

Deliverable T2.3.1

Report on monitoring and end-user experience data per demonstration

Project Information	
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Deliverable Information	
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1. General

Evidence from the logistics sector shows a strong growing interest in reducing environmental impact through the use of zero-emission vehicles. This is particularly the case for the EU, where the logistics sector contributes 25% of total transport sector CO₂ emissions. While battery electric trucks can operate efficiently in urban areas, hydrogen technology has a key role to play in zero-emission logistics over longer distances. Heavy-duty vehicles with a fuel cell range extender - while not yet commercially available in the EU - have huge potential. While opening a new market, it can also contribute to green transport solutions by reducing carbon emissions and improving air quality.

The project H2-Share aims to unlock this potential and will join forces beginning with four front-runner NWE regions in the three member states (BE, NL, DE) experienced in hydrogen technology. (H2-Share stands for 'Hydrogen Solutions for Heavy-duty transport Aimed at Reduction of Emissions in North-West Europe'.) Based on the project partners' experiences and contacts with innovative end-users, one 27 ton rigid truck run on hydrogen and one flexible low energy mobile refueler will be built and tested.

These will be developed in collaboration with important end-users involved in different regions. A demo plan will be created through the joint effort of sectoral agencies to ensure maximum involvement of regions, end-users, associations and other stakeholders. These demonstrations will build strong visibility, joint experiences and public awareness around hydrogen solutions in heavy-duty transport. They will also develop a joint roadmap for NWE.

The goal is to facilitate wider implementation of transnational low-carbon transport solutions. By activating this market, North West Europe will become a leader in Europe for zero-emission heavy-duty transport.

More information on the H2-Share project can be found on the website:

<http://www.nweurope.eu/projects/project-search/h2share-hydrogen-solutions-for-heavy-duty-transport/>

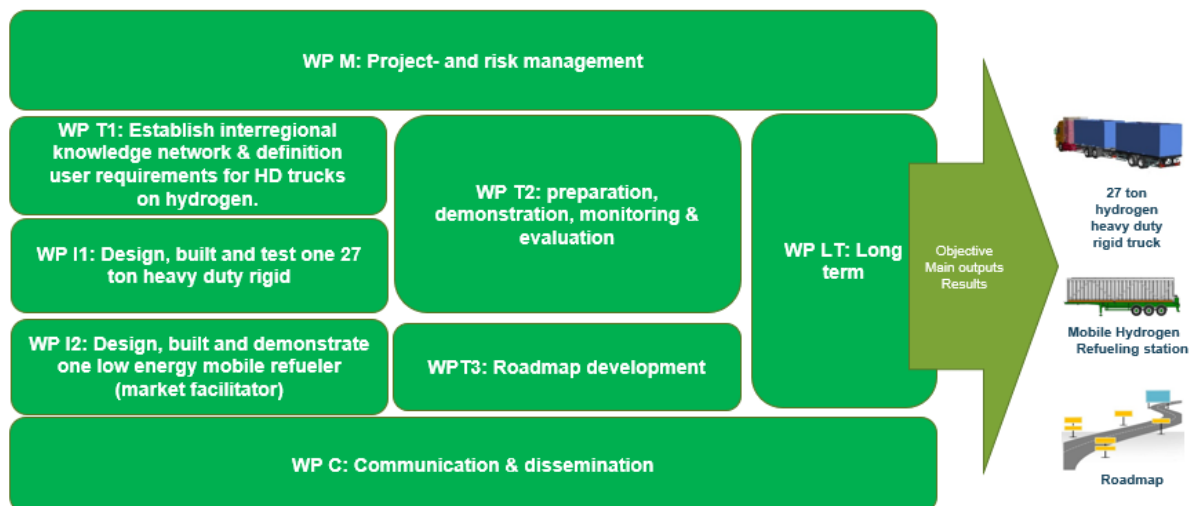
The H2-Share project is structured around different workpackages which is shown in the picture.



Foto 2: The 27 ton electric rigid truck with hydrogen range extender refueling at the mobile refueler.



