IRU

Intelligence
Briefing.

TCO and CO_2 in France: the cost of tomorrow's trucks

Preview

Introduction

Road freight is the backbone of the economy, accounting for close to 90%[1] of goods and materials exchanged between businesses and their customers across all sectors in France. Its efficiency and operational flexibility provide businesses with a fast, reliable and cost-effective tool for delivering their products.

Historically, French and European road freight has relied on diesel to move vehicles. Delivering high torque at low speeds, diesel is ideal for hauling heavy loads while keeping fuel consumption under control, thereby reducing the total cost of ownership (TCO).

TCO is an indicator that aggregates all costs associated with the purchase (CAPEX) and operation (OPEX) of a vehicle. It helps operators position their transport offering in the market and guides them in their investment decisions.

However, diesel is a carbon-rich fossil fuel. Its combustion emits carbon dioxide (CO_2), a greenhouse gas whose reduction is essential for achieving carbon neutrality by 2050.

Numerous diesel alternatives exist to reduce CO_2 emissions, particularly in France, where operators have access to B100 biofuel and biomethane. However, the use of these solutions has an impact on the TCO.

This IRU Intelligence Briefing analyses the TCO and CO_2 emissions of all alternative powertrains over the first life of an articulated truck and a rigid vehicle used in long-haul and regional operations. It breaks down the different TCO components to help operators navigate their energy transition and shippers to identify decarbonisation pathways.

The analysis begins with a contextual overview of French road freight, justifying the choice of vehicle types and use cases. This is followed by an analysis of the environmental performance of diesel alternatives, then the energy performance of the different powertrains, using models developed by IRU, such as the Alternative Fuels Efficiency Model.

Based on these energy consumption figures, the carbon emissions and TCO of all technologies are calculated. The dataset aims to be as close as possible to real-world conditions, yet it remains an average that masks considerable variation. Operators have their own characteristics and rules which could differ from the assumptions taken in this report. A TCO sensitivity analysis is provided for the most influential parameters. Finally, a summary chart brings together all the results to offer an overview of the TCO–CO_2 trade-off.

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1 EUROSTAT

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Executive summary

France plays a major role in EU road transport. French roads carry 15% of EU volumes,[2] making France the bloc's second-largest market, behind Germany. French operators dominate domestically, carrying 92% of their tonne-kilometre volumes within France and accounting for over 56% of total road freight on French territory.

France also benefits from a rich energy system. Given the country's strong agricultural industry, its operators have access to a broad range of bioenergies: from B100, a first-generation biofuel, to biomethane, and HVO (also locally known as XTL), a more advanced biofuel. France also has a low-carbon electricity generation system currently in surplus, underpinned by a strong network of nuclear power stations and productive renewable energy sources. The result is electricity that is among the cheapest and least carbon-intensive in the EU.

In a world striving to reduce carbon emissions, the French market offers operators several technological solutions to replace diesel. Although conditions are favourable for decarbonising road transport, challenges remain significant, starting with the additional costs of the energy transition and its broader logistical implications.

The use of diesel has enabled road transport to achieve competitive pricing relative to other transport modes while providing a logistics tool that is both resilient and reliable. Today, no solution exists that can fully replace diesel for complete decarbonisation at the same cost and without operational impact.

After a detailed analysis of the costs and emissions of all fuels in France, battery-electric vehicles (BEVs) were found to have a lower TCO than diesel while reducing CO_2 emissions by over 95%. This performance is largely due to the revisions announced by the French government, which are scheduled to be implemented in June 2026. However, this report's analysis assumes that vehicles can be charged whenever needed, particularly via a suitable charging network, which is currently not the case.

Other alternative powertrains were also found to have a lower TCO than diesel due to the implementation of ETS2, which increases the cost of operating a diesel truck.

Hydrogen stands out as a powerful decarbonisation solution, but its TCO far exceeds that of diesel. With an acquisition cost higher than BEVs and very high hydrogen prices, this technology cannot offset its substantial CAPEX with a low OPEX, as BEVs do, making it an economically unviable option for operators.

The TCO and CO_2 calculations are highly dependent on vehicle usage, and the analysis presented in this report is based on generic values. Caution is warranted; the results should be interpreted in light of the underlying assumptions. For a more tailored calculation, contact IRU for a simulation adapted to your specific operational needs.

