Q&A E-fuels in trucks

November 2022

This document addresses questions made in response to the publication of the study E-fuels in trucks: expensive, scarce, and less green than batteries, published on 15 November 2022. Other potential questions related to the study's modelling have also been included.

1. Total cost of ownership

1.1. How were future energy prices projected?

Cost projections other than for e-diesel price come from the research organisation TNO. Future cost advantages of zero-emission trucks compared to diesel depend on the development of energy prices including diesel and electricity, which are notoriously difficult to project for future years. To overcome this uncertainty and look beyond the short-term volatility of energy markets, the analysis by TNO looked at 10-year average diesel and electricity prices, and forecasted them based on price projections by the U.S. Energy Information Administration, the International Energy Agency and the EU Reference Scenario.

1.2. Is the e-diesel price in line with other sources?

The study assumes e-diesel will cost 1.46 €/l in 2030 before taxes, or 1.90€/l with excise duty, and decreases from there. This is based on research from Frontier Economics commissioned by Agora Energiewende, and assumes production in North Africa. This is slightly cheaper (by 1%–4%) than the midpoint forecasted by Prognos et al whose estimates are used by the eFuel Alliance. This study also assumed imports from North Africa.

However, based on recent literature, both these prices may be very optimistic. Concawe, FuelsEurope's research organisation, just released a report where they projected e-diesel imported from the Middle East and North Africa would cost 1.89 €/l in 2030, going up to 1.92 €/l in 2050, before taxes. In other words, Concawe's assumption is that e-diesel would be 29% more expensive in 2030 than what T&E's study assumed, and that production costs would not go down until after mid-century. T&E's assumption is thus on the optimistic side for e-fuels.

1.3. Why focus on 2035 rather than today?

T&E analysed the total cost of ownership and lifecycle emissions of trucks in 2030, 2035, and 2040. The results for 2030 and 2040 are included in the annex. Years before 2030 are not relevant as e-fuels are not expected to be commercially available before then. The main findings focus on 2035 for two reasons: first, e-fuels are expected to be more mature (possibly fuelling 2% of cars and trucks), and second, 2035 is the year when all new freight trucks should be zero-emission, based on T&E modelling.

1.4. Why isn't the fuel tax shortfall due to high electrification considered?

Battery-electric trucks are cheaper to own and operate than diesel trucks. This means that taxes can be raised by governments to limit the revenue shortfall due to reduced fuel taxes, while the total cost of ownership remains beneficial for zero-emission trucks. In other words, the economic benefits of going electric can be shared between hauliers and governments. On the contrary, e-diesel is much more expensive than fossil diesel and a fuel tax on top would thus place a serious economic burden on hauliers.

2. Lifecycle analysis

2.1. How was the electricity mix used in different scenarios determined?

T&E considered multiple scenarios: a typical case and a best case scenario, in 2030, 2035, and 2040.

- The **typical case** compares battery-electric trucks charged with average grid electricity with e-diesel produced under the Renewable Energy Directive (RED II) criteria — which stipulates that e-fuels must reduce greenhouse gas emissions by at least 70% compared to a fossil fuel baseline.
- In the **best case**, 100% green power is used to both produce e-fuels and charge e-trucks.
    - For **e-diesel produced from 100% renewable electricity**, the study considered all electrolysers planned in Europe, the Middle East, and Africa, with an average carbon intensity of 19 gCO_2e/kWh, slightly declining over time.
    - For **battery-electric trucks running on 100% renewable electricity**, the study assumed that this electricity would be generated with roof-mounted solar panels with a carbon intensity of 37 gCO_2e/kWh.

This means that in the best case, the study assumed the carbon intensity of the electricity to charge BETs to be almost twice as high as that of electricity used to produce e-diesel (37 vs. 19 gCO_2e/kWh). Assuming another 100% green power mix for charging (e.g. including wind power for example along the highway) would have reduced the carbon intensity of the electricity to charge the BET (13 gCO_2e/kWh for wind vs. 37 gCO_2e/kWh for solar) and therefore have even further widened the gap in favour of battery-electric trucks.

