FUTURE FUEL FOR ROAD FREIGHT

TECHNO-ECONOMIC & ENVIRONMENTAL PERFORMANCE COMPARISON OF GHG-NEUTRAL FUELS & DRIVETRAINS FOR HEAVY-DUTY TRUCKS

An expertise by LBST and Hinicio for Fondation Tuck
in the context of «The Future of Energy»
call for proposals 2018

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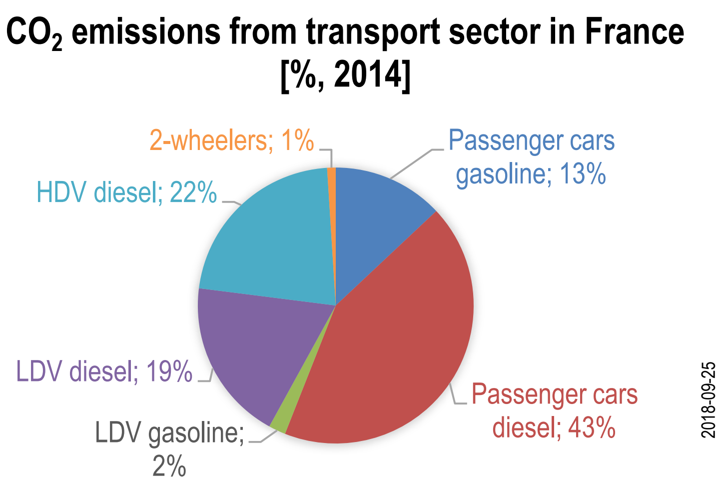
– EXECUTIVE SUMMARY –

Background & approach

Heavy-duty trucks are responsible for 22 % of greenhouse gas emissions from road transport in France and tractors are the vehicles that transport the most goods (95 % in terms of ton-km). Following the passenger car CO_2 regulation, the EU is about to introduce CO_2 emission performance standards for new heavy-duty vehicles in the order of -15 % in 2025 and -30 % in 2030 (compared to 2019).



The study compares Diesel, CNG/LNG, hydrogen fuel cell (FCEV), and catenary (CEV) powered heavy-duty trucks with regards to their environmental and techno-economic performance for France, including renewable fuel import as an option.

Key results

All alternative powertrains can provide quasi zero greenhouse gas **emissions** based on renewable and low-carbon electricity. Only fuel cell and catenary trucks offer both zero greenhouse gas emissions and zero local air pollutant emissions.

Costs of alternative truck powertrains are converging, series production provided. Costs of new fossil, nuclear and renewable power also are converging. The costs of imported synthetic fuels (synthetic methane via power-to-methane, synthetic diesel via power-to-liquid) are about 20 % lower than those from domestic production.

Based on French stock of long-haul trucks **cumulative investments** have been calculated assuming a ceteris paribus introduction of new fuels/powertrains, incl. primary energy and distribution infrastructure. Fuel cell electric trucks and infrastructure have low cumulative investment among the renewable options. The cumulative investments seem, however, manageable for all options investigated in this study.

Pros & cons

Fuel cell and catenary electric trucks can provide zero greenhouse gas and zero pollutant **emissions** as well as reduced noise signatures at low speeds and during acceleration.

Diesel via power-to-liquid and CNG/LNG via power-to-methane require roughly 2-4 times the **primary energy demand** compared to electric powertrains (FCEV, CEV), translating into a significantly higher number of renewable power plants and area required to cater the e-diesel and e-methane fuel demand.

Hydrogen fuel cell powertrains for trucks share the technology basis and **infrastructure** with other hydrogen uses, e.g. buses and passenger vehicles. The catenary system is exclusive to the relatively small number of long-distance trucks, and possibly buses. CEV competes with rail freight, and possibly public rail transport in case of catenary buses.

