The Prospect of the Utilization of Hydrogen as a Viable Renewable Energy Source, in the European Union

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Abstract

The Paris Agreement from 2015 brought together 196 countries, from around the world, in pledging to reduce carbon emissions at a level able to limit global warming below 2 degrees Celsius, compared to pre-industrial times, withing 40 years. Thus, the light is now shining on the decarbonization of the energy and transport sectors. An aggressive push, considering not 20 years earlier, most countries did not even consider global warming a reality. It has sparked a revival in interest for the utilization of hydrogen (the most abundant element in the universe) as a zero-carbon electricity producer. Whilst hydrogen has been in use in the chemical and energy industry for decade, renewable hydrogen has become an economically viable option, only in the past few years. This article will analyse the geopolitical impact and market potential that hydrogen's adoption will have on the European Union, presenting possible scenarios in terms of costs, energy security and independence. The research method was a mix between qualitative and quantitative techniques, by analysing documents, official studies, articles, and research papers, coupled with document screening, to assess the potential, impact, and costs of the transition to hydrogen. The paper concludes that the attainment of self-sufficiency in the production of hydrogen is achievable, but the investments represent a significant obstacle in the development of an efficient hydrogen market.

Keywords: Hydrogen, EU, Green, Energy, Independence, Transition.

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Introduction

The European Union has determined that hydrogen is a key element its strategy of becoming a global leader in the unions push to become cardon neutral whilst ensuring a stronger, cleaner, and more secure economy is working to become a leader in the development.

In this sense, this article ponders what would it be necessary for the EU to become hydrogen independent; if existing gas infrastructure can be retrofitted to transport hydrogen; what areas of Europe are best suited to produce the fuel; what the risks are and how can they be diminished. By answering these questions, we will be better able to evaluate the geopolitical and economic implications of the adoption of hydrogen.

The process of splitting water has several uses, of which renewable hydrogen is one. It can be used to resolve most of the problems stemming from the utilization of fossil fuels in industry, aviation, short and long-distance transport and even heating. All these sectors add to more than 37% of the global emission of carbon dioxide (CO2) (IEA, 2020).

While the production costs of green hydrogen have, resulting from electrolysis, been traditionally higher that the extraction and processing of fossil fuels, with the unprecedented increase in gas and oil prices in early 2022, the renewable fuel has unexpectedly become price competitive much faster. Standards and Poor reported in October 2021, that green hydrogen produced at 4$/kg in Norway (Burgess, 2021), had reached cost parity with gas, at 1000$/m3 (Eurasia Business News, 2021). By March, due to the war between Russia and Ukraine, natural gas had reached the price of 2200$/m3 (Economica.net., 2022).

The EU sees renewable hydrogen as the key to achieving carbon neutrality in 2050 (H2GreenTECH, 2021). With the pressure of decoupling from the Russian natural gas supply and economy, as well extreme gas prices, Europe find itself in a situation in which the energy transition must happen sooner than expected. The EU hydrogen strategy envisioned the launch of mass utilization of hydrogen in the European economy, in 2030 (European Commission, 2022), painting a picture of how to create a competitive and open market. The strategy stipulates that full maturity for the utilization of hydrogen is to pe expected by 2050, in all sectors, with natural gas acting as an intermediary. In the new post pandemic and post Russian economy decoupling, this strategy most certainly must be revised and be made more ambitious. While the EU is one of the global leaders in hydrogen technology development, it must push further and faster than ever. And while full adoption will not be possible for many years, a 2050 term is a luxury the EU cannot afford anymore.

1. The utilization of hydrogen in the European Union

In the 2020 European Commission strategy on hydrogen, the EU proposed a 34-step plan beginning in 2020 and ending in 2050, split into 3 phases (2020-24, 2024-30, and 2030-50 (European Commission, 2020)), to produce green hydrogen from solar and wind powered electrolysis of water. The strategy also encompasses the utilization of low-carbon hydrogen, or blue-hydrogen, which results from natural gas refinement, which could play an intern role on the short and medium term.

In the two first phases, the strategy plans the construction of electrolysers (hydrogen production plants) of 6GW (by 2024) and 40 GW (by 2030) (European Commission, 2020), which are estimated to produce 10Mt (million tons)/year of hydrogen. But the EU's needs by 2050 they currently stand, envision that approximately 50Mt/year will be required, to achieve net zero emissions. In the third phase, the ambition is to increase production from 10Mt to the required 50Mt, but there are not clear specifications in the strategy that would detail how Member States can produce and from where they can import this difference of 40Mt. Yet, the EU aims at building "an open and competitive hydrogen market, with unhindered cross-border trade and efficient allocation of hydrogen supplies among sectors" (European Commission, 2020), with the belief that Member States that are abundant in resources will develop hydrogen production industries which will surpass internal needs and become exporter towards less fortunate Member States.

