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Environmental issues: Alternative fuels in the EU –Green hydrogen's potential in the post-pandemic era

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【概要：Summary】

At present, the EU transport sector accounts for about a quarter of the EU's total GHG emissions. In order to achieving the decarbonisation of the EU's transport system and to reach the target of net-zero GHG emissions by 2050, all transport modes need to contribute to the reduction of GHG emissions. There exist a variety of alternative fuels and power sources that could help to reach the decarbonisation of transport. The European alternative fuels strategy (COM/2013/017 final) has identified electricity, hydrogen, biofuels, natural gas, and liquefied petroleum gas (LPG) as the principal alternative fuels with a potential for long-term oil substitution. Hydrogen-based fuel cell propulsion is one of the possible mobility-related options of alternative propulsion systems. However, most hydrogen used today is extracted from natural gas in a process that produces carbon emissions, which defeats the objective of decarbonisation. However, there is potential to extract "green" hydrogen from water with electrolysis, if the process is powered by renewable electricity. If this process is introduced for producing hydrogen it could replace fossil fuels in sectors that lack alternatives to align operations with the EU's Green Deal plan. In the transport sector, hydrogen based fuel cells propulsion is just one option of alternative propulsion. Clean hydrogen, produced from renewable sources and hydrogen-derived fuels could be vital for decarbonising parts of the transport sector, like shipping, aviation, and road transport.

Considering the way forward in the post-COVID-19 pandemic era, for the purpose of accelerating the energy transition, a cost-effective European hydrogen strategy could become a pillar of a EU economic recovery plan, also towards achieving the net-zero emissions target of 2050.

【記事：Article】

1. Background to reduce GHG emissions in the EU's transport sector

On 28 November 2018, the European Commission has presented its strategic long-term vision for a prosperous, modern, competitive and climate neutral economy by 2050 – A Clean Planet for all. This future vision aims at achieving the decarbonisation of the EU's mobility system and to reach net-zero emissions by 2050. All transport modes and a variety of alternative fuels and power sources need to contribute to this goal. In order to achieve climate neutrality, a 90% reduction in transport emissions needs to be achieved by 2050. On 11 December 2019, the European Commission presented the Communication COM(2019) 640, "The European Green Deal", which is a new growth strategy

that aims at achieving a modern, resource-efficient and competitive economy where there are no net emissions of GHG emissions in 2050. In order to achieve the European Green Deal's targets, there is a need to rethink policies for clean energy supply and transport, among others. Key targets of the European Green Deal will be the assessment of legislative options to boost the production and supply of sustainable alternative fuels for the different transport modes.

The Commission will adopt a strategy for sustainable and smart mobility in 2020 and in 2021, a review of the Alternative Fuels Infrastructure Directive (The Commission will also review the Alternative Fuels Infrastructure Directive, (Directive 2014/94/EU)) and the Trans European Network - Transport regulation will follow. Therefore, while the Green Deal does define a roadmap, it does not mention alternative fuelling structures like hydrogen. The Green Deal only points out that the regulatory framework for energy infrastructure, including the Trans-European Networks - Energy (TEN-E) Regulation (TEN-E Regulation), needs to be reviewed in order to foster the deployment of innovative technologies and infrastructure, such as smart grids, hydrogen networks or carbon capture, among others. Partnerships with industry and Member States will support research and innovation on transport, including batteries, clean hydrogen, low-carbon steel making, circular bio-based sectors and the built environment. The Commission will propose more stringent air pollutant emissions standards for combustion-engine vehicles and a revision of the legislation on CO2 emission performance standards for cars and vans by June 2021, to ensure zero-emission mobility.

2. Hydrogen based fuel cell propulsion in the EU's transport sector

2.1. FCH as alternative fuel

Based on the European alternative fuels strategy (COM/2013/017 final), the European Commission has repeatedly identified electricity, hydrogen, biofuels, natural gas, and liquefied petroleum gas (LPG) as alternative fuels. In particular, electricity and hydrogen are considered as alternative power sources for an environmental friendly transport, with a potential for long-term oil substitution.

In the European Commission's Alternative Fuels Infrastructure Directive (Directive 2014/94/EU), electricity and hydrogen are mentioned as particularly attractive power sources for the deployment of electric/fuel cell vehicles, which can contribute to improving air quality and reducing noise. Therefore, also the build-up of sufficient hydrogen refuelling infrastructure is considered essential in order to make larger-scale hydrogen-powered motor vehicle deployment possible. Converting hydrogen gas into electricity produces only water and heat as by-products.

