Refuelling and charging requirements Clean Energy Hub

Summary

The Clean Energy Hubs (CEH) programme intends to realise a nationally aligned network of refuelling and charging stations in the Netherlands for heavy road transport and inland navigation, providing two or more renewable energy carriers ('Clean Energy Hubs') by 2050. However, it is still uncertain exactly what shape the mix of energy carriers for heavy road transport and inland navigation will take in the future. To avoid a mismatch between the actual energy mix and refuelling and the charging infrastructure in the Netherlands, the Clean Energy Hubs programme asked CE Delft to investigate how many charging and refuelling points are expected to be needed to meet European and Dutch policy targets by 2030.

Refuelling and charging infrastructure for trucks

We conclude that a large number of new charging points are needed for battery-electric trucks. This is prompted, on the one hand, by regulations and targets concerning the supply of renewable energy carriers, as laid down in the Annual Renewable Energy Obligation for Transport (Jaarverplichting Hernieuwbare Energie Vervoer), the Climate Agreement (Klimaatakkoord) and the upcoming EU Renewable Energy Directive (RED III). On the other hand, the proposal for the new EU Alternative Fuel Infrastructure Regulation (AFIR) contains requirements for a minimum amount of charging infrastructure.

Exactly how many additional hydrogen stations are needed is a lot more uncertain. The implementation of RED III plays an important role in this context, such as how the Renewable fuel of non-biological origin (RFNBO) target will be met, as well as the availability of hydrogen-powered vehicles. The expectation is that a moderate to high number of additional LNG, bio-LNG and Hydrotreated vegetable oil (HVO) refuelling points will be needed. The number depends on the choices made by the market to meet RED III targets by 2030: electric or biofuels. HVO refuelling points have the advantage that they are relatively easily realised with the existing diesel infrastructure.

Scenarios 2030

This study was based on an overview of the current situation regarding the refuelling and charging infrastructure in the Netherlands, policy objectives and other factors influencing the development of the refuelling and charging infrastructure between now and 2030. Five scenarios were then drawn up and a mathematical model was used to determine the need for public refuelling and charging points for renewable energy carriers for trucks in 2030.

The scenarios (see Figure 1) meet the policy targets included in the Annual Renewable Energy Obligation for Transport, RED III and the Climate Agreement. The baseline scenario follows the assumptions of the Dutch Climate and Energy Outlook (KEV 2022). Scenarios A to D have higher renewable energy deployment in order to contribute to meeting expected

European RED III targets[1]. Scenarios A and C assume increased electricity consumption by trucks; Scenarios B and D assume the deployment of more biofuels. The deployment of hydrogen by trucks and the contribution that trucks thereby make to the RFNBO target varies between the scenarios (see Figure 2).

