【欧州】【Common】

Common - Emerging technologies: European hydrogen strategy to achieving energy transition and climate-neutrality by 2050

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【概要：Summary】

Hydrogen fuel cell propulsion does not create direct pollution at the point of utilisation, and therefore, this technology is a promising option to replace combustion engines in transport. The European Alternative Fuels Strategy (COM/2013/017 final) and the European Commission's Alternative Fuels Infrastructure Directive (Directive 2014/94/EU) mention hydrogen as a potential alternative power source. In the transport sector, hydrogen based fuel cells (FCH) technology is already utilised in passenger vehicles, buses and trains in several countries.

However, whether hydrogen does emit GHG is dependent on the choice of the hydrogen production method. The cleanest hydrogen production method is based on the utilisation of renewable energies. Therefore, the key precondition for a reduction of GHG emissions by the use of hydrogen is related to the utilisation of renewable energies for the production of hydrogen. This promotion of clean hydrogen is the target of the European Commission's Hydrogen Strategy for a climate-neutral Europe and the Clean Hydrogen Alliance, which were published and launched on 8 July 2020. The aim is to pool resources to bring the use of clean hydrogen to a sufficient scale and impact for creating the momentum towards a sustainable industrial hydrogen ecosystem in EU. The EU Hydrogen Strategy addresses the transformation of the hydrogen potential into reality, by considering the necessary investment, regulation, market creation as well as research and innovation.

【記事：Article】

1. Hydrogen as alternative fuel in the transport sector

Hydrogen is considered being one of the alternatives to replace fossil fuels in the transport sector. In the European Alternative Fuels Strategy (COM/2013/017 final), and in the European Commission's Alternative Fuels Infrastructure Directive (Directive 2014/94/EU) hydrogen is mentioned as promising alternative power source for the deployment of fuel cell vehicles, which can contribute to improving air quality and reducing noise. Hydrogen is seen as a potential alternative power source in particular in passenger vehicles, buses, trains as well as for maritime transport. FCH trains could be a more sustainable solution and replace diesel engine - powered trains where electrification is not possible or too difficult. Regarding maritime transport, hydrogen is one of the most discussed potential alternative fuels. The use of FCH for ship propulsion is still at an early stage, but hydrogen seems to have a potential as a long-term solution in maritime transport, with

applications in smaller passenger ships, ferries or recreational craft. However, this will also require the amendment of the legislative framework, including the IMO's International Code of Safety for Ships using Gases or other Low-Flash-Point Fuels (IGF Code).

Regarding FCH passenger vehicles and public transport, several automobile manufacturers are already developing or producing cars with hydrogen fuel cell propulsion. Considering alternative fuels in public transport, the main attention is on replacing buses with internal combustion engines with electric battery or hydrogen based fuel cells. Hydrogen-powered buses are already utilised in public transport in several cities and regions in Europe and worldwide.

While hydrogen fuel cells are tested and used in several applications in the transport sector, the main precondition for an environmentally friendly use of hydrogen as fuel is its production from renewable sources. Hydrogen powered transport means can only reach zero CO2 emissions if the production method of hydrogen is considered. It is differentiated between "grey", "blue" and "green" hydrogen. Grey hydrogen comes from natural gas and still generates significant amounts of CO2 emissions, while blue hydrogen production relies on technologies like the capture and storage of carbon emissions (CCS). The cleanest version of all hydrogen production methods is based on renewable energies, which are used to produce the so-called green hydrogen without producing GHG emissions. However, green hydrogen is currently also the most expensive option and it is still more economic to produce grey hydrogen. Furthermore, there is the investment required for the infrastructure including hydrogen filling stations and the transportation of hydrogen to filling stations, among others. Therefore, the key precondition for achieving a reduction of GHG emissions by the utilisation of hydrogen in transport would be to produce so-called green hydrogen from renewable energies. Meanwhile, the economic crisis following the Covid-19 pandemic could cause a significant delay to the adoption and commercial rollout of clean hydrogen. The pandemic's impact could even permanently endanger the capacity of the clean hydrogen sector and its role as the missing link in the energy transition. Therefore, it is expected that also the Next Generation EU recovery plan for the recovery of the EU's economy from the COVID-19 pandemic will include financial resources to facilitate the utilisation of hydrogen.

2. The European Green Deal and the Clean Hydrogen Alliance

In December 2019, the European Commission proposed European Green Deal, setting the main goal for Europe to become the first climate-neutral continent by 2050. The presentation of the European Green Deal was followed up with a proposal for a EU Climate Law on 4 March 2020 to ensure a climate-neutral European Union by 2050.

