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

IEWT 2023, 16.02.2023, EI 8: Strommarkt

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Daimler Truck TenneT

Decarbonisation and electrification drives flexibility requirements …

Daimlers Abschied vom Diesel

Ab 2030 nur noch E-Stadtbusse

Stand: 02.05.2022 14:22 Uhr

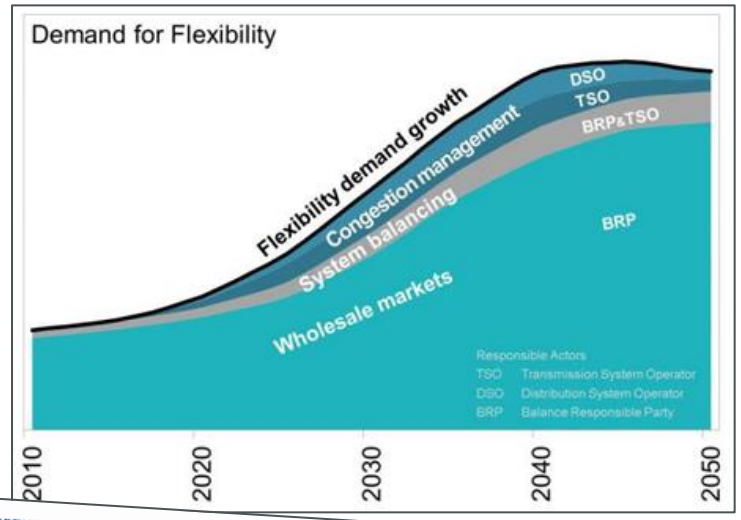
Daimlers Bussparte stellt das Stadtbu… Elektroantriebe um. Bis dahin dürfte … auf deutschen Straßen kräftig steige…

28.02.2022

DACHSER bringt Serien-eActros zum Einsatz

May 24, 2022 - 03:01 pm

Germany's electric bus market continues to grow with the eCitaro in the lead



Stromversorgung

Die Auswirkung der Dunkelflaute auf die deutsche Energiewende

Erneuerbare Energien sollen in Deutschland zukünftig den Hauptanteil der E… men und konventionelle Energieträger mehr … kelheit oder …

15.02…

Daimler Truck erhält US-Auftrag für bis zu 800 E-Lkw

Der Lebensmittellieferanten Sysco hat bei Daimler Truck 800 ersten Fahrzeuge der US-Marke Freightliner wird der deutsch… voraussichtlich noch in diesem Jahr an den Kunden liefern.

25.05.2022, 16.31 Uhr

E-Mobilität: Aral eröffnet erste Ladestation eines Korridors für Elektro-Lkw

Nach dem Aufbau eines Schnellladenetzes für E-Autos an seinen Tankstellen will Aral auch E-Lkw mit Strom versorgen. Im Südwesten entsteht ein erster Korridor.

23.01.2023 14:25 Uhr | Autos

Teilen Drucken Merken

Stuttgart

EnBW-Tochterunternehmen beschreibt, was für die Energiewende nötig ist

Der Netzbetreiber Transnet-BW hat eine Studie vorgelegt, wie Europa bis 2050 klimaneutral werden kann. Klar wird: Es sind gewaltige Anstrengungen nötig. Was erschwerend hinzukommt: Die Autoren gingen von einem Idealzustand aus.

