Interreg North Sea

Co-funded by the European Union

LIHYP

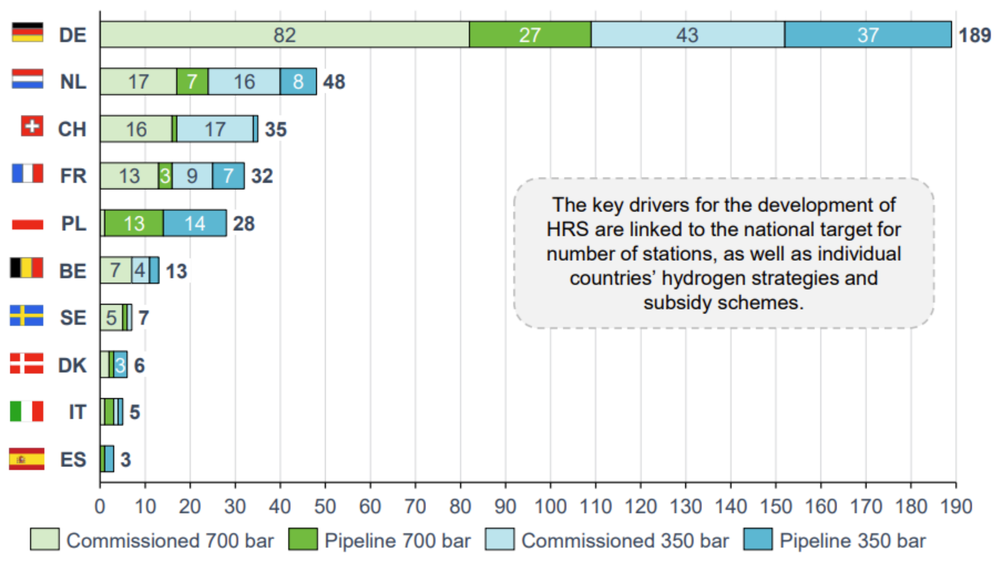
Uniting Stakeholders to build a regional hydrogen economy in the North Sea Region!

Handest Hede – Study on Hydrogen Refueling Combined with Renewable Energy

Activity 2 – Stakeholder Analysis of Hydrogen for Heavy-Duty Vehicles in Denmark up to 2040

Operational and planned HRS (# of stations)

There are currently approx. 250 hydrogen refuelling stations in operation across Europe. EU have targeted to have 300 truck-suitable HRS by 2025 and at least 1.000 by 2030.



The key drivers for the development of HRS are linked to the national target for number of stations, as well as individual countries' hydrogen strategies and subsidy schemes.

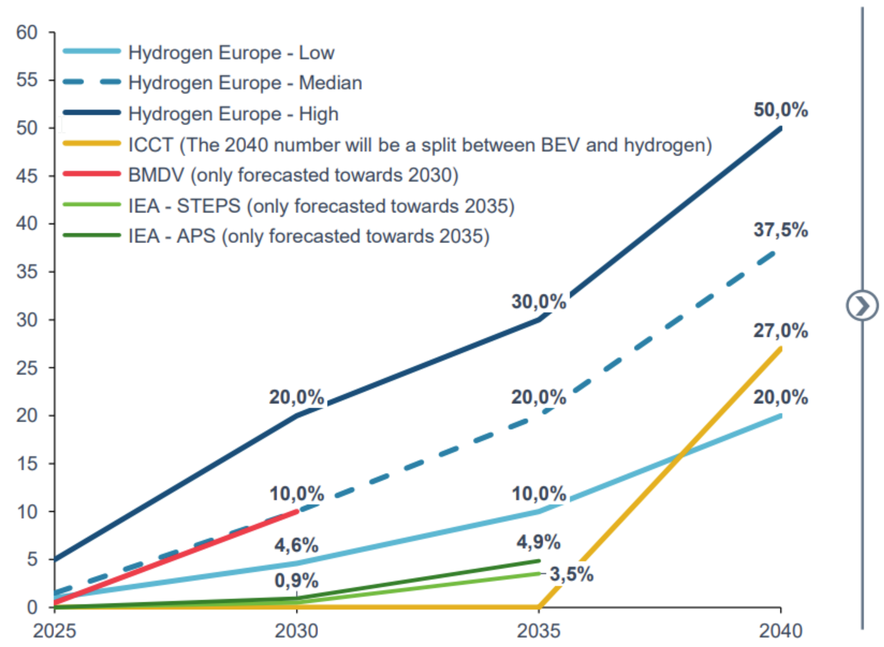
Progress toward the 2030 target for HVD HRS (350 bar)