As it currently stands, demand for hydrogen in the EU amounts to around 9.7Mt, or about 11% of global demand. Of these 9.7, 42% are utilized for the production of fertilizers and 52% are used in refining, with a measly 2% utilized in energy production and transport. At the forefront as the largest consumers, are the Lower Countries and Germany, utilising around 40% of the EU's demand, with France, Belgium, Italy, Spain, and Poland utilising over 0.5Mt/each. The remaining 25% of EU demand is split between the remaining 20 Member States. Currently, the EU's production capacity stands at 11.3 Mt/year of dirty hydrogen (resulting from the utilisation of fossil fuels) (EU Joint Research Center, 2019). At the moment, internal EU hydrogen needs are more than met by internal production, resulting from dirty industrial processes. Therefore, it is of the essence that policies must be hastened and a new strategy to be adopted to not only convert current hydrogen production capacities to electrolysis, but to achieve the required 50Mt needed by the EU sooner than 2050, in line with new objectives from Germany and France of renouncing natural gas as soon as 2040 (Euractiv, 2021). Achieving green hydrogen's potential necessitates a careful balancing of what the EU currently demands and what it will need. Thus, the moment to act is now, as today's policies will translate in results that will be visible in years and decades, as infrastructure will need to be built.

2. Green hydrogen in 2050

While the quantity of green hydrogen needed by the EU has been estimated at around 50 million tonnes annually, this remains but an estimate. The EU's strategy does not specify concrete levels of hydrogen consumption in 2050, it does cite numerous projections in which energy demand will vary between 6 and 12 PWh (50Mt/year), of which hydrogen will provide 25%, with the rest of 75% being covered by renewables such as solar, wind, hydroelectric sources (European Commission, 2020). Regardless of this wide projection, the need to decarbonise the European economy will boost demand for hydrogen. Guaranteeing that green hydrogen is available for future demand requires the envisioning of a clearer strategy than the one put forward in 2020. As stated earlier, with current targets, by 2030, Member States will have a production capacity of 10 Mt/year, a far cry from the 50 Mt/year envisioned in 2050. Thus, production capacities will need to increase more than 5 times by 2050 (European Commission, 2020). To this end, a scenario of completely meeting hydrogen needs from internal production in the EU, while desirable, seems unlikely. Internal, regional, and long-distance supplies must all be taken into consideration

for meeting hydrogen needs. Thus, three scenarios emerge for the hydrogen future of the EU: 1. Imports from long distance hydrogen producers; 2. Regional imports from third party countries; 3. Internal production independence. All three scenarios pose geopolitical, geo-economic and strategic effect, which need to be considered when evaluating the cost, security, and independence of the energy supply. Below we shall see what all three scenarios entail.

3. Internal production independence

In this scenario, the European Union would sufficiently prioritise resources and organise its strategy in a manner which would result in the development of self-sufficient green hydrogen production and markets. While more costly, it would move the EU towards energy independence Energy independence would require, according to the EU strategy, for Member States to be able to produce more than 70% of internal demand, thus almost fulfilling the needs of the internal market. Not only would the security provided be benefitting from energy independence ensure a stronger internal market, but also stronger economic development and cheaper prices. The main producers of hydrogen would be the Baltics States, Ireland, Denmark, and the Iberian Peninsula, providing close to 90% of the internal production capacity. Of particular note would be the Iberian Peninsula, as Spain and Portugal would be able to produce an estimated 22 Mt/year, ensuring 45% of 2050 estimated required amounts and 75% in the worst-case scenario. Ireland would be second, by providing close to 12 Mt/year to the mainland, or 23% of 2050 estimated amounts. The Baltic States a close third with 11 My/year, or 22%. And Demark would provide 5 Mt/year, or 10% of 2050 estimated requirements (European Commission, 2020).

The EU benefits from a partial advantage for internal distribution as existing gas pipelines could be retrofitted for the utilisation of hydrogen transport. But the system is not completely interconnected and is more clustered at the moment. Substantial investments would required not only to retrofit the existing systems, but also interconnect them to ensure better distribution, especially to the centre of the continent, where resource starved, and resource poor countries will reside (example: Germany). An integrated infrastructure is of the essence for the EU to become self-reliant and allow optimal distribution of green hydrogen where is needed.

4. Regional imports from third party countries

In this scenario, the EU would be more price conscious and seek to invest only in the most optimal and low-cost internal production options, seeking to satisfy the rest of the EU's demand by importing from Norway, Iceland, Egypt and Morocco, countries which have abundant green hydrogen production potential. But this would incur higher costs due to the need to transport hydrogen via shipping, but not as high as transporting it from long distance providers. Morocco, Norway, and Iceland are the most resource reach of the EU's neighbours, having the potential to provide 30Mt/year (Wettengel, 2021), each, providing more than ample capacity to satisfy the expected 50Mt/year in 2050. Together with internal production capacities, the utilisation of regional exporters as a means of supplementing the remaining green hydrogen needs, would allow for accessible prices to be practiced in the EU. With neighbouring countries competing to access the EU's internal market, competition would allow for lower prices to be practiced. Yet, the risk is that internal production, if unable to keep up with the lower prices practiced by neighbours, will be affected and risk needing support to stay afloat or become too uncompetitive to survive. Thus, a careful management of the situation is required, balancing internal production with regional imports, otherwise risk duplicating a situation where the EU becomes too dependent on a provider, such as is the case with Russian gas.

