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Trailer-Mounted CNG Fuel Storage System

Gas Network Ireland

Virginia International Logistics

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Trailer-Mounted CNG Fuel Storage System

Project Overview

In order to extend the range of our HGV Tractor Units the only solution is CNG stored underneath (not impacting the payload) of our trailers. Currently we are fitting carbon fibre tanks on our new Iveco HGV tractor units, this initiative extends the range of an OEM truck. These tanks are provided by Hexagon Agility (USA) and fitted in their 3rd party EU facility in Verona, Italy.

Our feet of 130 trucks today are primarily Diesel, we have a desire to migrate to CNG for various reasons. However standard CNG storage on an OEM Truck has limited range, our experience to date across the feet is as follows:

- Iveco twin axil with factory fitted (steel) CNG Tanks: 450 Km
- Scania twin axil with factor fitted (steel) tanks: 450 Km
- Iveco twin axil with Carbon Fibre CNG tanks: 600 Km
- Iveco three axil with Carbon Fibre CNG tanks 450 km

Due to limited range of mileage provided by CNG trucks currently, Virginia International Logistics together with Gas Network Ireland agreed to conduct a project to identify new options to increase the CNG truck range by adding additional CNG storage under the trailer.

Fitting the storage under the trailer will facilitate an additional 250Kg, therefore an adding up to 650 Km to our journey. The proposed cylinder housing will be aluminium 2800mm x 2220mm bolted to the underside of the trailer, weight circa 673Kg. This will facilitate five carbon fibre cylinders of CNG and house all fuelling and safety systems. It will have an operating pressure of 250 bar. This additional storage removes range anxiety for Drivers and Fleet Operators, therefore encouraging more companies to make the switch to CNG as a transport fuel.

Project Design

Design discussions commenced with our partner Hexagon Agility Canada during 2018, when we had concluded an agreement to use their composite tanks on our new Iveco

trucks while maintaining the manufacturers truck warranty. From 2019 all of our Iveco HGV tractor units are now fitted with Agility Composite fuel tanks.

Hexagon Agility is the leading global provider of highly-engineered and cost-effective

compressed natural gas fuel systems for commercial vehicles. Over the last 4.5 years we have found the Agility tanks to be an ideal match for our fleet of 17 Iveco Trucks

Since summer 2020 we have been collaborating with the design team at Agility to develop this first under trailer unit (figure 1) in Europe. Having the additional fuel stored on the trailer solves the capacity issues, but also adds new considerations for the product. The base fuel storage system design comes from the experience of Agility but to utilize the full capacity of the trailer system, there needs to be a fuel connection between tractor and trailer systems. This connection is a new concept and with the articulation between the bodies, a flexible fuel hose solution needs to developed to ensure safe and effective fuel transfer to the engine.

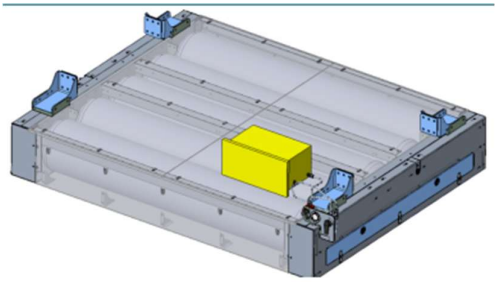


Figure 1: Trailer System

During the development it was decided to split the project into two phases to accelerate field data and experience. Phase 1 would verify the storage system on the trailer chassis and the fuel transfer would be completed while the vehicle is stationary. The fuel would be transferred by way of an external hose (figure 2) connected between the tractor and trailer fill panels. The fuel transfer would be limited to equilibrium between the systems. Phase 2 would add the live fuel connection between the tractor and trailer to consume the full capacity of the fuel system.

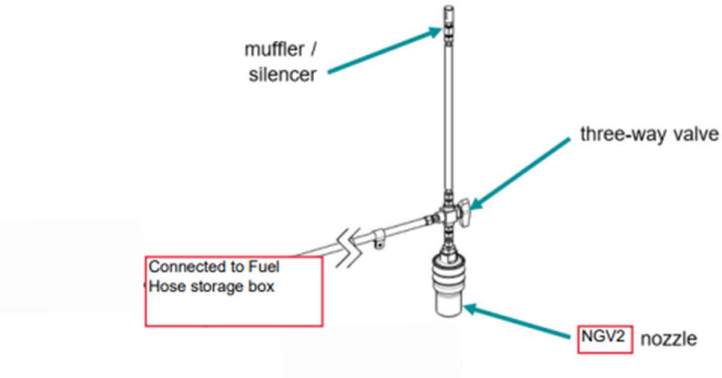


Figure 2: Fuel Transfer Hose

Due to the Covid 19 pandemic the project was delayed during final testing and certification. Final certificates were issued late 2022 and this initial unit was then shipped to Virginia International Logistics, Maghera, Virginia, Co Cavan in December. Opening of a CNG Station on site further delayed final installation which was completed on a curtain side trailer late May ’23 (figure 3)

Figure 3: Fuel system installed on curtain side trailer.