2.2. Won't e-fuels be produced from 100% renewable electricity, rather than merely complying with RED II?

Though the industry claims to aim for 100% renewable electricity in e-fuel production, there is no legal obligation for them to do so and thus no guarantee that this would happen. Concawe's recent report mentioned that *"some more economical schemes might be possible, which are not 100% dependent on green power as the sole energy input but accept some use of fossil energy"* (p XIV). Therefore, the environmental performance of e-fuels which merely comply with RED II should be analysed. Nonetheless, T&E also shows the most optimistic case with e-diesel produced from 100% renewable.

2.3. Doesn't T&E's analysis show that trucks fuelled with e-diesel produced from 100% renewable electricity are cleaner than battery-electric trucks charged from the average EU grid?

For trucks bought in 2030 and 2035, a truck running on e-fuels produced from 100% renewable electricity would be cleaner than an e-truck powered from average EU grid electricity. However, the situation changes in 2040, as the footprint associated with battery production keeps dropping (due to improvements in battery density and greener battery production). As a result, battery-electric trucks bought in 2040 are the greenest choice, regardless of how they are powered and of how e-fuels are produced.

However, e-fuels and battery-electric trucks should be compared on a level playing field, i.e. assuming either the typical case for both powertrains, or 100% green power for both. E-diesel produced from 100% renewable electricity will not represent the majority of cases. As such the "typical" case is comparing e-diesel produced under the RED II criteria with battery-electric trucks running on grid electricity. To compare the best case scenario, e-diesel produced from 100% renewable electricity should be compared with charging e-trucks with 100% green power. In this case, a truck running on e-diesel would still emit more over its lifetime than a battery-electric truck charged with 100% renewable electricity.

2.4. Is the e-diesel GHG intensity in line with other sources?

Yes. For 100% renewable e-diesel, we calculated an average carbon intensity of 9.2 gCO_2e/MJ, assuming electrolysers located in Europe, the Middle East and North Africa, and an average efficiency of 57% for electrolysis and synthesis. Concawe, in a recent report, estimated that by 2050 e-diesel produced in the Middle East would have a carbon intensity of 8.8 gCO2e/MJ. The overall average for Europe and the Middle East is 9.3 gCO_2e/MJ.

3. Availability

3.1. Why are there enough e-fuels for 6% of trucks, but only for 2% of cars?

The figure presented by T&E for cars in October, assumes that road e-fuels go to all road transport modes: cars, vans, and trucks. The exact allocation is based on their current share of road transport's oil consumption. In that case, only 2% of cars and 2% of trucks can be e-fuelled.

In this analysis, we also considered a scenario where all road e-fuels go to trucks and none go to cars. In this case, up to 6% of EU trucks on the road in 2035 could be e-fuelled. This is an optimistic assumption for e-fuels.

For comparison, if the targets T&E recommends for the revision of the truck CO_2 standards were adopted (-65% CO_2 in 2030, and -100% CO_2 in 2035 for freight trucks), then one-third (32%) of the heavy-duty vehicle fleet would be zero-emission by 2035.

3.2. Why doesn't the e-fuel supply in 2035 include imports from outside the EU?

Though T&E found projections on the cost and carbon footprint of imported e-fuels, T&E was not able to source credible projections for import volumes of road e-fuels. On the contrary, recent literature shows that imports of road e-fuels are unlikely to materialise in the mid-term. In the long-term, the only fuels derived from hydrogen imported into Europe by 2050 will be synthetic kerosene (for aviation) and ammonia (for shipping and other sectors), based on a recent report from the Hydrogen Council.

3.3. Doesn't Europe have enough potential for renewable power production to produce e-fuels for all sectors?

Previous T&E analysis shows that while the EU has enough renewables potential to meet future demand, there is no room to use renewable electricity inefficiently. Allowing for synthetic fuels in road transport — where efficient, cheaper, and cleaner alternatives exist — would waste large quantities of renewable energy and risk derailing decarbonisation efforts.