… however, little to none research has been conducted regarding the flexibility potential of electrified trucks and busses → **rationale of this feasibility study**

Targets

- ✓ Learn to communicate between energy and transport sector
- ✓ Study flexibility potential [MW] for the electricity system from unidirectional charging
- ✓ Examine reduction potential of electricity cost [EURct/kWh] for truck customers
- ✓ Create awareness in e-mobility community focussed on passenger cars

Approach

- **Expert workshop sessions**
- **Examined bus and truck use cases**
- **Flexibility and market modelling**
- **Mutual positions for policy recommendations**

“Passenger cars are bought primarily with the heart, trucks are bought with the calculator”

- Frans Timmermans, EU-Kommissar für Klimaschutz

Main results of the expert workshop sessions

There are **three key take-aways**:

1. **Daimler Truck's customers** will not use e-vehicles if there is no positive business case.
   - Depending on, e.g., vehicle price, electricity costs (incl. potential rebates/ revenues), trust in technology

2. **Promising flexibility segments** are balancing power and redispatch.
   - Balancing: FCR and aFRR are most suitable because battery charging fulfils "high quality" requirements.
   - Redispatch: future "Redispatch 3.0" regime in DE – including electric vehicles – is to be shaped. A market-based remuneration is needed to incentivise depot operators to provide redispatch services.

3. "**Equigy – the Crowd Balancing Platform**" can facilitate the integration of decentralised flexibility potentials.
   - TSO-owned entity (TenneT is founding member) to support them in their role as market facilitators.
   - It facilitates the provision of balancing and redispatch services by integrating asset data from back-end systems via the blockchain.
   - For aggregators and OEMs, the platform can provide new opportunities to allow a more efficient pooling of flexibility potentials of individual assets and offer the aggregated flexibility.

Our ambition: All new vehicles in Europe, North America and Japan are **locally CO_2-neutral by 2039**

2021	2022	2020	202X	2024	2027+	2021	2018	2022	2023	2022	2023
Thomas Built Buses Saf-T-Liner C2 Jouley	Freightliner eCascadia	Freightliner CustomChassis eWalk-in Van	Mercedes-Benz eAtego	Mercedes-Benz eActros LongHaul	Mercedes-Benz GenH2 Truck	Mercedes-Benz eActros	Mercedes-Benz eCitaro	Mercedes-Benz eEconic	Freightliner eM2	Mercedes-Benz fully electric bus chassis eO500U	FUSO eCanter

Hundreds of customers have already covered tens of millions of kilometers with our electric trucks and buses.

Years after 2022 indicate planned start of production

Examined bus and truck use cases

- **12 use cases** were defined:
  - 1 x city bus
  - 3 x line haul
  - 3 x retail / distribution
  - 3 x construction
  - 2 x waste

Two key differences to passenger cars:
1) larger battery, 2) better planning

- Spotlight on the use case **“retail / distribution”**:
  - Charging concepts: centralized charging infrastructure at the truck depot, 1 charger / truck
  - Assumptions on average depot size, driving distance and driving schedule
  - Power and energy requirements can be assumed immutable from Mon – Fri, all other days consumption is lower

Table 1: Metrics and units used for the description of the use cases

Metric	Unit	Additional description
Min required SOC	%	Minimum state of charge needed for daily route(s)
Available battery capacity	kWh	As installed in the vehicle
Max. available charging power	kW	As installed at example depot
Energy demand per Veh. & day	kWh	Derived from exemplary daily mileage
Time departure 1	h	Vehicle leaves depot for first shift
Time arrival 1	h	Vehicle returns to depot after first shift
Time departure 2	h	Vehicle leaves depot for second shift
Time arrival 2	h	Vehicle returns to depot after second shift
Variability of departure		High if vehicles leave all at same time due to tight trip schedules
# vehicles in example depot		Number of vehicles operating out of example depot
Comment		(If applicable)

		4	5	6
Min required SOC	%	100%	100%	100%
Available battery capacity	kWh	600	400	400
Max. available charging power	kW	50	150	150
Energy demand per veh. & day	kWh	575	350	400
Time departure 1	h	08:00	05:00	05:00
Time arrival 1	h	16:00	13:00	13:00
Time departure 2	h	-	14:00	14:00
Time arrival 2	h	-	20:00	20:00
Variability of departure		low	low	low
# vehicles per example depot		20	30	30
Comment			2 full shifts	2 full shifts

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Main results of the flexibility and market modelling 1/2

