

Energy synergies

The transition towards the deployment of hydrogen and fuel cells in road transport in the Nordic countries is challenged by a number of path dependencies which have been revealed by several case studies conducted for the TOP-NEST Project. With regard to the deployment of hydrogen and fuel cells in road transport, the path dependencies which exert a significant influence include the existing energy system, the possibilities to produce hydrogen in a sustainable way, the spatial dimension of these factors, and political steering. Moreover, the technology competes with other alternatives for sustainable fuels, such as biofuel or electricity. However, there are also possible synergies.

Hydrogen production

Energy production in the Nordic countries is based on different mixes of energy sources, and the share of renewable electricity differs, with 98% for Norway, 59% for Sweden, 39% for Denmark and 28% for Finland (Eurostat).

The availability of cheap renewable electricity is important for hydrogen production via electrolysis. There are several options for the production of hydrogen: electrolysis, natural gas steam methane reforming, biomass gasification, and by-product hydrogen from existing industry plants. The production can be localised on site or in central production units.

In Norway, we can see a clear shift from centralised reforming natural gas towards producing hydrogen by electrolyzers on site. The reforming of biogas will increase in the future. The integration of several sustainable hydrogen production technologies has been demonstrated.

In Denmark, hydrogen for refuelling stations is produced by electrolysis either produced on site or remotely. In Finland, the hydrogen has so far not been produced for use in transport but is an industrial by-product. Both in Finland and Sweden hydrogen has been produced via the steam reforming of natural gas, but only for industry purposes. Electrolysis is too expensive in Finland. There are also promising R&D projects using biomass gasification.

Refuelling infrastructure

The future network of refuelling stations will differ, firstly regarding the access to hydrogen, on site hydrogen production, either electrolysis or SMR, or central hydrogen production, and secondly, the delivery options to the refuelling stations, pipelines or gaseous hydrogen trucks.

In Norway, on site production is the preferred option, supplemented with short pipelines and transported-in hydrogen. In Denmark, these are the favoured methods, while there are hopes to use the existing natural gas pipelines, as is the case in Sweden. In Finland, plans are in place to use either mobile filling stations or central production combined with transported-in hydrogen.

The development of the refuelling infrastructure is again dependent on the existence of fuel cell cars which use this infrastructure; otherwise the operation and maintenance costs are simply too high.

Competing niches

Hydrogen and fuel cells technologies compete with electric mobility and biofuels technologies for resources and attention, including financial resources and funding for research, development and demonstration for the different technologies. Synergies could occur due to improvements in the upgrading of biogas.

A further issue concerns the funding of operation and maintenance costs for the refuelling infrastructure. While biofuel refuelling infrastructure is commercial, at least to some extent, this is not the case for the few hydrogen refuelling stations that currently exist.

The infrastructure for recharging electrical cars and fuel cell vehicles could be combined to avoid competition and to gain synergies, especially in so-called 'corridors' between larger cities where fast chargers are needed and hydrogen refuelling stations have to serve the few existing fuel cell vehicles. The public procurement of fuel cell vehicles is challenged by high costs, and a limited number of available models, as well as by the competition presented by cheaper electrical battery vehicles.

Political steering

Nordic policy makers have addressed the possibilities of hydrogen and fuel cells in road transport in different ways. While Denmark and Norway in particular have financed a number of demonstration projects to promote this pathway, and to a different degree have implemented policy incentives for the purchase and use of fuel cell vehicles, politicians in Sweden and Finland have not introduced such incentives.

Several projects now exist which are attempting to link the hydrogen infrastructures in Denmark, Sweden and Norway. This has attracted major automobile producers to use this region as an early market and a test bed for their upcoming rollout of fuel cell vehicles after 2015.

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