3.4. Won't low-carbon fuels other than synthetic fuels be available?

Apart from synthetic fuels, first-generation and advanced biofuels are also claimed to be solutions to reduce emissions from transport. First-generation biofuels, based on food and feed, damage food security, biodiversity, and the climate, and can not be considered as credible climate solutions. For advanced biofuels, based on waste and residues, only limited quantities are truly sustainable and not already used in other industries. The very limited, truly sustainable advanced biofuels which can be produced should be reserved to sectors where direct electrification or hydrogen are not yet credible solutions, e.g. aviation and shipping.

The study that FuelsEurope often cites as proof that there's enough sustainable biomass in Europe is rife with unsustainable practices — such as cutting down trees or harvesting tree stumps — and biomass with existing use, which could lead to high indirect emissions — e.g. agricultural and secondary forest residues, or used cooking oil.

4. Regulatory aspects

4.1. If zero-emission technologies are better, why is a ban on the internal combustion engine for trucks needed?

The EU needs to reach climate neutrality by 2050, as set out in the European Climate Law. To do so, all heavy-duty vehicles (HDVs) need to be fully decarbonised by that date. 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. T&E modelling shows that this would reduce overall HDV emissions by 95% by mid-century, with only a small share of the remaining fleet relying on diesel.

[Analysis](#) shows that by 2035, new electric freight trucks will have a lower total cost of ownership (TCO) compared to diesel in virtually all cases while delivering the same capabilities in terms of range, payload and driving times. But legal requirements are necessary so that supply of zero-emission trucks is sufficiently ramped up within the needed time frame. Strong targets would also compel truckmakers to deliver on their voluntary announcements. In the past, car OEMs have missed their voluntary targets, and then took advantage of weak CO_2 targets to delay the transition, rather than fully harnessing the market uptake potential.

Lastly, binding targets are needed to set a clear trajectory forward. National governments and the private sector need a clear signal on the timeframe to deploy charging infrastructure, secure raw materials, invest in battery factories, and so on.

4.2. Wouldn't a fuel crediting mechanism preserve technology neutrality?

Including a fuel crediting mechanism in the truck CO_2 standards would sow uncertainty as to the EU's commitment to clean up transport and to the zero-emission transition. This would in turn delay investments in zero-emission vehicles and charging infrastructure. Rather than opening up choice for hauliers, it would actually keep them locked in diesel technology for longer. And in doing so, maintain fossil fuel demand in the existing fleet for longer.

4.3. Isn't it necessary to include e-fuels in the CO_2 standards to foster investment?

Investments in e-fuels should be fostered through legislation that directly regulates fuels. The truck CO_2 standards regulate truckmakers, who have no direct control over how their vehicles are fuelled once they are sold. Therefore, the HDV CO_2 standards should regulate what truckmakers actually produce and are not the proper regulatory tool to promote e-fuels.

But investments in e-fuels can be promoted through higher targets in the Renewable Energy Directive (the main legislation regulating renewable fuels in Europe), in ReFuelEU (which regulates jet fuel suppliers), or in FuelEU Maritime (which applies to the fuel used by ship operators).

T&E strongly believes that carbon-neutral e-fuels produced from additional 100% renewable electricity are crucial to decarbonise shipping and aviation, and advocates for higher ambition in the related regulations.

4.4. Won't e-fuels be necessary to decarbonise the existing fleet?

T&E analysis shows that fuelling a secondhand diesel truck with e-diesel will be costlier for hauliers than buying and operating a new electric truck. Therefore, decarbonising the existing fleet with e-fuels is not an economically sound choice. Plus, as shown by T&E, the HDV sector can be decarbonised with zero emission vehicles.

What's more, e-fuels should be prioritised to other sectors as diverting scarce e-fuels to road transport would deprive aviation and shipping, which cannot fully decarbonise through direct electrification and will rely on e-fuels.

Further information

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