Flexibility potential [MW]

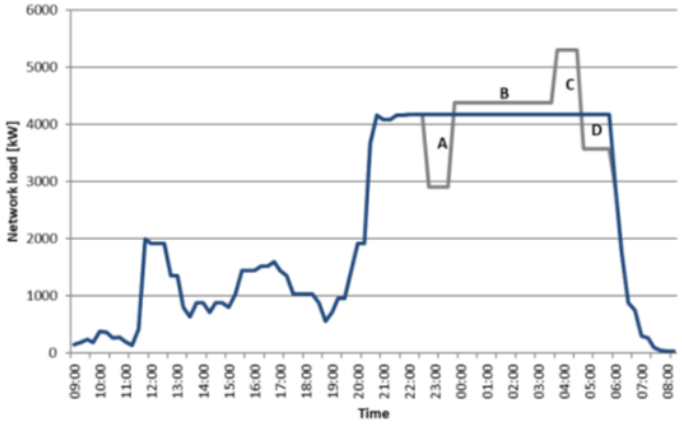

Figure 2: Network load for the bus use case (blue) and exemplary balancing power activation (grey)

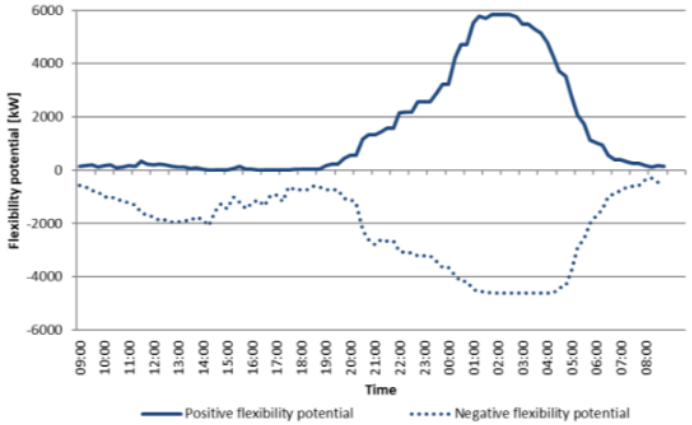

Figure 3: Flexibility potential for the bus use case (149 vehicles)

+ assumed ramp-up rates

	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

Constant positive / upward (+) and negative / downward (-) flexibility potential for DE in 2025, 2030, 2040 [MW]

- **Flexibility potential is substantial** for line haul and retail truck use cases and large bus depots play a substantial role in the early morning hours.
- **In 2040, over 4,000 MW of constant positive and negative flexibility potential available from 16:00-04:00**, peaking at over 23,000 MW of negative flexibility (7,000 MW positive flexibility).
- Thus, electrified trucks and busses **can have a significant impact** on, e.g., the balancing power market in 2040: the current demand in 2022 for positive and negative balancing power is around 7,100 MW in DE.

