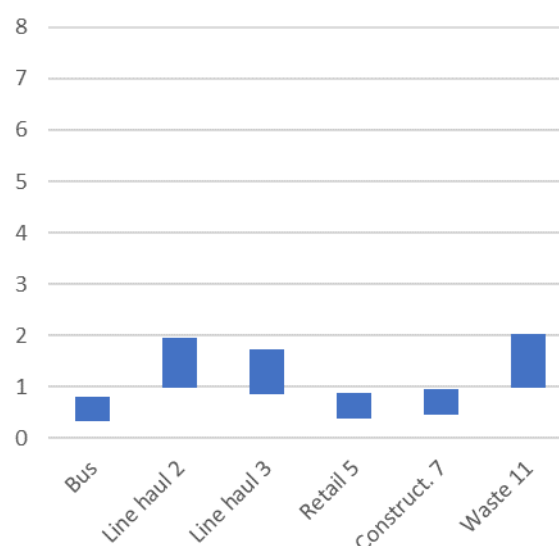


Table 1: Range of maximum possible revenue per consumed kWh from flexibility segments, in EURct/kWh (minimum revenue with 2020 prices, maximum with 2021 prices)

There are several limitations to these findings. First, the analysis does not allow for profitability conclusions because only the revenue side is presented (i.e. costs are not included). Second, the flexibility potential assumes that it can be offered over the entire bid timeframe, which is in practice not possible because actual flexibility delivery can reduce the potential considerably. Furthermore, the flexibility potentials are based only on a selection of bus and truck use cases (6 out of 11) and consider only weekdays (neither weekends nor bank holidays). Finally, we used market data from 2020 and 2021 to illustrate revenue ranges; predictions of future prices require further analysis.

Policy recommendations for balancing power are that the prequalification criteria should avoid redundancy and minimize costs for balancing service providers (e.g. by establishing largely automated prequalification processes). Furthermore, the vehicle operators' risk of insufficient state of charge must be nullified through smart IT solutions. For congestion management, a market-based approach should complement the existing cost-based provision of redispatch services and address these decentralised generation or consumption assets for which there is no mandatory participation in the current redispatch regime. This means that an attractive market solution is needed to allow for voluntary participation from consumers rather than mandatory load reductions.