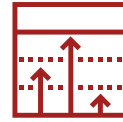

European Fleet Electrification

From Electric Vehicle Sales
to a complete Fleet Transition

December 2023



Until 2030 the EU fleet electrification will create cumulated savings of €330bn in TCO and more than 1bn t in CO₂



Bringing electric vehicles on the road...

By 2040, up to 100% of light- and commercial vehicles sales will be zero-emission vehicles, meeting EU regulations. With the simultaneous fleet transition, nearly 50% of EU's annual mileage will be decarbonized.



...creates tangible sustainable value...

With cumulated €330bn in TCO savings, more than 1 bn t cumulated CO₂ emission reduction until 2030, the electrified fleet has significant economic and environmental value. Furthermore, fleet transition offers a tangible outlook on reduced dependencies on carbonized and fossil energy, by lowering cumulated diesel consumption by 340bn litres until 2030 and replacing it with cumulated 540 TWh locally produced electricity.



...yet, potential headwinds might arise

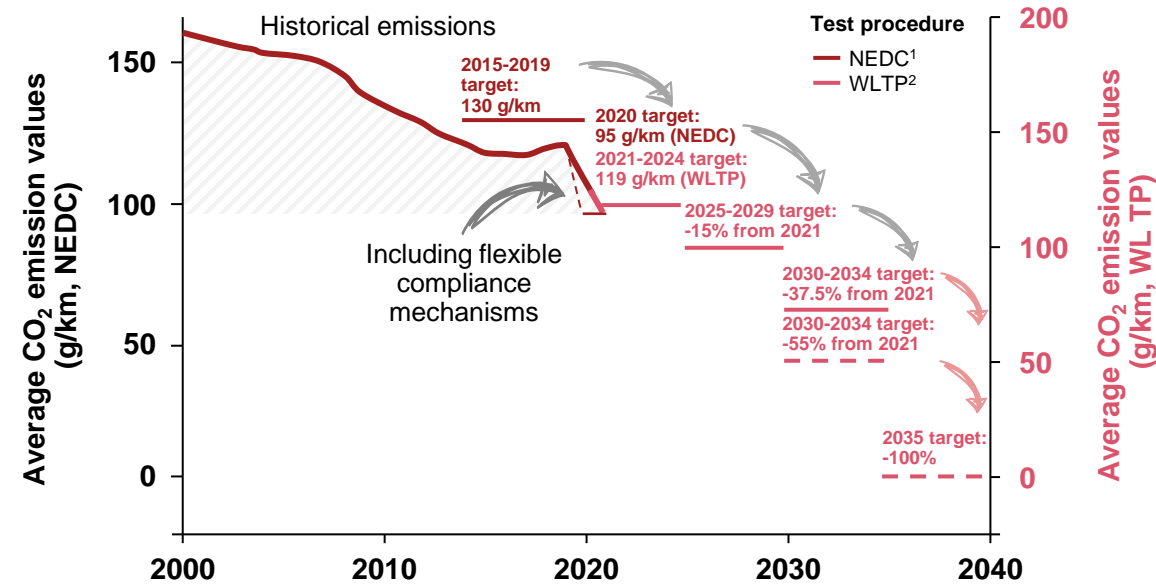
Even with headwinds ahead, the fleet electrification remains a substantial value driver for the EU mobility and transportation sector.

European legislation sets stringent sales based targets facilitating market uptake of zero-emission vehicles



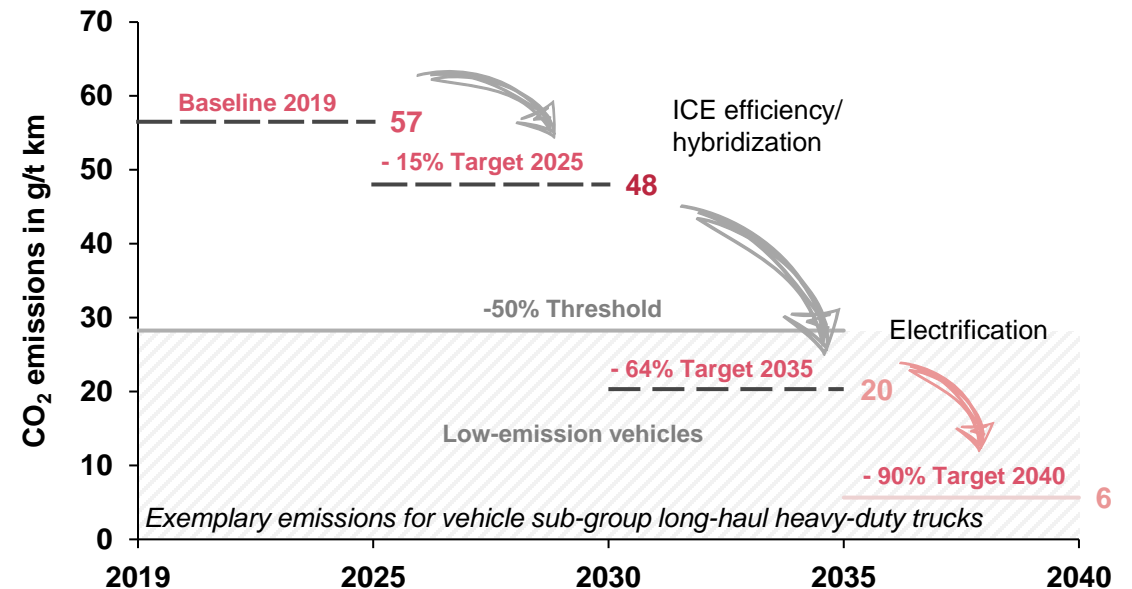
Sales based CO₂ targets for road based vehicles

Light vehicles



- 2025: Reduction of tail-pipe emissions by 15% compared to 2020 (95 g CO₂/km for cars and 147 g CO₂/km vans)
- 2030: cars 55% and vans 50% reduction
- 2035: 100% reduction = 100% zero-emission vehicle (ZEV) sales

