Why the future of long-haul trucking is battery electric

And how the EU truck CO_2 standards can make or break the transition

Battery-powered trucks can already halve emissions today and fully decarbonise in the long term

Just like passenger cars and vans, trucks as well need to urgently shift to zero emission vehicles. Greenhouse gas (GHG) emissions from trucks were at 23% share of EU road transport emissions in 2019 whilst making up only 2% of the vehicles on the road. Transitioning to zero emission road freight, alongside shifting to electrified rail, is the best viable option to fully decarbonize the sector when compared to combustion-powered trucks running on gas or diesel and including those running on biofuels or synthetic fuels.

The lifecycle GHG emissions of battery electric trucks (BETs) are 50% lower already today than their diesel counterparts and will continue to decrease according to the lifecycle assessment commissioned by the European Commission. This climate benefit can be explained by the fact that trucks are running very long distances over their lifetime (1.5 million km) and as a result each diesel truck that is replaced by a BET prevents a large amount of GHG emissions for every additional km driven.

The Commissions' lifecycle assessment also shows that trucks running on liquefied fossil gas (LNG) do not reduce GHG emissions compared to diesel. And when looking at a 20-year global warming potential, LNG trucks can even increase GHGs due to higher methane emissions.

The deployment of zero emission trucks (ZETs) therefore needs to ramp up drastically in the next decade and replace the sales of most combustion engine trucks by 2035 in order to reach a zero emission road freight sector by 2050 (see 'ambitious truck CO2 standards' below).

Electric long-haul trucks are coming

There is increasing consensus among European truck manufacturers and industry stakeholders that BETs will play a dominant role in the decarbonisation of the road freight sector, including for long-haul.

Truck makers have announced that 4 - 9 % of their truck sales will be zero emission by 2025, rising to 41 - 47 % by 2030 according to T&E calculations (individual announcements range from 35% to 60% ZEVs in 2030). The main OEMs, including Daimler, MAN, Scania and Volvo, are now focussing on bringing battery-powered trucks to the mass market for all vehicle segments.

Over 60 BET models have been announced for 2023. The first electric long-haul trucks

with ranges of 500 km are expected to hit the market in 2024 as announced by MAN, Scania, and Daimler. For example, Daimler is readying its eActros LongHaul truck with a 500 km range for series production in 2024. MAN is also planning with 500 km ranges from 2024. Scania intends to enter the long-haul market by the same year with vehicles capable of running four and a half hours.

Truck drivers in the EU are allowed to drive 4.5 hours between their mandatory breaks of 45 minutes. With an average speed of 80 km/h, that means that a truck driver can drive a maximum distance of 360 km before the next break to recharge, thus effectively unlocking long distance trips.

Battery-driven trucks also outperform other technologies such as gas-powered trucks or even those driven on e-diesel, over long distances. And hence, so-called renewable and alternative fuels used in combustion engines are not a solution to decarbonise the sector as advanced liquid or gaseous biofuels will only be available in very limited quantities and will not reduce air quality problems of truck operations, while e-fuels will be too costly and uncompetitive for road freight.

Cost parity with diesel trucks will be reached by the mid 2020s

Purchase choices in the logistics sector are governed by very thin profit margins. The attractiveness of BETs is therefore mainly due to economics: purchasing the truck is only one part of the total cost of ownership (TCO) equation, the other parts being the costs to fuel and maintain it. Energy efficiency differences mean that direct electrification based on batteries requires half as much energy than fuel cell trucks powered by renewable hydrogen (another zero emission alternative) and just a third compared to combustion trucks. BETs also require less maintenance than any other technology. With trucks being heavily used capital goods, the advantage of BETs in terms of lower fuel and maintenance costs grows with increasing mileage, making them particularly competitive for long-haul transport.

Adding on, battery costs are rapidly falling due to the accelerating economies of scale in the passenger car segment, an effect which will spill over to trucks as well.

Recent studies by T&E, the ICCT and TRATON expect TCO cost parity of BETs before or by the mid 2020s depending on the policy incentives.

One of these is the new Eurovignette Directive, which will require countries to vary truck tolls based on their environmental performance. From 2023, ZETs will get at least 50% of road tolls or avoid CO_2 charges that will be levied on combustion trucks. This will have a significant impact on TCO parity given that annual tolling costs of a diesel truck can reach up to €25,000, or one quarter of the TCO.

Another example is the credit mechanism under the Renewable Energy Directive (RED) which can help charging point operators to recover part of the infrastructure costs by selling credits to fuel suppliers. Such a system exists already

in Germany and the Netherlands, similar to the Low Carbon Fuel Standard in the US. Meanwhile, hydrogen fuel cell trucks are expected to enter series production only by the late 2020s according to Daimler and Volvo, reaching TCO parity years later than for BETs. That is not to say that for specific niche applications hydrogen trucks will not be part of the solution. Examples could be off-road or heavy construction vehicles, heavy-load and special freight movements, drayage operations around ports or trucks with highly irregular or unpredictable operations.

