TECHNO-ECONOMIC UPTAKE POTENTIAL OF ZEV TRUCKS IN EUROPE

EU Green Trucks Summit
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PROJECT GOAL & SCOPE

PROJECT GOAL

To assess the techno-economic market uptake potential of zero-emission trucks for the European Union (EU) and the United Kingdom (UK) over the timeframe 2020 – 2040

SCOPE

Configuration	Truck type	Mission profile	BEV medium range	BEV large range	FCEV range
	Rigid truck	Urban delivery	150 km	200 km	NA
	Tractor trailer	Regional delivery	300 km	400 km	NA
	Tractor trailer	Long haul	500 km	800 km	800 km
	Tractor trailer	Construction	150 km	300 km	300 km

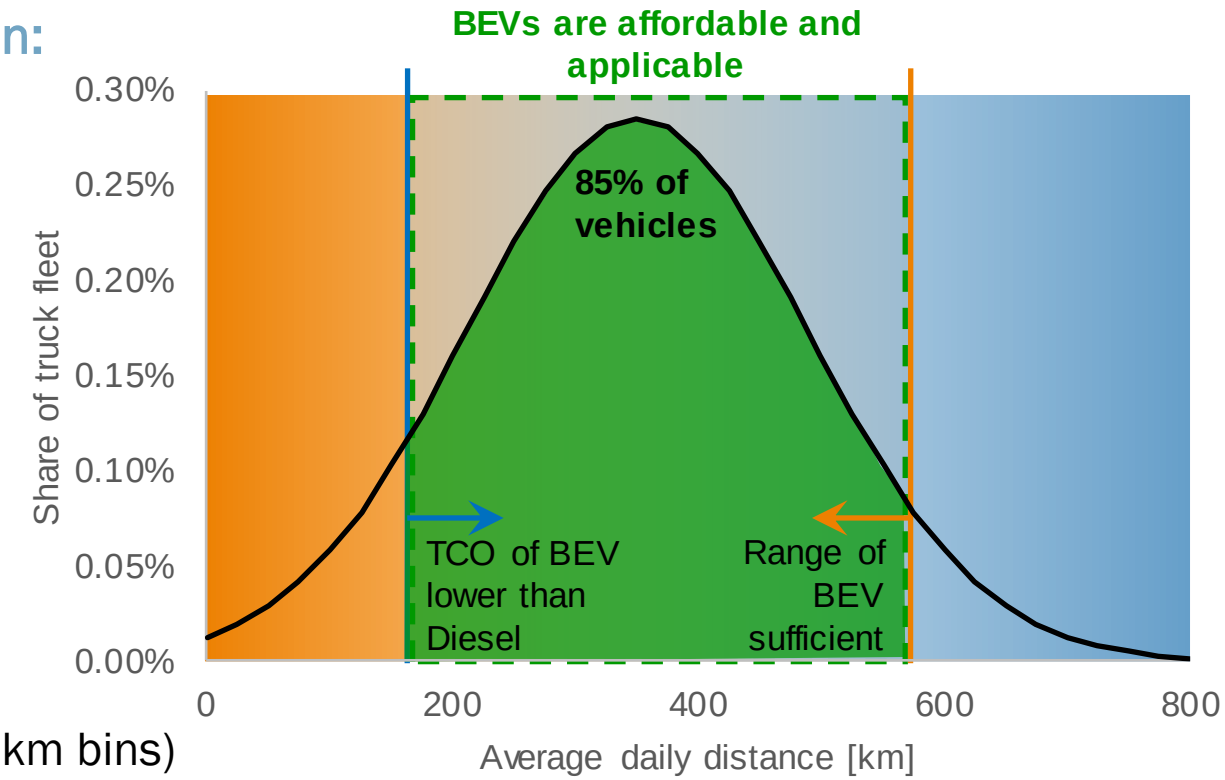
METHODOLOGY

Feasibility for replacing ICEV by ZEV is evaluated on:

Affordability (Total Costs of Operation - TCO)

- Energy costs (energy consumption & energy prices)
- Investment cost (glider & drivetrain components)
- Other costs (e.g. maintenance)

⇨ ZEV affordable if TCO are same or better than diesel equivalent



Applicability

- Average daily distance (average daily mileage in 25 km bins)
- Daily distance variation (assumed 30% lower as in current situation due to adaptation in vehicle deployment)
- 90% of the trips for BEVs can be performed with one full charge plus 45 minutes fast charging

⇨ ZEV is applicable when operational constraints are fulfilled

DISCLAIMER: ACTUAL UPTAKE ≠ UPTAKE POTENTIAL

The actual uptake of ZEVs will likely differ from the uptake potential, depending on:

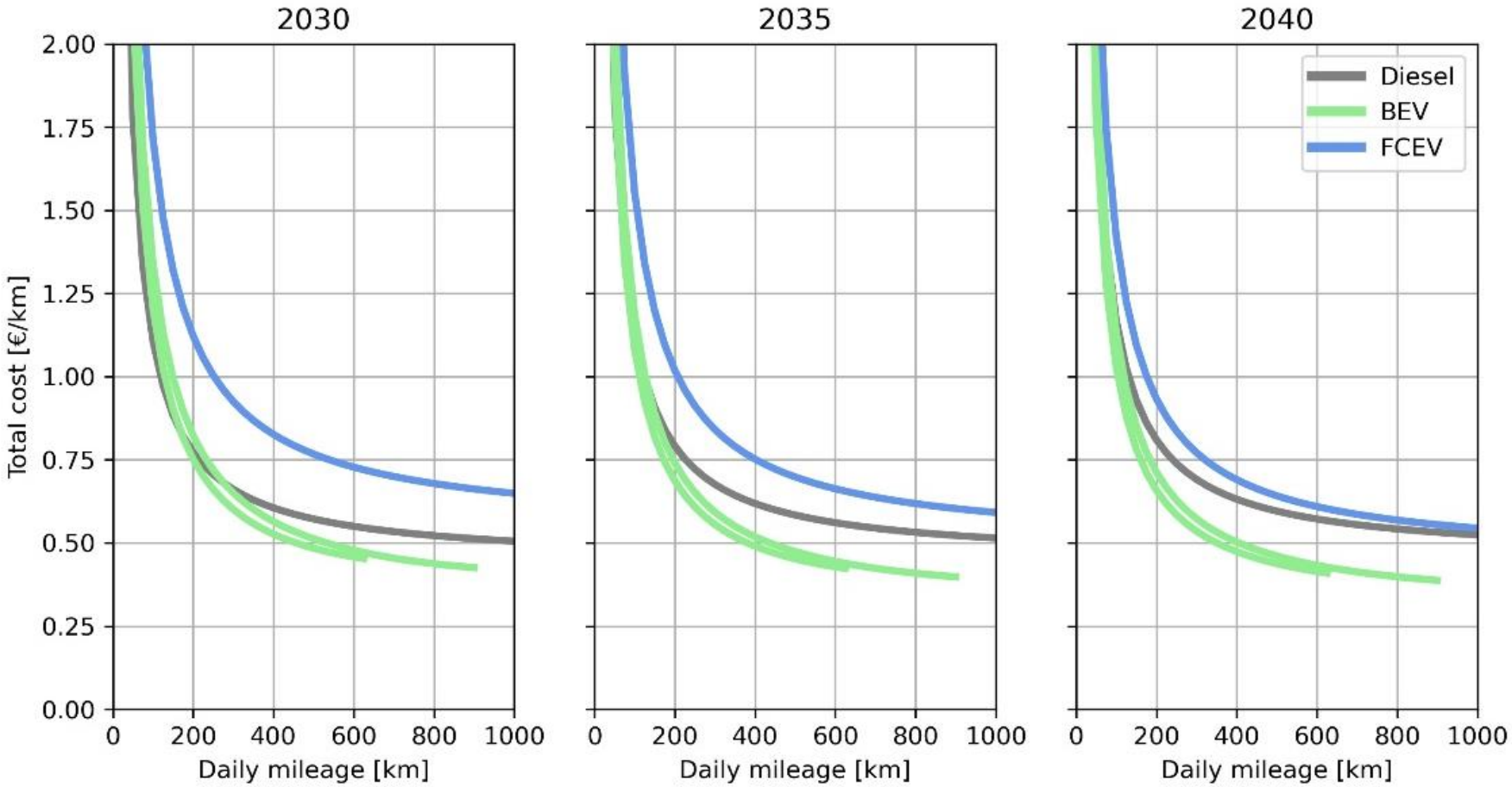
- Sufficient production and availability of ZEVs
- Sufficient infrastructure for charging/refuelling
- Acceptance by transport operators
- Other policies that assessed not in this study (e.g. zero-emission zones)
- Public awareness and social responsibility