Trucks



- Tail-pipe CO₂ reduction targets for fleet wide average in truck sales in EU: -43% by 2030, -64% by 2035 and -90% by 2040 compared to reference period mid 2019 to mid 2020
- This implies high ZEV sales as further efficiency improvements in diesel trucks are limited

Further European and national policies support ZEV uptake – Effort Sharing Regulation pushes national governments

European Effort Sharing Regulation



EU Effort Sharing Regulation

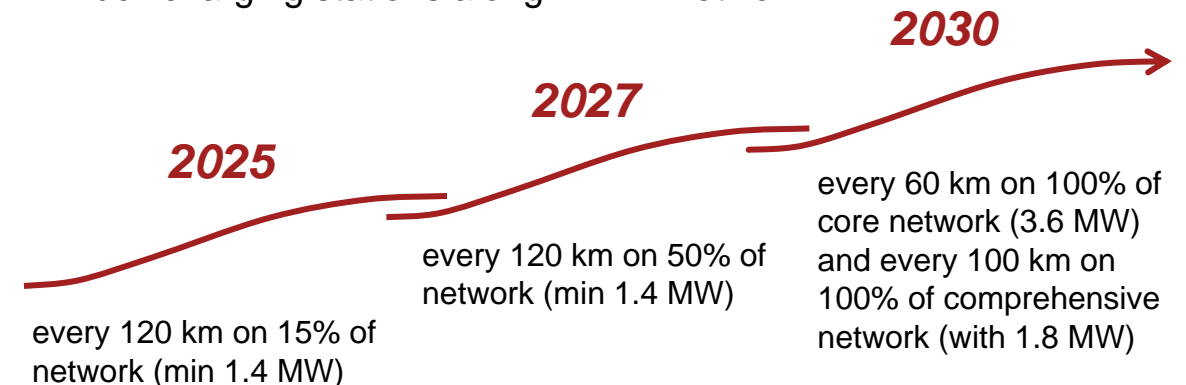


- *Effort sharing regulation (ESR)* sets **nationally binding emission reduction targets** for all EU member states
- Within the fit-for-55 package, the effort sharing regulation has been revised and now entails an **EU wide target of -40% GHG emissions from transport and buildings by 2030** compared to 2005
- This implies for all commercial vehicles (including <12 t) an **approx. 30% reduction** compared to 2005 (and roughly 30% reduction compared to 2019) **in stock**
- **Targets apply to individual member states** and **cover all of transport** and buildings with stricter reduction targets for high GDP per capita member states and lower targets for low GDP per capita member states
- However, **member states have to buy emission certificates if they miss the target** and thus will take action to meet targets

EU Infrastructure Roll-Out



- **EU also requires and supports infrastructure roll out** for zero-emission cars and trucks
- **Alternative Fuels Infrastructure Regulation (AFIR):** Truck charging stations along TEN-T network

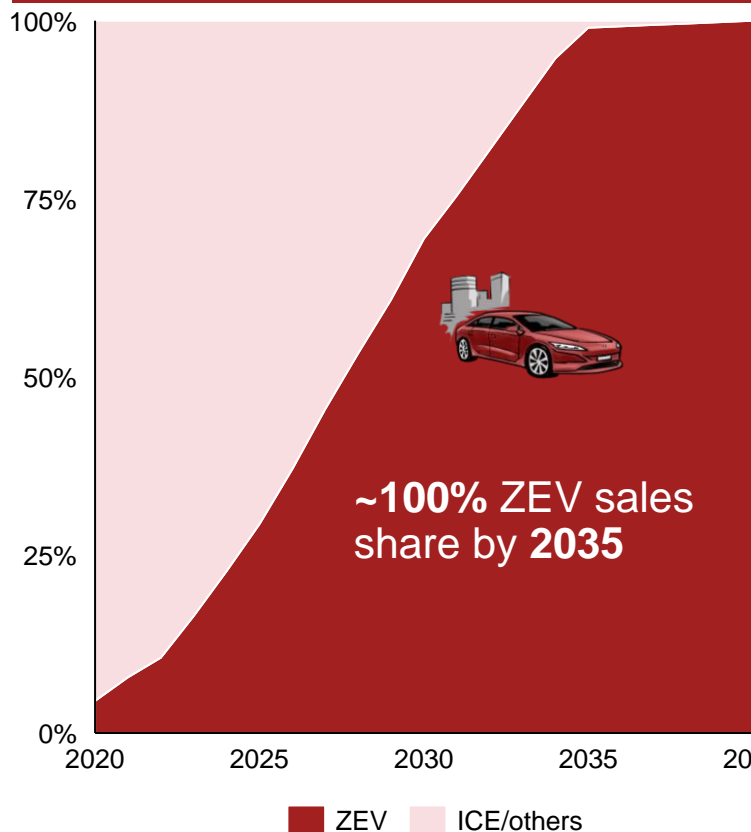


- **Alternative Fuels Infrastructure Funding (AFIF):** €189m in EU funding for projects supporting greener mobility

