Green Inland Ports

Good Practices

Funded by
the European Union

Alternative fuel stations for road transport

Alternative fuel stations for road transport

1.1 Description

As outlined in the European Green Deal, the European Union is aiming to reduce greenhouse gas emissions by 90% by 2050 (European Commission, 2021). As road transport constitutes the highest proportion of overall transport emissions, emitting around 76% of all EU's transport GHG emissions in 2021 (EEA, 2023a), efforts should be put into making road transport more sustainable.

In the EU-27, electric car registrations have steadily been rising over the past years (EEA, 2023b), proving that electric vehicles are promising alternatives. The expectation is that battery-electric vehicles will be sufficient for a large share of heavy-duty road transport. For vehicles that are not substitutable by battery-electric vehicles, it is important that investments are made in other alternative fuels, such as hydrogen and sustainably produced carbonaceous fuels (e.g. biodiesels, biogas) (TNO, 2023). Multi renewable energy stations for road transport improves the infrastructure for cleaner fuels for road transport, thus making them more attractive alternatives. Currently, HVO100 (pure HVO fuel, no blend) is a well-known substitute for diesel, with the benefit that it is a drop-in fuel, and the engine does not need to be retrofitted. Pilots have been executed with hydrogen for road transport. Currently, it is not being used on a large scale, as the technology is still very expensive, but could be a solution for the future when hydrogen vehicles and hydrogen as a fuel fall.

In the port of Lyon, six renewable energy stations (two clean hydrogen-, two green electricity- and two biogas-dispensers) are under construction, which will meet the needs of all kinds of mobility, such as personal cars, transport fleets and urban transport vehicles for goods, waste or materials. This plan has received funding from the Fuel Cells and Hydrogen Joint Undertaking, which is supported by the European Union's Horizon 2020 program, Hydrogen Europe and Hydrogen Europe Research (McPhy, n.d.).

In the port of Basel, there are currently two hydrogen (H2) fuel stations. It has been initiated by two companies within the port area that have 50 hydrogen trucks running. However, apart from 50 trucks there are not many other users of the hydrogen fuel stations due to the high price of hydrogen compared to alternatives. The port of Basel is currently building a 15 MW electrolyser within the H2 hub project (Roethlingshoefer, F., 2023). When hydrogen is produced within the port area, it may have a positive effect on hydrogen supply and hydrogen price within hydrogen stations.

1.2 The aim of an altenative fuel station

The goal of a renewable energy station is to facilitate renewable fuels for third parties but can also be used for port authority's own use. The main goals are to reduce the emissions of greenhouse gases and air pollutants.

1.3 Inland ports with alternative fuel stations

- Compagnie Nationale du Rhône (port of Lyon)
- Port of Den Helder
- Port of Switzerland (Basel)

1.4 Stakeholders

- **The port authority:** The port authority is responsible for the management of the area. They must give approval and might even have to take (part of the) responsibility of the renewable fuels' infrastructure.
- **Companies within the port area**: When there is sufficient demand for alternative fuels, such as hydrogen, a fuel station can be created. Companies are the main parties purchasing alternative fuels and they must show the port authority that there is a high demand for alternative fuels.
- **Owner and operator of an alternative fuel station**: to supply alternative fuels to the companies which demand fuel, a final and crucial stakeholder plays a big role: the owner and/or operator of the fuel station. The owner will also need to make an investment in the fuelling station's infrastructure so that vehicles are able to fuel.

1.5 Voluntary or mandatory

To comply with European rules and regulations long-term, it is necessary for transport and logistic-intense areas to facilitate a switch to alternative fuels, which can be realised through alternative fuel stations. However, it is not currently mandatory to implement and based on the amount of renewable energy stations that receive funding, the ports that invest in renewable energy stations can be classified as first movers.

1.6 Realised/potential impact

The case within the port of Basel shows that the realisation adoption of a renewable energy station can have a supporting role on the type of vehicles companies within the port area would invest in (Roethlingshoefer, F., 2023). Yadav, J. et al., (2023) have tested the effect of four different renewable fuels (70% Diesel/30% Octanol blend, 100% Octanol, 60% B0-Diesel/40% RF blend, and 93% REDIFUEL /7% Used Cooking Oil Methyl Ester) or fuel blends on heavy-duty engine performance and raw emissions. The results show that all renewable fuels lead to a GHG emission reduction potential of around 2.5% to 5.5% in the Tank-to-Wheel analysis. In the case of the port of Lyon, the hydrogen and electricity dispensers have the potential to be emission free, depending on the source of electricity or whether green hydrogen is being used. According to CNR, (2019), CNG (an alternative fuel mainly composed of methane) can decrease NOx by 50%, lower PM emissions by 90% and lower CO2 emissions by 20%, and even 75% if the CNG when bioCNG is used, compared to gasoline.