The first prototype installation verified the fitment on the chassis of the trailer (figure 4). The system sits between the trailer axles, stands and side rails. The system was positioned so there is clearance to existing trailer components and so the fuel receptacle panel is fully accessible while the side rails are in the down position (figure 5 & 6). During the installation, it was understood what preparation is required for the chassis and what improvements to the system could be completed to increase the overall fit and function.

Figure 4: Side profile of installed trailer system

Figure 5 Fuel system with side rails up

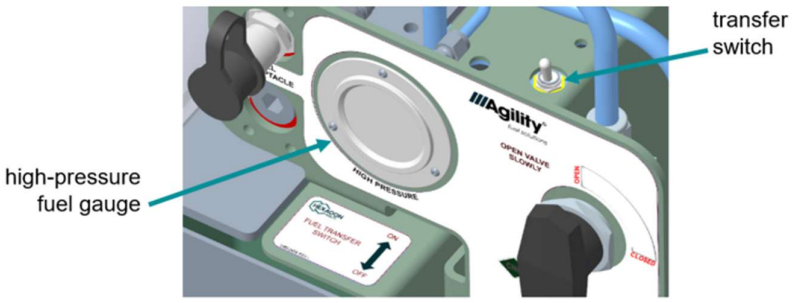
Figure 6 Fuel system with side rails down

Trailer connection system

The connection process is very straightforward, but a first induction and demonstration to the driver is required in order to properly operate the system.

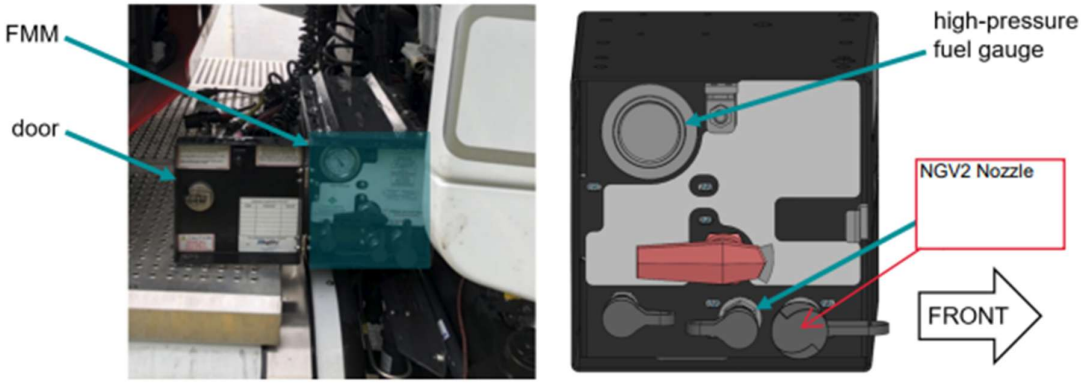
The steps are the following:

1. Turn off vehicle, leave trailer lights on (electricity for the system to operate)
2. Ensure the transfer switch is off

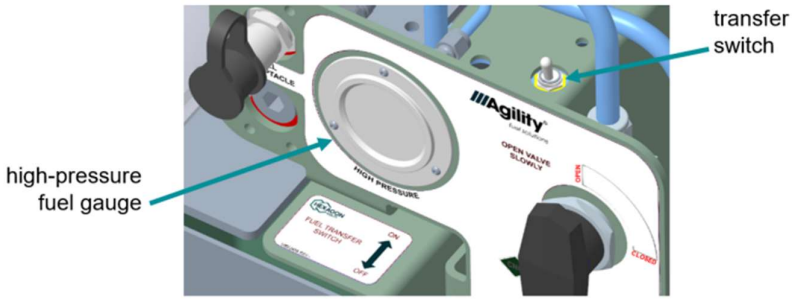


3. Open the box and take the hose for refuelling.

4. Connect the hose to the truck NGV2 nozzle



5. Turn ON the transfer switch on the FMM box



6. Allow CNG transfer until pressure is the same for both under trailer storage unit and the tractor storage unit.

7. Turn off the transfer switch on the FMM box
8. On the hose, turn on the decompressing valve and wait for the decompression to be done.
9. Disconnect the fuel transfer hose from truck and put the hose back in the designated location on the trailer.
10. Close your vehicle FMM.