Foto 1: The mobile hydrogen refueling station.



This deliverable is part of workpackage T2 of the H2-Share project. This workpackage is about the demonstration of the truck and hydrogen mobile refueling station which serves as a market facilitator.

This deliverable is a report which describes the experiences and learnings based on a final evaluation meeting. We collected this information from partners and the main end-user of the vehicle, Breytner Zero Emission Transport. Breytner used the truck from April-June 2020.

Other deliverables in this workpackage are:

T2.1.1	A demonstration program with planning of specific demonstrations for all locations
T2.2.1	A demonstration plan and checklist per location
T2.3.1	Report on monitoring and end-user experience data per demonstration
T2.4.1	Small peer review evaluation workshop and report on results, conclusions and recommendations per demonstration
T2.4.2	Comprehensive report on monitoring data, learnings and recommendations of all demonstrations
T2.4.3	Closing workshop on demonstration results

1.1 Objective

This deliverable is a report based on a evaluation workshop (June 23, 2020). The workshop is part of deliverable T2.4.1 and that's why deliverable T2.3.1 and T2.4.1 are combined. We collected experiences and learnings from partners and the main end-user of the vehicle. In this case, Breytner Zero Emission Transport used the truck from April-June 2020.

The main objective of this report is:

- To collect and report on experiences and lessons learned from the demonstration of the truck and the use of the hydrogen mobile refueler.
- Formulate 'tips and tricks' for next demopartners

1.2 Operational profiles

Breytner Zero Emission Transport targeted three different deployments/use cases for using the truck:

1. line haul from Schelluinen to Rotterdam. Goods are transported from Schelluinen to feed Swap Bodies located in Rotterdam. These swap bodies are then used by an battery electric truck to deliver goods in the city.
2. line haul to a logistic hub in the region of Brabant (deliver & pickup swap bodies)
3. product return flow from customer. This became less due to Corona which impacted amount of driving days.

2. Experiences and lessons learned

In this chapter, we present in bulletpoints the main lessons learned concerning the truck and mobile refueler. We will also present a list with some practical advices.

2.1 Experiences with the truck

- Due to Corona measures, the mobile refueler could not be installed in time and Breytner decided to refuel at the Air Liquide station in Rhoon/Rotterdam (The Netherlands). This station was allready chosen as a plan B possibility.
The drivers experienced a broken part of the truck refueling tankcover. It looked like there was a malfunction so personell from Air Liquide and VDL came to the station. In the end, it was only the tankcover not closing properly enough.



Foto 3: A driver is refueling the truck at the refueling station of Air Liquide in Rhoon (nearby Rotterdam).

- From the start of the demonstration, it was not clear which minimum truck tankpressure was needed in order to refuel at the station in Rhooen. Hydrogen refueling stations normally are bounded by a minimum tankpressure setpoint in order to refuel. This setting can be changed remotely. We advice to check this first with the station owner.

- Breytner also refueled at the 'WaterstofNet' station in the city of Helmond (South of The Netherlands). According to Breytner, this has proven to be a reliable station during the demonstration.

- Breytner experienced difficulties with putting swap bodies on the truck. They need a flat surface for this. Therefore, Breytner started with return flows from around 6 cities where they have a flat surface. The hub in the Brabant region doesn't have a flat surface so only Rotterdam was chosen. This operational profile is called a combined return flow with line haul to Rotterdam.

- Breytner once drove to their customer in the city of Heerlen (region of Limburg) which was a very good 'use case' because of a longer route. Normally, this trip takes 4,5 hours with diesel for 340 kilometer.

Unfortunately, the fuelcell couldn't catch up with the energy requirement of the truck for this route and it took over 7,5 hours; the truck had to park for 3 hours to recharge the battery. The net capacity of the fuelcell is only 60 kW.

- Using the truck on the highway gives you 100 km range with battery capacity. When you arrive at the destination it's advisable **not** to shut down the truck so the battery can be recharged by the fuelcell.