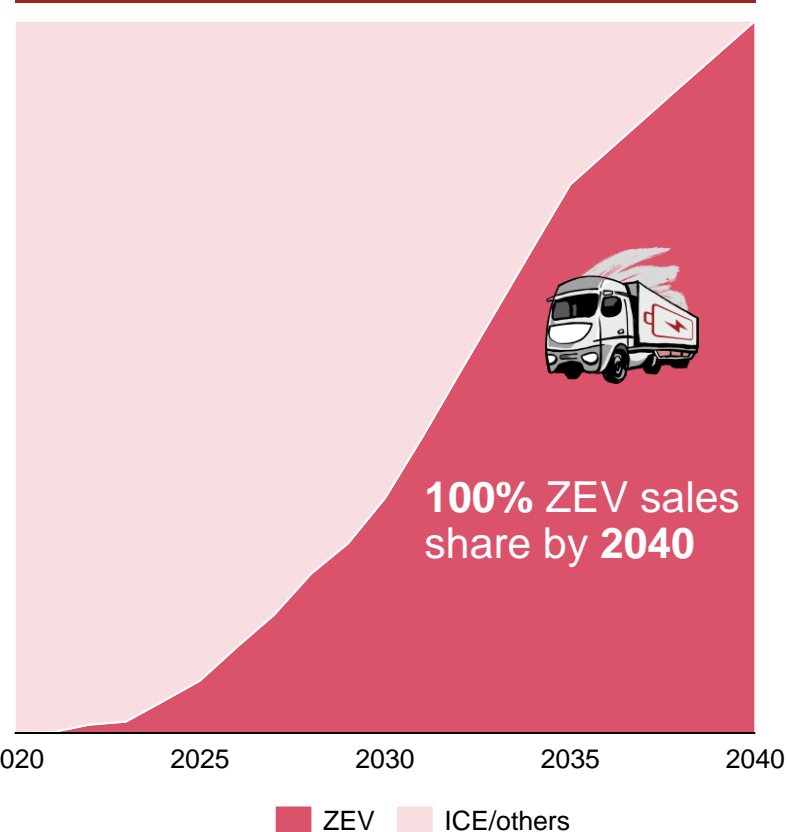
For 2040, we expect 100% of new light vehicles and trucks to be a ZEV, with light vehicles leading the way

Diffusion of zero-emission vehicle sales (from 2020 to 2040)

Light vehicles¹ sales (% of new sales)



Truck² sales in Europe (% of new sales)



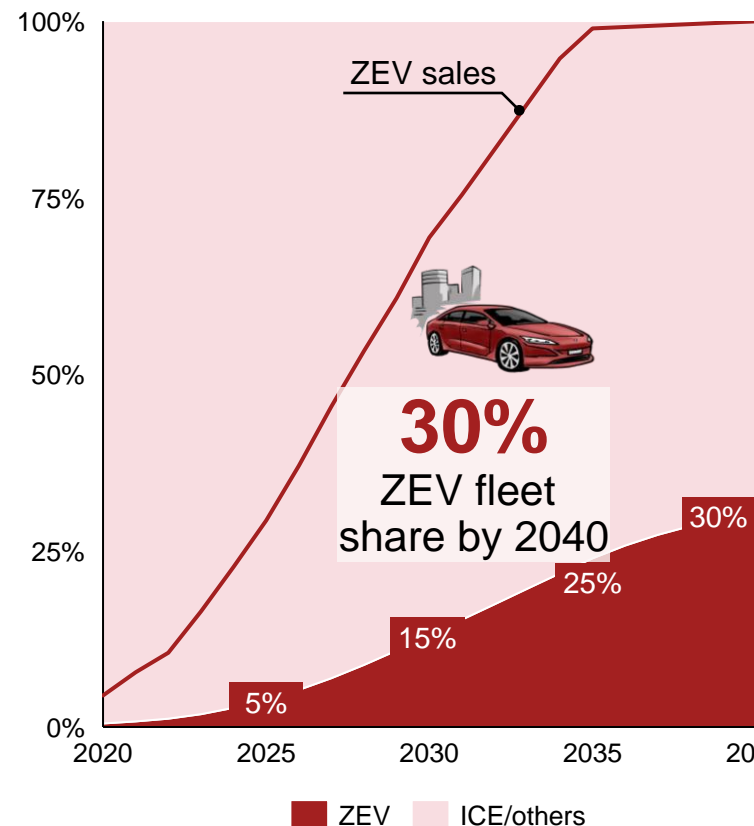
Comments

- For both light vehicle and truck sales, battery electric and fuel cells vehicles are **categorized as zero-emission vehicles (ZEV)**
- Truck sales **exhibit a later start**, but the transition to zero-emission vehicles will be **noticeably faster** than for light vehicles, while both are **expected to reach 100% ZEV share by 2040**
- Light vehicles are on track to **achieve >99% ZEV share by 2035**, aligning with **EU regulatory requirements**
- While **fuel cell vehicles** exhibit only a **marginal presence among light vehicles**, their market share is **potentially higher in the truck segment**

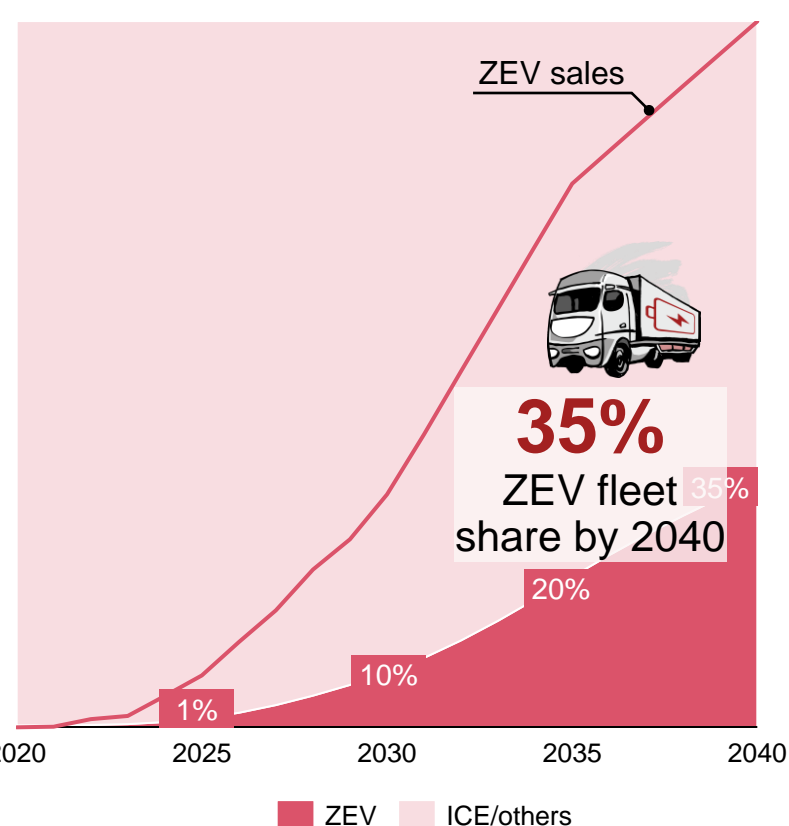
By 2040 more than 30% of vehicles on the road in Europe will be powered by decarbonized powertrains – still ~70% are ICEs