According to CE Delft, (2023b), (battery-)electric and hydrogen vehicles do not emit Tank-To-Wheel (TTW, tailpipe emissions) CO2-eq. emissions. Depending on the cleanliness of electricity

that is being used, the Well-To-Tank (WTT, emissions from production and transport of the fuel) CO2-eq. emissions can range anywhere between 0 and larger than the WTT emissions of its diesel counterpart, but in general, the total Well-To-Wheel (WTW, total emissions combined) CO2-eq. emissions of hydrogen and (battery-)electric vehicles are significantly lower than its fossil diesel counterpart. Also, the total WTW emissions for HVO100 as a fuel (both Tank-To-Wheel and Well-To-Tank combined), the emissions are significantly lower than for its fossil diesel counterpart. For the "average" car this means that HVO100 emits almost 10 times less CO2-eq. emissions compared to fossil diesel.

1.7 Possible obstacles

- When you are investing in a renewable energy station, the port would like confirmation that the hydrogen station would be used for road transport, but companies within the port area wish to have certainty before investing in hydrogen vehicles, which leads to a chicken and egg situation (Van Santen, A., 2023). However, when the initiative is being suggested or supported by companies within the port company and there is certainty that sufficient hydrogen vehicles will be purchased and the hydrogen station will be set up, this problem could be prevented (Roethlingshoefer, F., 2023).
- The electric utility grid has been well developed due to its long-standing character. However, this is not the case for hydrogen and will require focused planning and coordination among stakeholders in government, industry and investors.
- For many transportation applications, electricity is already cost competitive. However, studies estimate that for hydrogen, a transition period of perhaps 10 to 15 years will most likely precede (Greene, D. L. et al., 2020).
- Regarding electricity as renewable fuel: electricity grid congestion, which poses a problem in many European countries, can form an important obstacle for large scale electrification of vehicles (CE Delft, 2023a).

1.8 Key learnings

- Due to ports being transportation hubs, there is large potential in making transportation flows more sustainable by using renewable fuels. When (inland) ports are trying to become an energy hub, it would be very useful to set up renewable fuel stations to take care of the supply of renewable fuels.
- Ports are often wary with when investing in renewable fuels infrastructure. This can be viewed as a 'chicken and egg' problem as ports want to see sufficient zero-emission vehicles in the port as a confirmation that there is enough demand for a renewable fuels station, but companies would rather wait to invest in zero-emission vehicles until the infrastructure surrounding renewable fuels infrastructure is more advanced. This problem can be solved with strong public-private partnerships between companies and the port authority.

1.9 Sources

CE Delft, 2023a. Mitigerende maatregelen in de praktijk. Oplossingen voor netcongestie voor elektrische logistieke voertuigen, Delft: CE Delft

CE Delft, 2023b. STREAM Personenvervoer. Emissiekentallen modaliteiten 2022, Delft: CE Delft

CNR, 2019. Quai des Énergies, Lyon: France.

EEA.2023a. Greenhouse gas emissions from transport in Europe, European Environment Agency https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-from-transport

EEA.2023b. New registrations of electric vehicles in Europe, European Environment Agency https://www.eea.europa.eu/en/analysis/indicators/new-registrations-of-electric-vehicles

European Commission, 2021. Sustainable & Smart Mobility Strategy, Brussels:

Greene, D. L., Ogden, J. M. & Lin, Z., 2020. Challenges in the designing, planning and deployment of hydrogen refueling infrastructure for fuel cell electric vehicles. eTransportation, 2020.

McPhy.n.d. Hydrogen ecosystem at the heart of Lyon's metropolis, https://mcphy.com/en/achievements/hydrogen-mobility-en/quai-des-energies/?cn-reloaded=1.

Roethlingshoefer, F., 2023. Interview Port of Switzerland (Basel) 16-11-2023.

TNO, 2023. The potential of e-fuels for heavy duty road transport in the Netherlands, Den Haag: TNO

Van Santen, A., 2023. Interview Port of Den Helder 22-6-2023.

Yadav, J., Deppenkemper, K. & Pischinger, S., 2023. Impact of renewable fuels on heavy-duty engine performance and emissions. Energy Reports, 2023, 1977-1989.