27%
34%
N/A
15%
35%
30%
5%
15%
3%
3%

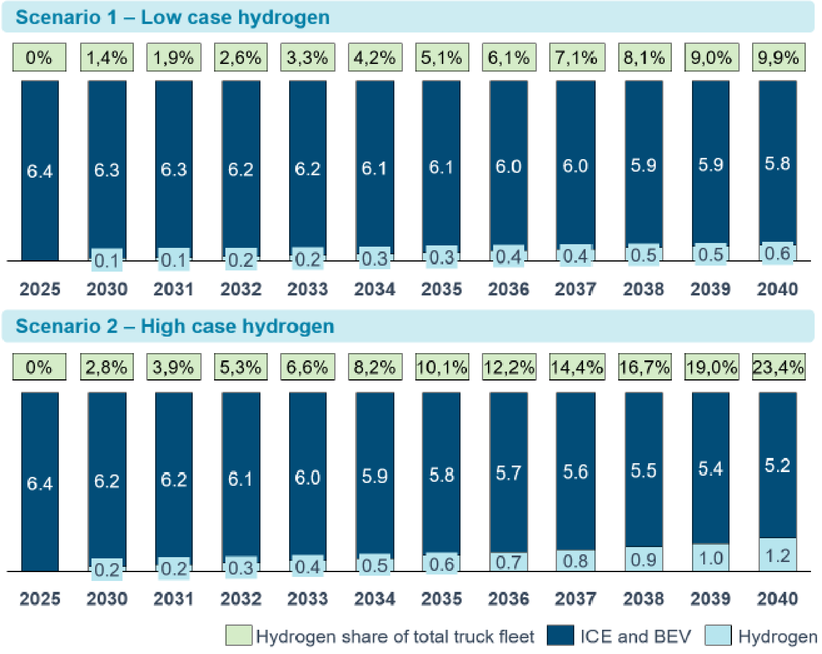
Insights

- EU countries are actively developing the infrastructure needed to meet the goals outlined in the AFIR. This includes HRS at 700 and 350 bar.
- Progress varies among countries in achieving the 2030 targets for 350 bar HRS. Poland, Belgium, the Netherlands, and Germany have the most promising progress towards targets, either through completed projects or planned HRS construction.
- However, there are notable differences in ambitions and targets among these countries regarding the development of HRS for HDVs. For instance, Germany needs to build 300 HRS, while the Netherlands requires 70 HRS for HDVs to align with EU targets.
- It remains challenging to predict how this will evolve by 2030 and whether the EU targets will be achieved.

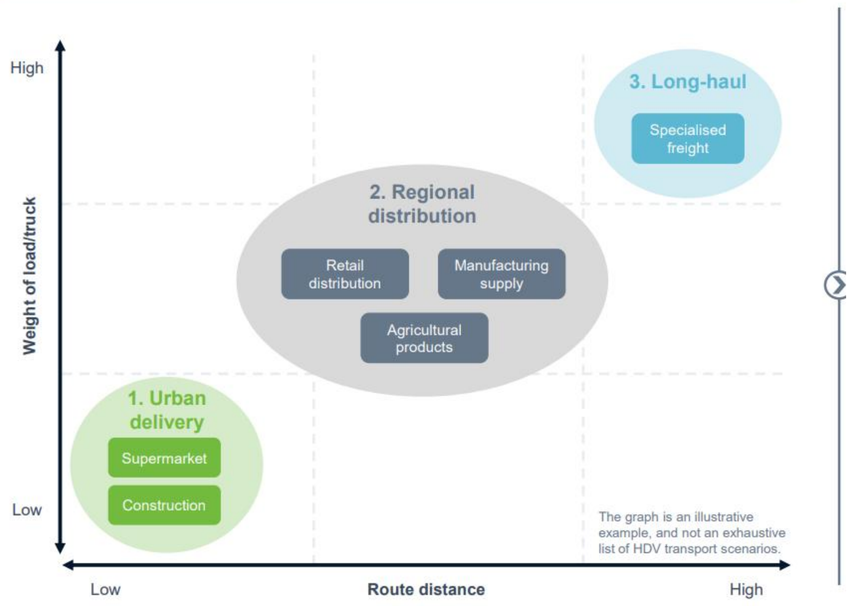
Penetration of hydrogen HDV in new vehicle new sales from 2025-2040 (in %)