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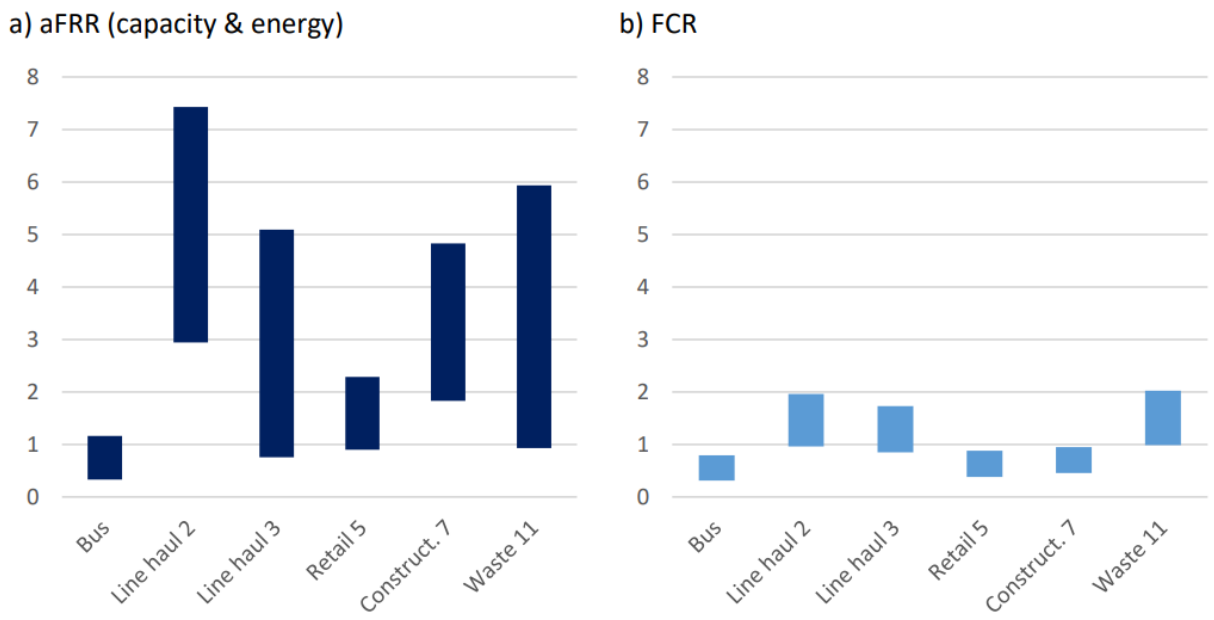
Main results of the flexibility and market modelling 2/2

Reduction potential for truck customers' electricity cost [EURct/kWh]



Maximum possible revenue per consumed kWh from flexibility segments, in EURct/kWh (bottom = 2020 prices, top = 2021 prices)

- In practice, depot operators may have electricity contracts with **aggregators who grant remuneration or rebate on electricity price** in exchange for provided flexibility.
- 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, revenue potentials can be significant** given average electricity prices for industry at around 20 EURct/kWh.
- If transport companies facilitate flexibility marketing reliably, **significant rebates on their electricity costs** are possible.
- **Limitations**:
  - Revenue, not profit (costs not considered)
  - Flexibility potential assumed to be offered over the entire timeframe → infeasible in practice
  - Only selected bus and truck use cases (6 out of 12) and consideration of only weekdays

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Mutual positions for policy recommendations

Balancing power

- **Prequalification criteria should avoid redundancy** and minimize costs for balancing service providers (e.g. by establishing largely automated prequalification processes).
- **Risk of insufficient range for vehicle operators must be eliminated** through the use of smart IT solutions and assurances of aggregator.

Congestion management

- In Germany, 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.

Summary

Main results

- This project laid the **foundation for a mutual understanding** of Daimler Truck and TenneT regarding future electrified commercial vehicles and future energy flexibility requirements.
- Focus is on **two promising flexibility marketing segments:** balancing power (maintaining a stable grid frequency) and congestion management (redispatch, i.e. solving of spatial grid bottlenecks).
- **6 use cases** were examined and flexibility [MW] and TCO reduction potentials [EURct/kWh] were derived:
  - **Significant flexibility potential [MW]:** Strong increase with ramp-up of electrified vehicles: 200 (1,200) [4,000] MW constant upward and downward potential in 2025 (2030) [2040] during 16:00-04:00.
  - **TCO reduction potential [EURct/kWh]:** Revenue potential depends strongly on use case and assumed prices, but it could lead to significant electricity cost reductions of up to 30%.
- **Mutual positions for policy recommendations** were aligned and are included in the study.

Next steps

- A **full economic examination** of the profitability potential is advisable.
- **Technical pilot**: technical implementation of customer-aggregator-TSO interaction, using existing standards for charging hardware and communication (c.f. passenger car project).

Thanks for listening!

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QR-Code zur Studie