⇨ Conclusions are only valid within the assumptions made for this study on energy costs, energy consumption, component costs, vehicle deployment etc.

⇨ Truck deployment differences between countries, temperature influences on energy consumption, mark-up factor in retail price etc. are all accounted for

TCO RESULTS

CALCULATED TCO FOR ARTICULATED LONG HAUL TRUCK IN EU+UK



- BEVs will become the most cost-effective drivetrain for many applications even before 2030
- FCEVs only become more cost-effective than diesel equivalents for very limited applications in a few countries

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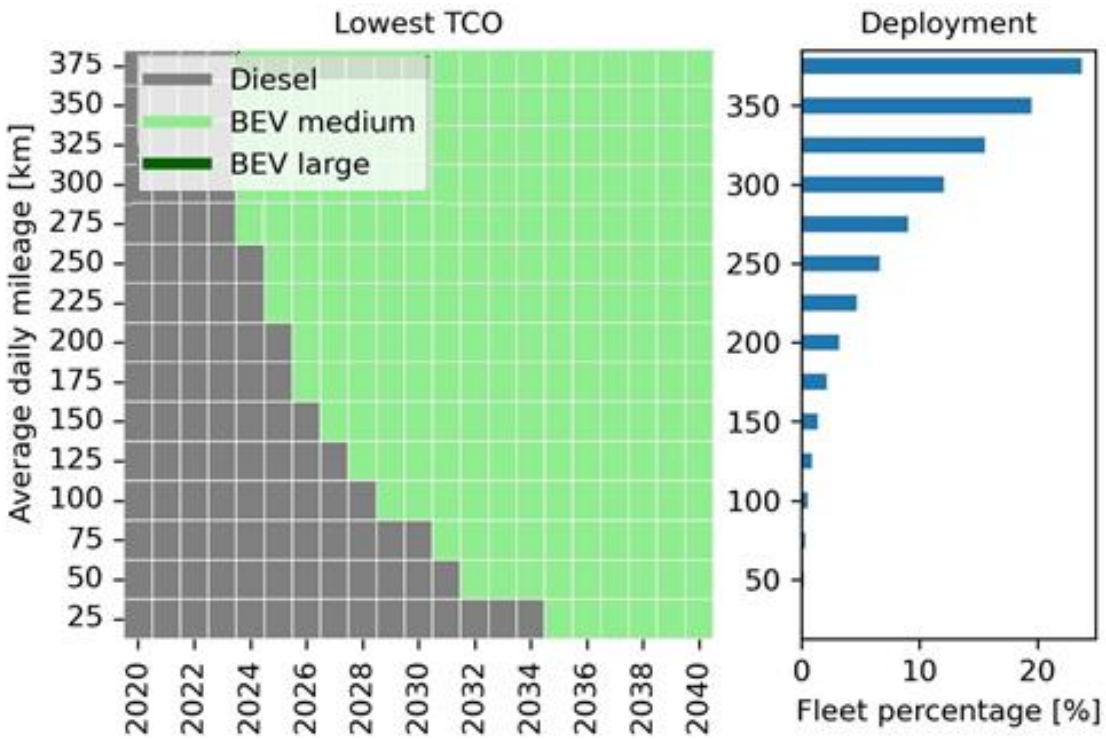
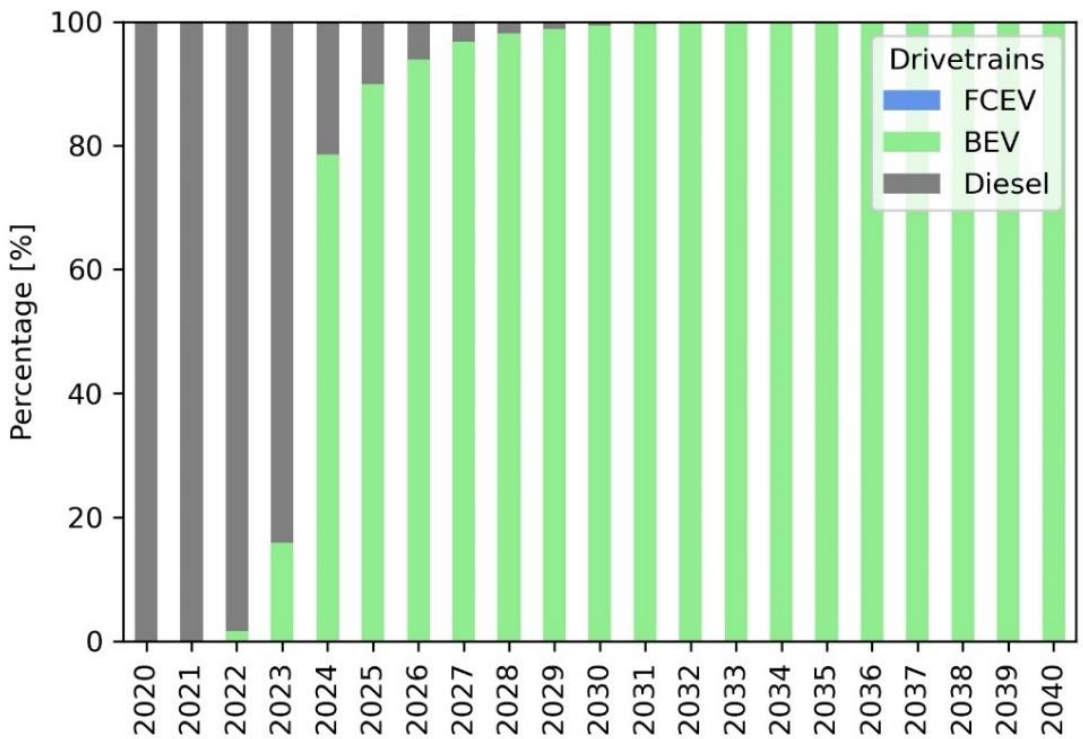
UPTAKE RESULTS