Fleet transition (from 2020 to 2040)

Light vehicle fleet transition (% of fleet)



Truck fleet transition (% of fleet)



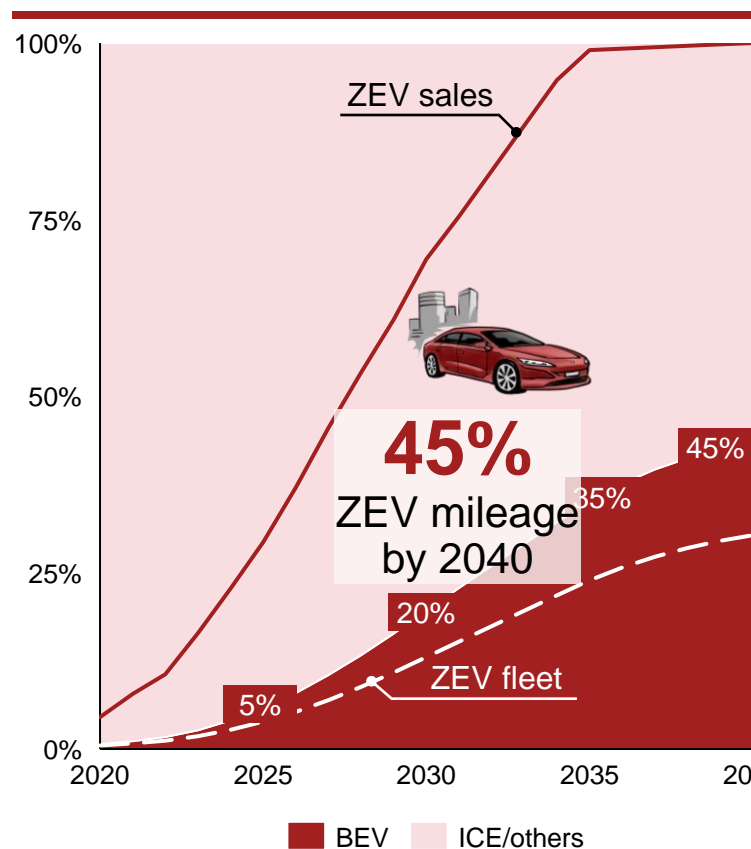
Comments

- **By 2030**, we expect ~15% of the total European vehicle fleet to be **zero-emission light vehicles and trucks**
- **By 2040**, electrified vehicles will comprise **more than 30% of the vehicle fleet** for both light vehicles and trucks
- Hence, the **majority of vehicles** on European roads will **still be ICEs** even in 2040
- **Transition towards ZEV is faster for trucks**, due to shorter average lifetime compared to light vehicles

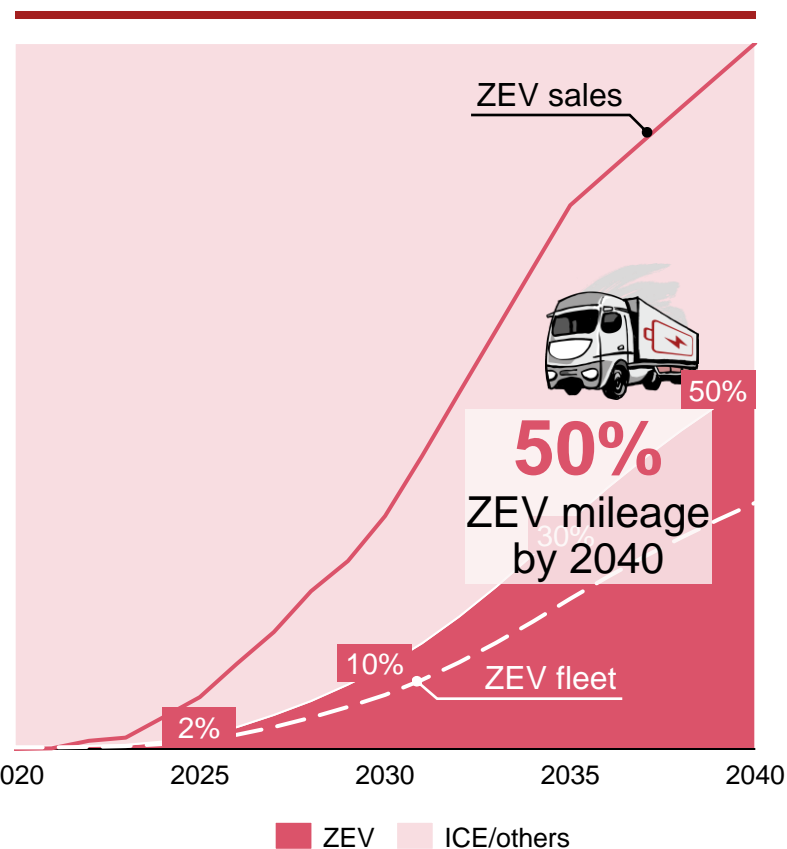
Translating vehicle ownership to actual usage, decarbonized mobility will account for ~45..50% of annual mileage by 2040

Annual fleet mileage (from 2020 to 2040)

Light vehicle mileage (% of total mileage)



Truck mileage (% of total mileage)



Comments

- **By 2030**, we expect between **10...20%** of all **European vehicle-kilometres** to be driven with **zero-emission** powertrains
- **By 2040**, nearly **half of the European vehicle-kilometres** are driven with zero-emission powertrains
- **Note:** *Due to the higher share of ZEVs among new vehicles, the kilometres driven in the fleet shift in favour of ZEVs as we assume that annual mileage is higher in the first few years and levels off as vehicles get older*

The fleet composition significantly impacts the macro factors total cost of ownership, CO₂ emissions and energy demand

Areas affected by fleet composition

Total cost of ownership



How much can be saved by electrification?

CO₂ emissions



How does eMobility contribute to CO₂ targets?