- It's important to have trained drivers from the beginning and that drivers can call service people who are always accessible. A very unambiguously and simple instruction is necessary to train the drivers. Also consider that drivers can be young, less experienced and for example have never talked, or had conversations, with engineers/service people. So this could create some extra tension for them. A confident driver is important because, when problems arise, you must not start to panic. It might be wise to offer a kind of a 'facetime' solution to help the driver remotely.

- The procedure to start the truck takes around 15 minutes and is too long. Due to this start-up time, Breytner experienced some problems at the refueling station because other people needed to wait first until the truck finished start-up procedure and could drive away.

- It's difficult for the driver to know the remaining driving distance. How to instruct the driver how far he can get with e.g. 100 bar hydrogen pressure and 60% SOC battery? The end-user needs to receive an instant number for the range in relation to the SOC of the battery and amount of H₂.

- The fuelcell range extender construction is big and the driver noticed he is losing some sight.

- There is pretty much heat coming from the range-extender if you're standing next to it.

- The fuelcell range extender and the system around (mainly cooling) makes some noise. The feedback in general from people at the depot was they actually didn't really understand. It could



Foto 4: Truck refueling at the hydrogen station owned by WaterstofNet in the city of Helmond.



Foto 5: Drivers of Breytner Zero Emission Transport are being educated and trained.

be that night delivery will be complicated because of the noise. According to VDL, the sound from the system has been tested and homologated for public road usage. You need to use the fuelcell during operation. The driver from Breytner experienced that other truck drivers, who were sleeping, woke up from the noise of the system.

- It's advisable to install a radio in the truck. Also cruise control was missing.
- Breytner experienced a very good service and reaction time from VDL due to a few malfunctions mainly in the beginning of the demonstration.
- VDL learned they need to be at the demolocation for 1 week in order to help the customer directly.
- For VDL, Breytner was a very good and flexible demonstration partner. It created a good learning curve for VDL.

2.2 Experiences with the mobile hydrogen refueler

- The mobile refueler started later because of the development and setup of the total system and the Corona measures from Germany. During the test phase at the location of Wystrach in Weeze, they experienced some difficulties. The pressure regulator was broken. When they were allowed to move to Schelluinen, they needed to fix this at the location.
- The refueling of the storage container in Antwerp experienced some difficulties because of the needed air pressure for the valves in order to couple with the Air Liquide fueling system. This has been solved a day later.
- The total system was setup in 2 days which demonstrated flexibility and speed of installation and experienced very good support from the team of Vlot Transport and Breytner.
- In May 2020, engineers from Wystrach were allowed again to go to Schelluinen and stayed for 3 days to improve software and refueling the truck stepwise. Since installation and a couple of tests, the station has been used by Breytner for about 2 weeks in full automatic and full operational mode. This was a big success.
- Regarding the permitting process, this was received very quickly. Of course, relevant information needed to be collected far before the official submission of the permit. But after that, it took some 8 weeks. Due to Corona, we needed to postpone the demo a few times. Therefore, the permit end date was postponed 2 times with great flexibility and success thanks to the regional environmental organisation (Omgevingsdienst Zuid-Holland Zuid)/Jeroen Fleurkens). The permit has in the end never been a risk which surprisingly most of the time is not the case for a lot of EU funded projects.
- The 'Omgevingsdienst Zuid-Holland Zuid' found a solution to decide on a short term period to provide a permit for max 6 months. In the law it's written that if you want to deliver hydrogen for more than 6 months, you need to go through a longer permitting period for receiving a fixed permit. Now the authorities could decide much faster and for max 6 months because this was a demonstration for a short period.
- It's important to engage with different authorities in early stage. Authorities are not familiar with hydrogen. The first question is about safety and what you're planning to do.
- Learning and experiences from the permitting process are being spread by the 'Omgevingsdienst Zuid-Holland Zuid' to other environmental organisations. This is very good thing.

2.3 Practical & operational advices

- It's important to have a list of all relevant contact persons in the truck who could be needed during operations.
- To prevent freezing windows, use plug with electricity connection.
- Watch out for the number plate lights, they stick out a little.
- Truck has a large turning circle.