TECHNO-ECONOMIC ZEV UPTAKE POTENTIAL FOR ARTICULATED REGIONAL DELIVERY TRUCK



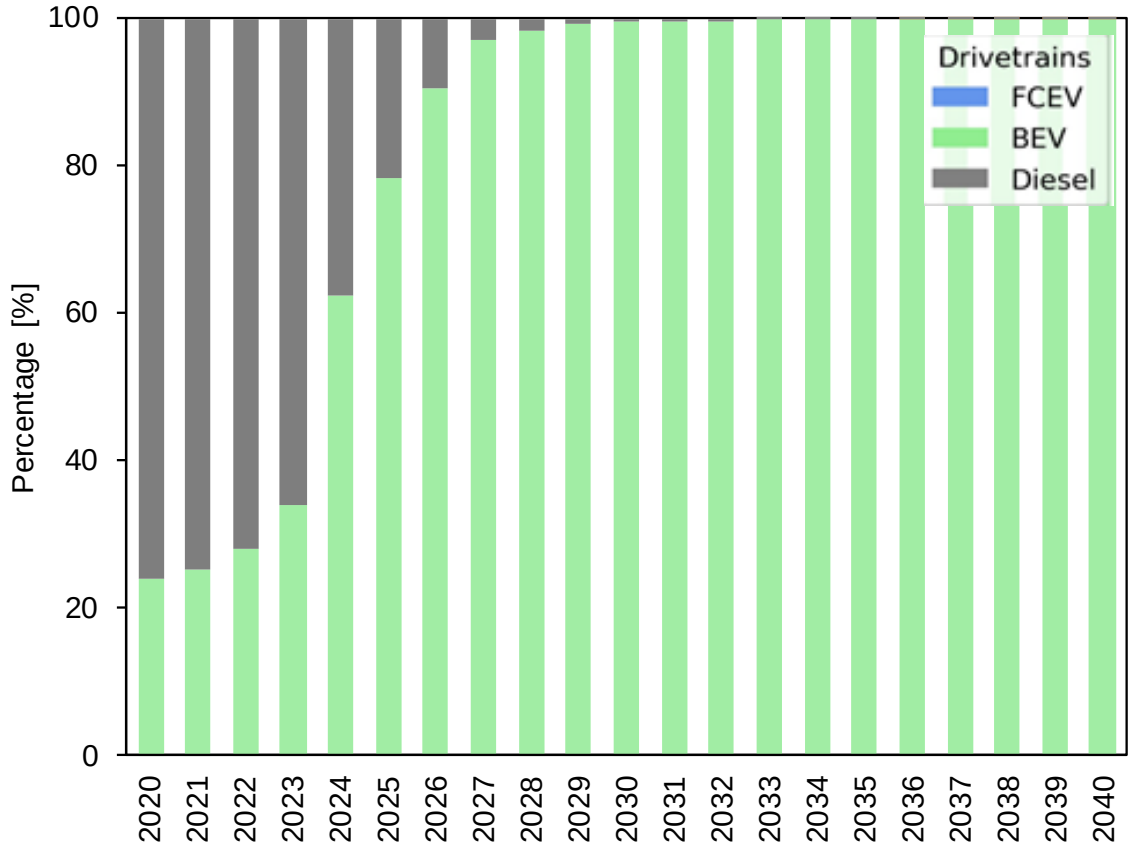


⇨Uptake potential depends on lowest TCO and average daily mileage distribution in the fleet

⇨For regional delivery truck the BEV drivetrain reaches >99% uptake potential by 2030

UPTAKE RESULTS

AGGREGATED TECHNO-ECONOMIC ZEV UPTAKE POTENTIAL FOR ALL TRUCKS (EXCEPT CONSTRUCTION)



⇨Considerable ZEV uptake potential already present for trucks today

⇨For all truck types (excluding construction truck) the BEV drivetrain reaches >99% uptake potential by 2030

OTHER RESULTS

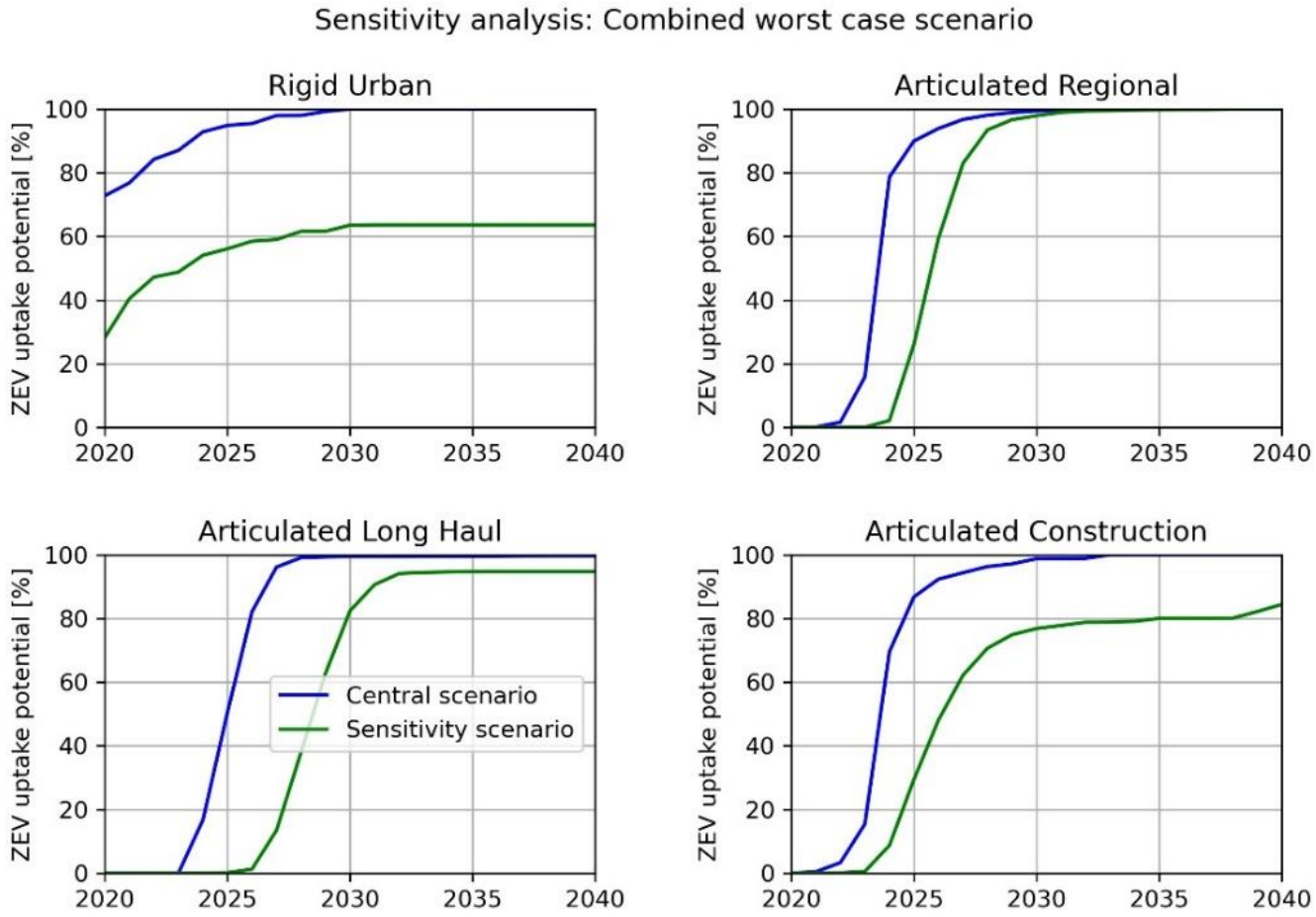
- Limited payload penalty for the long range BEV only (3 tons in 2020, none by 2030)
- Uptake curves are not significantly different between countries in EU+UK

