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# A hybrid natural gas engine – future option for heavy transport?

The beginning of this decade was hectic before the COVID-19 pandemic turned the whole world upside down and a recession now threatens in the wake of this international health crisis. The energy sector itself is also going through a period of change, due to the efforts being deployed everywhere in the world to reduce greenhouse (GHG) emissions.

Against this backdrop, we will present an overview of the issues and look at how hybrid technology can be applied to goods transport.

## A cap on decarbonization

At a conference organized by the Chair in Energy Sector Management at HEC Montréal in November 2017, Alan McKinnon, Professor of Logistics at Kühne Logistics University in Hamburg, put forward five approaches to decarbonize goods transport:

- Reduce demand for goods transport
- Shift freight to modes of transport with lower carbon emissions
- Optimize vehicle loads
- Increase energy efficiency in moving freight
- Reduce the carbon content of energy in goods transport

While these perspectives are all interesting, this article will concentrate on the choice of energies and technologies.

## Challenges on the road ahead

Later, in 2019, the North American Council for Freight Efficiency (NACFE), a non-profit organization dedicated to improving the efficiency of goods transport in North America, published a study, some of the highlights being:

- The trucking industry is entering a period of major change in the choice of powertrain technologies. Vehicle fleet managers are facing a multitude of constantly evolving solutions, notably the internal improvement of the diesel engine, hydrogen fuel cells and several others (electric batteries and electrical catenary wire, for example). Adding to the complexity of choice, fuels today are described as “green,” “clean,” “near zero emission” and “renewable,” without any of those terms being clearly defined or standardized.
- The industrial landscape is also in the midst of change. North American manufacturers of heavy trucks that dominated the transportation market until recently are now facing new foreign brands that are looking to carve out a place in North America.
- Confronted by competition and constantly tightening regulations, fleet managers are beginning to envisage purchasing alternative fuel vehicles because of the savings and environmental advantages they offer. Also, to support the introduction of different green technologies for heavy transport, significant investments will have to be made to develop ways of producing energies such as electricity (hydraulic, wind or solar sources), renewable natural gas, renewable diesel and propane, hydrogen, and others.

Again citing NACFE, the most promising solutions in the short and medium term are:

- Commercial batteries for electric vehicles (CBEV)
- Hybrid fuel cell electric vehicles (FCEV)
- Renewable natural gas (RNG)

- Compressed natural gas (CNG)
- Liquefied natural gas (LNG)
- Hybrid diesel electric (HDE)
- Renewable diesel (RD)

However, for these new technologies to be adopted, they need to meet the requirements of carriers as regards power, vehicle weight, purchase price, reliability, autonomy, and availability of fuels.

## Technologies taking the lead

In the light of these conclusions, it is interesting to examine the technologies already deployed or emerging in North America (and elsewhere) to see how they align with the needs of users:

- **Electric vehicles** offer autonomy of up to 350 km and are usually reserved for local transport. However, some manufacturers are announcing vehicles whose autonomy could reach 800-1,000 km; the main drawback is the purchase price of electric trucks, which remains high, along with the long recharging time.
- **Vehicles with hydrogen fuel cells** are currently being tried out in several North American municipalities, mostly in public transit applications.
- **Hybrid diesel powertrain** (coupled with an electric motor) is already in use by several public transit services around the world and some manufacturers have begun to develop this technology for goods transport.
- **Natural gas** (compressed or liquified) is booming in California, and in Europe some markets are resolutely committed to developing the RNG sector. In fact, RNG already represents 17% of the consumption of natural gas for vehicles (NGV) in Europe. Some Scandinavian countries, like Denmark and Ireland, even offer NGV composed 100% of RNG. In Québec, the production of RNG is also on the rise, encouraged by the government, which has set at 5% the quantity of RNG that Énergir must inject into its network by 2025. As well, a study by Deloitte & WSP Canada on the techno-economic potential of RNG, published in November 2018, shows that this energy source could represent almost two-thirds of the volume of natural gas distributed here by 2030, that is, 144 million gigajoules.
- **Hybrid natural gas powertrain** — another promising technology that combines an electric motor with an engine fuelled by GNG or LNG. Hyliion, a U.S. company, already offers hybrid natural gas systems that can be integrated into Class 8 vehicles. The company has also just unveiled its Hypertruck ERX, a new hybrid truck with an engine fuelled by renewable natural gas that offers an autonomy of almost 2,000 km, that can be refuelled in about 10 minutes and weighs less than diesel or entirely electric vehicles.

### What is a hybrid electric vehicle?

The term “hybrid electric vehicle” covers all vehicles whose propulsion is driven by two energy sources: either by electrical energy through the intermediary of an electric motor, or by fuel through the intermediary of a combustion engine. Generally, hybrid electric vehicles have a relatively modest electricity storage capacity (batteries) since the supply of electrical energy is mainly provided by regenerative braking. During this process, the electric motor works like a generator, recharging the vehicle’s batteries by restoring the kinetic energy normally dissipated in the form of heat during braking. As this type of vehicle does not have an external electricity supply, the electrical energy available is limited and is mainly used in the first seconds of the vehicle’s acceleration. Hybrid electric vehicles thus have restricted autonomy in a purely electric mode, and the combustion engine, as well as the tank, need to be sized to meet the highest power demand and the desired autonomy.

## The ideal solution?

In the context of the fight against climate change, the question often asked is which technology to choose to reduce GHG emissions. While electric vehicles do not actually emit GHGs, when analyzing their life cycle, account needs to be taken of the emissions generated by their manufacture, by the manufacture of the batteries, and the emissions at the source of the electricity that fuels them.

These considerations open the door to a wide range of technological choices when it comes time to choose the ideal vehicle for heavy transport. And here, the rechargeable natural gas (or RNG) electric hybrid turns out to be particularly attractive due to its advantages: reduced GHG emissions, greater autonomy, reduced refuelling time, energy efficiency (with recovery on braking), and power on demand.

Will hybrid natural gas vehicles be able to respond to the challenges of Québec's geography, with its huge distances and steep hills. The future will tell, but one thing is sure, Québec is in an advantageous position to move this technology forward, since it can count on a sound NGV supply chain, a growing RNG sector, and an abundant hydroelectric resource. Altogether, an undeniable advantage for the whole transportation industry!

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1 Source: NGVA Europe.

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