In light of the vital objective to decarbonize the road freight sector by 2050, battery electric trucks are not only market-ready and most efficient, but are also bound to be the cheapest solution.

Infrastructure will be available and sufficient for all ranges

80% of truck activity in Europe consists of trips below 800 km. Given a dense network of charging infrastructure in the near future, electric trucks will be able to recharge during the drivers' mandatory rest periods without delaying any journey (45 minutes every 4.5 hours).

With the Alternative Fuels Infrastructure Regulation (AFIR), the European Commission has proposed mandatory targets to roll out a first network of truck charging stations across Europe already by 2025 (every 60 km along the main highways). Although the Commission is underestimating the expected market deployment of BETs, the proposal is a good starting point and would ensure a basic coverage of truck charging points just in time when the first long-haul BETs will hit the market. Hence, with the right AFIR framework electric truck drivers can charge and operate their long-haul trucks seamlessly no matter the trip length.

Connecting high-power truck chargers to the electricity grid is technically and economically feasible and would not pose any fundamental challenges. CharIN, the industry's standardisation initiative, is currently developing the MCS standard, which can deliver sufficient power levels to charge long-haul trucks between their daily breaks.

Electric long-haul trucks will not lose payload

It is often claimed that BETs would suffer from reduced payload capacity due to the weight of the onboard battery. However, with continuing improvements in battery energy density and by replacing the internal combustion engine with a much lighter electric drivetrain, the additional weight can be reduced significantly.

When also taking into account the two-tonne additional weight allowance for ZETs under the EU Weights & Dimensions Directive, electric long-haul trucks will not lose more than half a tonne of payload by the middle of the decade. Ultimately, battery improvements will compensate for any negative battery weight impact on the truck load capacity.

Ambitious truck CO_2 standards are needed to accelerate the supply of ZETs

Truck makers are currently only producing a small number of ZETs. The review of the CO_2 standards for trucks planned for the

end of 2022 is the crucial opportunity to increase the supply of ZETs across the EU and bring their costs down as a result. Ambitious CO_2 standards can create the necessary market certainty to enable truck makers to scale up their ZET production and for logistics companies to transition their fleets to zero emission.

In order to meet the EU's 2030 climate targets, increasing the 2030 truck CO_2 target alone is not enough as fleet turnover takes many years. So an additional milestone before 2030 is needed to advance CO_2 reductions. For this, the 30% CO_2 target should be be moved forward to 2027 as an intermediate target and the 2030 target needs to be increased to at least 65% - in line with market feasibility[1]. By 2035, a 100% target should apply to most new truck sales, including long-haul ones but excluding some niche applications like construction vehicles. This is necessary to reach 100% zero emissions in 2050 given that on average most trucks last more than 15 years on the road. In addition, currently unregulated vehicle types including smaller and medium lorries, vocational vehicles such as construction trucks, trailers and also buses and coaches should all be included in the regulation.

Financing the shift to zero emission trucks

Encouraging the shift to zero emission road freight financially will also enable small- and medium-sized companies (SMEs) to make the most out of the transition. The initially higher up-front capital costs of ZETs are gradually reducing thanks to technology progress and scale but both the EU and Member States support the purchase of ZETs and deployment of infrastructure with a variety of financial and fiscal incentives.

The EU is supporting the roll-out of infrastructure via the Alternative Fuels Infrastructure Facility. A large part of the total €1.5 billion budget will be used to finance the deployment of public truck charging infrastructure across the EU.

National authorities are also rolling out incentive schemes to accelerate the transition to ZEVs. Programmes in France, Germany, the Netherlands, Denmark, Spain and Austria entail a mix of tax incentives as well as purchase grants for vehicles and infrastructure. For example, the German government provides a purchase bonus that compensates for 80% of the price difference between a ZET and a diesel truck and covers 80% of the cost to install private truck charging infrastructure. Once ZET production is scaled up and up-front costs are reduced, governmental subsidy programmes could be gradually phased out.

In order to ease the transition to zero emission fleets (in particular for SMEs), new financing options such as leasing, renting, pay-as-you-drive or truck-as-a-service (TaaS) will become more common. OEMs such as TRATON, Volta Trucks and Daimler and Scania have already announced plans to offer such services soon.

[1] A 65% CO2 reduction in 2030 is in line with the highest ZET commitment from a main OEM (60%) and business as usual improvement on the efficiency of ICE trucks. T&E will be conducting additional analysis to assess further the optimal techno-economic deployment of ZETs.

Further information

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