Sensitivity analysis

- In the combined worst-case scenario the uptake will be delayed and the maximum uptake potential reduced
- Reduction of maximum uptake potential is mainly related to the battery size, not TCO

Policy driven scenario

- Effect of tolling, CO_2 pricing & purchase subsidies on the uptake potential of ZEVs:
  - towards 2030: advanced up to 4 years
  - beyond 2030: equal to situation without these drivers (close to 100% uptake)



Towards 2030: battery price +31%, diesel price –12%, electricity price +26%, average yearly mileage +25% & current daily distance variation (without 30% reduction)

CONCLUSIONS

Main takeaways from this study:

- Overall uptake potential for the vehicles in this study reaches 99.6% in 2030 in the central scenario (2033 for construction truck).
- Even if battery prices do not come down as fast as expected, diesel prices would be relatively low or electricity prices relatively high, the uptake potential of BEVs is close to 100% by 2030.
- A more demanding deployment scenario for ZEVs will delay the uptake potential in the 2020s, but hardly lower the maximum uptake potential (since TCO of BEVs will often still be lower than for diesel, even with higher range/larger battery)
- FCEVs are not cost-competitive for trucks in scope, but may be in certain other (niche) applications
- The actual uptake of ZEVs can only materialise if important boundary conditions are met (e.g. availability of ZEVs and charging/refuelling infrastructure).


THANK YOU FOR YOUR ATTENTION

ELECTRIC TRUCKS TAKE CHARGE

THE TECHNO-ECONOMIC UPTAKE POTENTIAL OF ELECTRIC TRUCKS AND RECOMMENDATIONS FOR EUROPEAN POLICYMAKERS

URS MAIER, AGORA VERKEHRSWENDE
SENIOR ASSOCIATE ENERGY AND INFRASTRUCTURE

TRANSPORT & ENVIRONMENT'S GREEN TRUCKS SUMMIT IN BRUSSELS ON 12 OCTOBER 2022

TNO, T&E AND AGORA VERKEHRSWENDE ON ZERO-EMISSION TRUCKS AND REACHING CLIMATE NEUTRALITY

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TNO report

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Techno-economic uptake potential of zero-emission trucks in Europe

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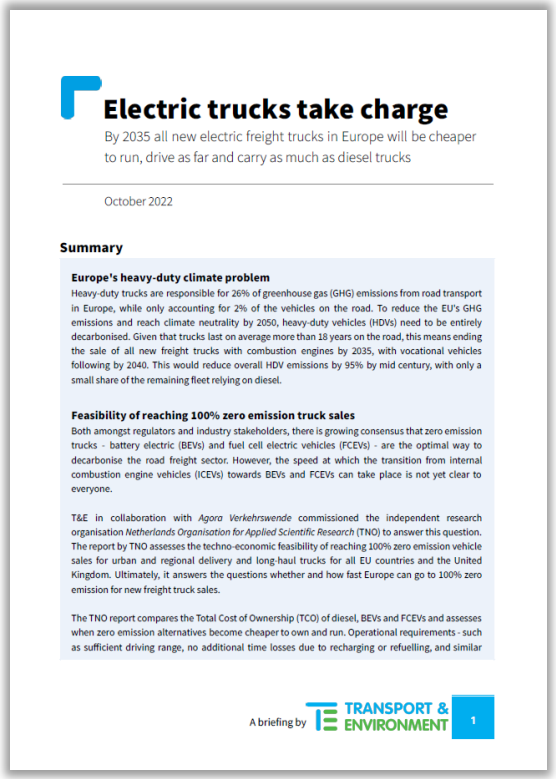

Electric trucks take charge

By 2035 all new electric freight trucks in Europe will be cheaper to run, drive as far and carry as much as diesel trucks

October 2022

Summary

Europe's heavy-duty climate problem

Heavy-duty trucks are responsible for 26% of greenhouse gas (GHG) emissions from road transport in Europe, while only accounting for 2% of the vehicles on the road. To reduce the EU's GHG emissions and reach climate neutrality by 2050, heavy-duty vehicles (HDVs) need to be entirely decarbonised. Given that trucks last on average more than 18 years on the road, this means ending the sale of all new freight trucks with combustion engines by 2035, with vocational vehicles following by 2040. This would reduce overall HDV emissions by 95% by mid century, with only a small share of the remaining fleet relying on diesel.

Feasibility of reaching 100% zero emission truck sales

Both amongst regulators and industry stakeholders, there is growing consensus that zero emission trucks - battery electric (BEVs) and fuel cell electric vehicles (FCEVs) - are the optimal way to decarbonise the road freight sector. However, the speed at which the transition from internal combustion engine vehicles (ICEVs) towards BEVs and FCEVs can take place is not yet clear to everyone.

T&E in collaboration with *Agora Verkehrswende* commissioned the independent research organisation *Netherlands Organisation for Applied Scientific Research* (TNO) to answer this question. The report by TNO assesses the techno-economic feasibility of reaching 100% zero emission vehicle sales for urban and regional delivery and long-haul trucks for all EU countries and the United Kingdom. Ultimately, it answers the questions whether and how fast Europe can go to 100% zero emission for new freight truck sales.

The TNO report compares the Total Cost of Ownership (TCO) of diesel, BEVs and FCEVs and assesses when zero emission alternatives become cheaper to own and run. Operational requirements - such as sufficient driving range, no additional time losses due to recharging or refuelling, and similar

A briefing by TRANSPORT & ENVIRONMENT 1

Agora Verkehrswende

Elektro-Lkw schneller auf die Straße bringen

Bis 2035 werden alle neuen Elektro-Lkw in Europa billiger im Betrieb sein, genauso weit fahren und genauso viel transportieren wie Diesel-Lkw. Schlussfolgerungen von Agora Verkehrswende in Kooperation mit T&E auf Basis einer Studie von TNO