Following the precedent of establishing the European Battery Alliance, the European Commission launched a European Clean Hydrogen Alliance, which intends to promote the production of clean hydrogen in an effort to speed up the decarbonisation of industry, including transport. Clean hydrogen has also a lot of potential for the post-pandemic recovery strategy. However, full-scale industrial deployment of hydrogen requires systemic action, from hydrogen production and transport to the industrial use as feedstock for energy-intensive industries or as fuel for transport or for balancing the renewable electricity output. Therefore, the Clean Hydrogen Alliance intends to bring investors together with governmental, institutional and industrial partners, to build on existing work and to identify technology needs, solutions and investment opportunities, among others.

The Clean Hydrogen Alliance was launched together with the Hydrogen Strategy for a climate-neutral Europe on 8 July 2020.

Clean Hydrogen Alliance initiative is part of the EU's new industrial strategy. The Alliance's board

members include representatives from the gas sector such as Shell, Gasunie and SNAM, but also Michelin and Daimler, as well as Vattenfall and EDF for the electricity sector.

One of the key objectives will be to deliver "a pipeline of large-scale investment projects in the clean hydrogen ecosystem" that will benefit from special status as so-called Important Projects of Common European Interest (IPCEIs). Financial instruments such as InvestEU, the Horizon partnership for clean hydrogen and the Cohesion Fund, are expected to be topped up by financial resources from the €750 billion Next Generation EU Recovery Fund for the recovery of the EU's economy after the COVID-19 pandemic. The Commission's economic recovery plan Next Generation EU Recovery Fund highlights hydrogen as an investment priority to boost economic growth and resilience, create local jobs among others.

During his speech at the debate on "the role of industry in the implementation of the European Green Deal and the Climate Law" on 5 May 2020, the European Commission energy chief Kadri Simson stated that hydrogen would be a "central element" in the European Commission's Strategy for Energy System Integration (COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. Powering a climate-neutral economy: An EU Strategy for Energy System Integration) (COM(2020) 299 final) of 8 July 2020. The European Commission is expected to create a EU-wide market for hydrogen "as soon as possible" rather than wait for renewable energy-based varieties to be commercially available.

The Commission Vice-president Frans Timmermans also pointed out that hydrogen is of essential importance for the future energy situation of the EU, when he talked to the MEPs of the Committee on industry, research and energy on 8 May 2020.

Therefore, also clean hydrogen could be an important means to achieve decarbonisation of the European economy.

3. The Hydrogen Strategy for a climate-neutral Europe

On 8 July 2020, in parallel to the launch of the Clean Hydrogen Alliance, the European Commission presented its Communication on the European Hydrogen Strategy for a climate-neutral Europe (COM(2020) 301 final). According to this communication, renewable electricity is expected to decarbonise a large share of the EU energy consumption by 2050, but not all of it. Therefore, hydrogen has a strong potential to bridge some of the gap, as a vector for renewable energy storage, alongside batteries, and in transport. The EU Hydrogen Strategy addresses how to transform this potential into reality, through investments, regulation, market creation and research and innovation.

Considering the ambition of the European Green Deal and building on the Commission's New Industrial Strategy for Europe and its recovery plan, the Communication sets out a vision of how the EU can turn clean hydrogen into a viable solution to decarbonise different sectors over time. At least 6GW of renewable hydrogen electrolysers should be installed in the EU by 2024 and 40 GW of renewable hydrogen electrolysers by 2030.

Thereby, the EU Hydrogen Strategy intends to give a boost to green hydrogen, based on renewable electricity (e.g. solar and wind energy). However, since green hydrogen is not yet cost-competitive against fossil-based hydrogen, the Commission acknowledges the potential of low-carbon hydrogen (via Carbon Capture Storage) as a facilitator to scale up production and stimulate the market demand for hydrogen. At the same time, the EU industry has developed an ambitious plan to reach 2x40 GW of electrolysers by 2030. Almost all Member States (26) have included plans for clean hydrogen in their National Energy and Climate Plans and some have signed up to the "Hydrogen Initiative" and included hydrogen in the context of their alternative fuels infrastructure national policy frameworks.

This Communication on the European Hydrogen Strategy identifies the challenges, lays out the levers that the EU can mobilise and presents a roadmap of actions for the coming years.

The European Hydrogen Strategy complements the Strategy for Energy System Integration, presented at the same time, which describes how the on-going work streams of EU energy policy, including hydrogen development, will foster a climate neutral integrated energy system with renewable electricity, circularity and renewable and low-carbon fuels. Both strategies contribute towards the achievement of the Sustainable Development Goals and the objectives of the Paris Agreement.