Figure 1 - Scenario overview

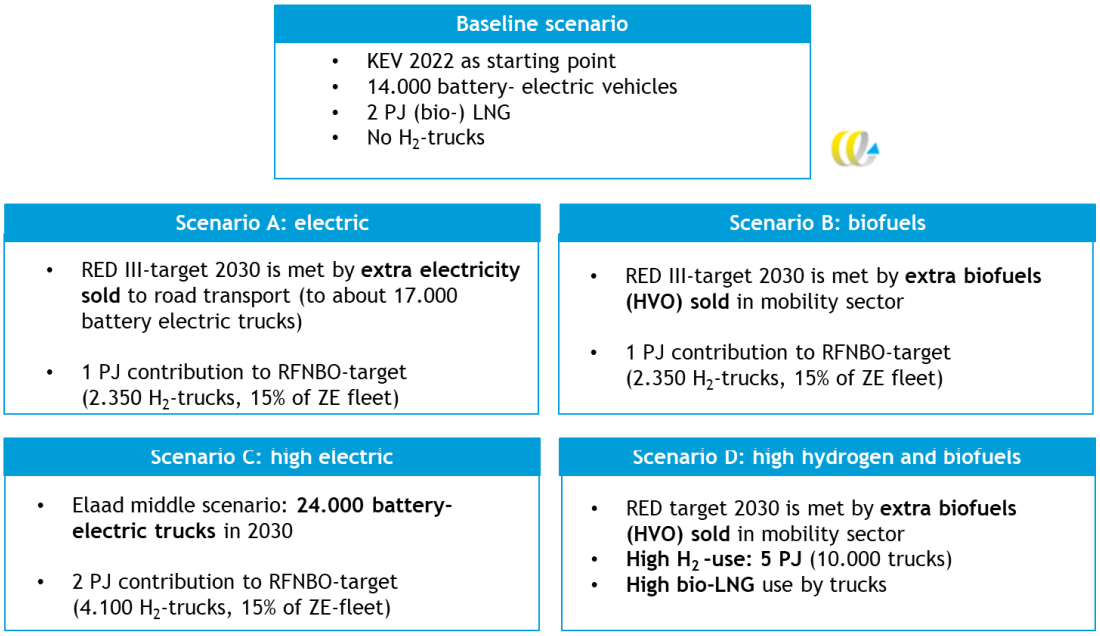


Figure 2 - Overview of energy carriers per scenario in the Netherlands

Fuel sales in 2030 based on KEV 2022					
Biofuels in B7	6,7 PJ				
HVO100	7,3 PJ				
Electricity	3,55 PJ				
Hydrogen	0 PJ				
(Bio)-LNG	1,96 PJ				
Extra sales in scenarios	**Baseline scenario**	**Scenario A**	**Scenario B**	**Scenario C**	**Scenario D**
HVO100			+ 6,7 PJ	- 2,9 PJ	+ 6,7 PJ
Electricity		+ 0,6 PJ		+ 2,42 PJ	
Hydrogen (RFNBO)		+ 1,2 PJ	+ 1,2 PJ	+ 2 PJ	+ 5 PJ
Bio-LNG					+ 1,1 PJ

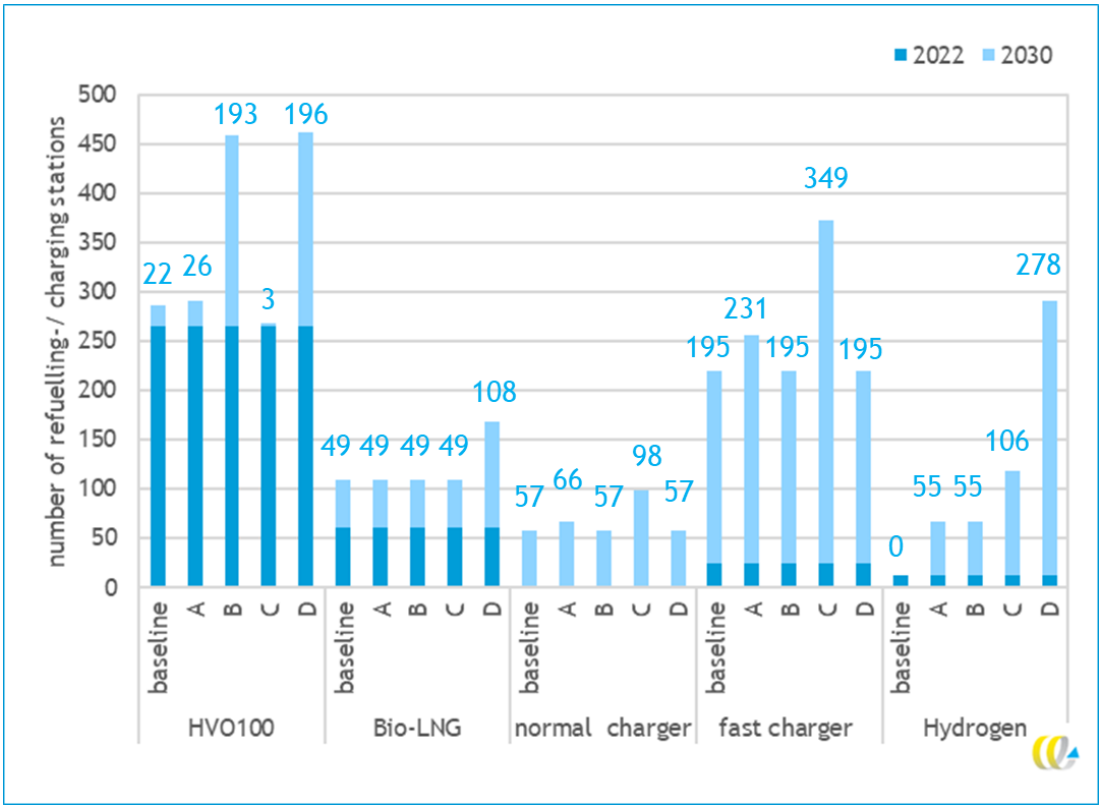
To achieve sufficient sales of renewable energy, all scenarios will require a significant proportion of newly purchased trucks to have alternative technology, such as battery-electric, fuel cell or LNG by 2030. In the baseline scenario, on average 20% of new vehicles are affected, while in Scenarios C and D this is about 33%.