Energy demand

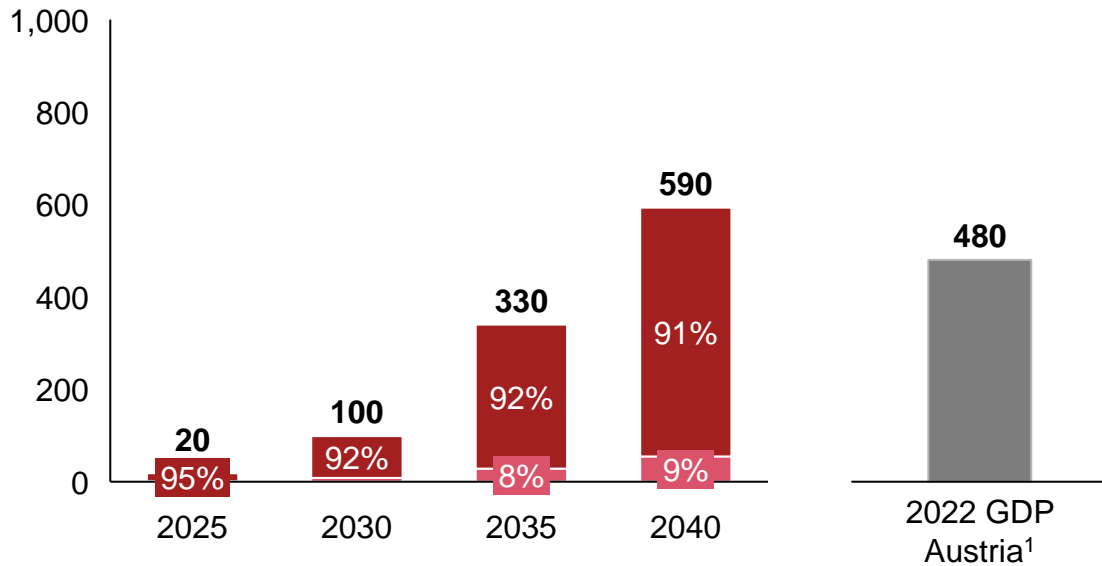


How does eMobility affect energy demand?

Transitioning the EU light vehicle and truck fleet will create substantial economic value by saving ~€330bn until 2030

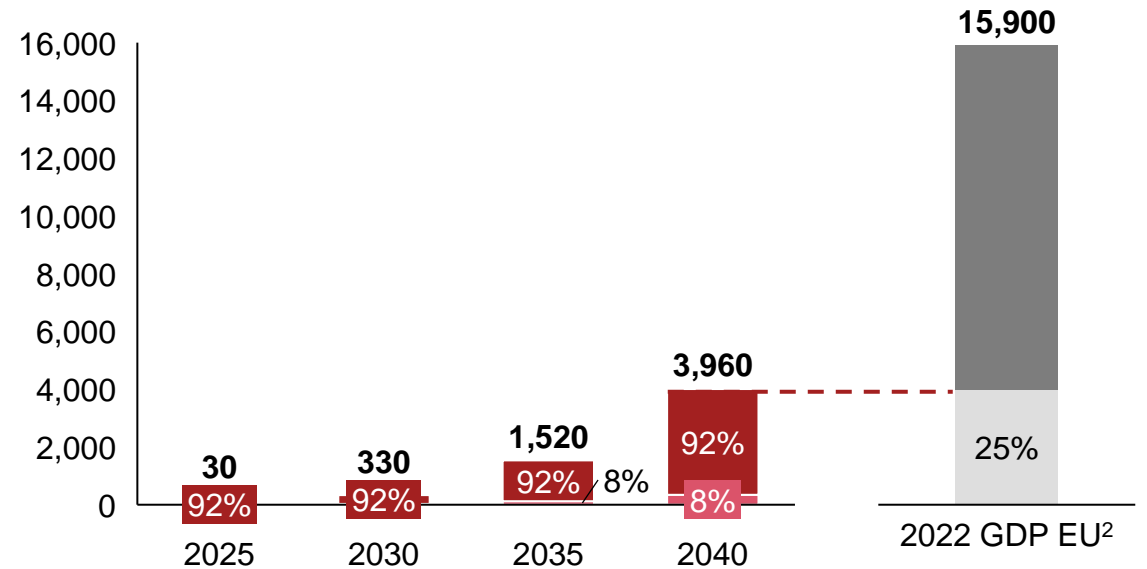
Fleet electrification – TCO Impact (from 2020 to 2040)

Annual TCO advantage (in € bn)



Annual operational cost savings amount to more than **€590bn** per annum – +20% more than GDP of Austria in 2023

Cumulated TCO advantage (in € bn)

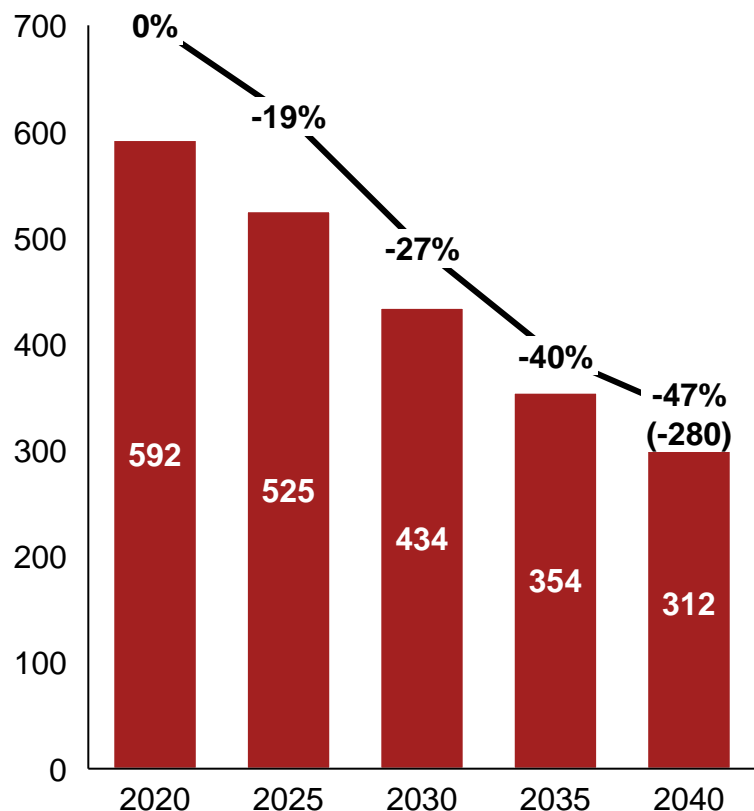


Cumulated savings amount to nearly **€4tn** until 2040 – ~25% of GDP of EU in 2022