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2 In tonne-kilometres

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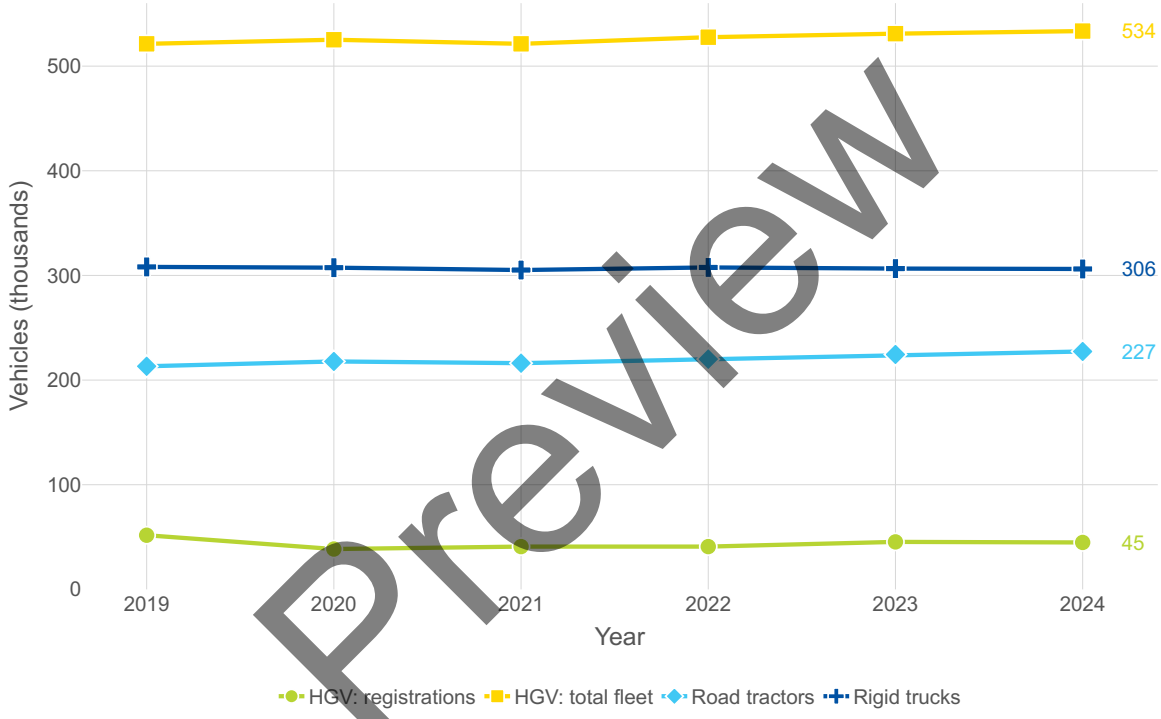
2.
Alternative fuels in France

Although tractor units account for 87% of French road freight volumes, this configuration represents only 57% of registered trucks in France, with the remaining 43% comprising rigid vehicles. On 1 January 2025, the French fleet totalled 527,000 trucks,[4] making it the fifth-largest fleet in Europe behind Poland, Germany, Italy and Spain. Despite nearly 50,000 new heavy vehicle registrations in 2024, the fleet recorded a net reduction of 6,000 vehicles that year, marking the first annual negative trend observed in the post-pandemic period.

Figure 5. Truck fleet composition and new registrations



Preview

Source: SDES

Like the EU fleet, the French vehicle fleet is 97% diesel. This technology has dominated EU trucks for several decades, offering high torque at low speeds. This makes it ideal for moving heavy loads while limiting fuel consumption. Low engine speeds and the absence of an ignition system also give the diesel engine superior reliability compared with other internal combustion engine technologies. These advantages enable operators to benefit from both a competitive TCO and a high vehicle availability rate. However, most diesel powertrains run on fossil fuels, emitting carbon dioxide.

4 Vehicles with a GVW above 3.5 tonnes.

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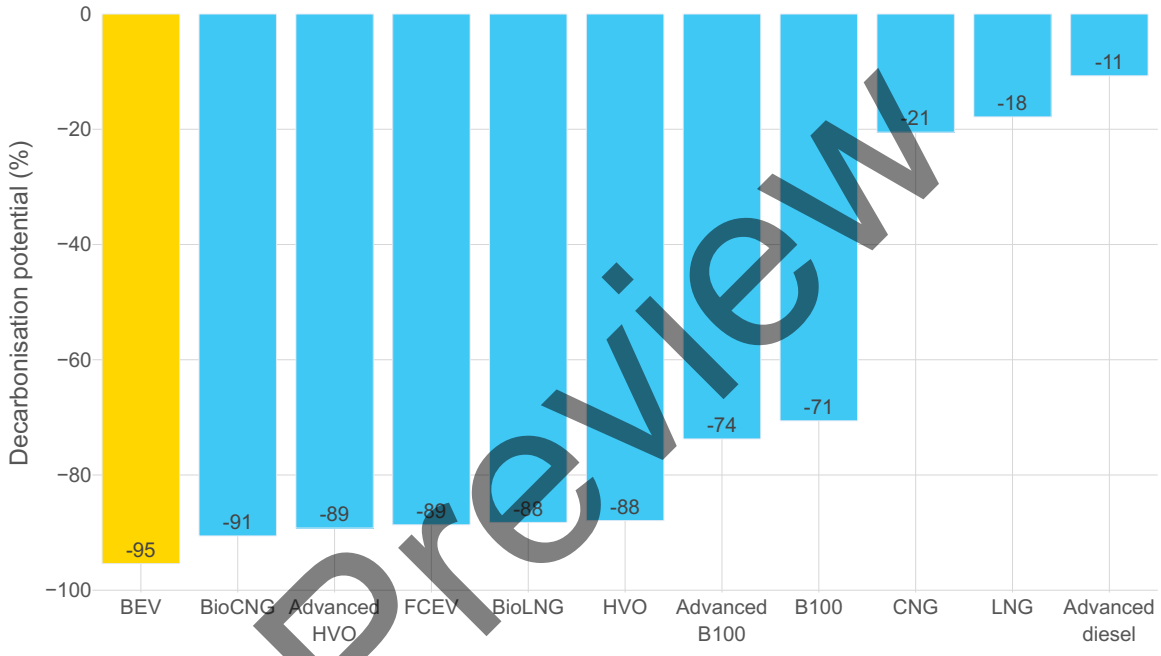
5.
Carbon emissions of alternative fuels

