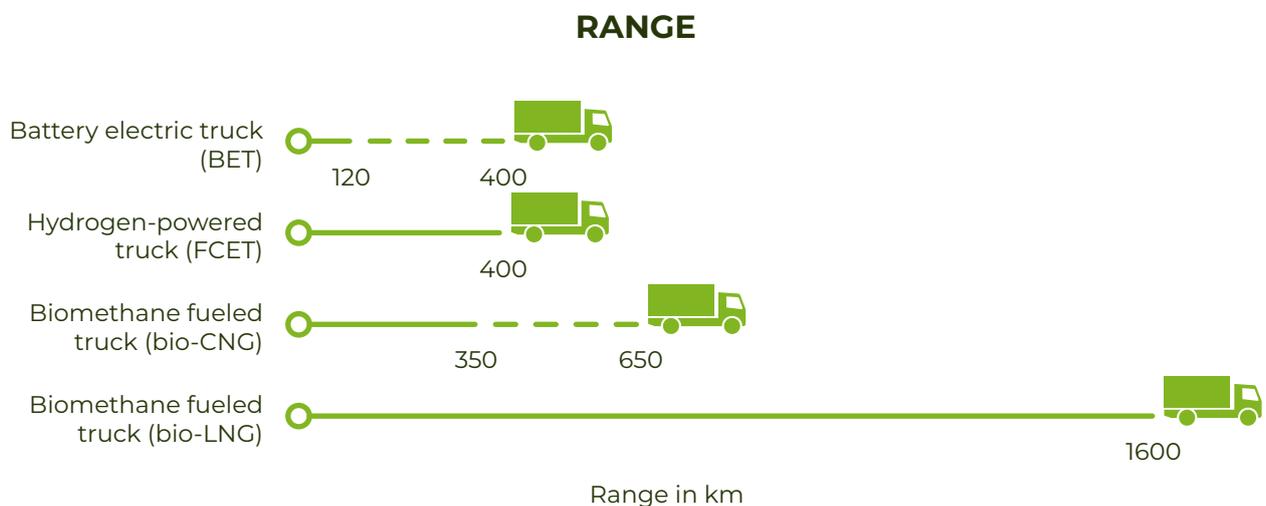


The business case for battery electric trucks (BETs) and hydrogen powered trucks

Biomethane, when used as a transport fuel, can provide both a short and long-term solution and help the EU achieve its emission reduction goals. However, EU policymakers opted for a very singular approach, merely focusing on a shift to full electrification and hydrogen powered vehicles, when voting on the CO2 EPS file for cars and vans earlier this year. Moreover, due to the different characteristics of the passenger (light-duty) and cargo (heavy-duty) transport sectors, not all assumptions carry over from the proposal on the CO2 emission standards for cars and vans towards those for heavy-duty vehicles (HDVs).

This begs the question: How viable is the business case for Battery Electric Trucks (BETs), Fuel-Cell Electric Trucks (FCETs) and biomethane-fueled alternatives?



Battery electric truck (BET)

Charging times are significantly longer than those for passenger cars, especially if no fast charge module is being used. In a truck with a 500kWh battery pack on board, the battery weighs about 3.500kg. This means that BETs will have an average weight that is several tonnes higher than a diesel or biomethane fueled truck. In addition, with the increase in battery size and weight, the BET energy consumption would increase.¹ The lifetime of a battery for a truck is around 5 years.²

Hydrogen-powered truck (FCET)

Fueling takes somewhere between 8 and 20 minutes. Mainly due to the limited range at this moment - trucks with a range up to 1,000 km are expected by the end of the decade^{3 4} - hydrogen trucks are not yet feasible to replace long-haul heavy-duty transport but would be a good fit for the last mile or for regional distribution.⁵

Biomethane fueled truck

Almost the same as a regular diesel truck around 1.666 km with a 500-liter tank.⁶

CHARGING AND REFUELING

Battery electric truck (BET)

Availability of charging infrastructure is currently limited⁷, it will depend on the improved revision of the Alternative Fuels Infrastructure Directive how this will evolve.⁸ Charging of an electric truck takes between 1 and 10 hours, depending on the battery capacity and charger power.