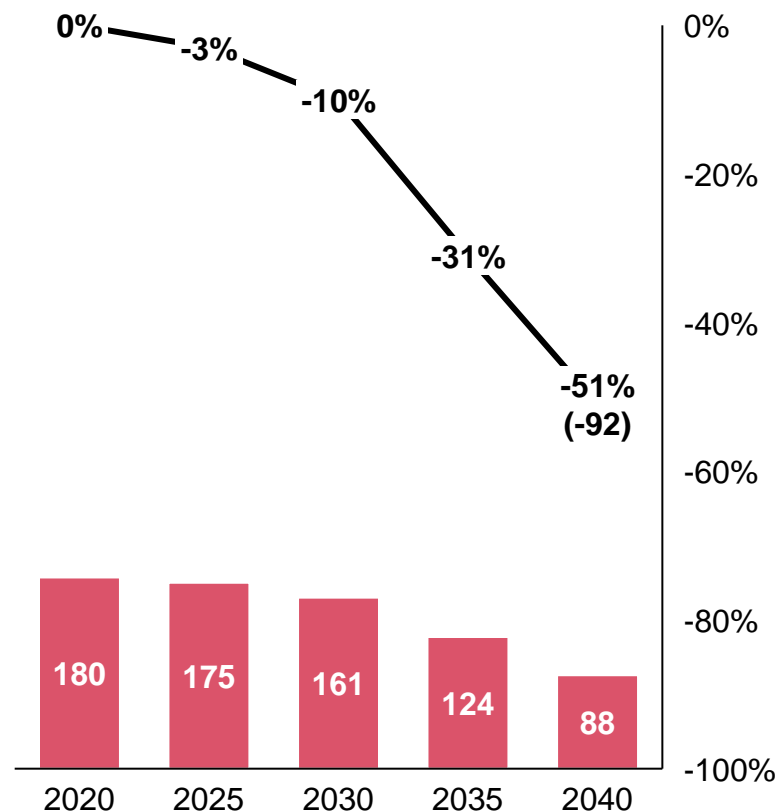
Subsequently, about 370 million tons CO₂ annually in 2040 – 3.8bn tons until 2040 – are saved in EU vehicle fleet

Light vehicle and trucks CO₂ emissions (from 2020 to 2040)

Light vehicle CO₂ emissions^{1,3} (in Mt CO₂/a)



Truck CO₂ emissions^{2,3} (in Mt CO₂/a)



■ Light vehicles ■ Trucks

Comments



Light vehicles

- Current emission of light vehicles of ~600 Mt CO₂/a (2020) are expected to **reduce by 27% until 2030 and 47% by 2040**
- Absolute reduction of emissions until 2040 of **~280 Mt CO₂/a** expected
- Reduction of fuel consumption to **130bn litres/year in 2040** (vs. 246bn litres 2020)