Conclusions & recommendations

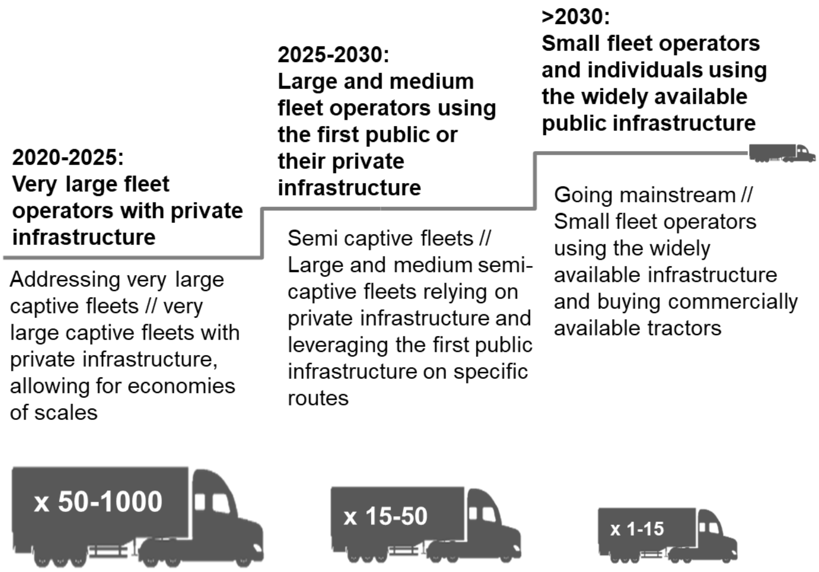
Catenary electric trucks can be ideal in case of frequent point-to-point relations. They should be investigated as an option for dedicated ring-fenced projects. **Fuel cell electric trucks** clearly stand out for their combination of zero emission capability and universal use. Hydrogen infrastructure is thus recommended for comprehensive roll-out. Achieving economies of scale across the value chain should be pursued as the number one priority in order to exploit cost reduction potentials as rapidly as possible.

On the **fleet operator side**, the priority focus should be put where favourable conditions are given, such as

- Captive fleets because a lower infrastructure investment is required;
- Fleets transporting high-value added goods (>35,000 €/t) for which transport represents a minor element in the cost structure;
- Fleets exposed to societal pressure as an additional driver of change.

On the **infrastructure side**, the priority for investors and operators is to

- Secure long-term supply contracts with at least one large fleet operator, to increase certainty on future revenues and limit risk exposure;
- Reduce fuel costs via economies of scales in order to help fleet operators reach cost parity with diesel;
- Leverage additional revenue streams (grid services, etc.) to strengthen the infrastructure business case.



On the **policy side**, to achieve rapid scale-up, a stable and supportive policy framework would be needed to encourage the appropriate level of private investments. The initial trigger will have to come from **market pull regulation** measures (binding measures such as included in the RED 2, the Eurovignette directive, zero emission zones, the fuel efficiency standards for HDVs directive, etc.), which will spark demand for vehicles, thus justifying investments in upstream infrastructure. However, in the initial deployment phase as FCEVs and CEVs tractors remain more expensive than conventional technologies, **market push instruments** (subsidies, access to cheaper financing, tax exemptions, etc.) will be needed to reduce the cost difference and incentivise fleet operators to make the switch.

Simultaneously, as final demand builds up, investments in infrastructure will need to be de-risked. As a matter of fact, investors in infrastructure are exposed to significant risks on incomes linked to uncertainties and lack of visibility regarding vehicle reliability and ramp up. A number of **market levers** can be activated. First and foremost, public money could be used to support the creation of insurance mechanisms, usually referred to as "take-or-pay contracts", providing infrastructure investor with a guaranteed level of revenue streams. Public funds could also be used for (co-)financing a minimum coverage of alternative fuel infrastructure. Ideally, this should not be put in place at the individual project level but rather on a larger scale, possibly at the national or even European level, e.g. in the context of the EU Alternative Fuel Infrastructure Directive, by bundling together large deployment initiatives thus mutualizing risks.

Furthermore, capturing additional layers of **revenue streams** can also contribute to mitigate financial risks for investors. Facilitating access to the ancillary services market for electrolyser could possibly play a major role in this regard. In addition, allowing gas grid injection and creating a suitable injection tariff (typically 90 €/MWh) could also help to de-risk investments during the ramp up phase.

On the way to achieving the Paris climate goal, subsidies will cease to exist and will be replaced by **regulations** such as CO_2 taxes, to bridge the potential remaining difference in total cost of ownership with conventional technologies.