Example: Charging a truck with a battery capacity of 250kWh at a 50kW charger takes 5 hours. Another truck with 700kWh of battery capacity at a charger with an output of 350kW will take about 2 hours to fully recharge. In general, charging times (even when using fast chargers) are significantly (hours) longer than refueling with fossil fuels or biomethane.⁹

The required energy amount for one driving period is 478.8 kWh and 658.8 kWh, respectively.¹⁰

Hydrogen-powered truck (FCET)

Availability of charging infrastructure is currently limited with 228 hydrogen stations in Europe at the end of 2021¹¹, but is expected to be improved with the revision of the Alternative Fuels Infrastructure Directive. The range of the hydrogen dispenser flow rate is estimated to be between 3.6 and 7.2 kgH₂ per minute which ensures refueling times of no more than 20 minutes if the onboard hydrogen tank of the FCET is completely empty.¹²

Biomethane fueled truck

Refueling an HGV with a 800 km range takes approximately 5-7 minutes.¹³ The infrastructure of filling stations for liquefied biomethane has reached a critical mass and is ready for deployment. Extensive infrastructure exists in Europe, with 4187 stations for CNG and 584 stations for LNG. Leading EU countries include Italy, Germany, The Netherlands, Sweden, Czech Republic, Switzerland, Bulgaria and Belgium.¹⁴

LOADING CAPACITY

Battery electric truck (BET)

The required battery would restrict the payload to 80% of a usual diesel truck payload.¹⁵ Maximum payload is between 22.5–27.3 tonnes.¹⁶

Hydrogen-powered truck (FCET)

The maximum truck payload capacity is 29,195 kg.¹⁷

Biomethane fueled truck

Same payload as an equivalent diesel truck.¹⁸

AVERAGE EMISSIONS

Battery electric truck (BET)

The TtW climate change impact of electric vehicles is 0. The WtW impact is linearly related to the carbon intensity of the origin of the electricity. In an average European electricity system, electricity has around 30% lower climate impact than diesel for a heavy truck.¹⁹

Hydrogen-powered truck (FCET)

The TtW climate change impact of electric vehicles is 0, but the electrolysis requires electric energy to produce hydrogen, which increases the upstream emissions.²⁰

Biomethane fueled truck

When trucks run on CNG, their equivalent carbon emissions are 10% lower than the baseline diesel, and when running on biomethane, their equivalent carbon emissions is 78% lower.²¹

WtW: GHG emission savings are 82% - 94%.²² Average European vehicle gas reduces the climate impact by up to 28% compared to diesel, or 11% compared to fossil natural gas. In some countries vehicle gas has lower climate impact than electricity.²³

Gas trucks using a mix of LNG and bio-LNG have lower total emissions than trucks running on grey hydrogen.²⁴