- When docking, pay attention to immobilizer (wegrijbeveiliging/ Wegfahrsperrre).
- To safe the mudguards, pay attention to the chassis height, install air suspension a bit higher and control the rear axle is down.
- The starting procedure is something to pay attention to. One wrong procedure makes you have to wait long.
- Take of handbrake only when you enabled E-drive. Or else you'll get a malfunction.
- The truck can be cleaned in a 'truck wash' but you need to switch of the fuelcell range extender with button #1.

Annex 1: Procedure opstarten en afsluiten truck



Waterstoftruck H2-Share

Procedure opstarten en afsluiten truck.

Opstarten:

1. Elektriciteit van truck af. De brandstofcel dienst 's nachts verwarmd te worden (nachtvorst) en staat aan de stekker. Stekker uit t stopcontact, daarna uit het | voertuig. Verlengsnoer kan op parkeerplaats blijven liggen. Klepje waar stekker inzit goed sluiten anders start truck niet!
2. Contact op stand 2 zetten, het systeem (dashboard) start op (handrem erop laten staan)
3. Chauffeurskaart in de tachograaf doen
4. Bij melding 'E-drive inschakelen' dan contact van stand 2 naar stand 3 (handrem erop laten zitten)
5. De brandstofcel slaat aan
6. Handrem eraf, Inschakelen R, uit parkeerplaats rijden, pionnen op parkeerplaats terugzetten zodat plek gereserveerd blijft

Als de handelingen te snel achter elkaar gebeuren dan start de truck niet en duurt het 15 minuten voordat je het opnieuw kunt proberen. Volg de instructie dus tot op de letter.

Tijdens het lossen de truck laten draaien. In Neutraal zetten. De brandstofcel vult het batterij-pakket bij.

Afsluiten:

1. Parkeer de truck op de parkeerplaats
2. Handrem erop, en in Neutraal
3. Schakel het contact terug van 3 naar 2, het system schakelt zich uit
4. Chauffeurskaart uit tachograaf
5. Dan van stand 2 helemaal uit.
6. Het klepje van het tanken en de stekker, aan de chauffeurszijde, gaat open door de pal omhoog en omlaag te bewegen die er aan de onderzijde uitsteekt . Verlengsnoer pakken en stekker aan chauffeurskant erin doen, daarna in stopcontact parkeerplaats.
7. Truck afsluiten en sleutel opbergen in de chauffeursruimte bij het desbetreffende kenteken.

Bijlage: Procedure tanken bij tankstation Air Liquide in Rhoon



Waterstoftruck H2-Share

Procedure tanken bij Air Liquide in Rhoon
Groene Kruisweg 397 Rhoon

1. Check 15 minuten voor aankomst of je minimaal 20% batterij hebt (SOC). Indien ja, zet dan de brandstofcel uit door op knop 1 te drukken. (rechts van dashboard). Hiermee schakel je de brandstofcel uit en kan deze het system afsluiten zodat je niet 15 minuten moet wachten alvorens te kunnen tanken.
2. Bij aankomst station, soorteer niet voor bij de pomp aan de rotonde. Deze is wel voor bussen en trucks maar functioneert niet goed, rijd verder naar het overdekte vulstation
3. Druk op knop 2 om de klepjes (aan weerszijde truck worden ontgrendeld) te openen.
4. In de groene map zit de pinpas en de pincode om te kunnen vullen
5. Voer pas en pincode in en kies als product 350 bar bus en negeer de vraag voor een bon want die geeft het apparaat niet
6. Pak vulpistool (voorzichtig, is erg storingsgevoelig) en Koppel aan truck, 1 slag draaien en vergrendelen met systeem. Check of de slang er goed aan vast zit
7. Druk op het pompstation op start
8. Truck gevuld? – Koppel slang af en hang voorzichtig terug. Pistool goed vastklikken in houder
9. Beide klepjes aan bijrijders kant en chauffeurskant goed sluiten
10. Logboek in groene map bijwerken – hoeveel gevuld, en of er problemen zijn?
11. Truck opstarten volgens procedure