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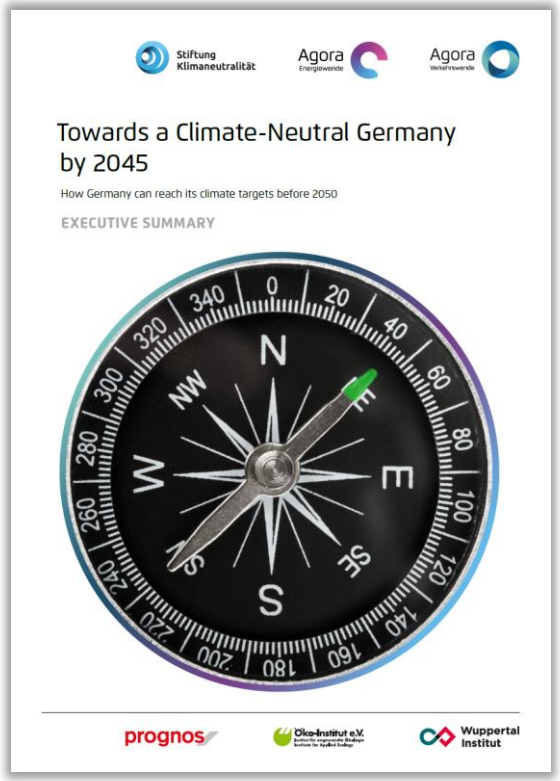

Stiftung Klimaneutralität · Agora Energiewende · Agora Verkehrswende

Towards a Climate-Neutral Germany by 2045

How Germany can reach its climate targets before 2050

EXECUTIVE SUMMARY

prognos · Öko-Institut e.V. · Wuppertal Institut

Agora Verkehrswende

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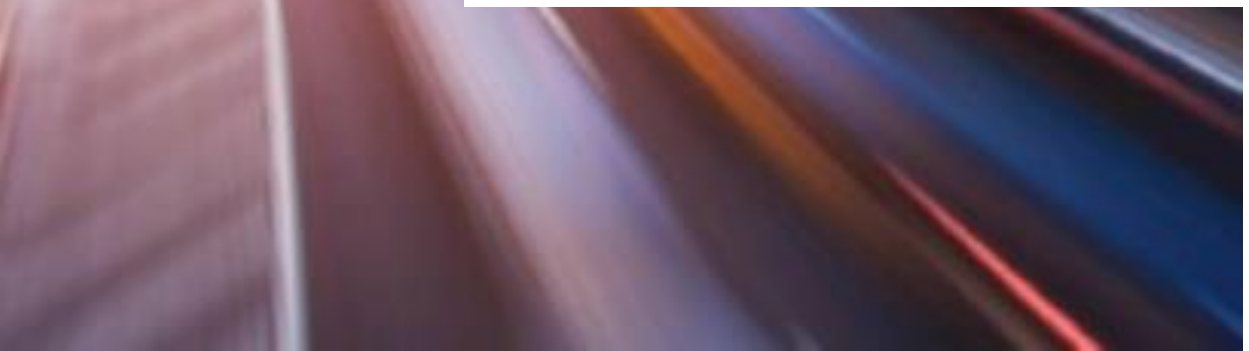
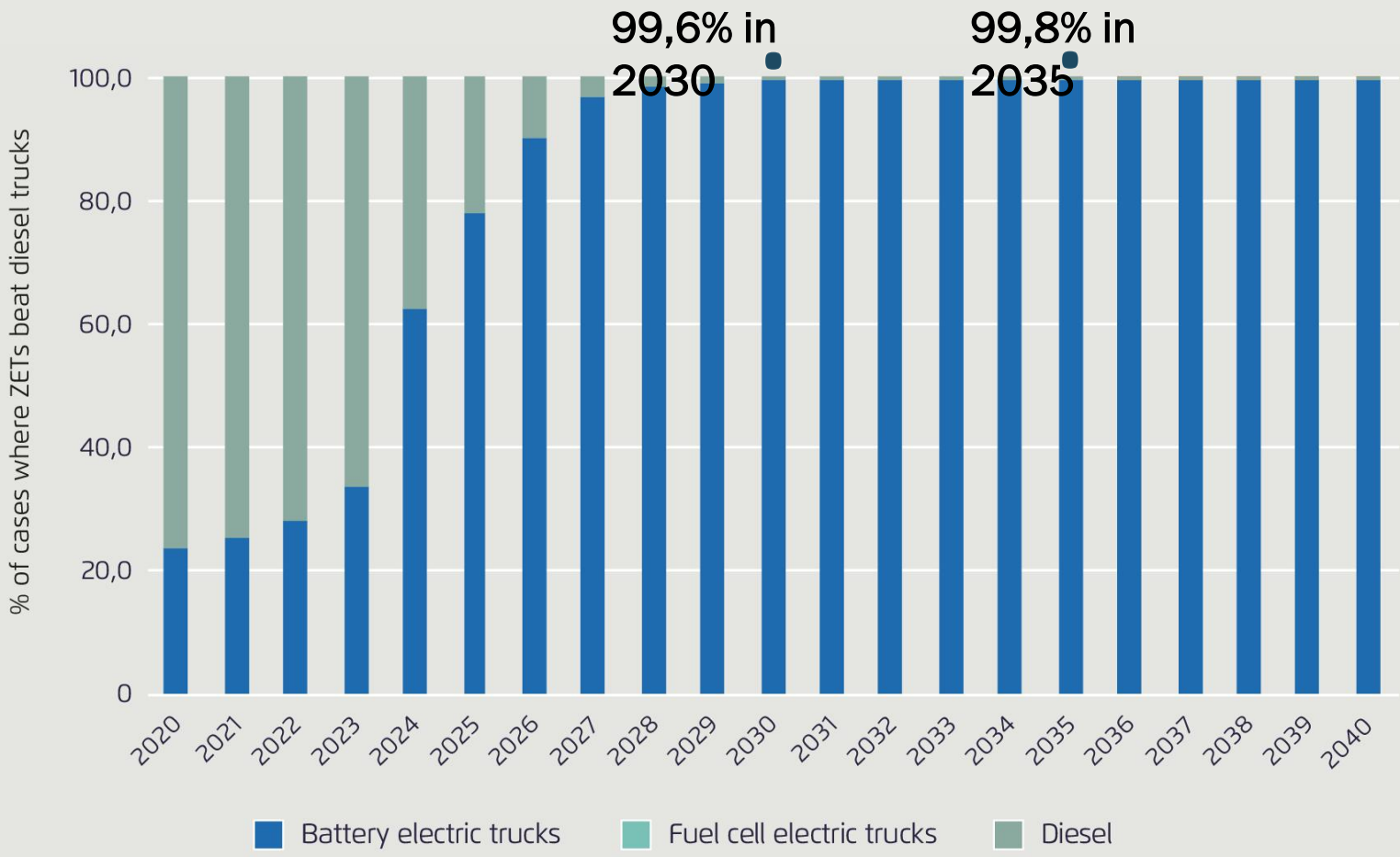
Total cost of ownership (TCO) and operational requirements – i.e. driving range, charging or refuelling time and payload – are no barriers to the rapid up-take of zero-emission trucks.