According to the Commission, the application of hydrogen in the transport industry is likely to develop through a gradual trajectory. The gradual transition will require a phased approach. In the **first phase (2020-2024)**, the objective is to produce up to 1 million tonnes of renewable hydrogen and to facilitate the up-take of hydrogen consumption in commercial fleets like taxis and specific parts of the railway network. Moreover, it could also be applied to heavy-duty transport, such as buses, lorries, coaches - currently responsible for about 6% of total EU CO2 emissions. The European Clean Hydrogen Alliance is expected to help build up a robust pipeline of investments. As part of the Commission's recovery plan, funding instruments of Next Generation EU, including the Strategic European Investment Window of the InvestEU programme and the ETS Innovation Fund, will enhance the funding support and help bridge the investment gap for renewables due to the COVID-19 crisis.

In the **second phase (2025-2030)**, the objective is to make hydrogen part of an integrated energy system and to produce up to 10 million tonnes of renewable hydrogen. In this phase, green hydrogen should become cost-competitive with other forms of hydrogen production. However, demand-boosting policies will be needed for the application of hydrogen in the railway sector and maritime transport. In this phase, dedicated demand side policies will be needed for industrial demand to gradually include the new applications, including trucks, rail and some maritime transport applications, and other transport modes. Hydrogen will also be used for daily or seasonal storage, as a backup and provide buffering functions within the electricity production.

In the **last phase** towards maturity **(2030-2050)**, renewable hydrogen and hydrogen-derived synthetic fuels could be applied to several hard-to-decarbonize modes of transport, such as aviation and deep-sea shipping, although the Commission acknowledges more research and innovation efforts are required to realize these ambitions. In this phase, renewable electricity production needs to massively increase and renewable electricity might be used for renewable hydrogen production by 2050. Sustainable biogas may also have a role in replacing natural gas in hydrogen production facilities with carbon capture and storage to create negative emissions.

The Commission is still exploring further renewable hydrogen appliances in the transport industry. This broader uptake of green hydrogen in the transport sector will be reflected in the Strategy for Sustainable and Smart Mobility, which is due for publication by the end of 2020. The public consultation for this Strategy for Sustainable and Smart Mobility has recently opened.

4. Boosting hydrogen demand based on the Hydrogen strategy and the way forward

Regarding the necessary boosting of demand for hydrogen in transport, in the first phase, early adoption of hydrogen as alternative fuel can occur in the utilisation by local city buses, commercial fleets (like taxis) or specific parts of the rail network, where electrification is not feasible.

Hydrogen refuelling stations can easily be supplied by regional or local electrolysers, but their deployment will need to build on clear analysis of fleet demand and different requirements for

light-and heavy-duty vehicles. The utilisation of hydrogen fuel cells should be further encouraged in heavy-duty road vehicles including coaches, special purpose vehicles, and long-haul road freight. The second phase (2025-2030) targets are expected to be an important driver to create a lead market for hydrogen solutions, once fuel cell technology is sufficiently mature and cost-effective. Projects of the Horizon 2020 Fuel Cells and Hydrogen Joint Undertaking (FCH-JU) are aiming to accelerate this process.

For inland waterways and short-sea shipping, hydrogen can become an alternative low emission fuel, especially since the Green Deal emphasises that CO2 emission in the maritime sector must have a price. Scaling up fuel cell power from one to multiple megawatts and using renewable hydrogen for the production of synthetic fuels like methanol or ammonia are required for longer-distance and deep-sea shipping. Hydrogen could also become a longer-term option to decarbonise the aviation sector through the production of liquid synthetic kerosene or other synthetic fuels. In the longer-term, hydrogen-powered fuel cells, requiring adapted aircraft design, or hydrogen-based jet engines may also constitute an option for aviation. These visions will require a roadmap for the considerable long-term research and innovation efforts. A key limiting factor for the use of hydrogen in industrial applications and transport is often the higher costs, including additional investments into hydrogen-based equipment, storage and bunkering facilities. Furthermore, demand side support policies will be needed. The Commission will consider various options for incentives at EU level, including the possibility of minimum shares or quotas of renewable hydrogen or its derivatives in specific end-use sectors (like for transport applications), allowing demand to be driven in a targeted way.

In order to specifically boost demand for and scaling up hydrogen utilisation in transport, measures should facilitate the use of hydrogen in the Commission's upcoming Sustainable and Smart Mobility Strategy and in related policy initiatives. Additional support measures should be explored including demand-side policies in end-use sectors. The Commission should also work on the introduction of a common low-carbon threshold/standard for the promotion of hydrogen production installations based on their full life-cycle GHG performance and work on the introduction of a comprehensive terminology and European-wide criteria for the certification of renewable and low-carbon hydrogen. In the process of revising the Alternative Fuels Infrastructure Directive and the revision of the Regulation on the Trans-European Transport Network Fuels Infrastructure Directive the development of different refuelling infrastructures should be considered. Furthermore, the establishment of the proposed Clean Hydrogen Partnership, focusing on renewable hydrogen production, storage, transport, distribution and key components for priority end-uses of clean hydrogen at a competitive price should be considered by 2021.

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