1 RED III is still under negotiation and a Commission proposal is currently on the table.

For each scenario, we calculated the additional need for refuelling and charging points in the Netherlands in 2030 compared to 2022, broken down by energy carrier and province (see Figure 3). The results show the following:

1. HVO100 or other HVO blends require few additional refuelling points in the baseline scenario. The same applies to Scenarios A and C, which rely on the deployment of additional electric trucks. If additional biofuel is deployed (Scenarios B and D), the number of refuelling points for HVO should almost double.
2. In all scenarios, there is a need for a relatively large increase in the number of charging points. In the baseline scenario and Scenarios A, B and D, about 60 publicly accessible regular chargers (150 kW) and 200 fast chargers (350 kW) are needed for 14,000 to 17,000 battery-electric trucks. In Scenario D, nearly 100 regular and 350 fast chargers are needed for 24,000 trucks. The number of chargers may be lower if higher capacities are assumed.
3. If trucks are going to contribute to meeting the RFNBO targets of RED III (Scenarios A to D), a considerable growth (increase from 55-278) of hydrogen refuelling points will also be needed. Scenario D assumes the largest contribution of trucks (5 PJ) to the total RFNBO target in RED III (estimated at 27 PJ). This scenario calls for substantial growth of hydrogen-powered vehicles, with an average of 12% of new trucks purchased by 2030 to be hydrogen-powered vehicles. This does not seem easily achievable as there are currently very few hydrogen-powered trucks on the market.
4. Extra charging and refuelling points are particularly needed in provinces, where there are important freight corridors connecting the seaport to the hinterland, such as the provinces of Gelderland, North Brabant and South Holland.

Figure 3 - Overview of existing (2022) and required (2030) refuelling and charging points by scenario



* The figures indicate the extra charging points needed, in addition to the existing charging points (dark blue).

In the context of Fit for 55, the European Commission's Alternative Fuel Infrastructure Regulation (AFIR) proposal (EC, 2021) established obligations for the minimum number of charging points and hydrogen stations (there are no additional requirements for other renewable fuels). The number of fast chargers required in all scenarios is of the same order of magnitude as required by the AFIR and best matches the ambitious electric Scenario C. The number of regular chargers (100-150 kW) required by AFIR is a lot higher than follows from the scenarios. It is therefore recommended that chargers be realised as far as possible in locations that also meet AFIR requirements. The number of hydrogen stations required by AFIR is in line with the baseline scenario and Scenarios A and B. Scenarios C and D require many more hydrogen stations.

Table 1 – Comparing AFIR proposal with scenario results

	Number of charging/refuelling points in 2030 (existing + new) in scenarios	Number of charging/ refuelling points required according to the AFIR proposal under negotiation	Explanatory note on AFIR
150 kW chargers	57-98	200-488 (100-150 kW)	44 rest areas with 4 chargers á 100 kW (176) and 2-26 urban hubs with 12 chargers á 150 kW each (24-312)[2].
350 kW chargers	219-373	347	Every 60 km on TENT-T core network (243 chargers) + every 100 km on extended network (104 chargers).
Hydrogen	12-290	13-37	At every 200 km Core + extended network (11 refuelling points) and at urban hubs (2-26 refuelling points). Assumption: 1 point per station.

Source: (TNO, 2021a), with an update on the latest insights regarding the AFIR negotiations.

Refuelling and charging infrastructure for inland navigation

Finally, we also looked at what is broadly expected to be needed in terms of refuelling and charging infrastructure for inland navigation in 2030 in the Netherlands. For inland navigation, much of the 5 PJ renewable energy target of the Climate Agreement can be met by blending biofuel into current bunker supplies. If 150 zero-emission vessels are realised by 2030, as stated in the Climate Agreement, about 25 2-MW charging stations are expected to be needed near strategic locations along the major Dutch inland waterways. For hydrogen, only a few vessels are expected until 2030 and where refuelling stations are needed will have to be considered on an initiative-by-initiative basis. Locations near ports where there is also a hydrogen pipeline nearby seem a logical choice for this.

[2] The number of urban hubs, according to the TENT-T definition, may be expanded from 2 to 26 in the Netherlands.