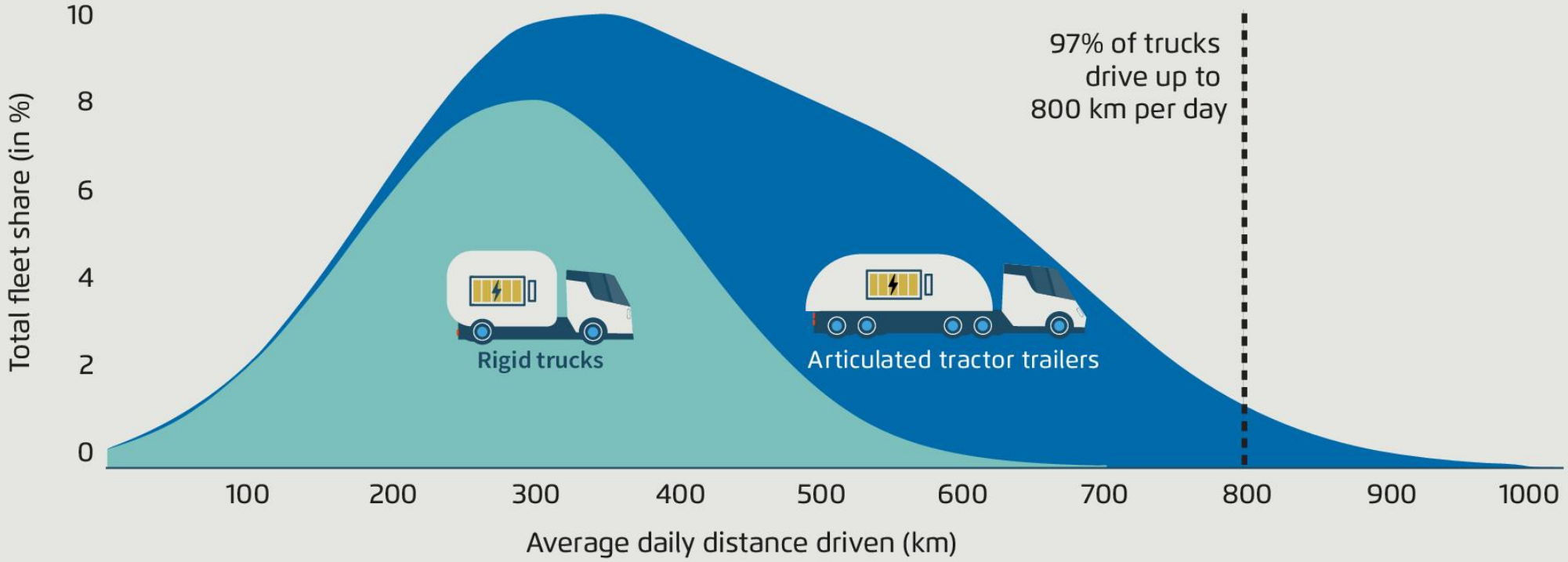
SHARE OF SALES WHERE ZERO EMISSION TRUCKS BEAT DIESEL TRUCKS



Note: Fuell cell electric trucks were included in the analysis and represent up to 0.02% of cases in 2040

Agora Verkehrswende (10/2022) | in cooperation with: T&E; source: TNO

AVERAGE DAILY DISTANCES DRIVEN BY TRUCKS IN EUROPE



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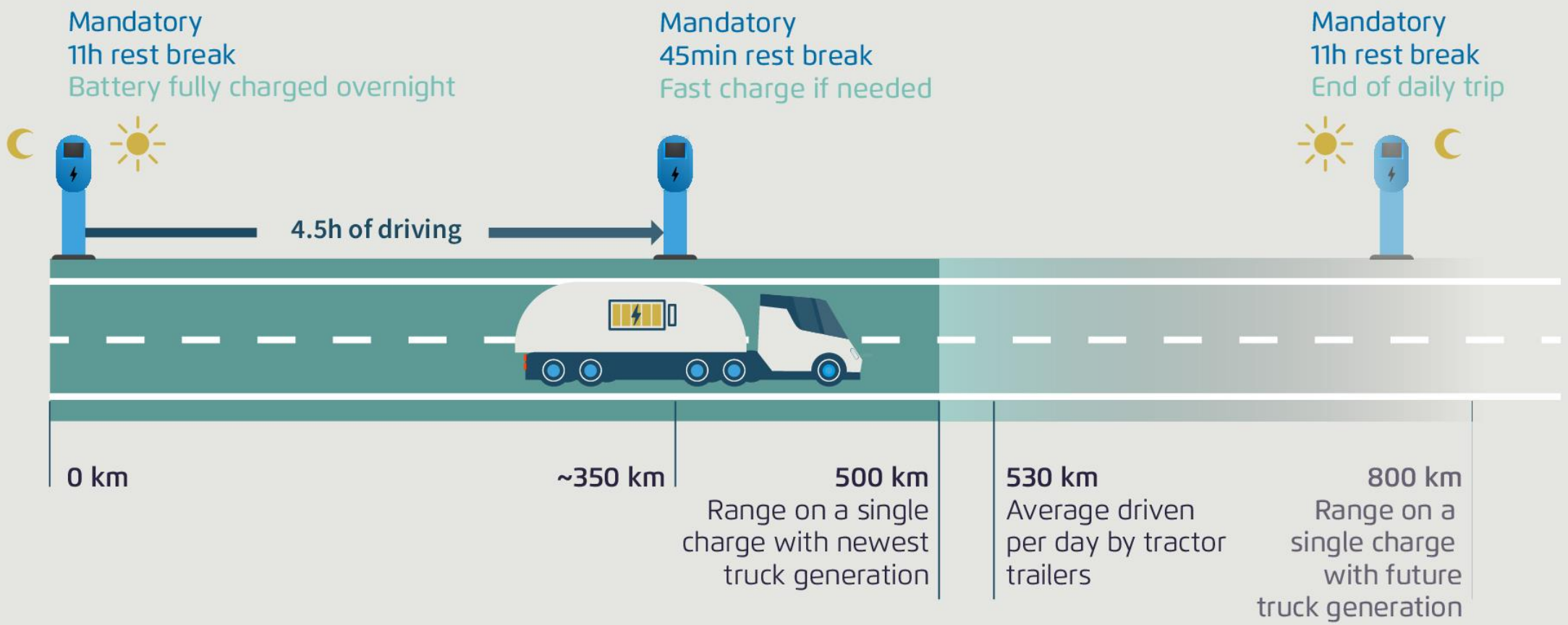
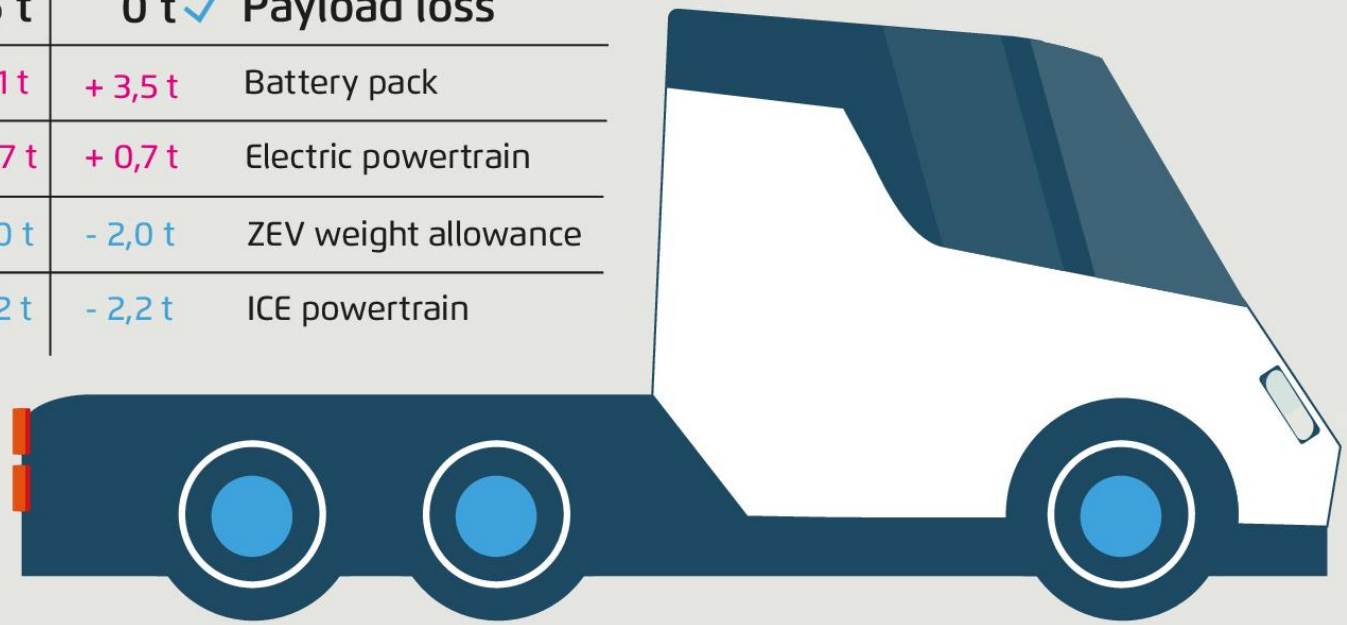
DAILY DRIVING PATTERNS OF ELECTRIC LONG-HAUL TRUCKS