Figure 7 Trailer system connection

The fuel transfer followed a procedure developed for drivers and was amended based on findings during the initial system installation and fuel transfer test. Modification will be made to the initial unit to streamline the overall procedure & efficiency. Notably, update the fill panel to allow for toolless operation.

Trial description

Equipment:

1. Vehicle used: IVECO Stralis AS460, 6x2,

Gas tank: Fibre

Pressure: up to 300 bar

Gas tank capacity: 160 kg – full

2. Trailer used: Curtainsider – Tigers

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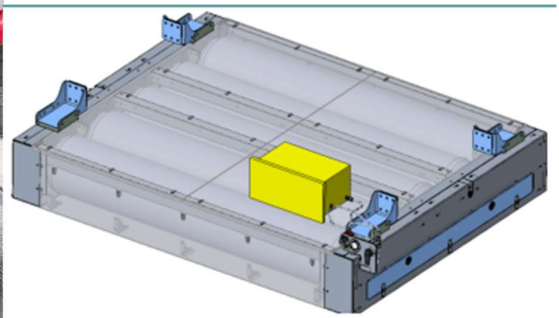
3. Under trailer kg capacity:

Pressure: 250 bar

Capacity: @ 240 kg



Driver: experienced employee with more than 5 years with CNG trucks and CNG refuelling equipment.

Trial description:

Trial date: 19.08.24 – 20.08.24

Start – Finish site: Virginia, Co Cavan

Start Odometer: 320418.6 km

End Odometer: 321276 km

Vehicle fully refuelling from CNG station before starting the trial.

Under trailer storage fully refuelled before starting the trial.

Trial Outcome

Day 1

The trial started on the 19.08.2024 with the vehicle fully refuelled from HQ.

Start Odometer: 320 418.5 km

Travelled km before refuelling needed :310 km

Odometer for refuelling: 320728 km

Vehicle gas pressure at the refuelling:40 bar

Note*: cannot go lower than 40 bar otherwise the truck may have trouble refuelling / not enough pressure for the refuelling process to take place.

Volume refuelled from the trailer storage :90 bar

The trailer storage is refuelling the vehicle for 50 % of his capacity

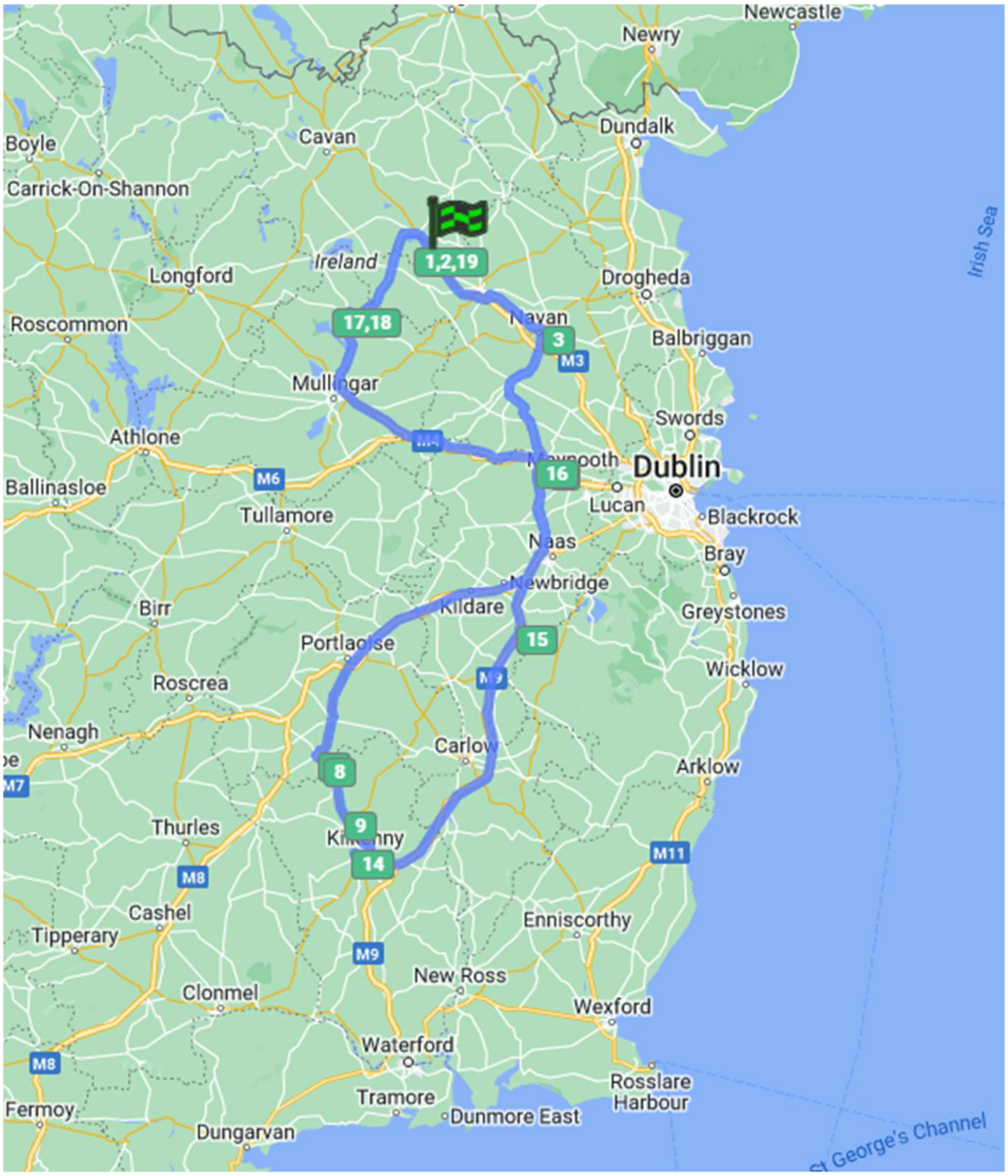
Start odometer after refuelling : 320728 km