By combining the environmental performance of alternative fuels with consumption values, it is possible to determine their decarbonisation potential. The following charts illustrate these values for articulated vehicles; rigid vehicles have very similar values.

Figure 9. Decarbonisation potential of alternative fuels, T2S3, 15 tonnes of payload



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Source: IRU AFEM

BEVs offer the greatest decarbonisation potential, reducing emissions by 95% over the vehicle's first life, taking a 2026 average diesel vehicle as the reference. It is already possible to reduce the carbon footprint of diesel by 11% with the most fuel-efficient engine on the market. Vehicles using HVO and BioCNG or BioLNG have a reduction potential close to that of BEVs, at around 90%, while B100 enables a reduction of between 70% and 75%, depending on vehicle efficiency.

The following charts give carbon intensity values (g/tkm) for the different energy types. It is notable that articulated vehicles have a lower carbon intensity in g/tkm due to their better payload-to-unladen-weight ratio.

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TCO sensitivity to the DREEV offer, rigid vehicle, in EUR/km

	BEV
Standard	**0.684**
Reduced rate and fast charger	0.658

Source: IRU AFEM

The flexible charging offer reduces the TCO of BEVs by 7% for articulated vehicles and by 4% for rigid vehicles. The large battery capacity of articulated vehicles maximises savings achieved at depots. Despite these reductions, B100 efficient remains the least expensive option for rigid vehicles.

7.4 ETS2

ETS2 is a carbon tax originally planned for 2027, now postponed to 2028. It affects, in particular, the fossil fuels used in road transport. Upon implementation, energy suppliers will receive an emissions allowance. The difference between this allowance and actual emissions will be valued at a price set by an exchange market.

Initially, the EU intended to cap this price at EUR 45 (adjusted for inflation). As this price is based on 2020, the initial value will be EUR 61 per tonne of CO_2 in 2028. This cost will be passed on to the price per litre of fuel according to its emission factor.

For this TCO study, the assumption adopted is that the price of ETS2 will evolve in line with inflation. Over the period considered, ETS2 varies as follows:

Hypothetical ETS2 trajectory

	ETS2 EUR/tonne
2026	0
2027	0
2028	60.87
2029	62.08
2030	63.26
2031	64.47
2032	65.69

Source: IRU estimates

ETS2 applies only to fossil fuels, only diesel and CNG/LNG are affected. An increase in ETS2 leads to a rise in the OPEX for vehicles running on such fuels. This worsens their TCO and strengthens the competitiveness of other alternative fuels.

Conversely, if ETS2 were withdrawn or halved, the TCO values for diesel and CNG/LNG would be as follows:

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its competitiveness deteriorates, as combustion engines become on average more efficient at higher loads, with the engine operating in the most efficient part of its fuel map.