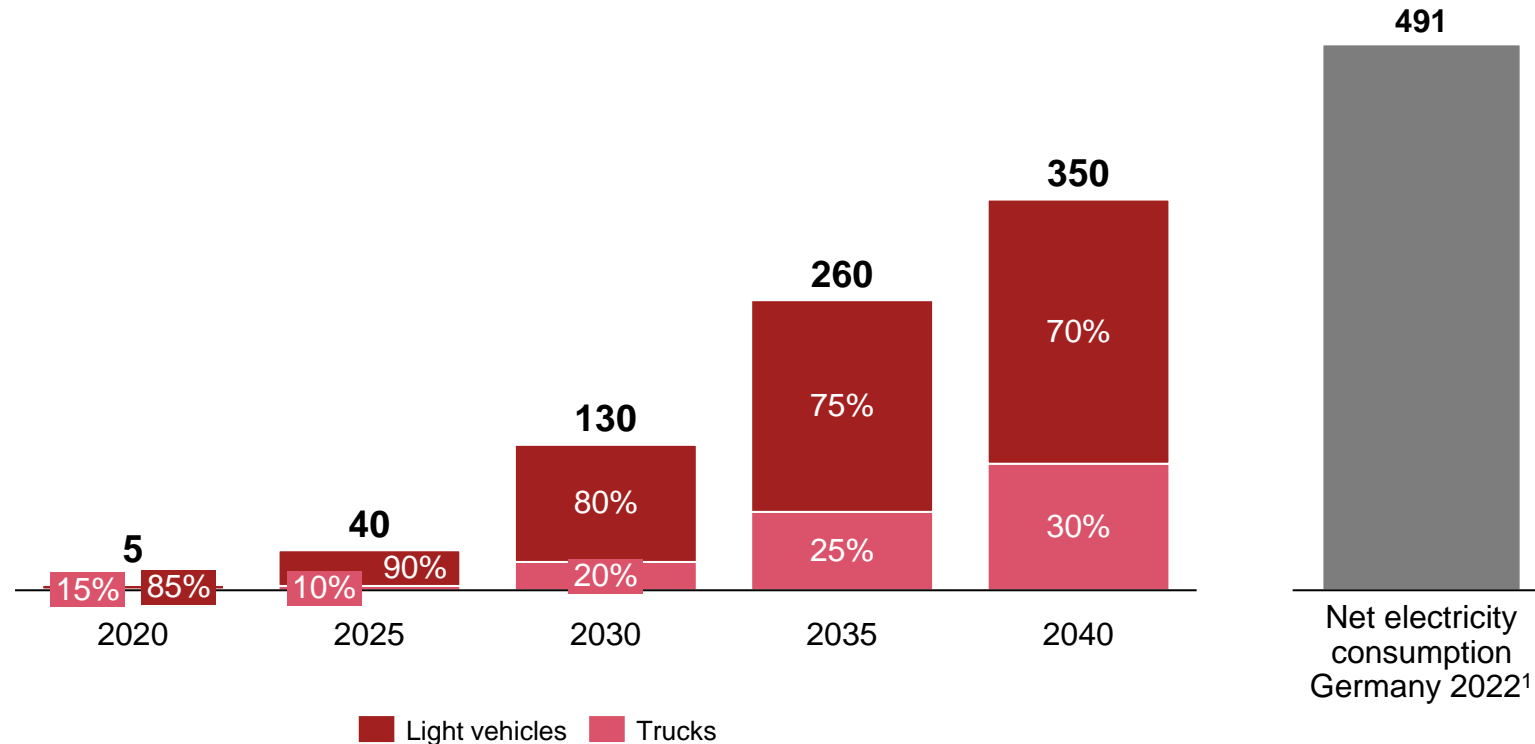
Trucks

- Current emission of trucks of ~180 Mt CO₂/a (2020) are expected to **reduce by 10% until 2030 and 51% by 2040**
- Absolute reduction of emissions until 2040 of **~92 Mt CO₂/a** expected
- Reduction of diesel consumption to **33bn litres/year in 2040** (vs. 68bn litres 2020)

2030 fleet electrification implies ~130 TWh electricity demand – ~25% of Germany’s electricity consumption today¹

Electricity demand (from 2020 to 2040)

Electricity demand of light vehicles² and trucks³ (in TWh)



Comments



Light vehicles

- Current electricity demand of light vehicles of 15 TWh (2023) is expected to **increase by factor 7 until 2030 and factor 15 until 2040**
- Overall demand for electricity from light vehicles at **~240 TWh in 2040 (about 9% of today’s European electricity production)**



Trucks

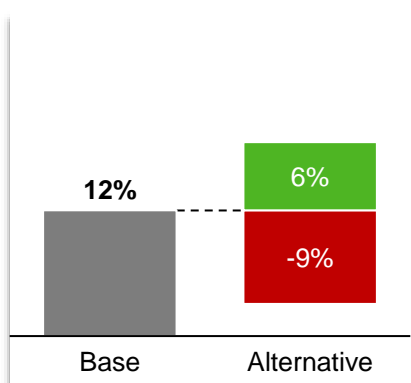
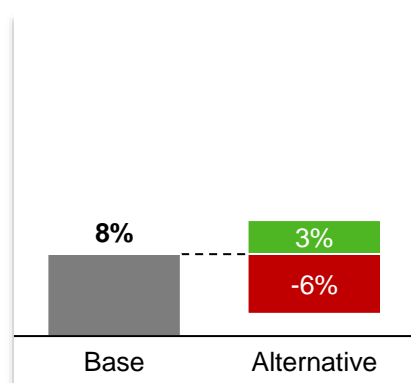
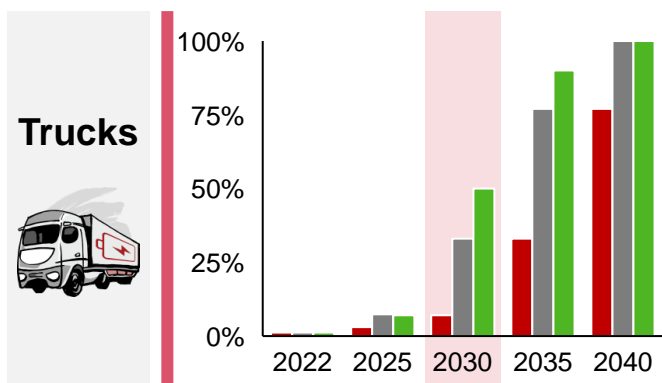
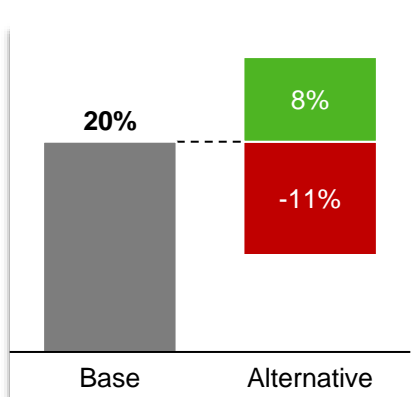
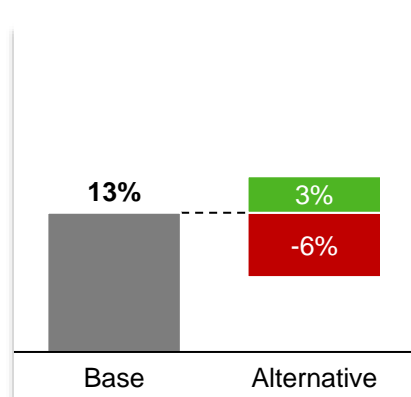
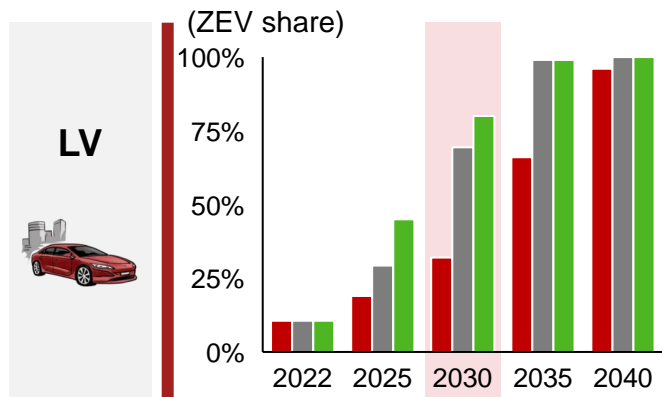
- Current electricity demand of Trucks of 1 TWh (2023) expected to **increase by factor 20 until 2030 and factor 100 until 2040**
- Overall demand for electricity from Trucks at **~115 TWh in 2040 (about 4% of today’s European electricity production)**