Agora Verkehrswende (10/2022) | in cooperation with: T&E; source: T&E

PAYLOAD LOSSES OF ELECTRIC LONG-HAUL TRUCKS

2025	2030	
+ 1.55 t	0 t ✓	Payload loss
+ 5,1 t	+ 3,5 t	Battery pack
+ 0,7 t	+ 0,7 t	Electric powertrain
- 2,0 t	- 2,0 t	ZEV weight allowance
- 2,2 t	- 2,2 t	ICE powertrain

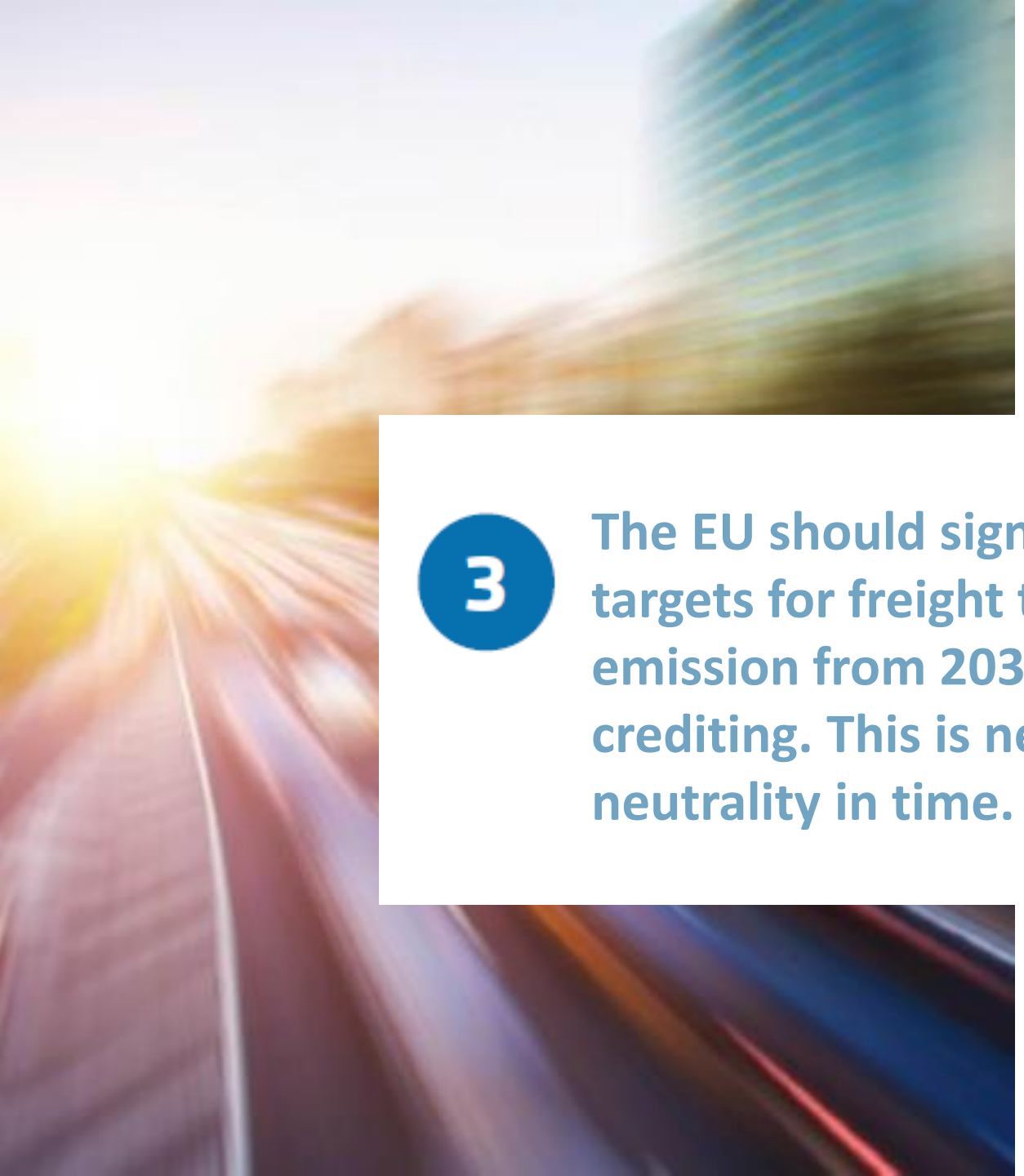


Note: All urban and regional delivery trucks have higher payload capacity than diesel