Distance travelled after : 99.7 km

Finish odometer for the day : 320828.3 km

Vehicle showing around 130 bar left in the tank.

Return to the HQ - end day 1.



Day 2

The vehicle started in HQ with the vehicle fully refuelled.

Start Odometer: 320828.40 km

Travelled km before bringing the vehicle to same requirements – 130 bar – 116.80 km

Odometer at the time: 320 945.20 km

Distance travelled until refuelling required: 231.80 km

Odometer at the refuelling required: 321 177 km

Vehicle gas pressure at the refuelling:40 bar

Note*: cannot go lower than 40 bar otherwise the truck may have trouble refuelling / not enough pressure for the refuelling process to take place.

Volume refuelled from the trailer storage :90 bar

The trailer storage is refuelling the vehicle for 50 % of his capacity

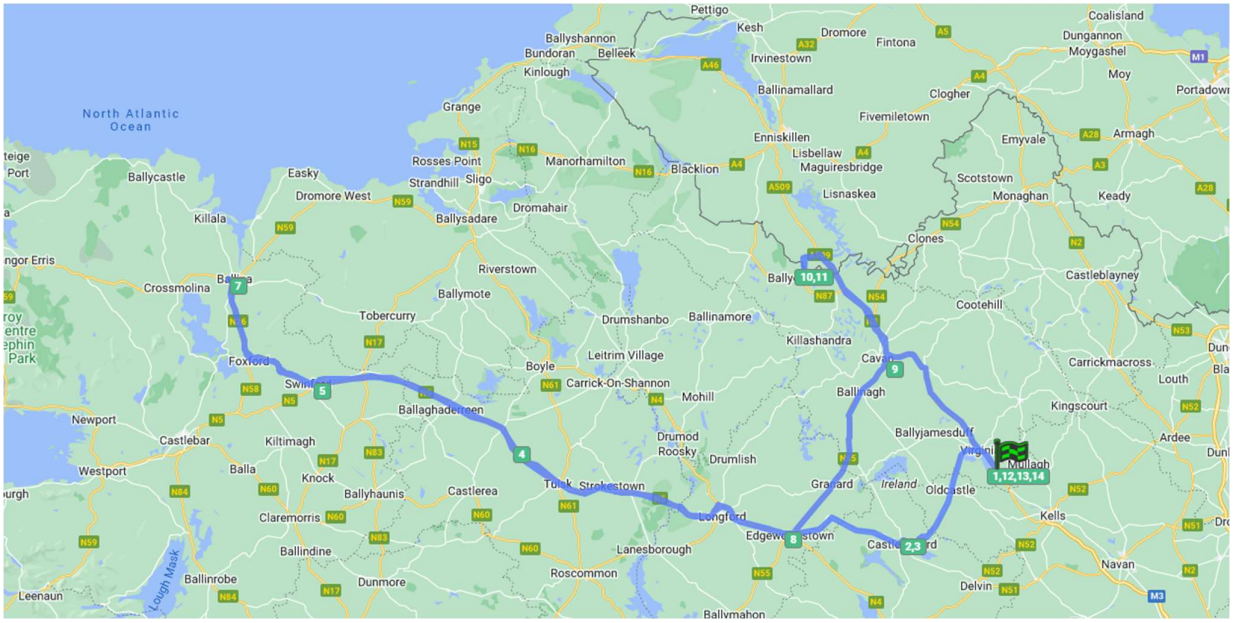
Start odometer after refuelling : 321 177 km

Distance travelled after : 99.5 km

Finish odometer for the day : 321276.5 km

Vehicle showing around 140 bar left in the tank.