Changes in ZEV sales as the leading variable exert a direct impact on the fleet transition and on decarbonized mileage

Scenario summary

Sales diffusion (% of sales)

Fleet transition¹ (2030) Mileage (2030)



■ Delayed ■ Base ■ Accelerated

1) ZEV share

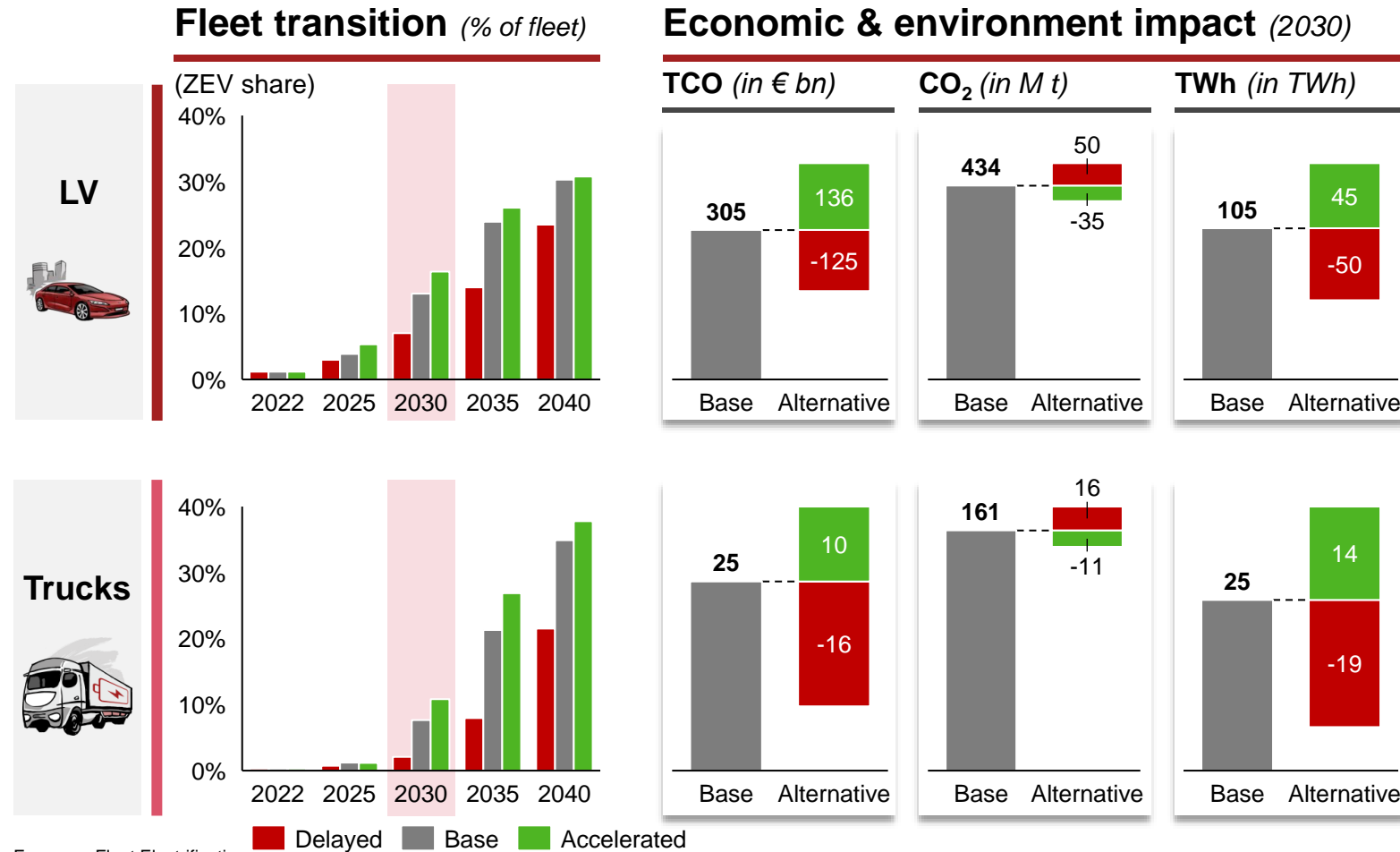
Source: Strategy& analysis

Comments

- ZEV sales diffusion is the **primary factor influencing subsequent metrics**, such as fleet transition and mileage
- Hence, **potential delay** of sales figure by **~5 years** or **acceleration** by **~2 years** would have a substantial impact on electrification
- Mileage, in particular, is **significantly influenced** by higher average mileage of new vehicles
- The described effects are **applicable to light vehicles and trucks** in a similar manner

This has a significant influence on the development of the macro factors Total-Cost-of-Ownership, CO₂ & energy demand

Scenario summary



Comments

- Both economic and ecological metrics undergo **substantial impact with any alteration in fleet transition** triggered by changes in sales
- Even a **mere acceleration** of sales by ~2 years can have a **significant impact on cumulated TCO** due to integral effect
- At first glance, **lower electricity demand** seems desirable, but it is merely the **result of a higher share of ICE vehicles**
- Since truck sales do not surge as early as those of light vehicles, **the economic and ecological effects of acceleration are not that pronounced** in the truck segment compared to light vehicles

To reach a decarbonized European fleet, stakeholder across all sectors should take actions

Cross-sector impact



Automotive

- ... increase average ZEV range
- ... build up aftermarket capabilities
- ... acquire new competencies



Energy and infrastructure

- ... build required infrastructure
- ... extend renewable energy supply
- ... balance and manage grid



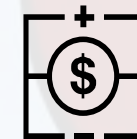
Fleet providers

- ... manage changed fleet
- ... rethink mobility concepts
- ... new investment needs



Public sector

- ... set regulatory environment for transition
- ... incentivize ZEV mileage
- ... foster new competencies



Financing and capital markets

- ... secure financial backing
- ... rethink mobility financing
- ... facilitate new collaborations

We would like to exchange our ideas with you!

strategy&
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