Several studies on fuel cells and hydrogen (FCH) technology have underlined the viability and advantages of the utilisation of fuel cells and hydrogen in the railway environment, for passenger vehicles, buses, in particular in public transport, as well as maritime transport. Even an utilisation of FCH in aviation is considered. According to the European Commission, hydrogen based fuel cells (FCH) technology is a promising option to replace combustion engines in transport. The FCH technology has a "great potential for clean, efficient power in stationary, portable and transport applications." Fuel cell propulsion does not create direct pollution. However, the producing of the hydrogen itself can lead to pollution, including GHG emissions. Therefore, this needs to be secured that hydrogen is produced by using renewable energy sources.

2.2. FCH powered trains

Although railways are considered being already an environmentally friendly means of transport, in order to further improve its carbon footprint and to achieve zero-emissions, the diesel traction

needs to be eliminated on the non-electrified part of the railway network. Due to the high levels of particulate matter and NOx emissions as well as CO2 emissions and the noise levels of the diesel-powered trains, there is a need to shift to low emission solutions. In this respect, the FCH trains could be a more sustainable solution. Fuel cell trains do not produce any NOx gases or particulate matter in operation and they can also reduce CO2 emissions by around 50%, compared to equivalent diesel engine-powered trains. In the mid and long term, the utilisation of fuel cell trains could lead to a more sustainable train operation as the diesel-powered trains.

On 20 September 2016, Alstom presented the first Coradia iLint hydrogen zero-emission train, and the train has been granted approval by the German Railway Office (EBA) for passenger service in Germany and on 16 September 2018. Two fuel cell powered trains offer commercial service for public transport on the nearly 100km line running between Cuxhaven, Bremerhaven, Bremervörde and Buxtehude. The fuel cell trains replaced the existing diesel trains of the public transport provider Eisenbahnen und Verkehrsbetriebe Elbe-Weser (EVB). After the Coradia iLint hydrogen trains have started their regular passenger service in Lower Saxony in Germany in September 2018, the Dutch province of Groningen had decided to start a test of the Coradia iLint fuel cell trains in 2020. The railway network in the Netherlands has about 1,000km of non-electrified lines and FCH trains could replace the diesel trains in this non-electrified part of the railway network.

2.3. FCH propulsion in maritime transport

Also in the shipping industry and maritime transport more environmentally friendly fuel sources and alternative fuels are discussed in order to reduce emissions. In order to meet the requirements of the IMO's 2020 global sulphur limit of 0.5% in marine fuels and the target of a 50% reduction of GHG emissions from shipping by 2050, compared to 2008, the maritime industry needs to consider alternative fuels and the appropriate infrastructure. However, the shipping industry will have to consider different solutions depending on the utilisation of a vessel in short-sea shipping or deep-sea shipping. While in short-sea shipping and ferry transport, electrification could be a viable solution, long distance ocean transport will need other fuels, including hydrogen and synthetic non-carbon fuels, like ammonia as possible low to zero carbon emission fuel alternatives and propulsion systems. Ammonia and hydrogen are currently the most discussed potential alternative fuels in the shipping industry. Each of the alternative fuels has its challenges, but hydrogen and other synthetic non-carbon fuels like ammonia seem to have the highest potential as a long-term solution. If zero-emission vessels (ZEV) need to enter service by 2030 in order to achieve the 2050 targets in emission reduction, the planning, designing and building of ships in the 2020s will already have to include considerations how a vessel can switch to zero emission technologies and alternative fuels in the vessel's operational life. Besides the construction of hydrogen fuel cell propelled vessels, this will also require specific vessels tailored to transporting and bunkering infrastructures.

The use of hydrogen-powered fuel cells for ship propulsion is still at an early design and trial phase, with applications in smaller passenger ships, ferries or recreational craft. It 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). However, while the international codes and standards for hydrogen fuel cell powered ships are not in place yet, countries can test the technology in their territorial waters. In Europe, Norway is one of the pioneers in developing and testing hydrogen-fuelled vessels, and to some extend also Sweden, Denmark and Finland.

2.4. FCH passenger vehicles and public transport

In 2017, the number of newly registered petrol passenger cars and diesel cars accounted for 97.1% of new registrations, while the share of plug-in hybrid and battery-powered electric cars rose from 1% to 1.5% in 2017. It was also the first year that hydrogen cars made a noticeable appearance. As of 2019, there are three models of hydrogen cars publicly available including the Toyota Mirai, the Hyundai Nexo and the Honda Clarity. Several other companies are developing hydrogen cars.