Return to the HQ - end day



Project outcome

During the design and fitting phase, a few challengers were noted and changes to the initial project design was done to overcome those challenges:

- ✓ The fill panel design will be updated to allow for a toolless operation of the transfer
- ✓ Streamlining the procedure to simplify the operator fuel transfer steps
- ✓ Determine the best storage location of the fuel transfer hose on the trailer

Once those challenges were overcome, we were able to successfully complete the trial, and the following points are to be noted:

- The preliminary results are showing a distance of around 663 km that can be achieved additionally with the under-trailer storage – but it is a variable result, and it will depend on the weight of the load carried.
- It is a challenge to plan in Ireland to have one trailer allocated to one truck. Usually, a truck will operate between 2-5 trailers during one workday in Ireland. It is more cost effective to drop a trailer to be loaded by the customer and move another one that is loaded to delivery or port or have majority of trailers fitted with under trailer storage tanks.
- The company may allocate the trailer and a CNG truck to a particular run and have it on the same work all the time. This will reduce the possibility of error when planning for other jobs and any mistakes from an operator (driver) side.
- Based on the location, the trailer may be used for an export. UK have a developed CNG infrastructure, and the driver will be able to refuel both truck and trailer, but the continent is still behind the technology required, which means the trailer will not be useful on export loads.
- Currently, there is no visibility on the actual volume stored under the trailer, unless the driver is visually checking pressure. Which means, when planning a trip, we may not have the accurate volumes of storage at the time, and the trip may become a failure, and a rescue cost and delays may occur due to inaccurate data.

Project Evolution

Although the project showed a considerable increase in the range of the CNG Vehicle, due to the points that we highlighted in the project outcome, we as a company believe that the under trailer storage is not a solution for a company that operates in multiples countries, different equipment and a wide range of industries with specific requirements.

This however may be a solution for a one man company or a company that has set runs to undertake and falls under the km range (additional 663 km as showed by the trial).

We do believe that as the alternative fuel market evolves, the industry is gaining additional insight into the challenges and limitations of the CNG vehicles. The main challenge and what is addressed above with the trailer system, is the usable fuel / range of the tractor unit. As the evolution proceeds, the market is starting to accept & explore options outside the confines of the normal operation to accommodate solutions for these challenges. The space limitation of additional fuel on the tractor unit is being put into question.

OEMs are exploring the option of putting CNG fuel behind the cabin of the tractor unit. This allows them to add additional range to the vehicle while being all contained on the tractor. The drawback is that the overall length of the vehicle would need to grow to accommodate this space behind the cabin. As legislation has limitations to the overall length and turning radius of the tractor – trailer combination, these need to be taken into consideration. Exemptions to these limitations are being explored by policy makers to allow alternative vehicles with sufficient range to increase adoption. In parallel, Hexagon Agility is exploring options in the already existing legislation which allow for longer HGVs to be deployed ahead of the overall adoption and mass production of the new vehicle configurations by the OEMs.

With the possibility to add an CNG Storage Tank fuel on the tractor, it is proposed to focus the second stage of this project to a “Behind-the-Cab” (BTC) system. This will increase the range of the vehicle by having more fuel onboard and is possible to use more of the fuel with respect to the trailer equilibrium transfer. With certain combinations of fuel systems provided by Hexagon Agility, CNG/RNG HGVs can achieve diesel-like driving range. This turns CO2-neutral HGVs into a viable and attractive solution and enables 1:1 substitution of diesel HGVs by fleets, which hasn’t been entirely feasible until now. Additionally, the new location of the tanks will simplify the system as fuel transfer / connection hoses from truck to trailer would not be required. Hexagon Agility has proven BTC systems designed and could be implemented on tractor units today.

The additional fuel will be visible to the driver and we may even explore a system to show live data through our tracking software.

The challenge around the trailer drop and trailer swap to accommodate business needs will also be eliminated as the additional storage will be linked to the truck itself.