Total number of all truck types in Europe* (# number of trucks in millions)



HDV transport examples



HDV use case segments

HDV segment*	Application	Range / routes	Weight	
Long-haul segment	Heavy-duty trucks used for long distance national and cross-border transportation	Long-distance back to base or point to point routes *(>500 km)*	> 18 tonnes	Expected higher attractiveness for hydrogen HDVs
Regional distribution segment	Trucks operating within a specific region or country	Regional distance and often back to base routes *(150-500 km)*	7.5-18 tonnes	
Urban delivery segment	Trucks for last-mile delivery in city environments	Shorter distance within urbans or regions and often back to base routes *(50-150 km)*	3.5-7.5 tonnes	

*Note: HDV segment covers trucks from 3.5 tonnes and above

Key elements for consideration

		Suited technology (2024 viewpoint)
1	**Distance and range**	HDVs require long driving ranges, which can be challenging for BEVs due to current battery energy density limitations, whereas FCEV can potentially offer comparable ranges to ICE.	ICE BEV FCEV
2	**Weight / Payloads**	The heavy weight of batteries in BEVs reduces the payload capacity of HDVs, making them less ideal for applications where maximising cargo weight is crucial, while FCEV and ICE offer better payload efficiency.	ICE BEV FCEV
3	**Charging and refuelling options**	Charging infrastructure for BEVs have developed at pace the last years, however the lack of widespread hydrogen refuelling infrastructure presents a barrier to adoption of FCEV.	ICE BEV FCEV
4	**Charging and refuelling time**	Longer charging times for BEVs compared to ICE can disrupt logistics and fleet operations, favouring FCEV that offer faster refuelling times similar to conventional fuels.	ICE BEV FCEV
5	**Driving patterns and planning**	HDVs often operate on tight schedules and long routes, necessitating careful planning for refuelling or charging stops; BEVs may require more frequent stops, while FCEVs and ICE provide more flexibility.	ICE BEV FCEV
6	**CAPEX**	High initial costs for BEVs (due to battery costs) and especially for FCEVs (due to fuel cell and storage costs) can be a barrier.	ICE BEV FCEV
7	**OPEX**	BEVs generally offer lower operating costs due to cheaper electricity and fewer moving parts, whereas FCEVs have variable fuel costs and may incur higher maintenance costs. ICE offers a moderate due to fuel, maintenance and emission related costs (e.g. filters).	ICE BEV FCEV
8	**Security / QHSE**	Hydrogen poses storage and handling safety challenges. BEVs also have risks related to battery fires but is overall considered safer in terms of fuel storage.	ICE BEV FCEV

Well suited · Moderately suited · Poorly suited

Key takeaways:

- **Hydrogen for long-haul trucks.** Stakeholders with hands-on experience in long-haul trucking generally consider hydrogen the best option for this segment, while those focused mainly on light and medium-duty vehicles tend to be more hopeful about BEVs covering most of the road transport market.
- **Battery development.** There remain uncertainties about the future progress of battery technology, especially in addressing the needs of long-haul, heavy-duty transport. Should batteries eventually provide comparable advantages, it is uncertain how much of the long-haul market hydrogen will secure, as BEVs currently offer a lower total cost of ownership compared to hydrogen alternatives.
- **BEVs and hydrogen as complementary options.** Battery electric vehicles and hydrogen heavy-duty vehicles should be regarded as complementary, each fitting distinct HDV applications. Hydrogen HDVs are most suitable for long-distance haulage, whereas BEVs are better suited for shorter, regional, and urban delivery routes.