Considering alternative fuels in public transport, the main attention is on replacing buses with internal combustion engines with electric battery or hydrogen based fuel cell buses. In order to meet the decarbonisation target of the transport sector and to improve the air quality regarding the reduction of NOx and PM emissions, electric and fuel cell buses are seen as possible solutions. Hydrogen fuel cell buses have a range of 500 to 700km, which equals currently used buses with diesel combustion engines. However, such a system change to alternative technologies like fuel cell technology usually requires very high investments also in refuelling infrastructures.

FCH buses are being tested and used by several public transport companies in different European regions and cities.

3. Key environmental precondition for hydrogen as fuel

While there are several trials with all kind of transport means on the way for the utilisation of hydrogen fuel cells, the main precondition for an environmentally friendly use of hydrogen as fuel is its production from renewable sources. There is no emission of CO2 directly connected with the use of hydrogen as fuel, but the production of hydrogen could be responsible for high CO2 emissions. 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 controversial technologies like the capture and storage of carbon emissions (CCS). The cleanest version of all hydrogen production is green hydrogen, which is generated by renewable electricity without producing GHG emissions. However, green hydrogen is currently also the most expensive option. In fact, in 2019, 98% of hydrogen is produced by steam methane reforming, which emits CO2. This would be a disadvantage in the utilisation of hydrogen as it creates high carbon emissions during production. Furthermore, there is the investment required for the infrastructure including filling stations to dispense hydrogen, transportation of hydrogen to filling stations among others. Therefore, the key precondition for the utilisation of hydrogen for the reduction of GHG emissions in transport would be to produce so-called green hydrogen from renewable energies.

4. Future perspective for the utilisation of green hydrogen in the post-pandemic era

With the COVID-19 pandemic and the related lockdowns, the economies of many countries need to recover. This could become a decision point to establish hydrogen as a clean alternative to fossil fuels in the mainstream market. According to IEA analysis, a broad portfolio of clean energy technologies would be needed to decarbonise all parts of the economy, including hydrogen-producing electrolysers.

However, currently, natural gas and coal are the primary sources for almost all of the approximately 70 million tons of hydrogen produced each year, according to IEA. Accordingly, the hydrogen production and utilisation is responsible for more than 800 million tons of CO2. However, green hydrogen and hydrogen-derived fuels could be vital for decarbonising sectors like the transport sector. Hydrogen production via electrolysis offers opportunities for synergy with some renewable energy power generation technologies, like wind power generation. In order to use the momentum to promote clean energy after the Covid-19 pandemic,

it will be important for governments to reassure investors about their commitment to hydrogen.

Considering the further way forward, Hydrogen Europe, the European Hydrogen and Fuel Cell Association representing more than 160 industry companies, 78 research organizations and 21 National Associations, which partners with the European Commission in the innovation programme Fuel Cells and Hydrogen Joint Undertaking (FCH JU), presented its analysis of the hydrogen sector in the post-COVID-19 pandemic era.

The analysis entitled "Post COVID-19 and the Hydrogen Sector - A Hydrogen Europe Analysis" outlines the need for action in the post COVID-19 era in order to tackle the still existing long-term, climate and environmental challenges. At the same time there is concern that 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, the analysis outlines several potential options for supporting the industry.

Furthermore, the European Commission is preparing a proposal to launch a strategy for the Energy system integration in which hydrogen should play a major role. 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 it would be important to integrate the deployment of new fuel sources like hydrogen into the energy system. Simson is convinced that hydrogen has the potential to be a game changer. It could act as an enabler, especially for the hard-to-decarbonise sectors like transport The European Commission is expected to announce the Energy System Integration Strategy, in which hydrogen could play a key role in the decarbonisation of the economy. On 11 May 2020, also the European Parliament's Transport and Tourism (TRAN) Committee discussed the response to the COVID-19 crisis and the future of the transport sector in the European Green Deal with the European Commission's Vice-President Frans Timmermans.

Timmermans acknowledged that transforming the transport sector is essential to the success of the European Green Deal. Many MEPs stated that there is no contradiction between the need to recover economically and to do it in line with the Green Deal. Actually, in order to restart the economies in the COVID-19 post-pandemic world, it would be best to spend the recovery aid for new available technologies. There is now a wide understanding that the larger use of clean hydrogen in future can be an important means to achieve decarbonisation of the European economy. A cost-effective European hydrogen strategy could become a pillar of a EU economic recovery plan in the post-pandemic era, which should accelerate the decarbonisation of European economies, in accordance with the European Green Deal.

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