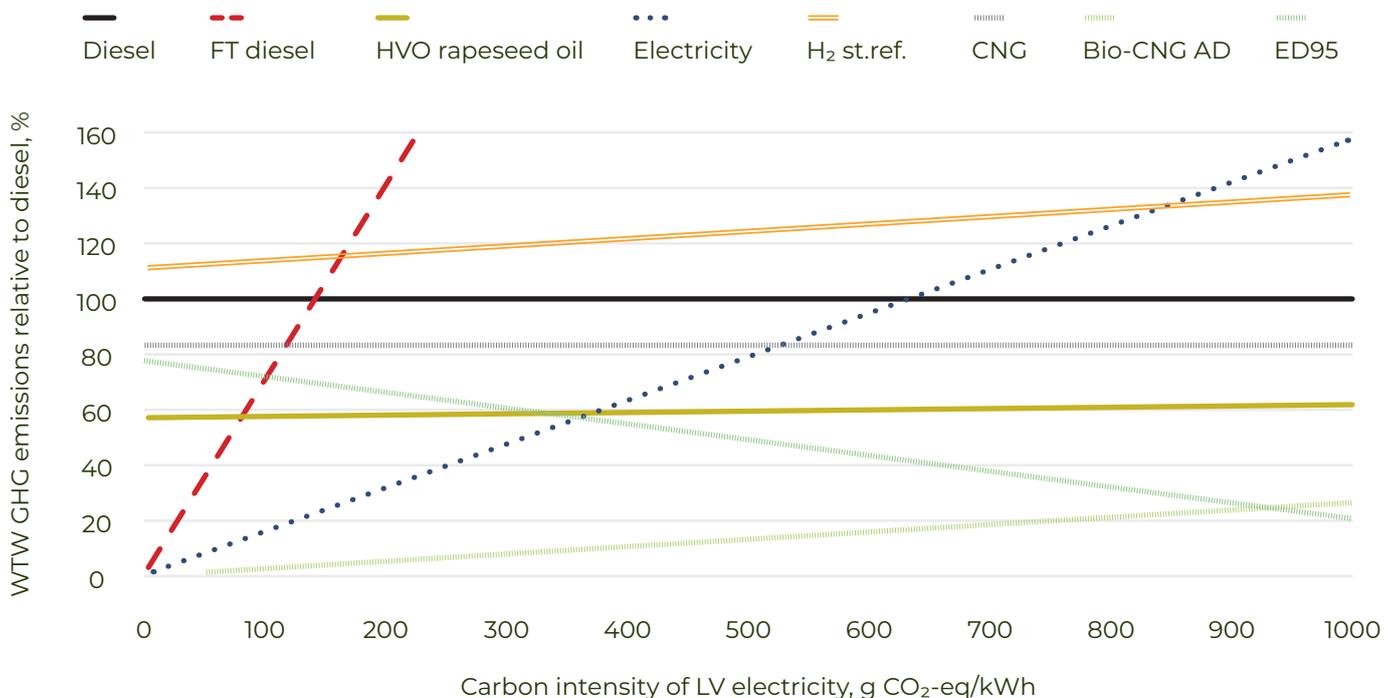
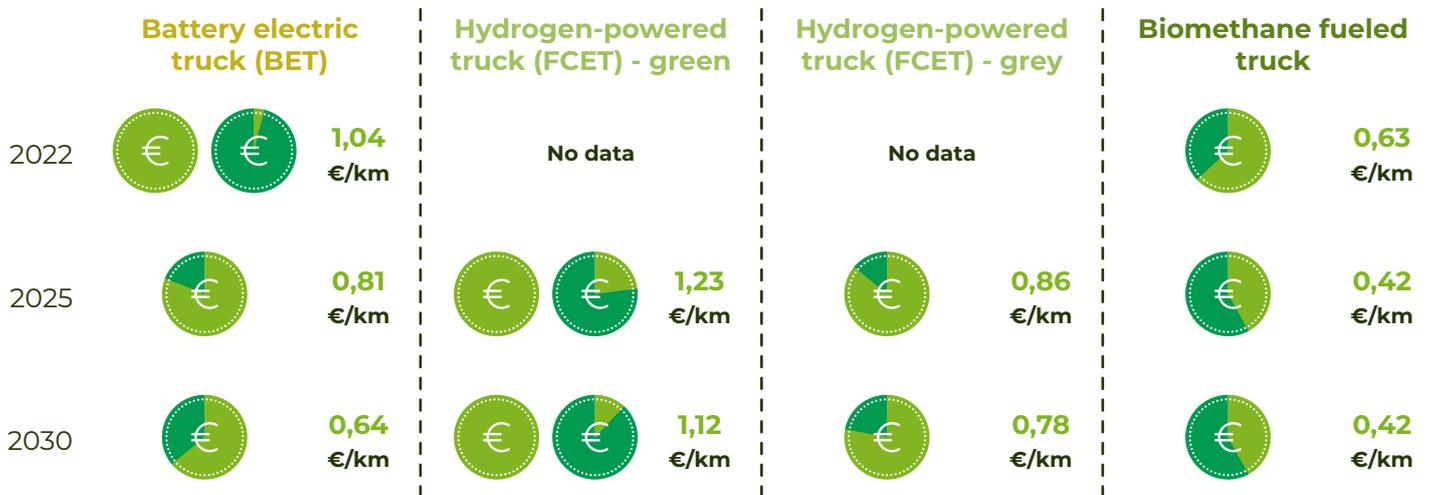


Figure 1: Well-to-wheel greenhouse gas emissions (relative to diesel) of energy carriers for a 40-ton long haulage truck, as a function of the carbon intensity of the electricity system.

Source: M. Gustafsson et al.; Transportation Research Part D 93 (2021) 102757

TOTAL COST OF OWNERSHIP (TCO) KM²⁵



Battery electric truck (BET)

BETs are a good option in the medium-to-long term, however there is some uncertainty around availability and cost of the vehicles, and the fuel supply until 2030.²⁶

Hydrogen-powered truck (FCET)

Fuel cell trucks are 2.6 to 3.4 times more expensive than diesel trucks (with e.g. fuel cell system prices including balance of performance of €500-750/kW) and 1.3 to 1.4 times for H2-HPDI trucks (mainly due to H2 storage tank).²⁷

AVERAGE DISTANCE FOR HDVs

- Last mile: Around 200 km per day, having 30 or 35 stops every day.
- National: Average of 450 km per day, when having 6 or 7 stops.
- Cross-border trips: up to 700 km per day, which equals around 9 or 10 hours driving.

Average speed is 75km/h, so a lot comes down to how many stops a truck must make every day.

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