Figure 16. T2S3 TCO variation with payload, EUR/km

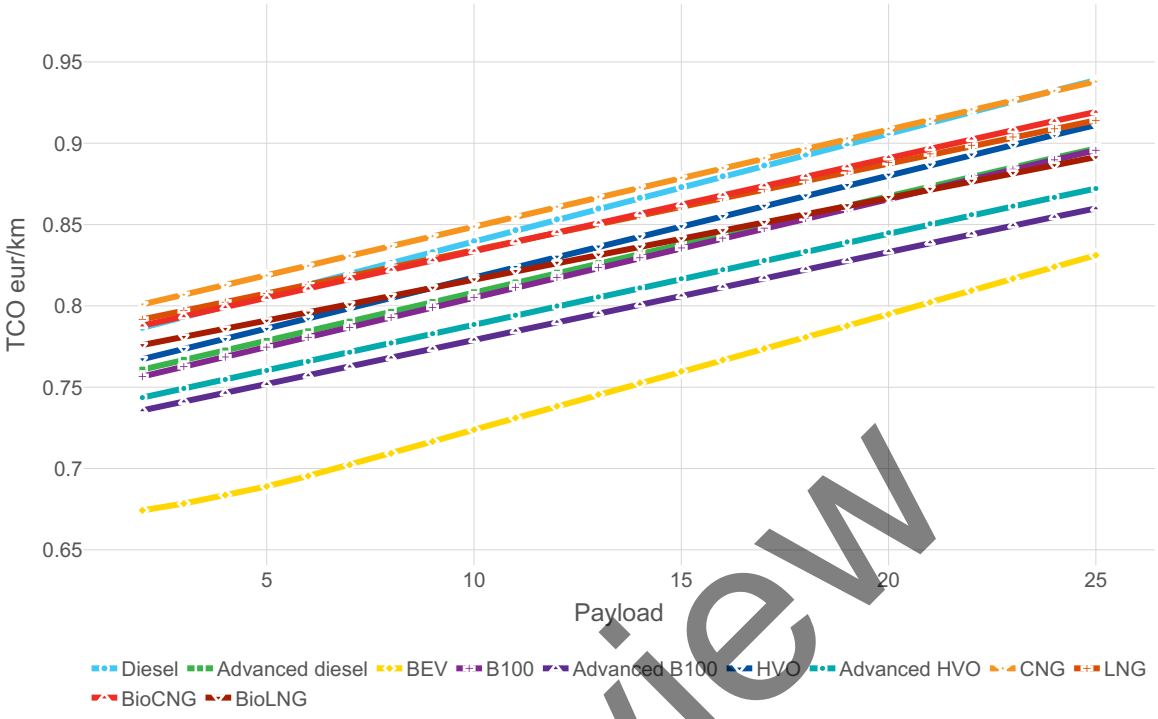
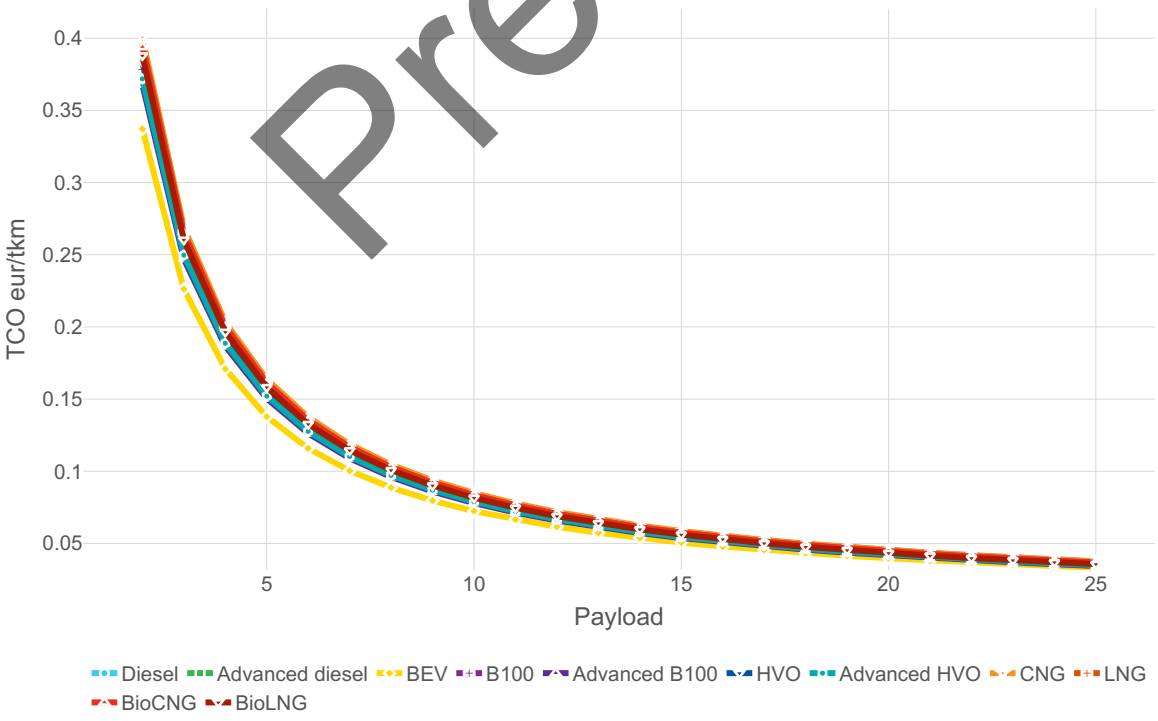


Figure 17. T2S3 TCO variation with payload, EUR/tkm



Source: IRU AFEM

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