5. Imports from long distance hydrogen producers

In this scenario, the European Union is uncapable of offering complete internal production security and thus must import large quantities from countries such as the United States and Australia (which have proven high capacities of production), supplementing regional imports and internal production. This scenario would be dependent on the EU having the opportunity of importing large quantities at low costs due to lower shipping costs. Currently, long distance imports of hydrogen stand at 0.1 Mt/year, while the amount could increase to 18 Mt/year (KPMG, 2020). Due to its proximity, the United States would be the most viable option to become the largest supplier of green hydrogen for the EU. While Australia has very high potential, transportation costs would dilute any decreases in demand that can be achieved through production scaling. In comparison to the scenario in which regional imports are highly important for the EU, in this scenario, the United States would provide most of the resource need to western European states

such as Belgium, the Lower Countries, France and Germany, whilst import from Marocco, Norway, Iceland or Egypt would likely be reduced due to their inability to completely fulfil EU needs.

In essence, long-distance imports are the least desirable of all three scenarios as it would require the EU to be put into a situation in which it is dependent on shipping and far away partners, as well as the whims of shipping costs which, as we have seen with COVID-19 can be highly disrupted due to unexpected shocks and explosive prices. The United States would be expected to cover close to 25% of the EU's need in this scenario (EU Joint Research Center, 2019). The security risk would be too high to bare and put it in a precarious position such as the EU is today with the Russian Federation and gas imports.

Conclusions

Achieving secure and competitive supply sources for green hydrogen is now more than ever an important strategic policy for the EU, due to the need to decouple from gas dependence of the EU economy. The union must thus increase its efforts to transition to a net zero economy and achieve it sooner than 2050. Utilising hydrogen at full capacity requires evaluating not only the production capacity but also the environmental, geopolitical, and economic impact. For the moment there exists no hydrogen electrolysis production plants, no mass transport liquefied hydrogen ships and no retrofitted or purposely built hydrogen pipeline. Thus, significant amounts of investments are required to full transition to hydrogen utilisation.

Previously in the article, the three scenarios were presented as the possible sources that the EU could tap into for the obtaining of green hydrogen. From analysing these three possible scenarios and due to current event in which Russia is utilising gas as a means of coercion, it becomes apparent that Member States must work together to achieve energy dependence and supplement the differences in hydrogen requirements from multiple neighbouring countries, ensuring they do not become dependent on a sole provider. The EU must therefore work to become a leader in green hydrogen innovation, to not only ensure robust economic growth, but also achieve the EU's energy and climate goals. This would require the coordination of society, policies, capital, and technology. In this sense, a transition that could be considered successful would require the following:

- Investing in research and innovation which would be able to help attain more efficient hydrogen production technologies as well as fuel cell engines able to utilise the resource at higher potential.
- The EU and Member states would elaborate clear standards and regulations for the transport and production of hydrogen. Adapting national regulatory frameworks as well as harmonising laws with the EU and amongst themselves would ensure a more coherent environment able to attract investors.
- Policies would be enacted to address commercial barriers, decrease market risk and boost the development of economies of scale.

The earlier these steps are met, the faster will they create effects that would allow market forces to dictate and internal policies to develop the most advantageous scenario for the EU. Policymakers will be wise to keep watch and ensure legislation will be designed to encourage the internal production capacities to flourish. They must also pay attention to:

- Create clearly defined policies that encourage the development of energy resources.
- Decrease market *risk and* remove barriers to commerce to ensure the development of economies of scale.
- Coordinate the development of infrastructure across the continent.
- Invest in innovation and projects to accelerate the development of competitive green hydrogen.
- Synchronize standards and national frameworks to ensure a seamless flow across borders.

The article works to show that the attainment of self-sufficiency in the production of hydrogen is achievable. Yet the investments required in the order of trillions, on a projected period of 30 years, could represent an additional obstacle in the success of developing of an efficient hydrogen market. Policymakers will need to clearly define a new EU hydrogen strategy, to increase investments and the development of new and existing infrastructures across the continent, while stimulating growth in renewable energy generation, which is mandatory for the production of green hydrogen through electrolysis.

Green renewable hydrogen is an integral piece in puzzle of the EU's primary objective of attaining a low carbon, net zero emissions economy by 2050. Its deployment faces enormous challenges from both the private and public sectors, which need to be addresses by both parties. Only though their cooperation will

the EU be able to become an innovation leader in green hydrogen production, transport and utilisation, contributing to the union energy independence and the creation of a more robust economy.

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