Agora Verkehrswende

2

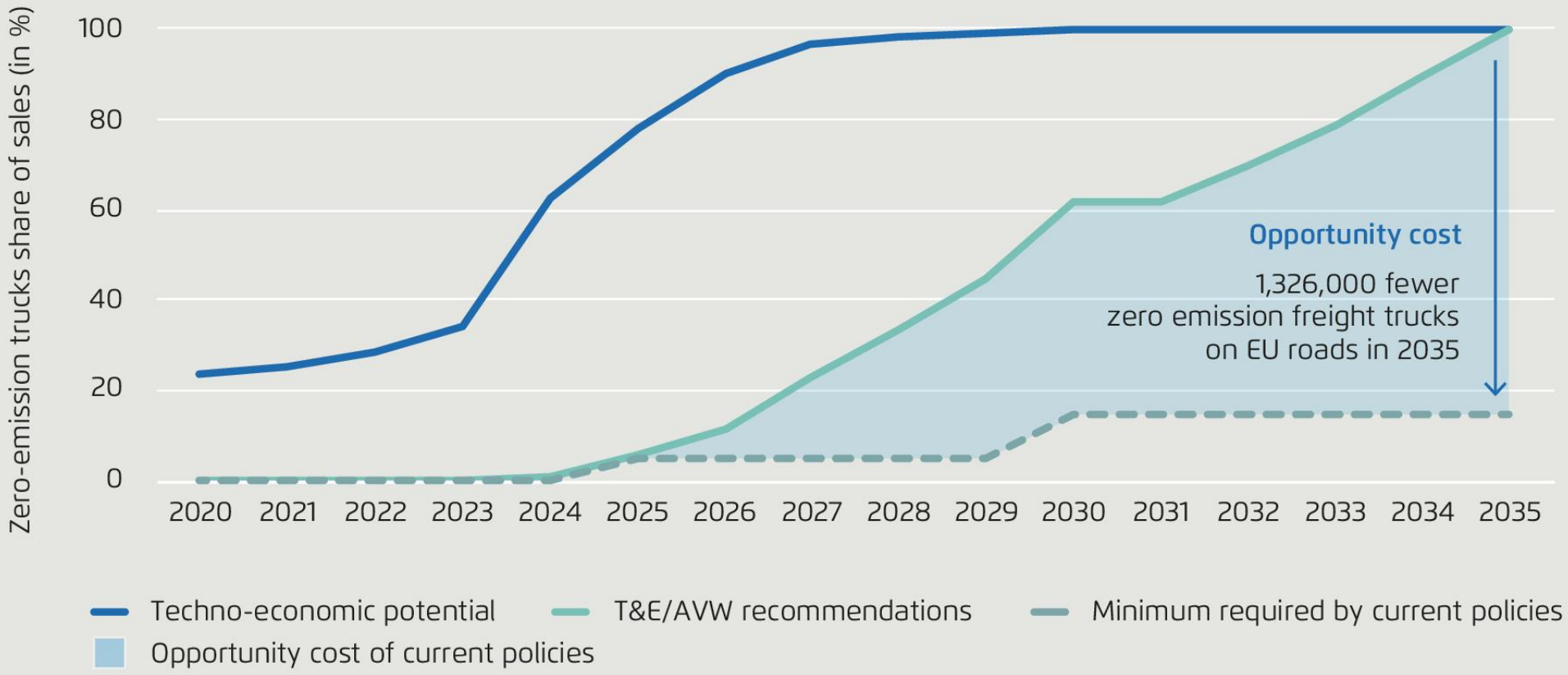
Zero-emission trucks are primarily battery-electric trucks. Fuel cell trucks are suitable for special uses, for example when very long ranges are required.



Agora Verkehrswende

3 **The EU should significantly increase its CO_2 targets for freight trucks to 100% zero-emission from 2035 and say no to fuels crediting. This is needed to reach climate neutrality in time.**

ZEV UPTAKE POTENTIAL COMPARED TO CURRENT POLICIES AND RECOMMENDATIONS BY T&E AND AGORA VERKEHRSWENDE



Note: Assumes ZEV uptake across all freight trucks, including currently regulated and unregulated vehicle groups

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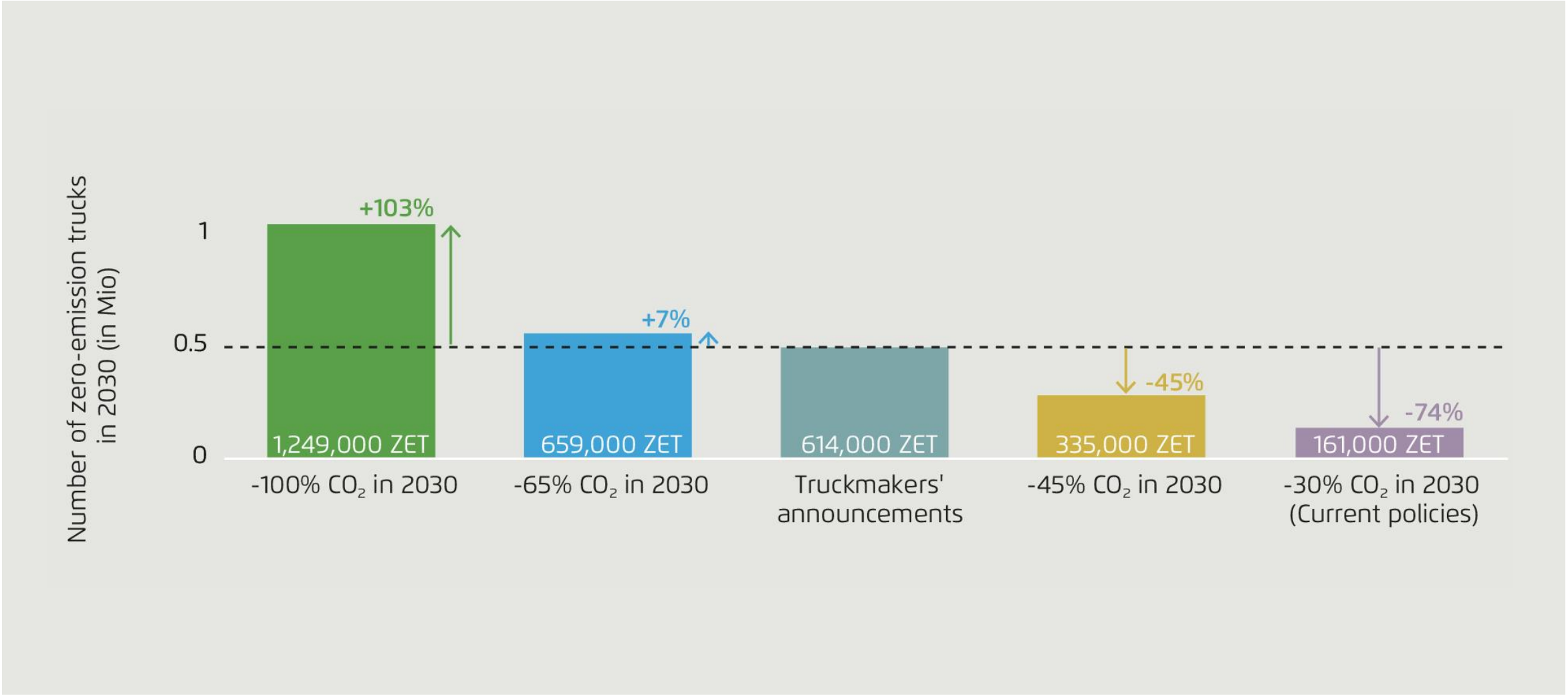
ZERO EMISSION TRUCK FLEET IN 2030 DEPENDING ON THE CO_2 TARGETS



Agora Verkehrswende (10/2022) | in cooperation with: T&E; source: T&E

Agora Verkehrswende

4

Ambitious emission standards are needed for the rapid expansion of the production capacities of zero-emission trucks. The EU and its member states are required to rapidly roll-out charging and refuelling infrastructure.

Agora Verkehrswende

5

Policy instruments on the demand side like purchase incentives, a CO_2 based truck toll and a CO_2 price on fuels speed up the transition particularly before 2030. As planned, Germany should add a CO_2 surcharge on the road toll.

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Agora Verkehrswende ist eine gemeinsame Initiative der Stiftung Mercator und der European Climate Foundation.