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Questioning the EU's Hydrogen Roadmap

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Introduction

In July 2020, the European Commission released a communication outlining the 'Hydrogen Strategy for a climate neutral Europe' (EC, 2020). This plan situates clean hydrogen as a critical component of the European Green Deal and outlines how the European Union (EU) will facilitate the increased deployment of hydrogen applications. Hydrogen plays an essential role in the EU's 2050 targets because it can decarbonize hard-to-abate sectors that cannot decarbonize on renewable electricity alone. It is projected that by 2050 hydrogen will increase from 2% to 13-14% of the EU's total energy consumption (Moya, Tsiropoulos, Tarvydas & Nijs, 2019). To reach this level of deployment, the EU has set hydrogen as an investment priority in the 2021-27 Multiannual Financial Framework and the Next Generation EU recovery plan. By spurring investment into the hydrogen supply chain, the EU hopes to lay the groundwork for a sector that could require between EUR 180-470 billion of investment by 2050 (EC, 2020).

But why is the EU targeting Hydrogen?

Hydrogen is a peculiarity in the energy space. It can be used as an input for virtually every sector, from heavy industry and manufacturing to power generation and mobility. There are two primary reasons why it is attractive. First, when consumed it produces no greenhouse gases or air pollutants, which makes hydrogen an ideal fuel for decarbonization – especially for hard-to-abate processes such as industrial applications of heat (IEA, 2020a). Secondly, hydrogen is a dispatchable resource that can be stored, distributed, or burned whenever and wherever it is required. This characteristic is particularly appealing when considering the intermittency of solar and wind electricity generation that does not produce supply in relation to the immediate demand (IEA, 2020b). To this end, electrolysers can produce hydrogen when there is a surplus of renewable electricity, which offers a way to – more or less – store the surplus supply of electricity for later demand peaks (Ibid.).

Why is hydrogen not widely deployed yet?

The current global deployment of hydrogen is negligible because it is not found in nature like oil, gas, or coal. It must be produced through a resource-intensive chemical, electrical or industrial process. Currently, the vast majority of hydrogen demand uses either the steam reformation of natural gas or the gasification of coal. This hydrogen is used in industrial applications to produce a wide range of byproducts. While hydrogen can be used as fuel, it remains mostly uneconomical when competing with hydrocarbons directly. This is because the current production process essentially consumes a fuel (hydrocarbon) to produce a fuel (hydrogen). From an economic standpoint, this is not sensible because the fuel being produced will always be more expensive than the readily available fuels, as their production cost is linked to the feedstock price.

In the same vein, the current production is carbon-intensive and produces roughly 830 MT of CO2 a year (IEA, 2019) – 70-100 MT of which is emitted by the EU 27 (EC, 2020). Fossil-based production dominates the hydrogen supply because its costs are considerably lower than low carbon sources. Hydrogen produced from hydrocarbons – otherwise called <u>black or grey hydrogen</u> – costs between USD 1.34-2.08 p/KG, whereas hydrogen produced from renewable energy – <u>green hydrogen</u> – costs between USD 5.78-23.27 p/KG (Calise, et al., 2019). Between these two falls fossil-based hydrogen equipped with carbon capture utilisation and storage (CCUS) – <u>blue hydrogen</u> – that costs between USD 1.63-2.27 p/KG (Ibid.). Within these prices there is some deviation. The cost of fossil-based hydrogen rises with its respective feedstock, and the cost of green hydrogen is based on the cost of electrolysers and the renewable electricity powering them.

It should be noted that a carbon price has a significant impact on the prices for grey and black hydrogen and to a medium degree for blue hydrogen. The EU's hydrogen strategy identifies that a carbon price of EUR 55-90 per tonne of CO2 is required to make blue hydrogen competitive with black & grey (EC, 2020). Green hydrogen remains uncompetitive with either blue or black & grey in the short and mid-term. The price of renewable electricity, electrolysers, and electrolysis facilities is still prohibitively high for competitive deployment. However, the International Renewable Energy Agency (2020) projects that these costs can be reduced considerably in the longer term as the technology takes advantage of the learning curve and economies of scale. The EU recognises this as well, and for this reason they have based their long-term hydrogen strategy on green hydrogen applications.

The EU's Hydrogen Roadmap

The EU's hydrogen roadmap highlights that their priority is to advance renewable hydrogen because it is the most suitable choice to match their net-zero targets. To reach the deployment levels necessary to meet climate commitments, the Commission has highlighted three phases of deployment.

For the first phase between 2020-2024, the EU aims to decarbonize the existing hydrogen applications and supply them with CCUS. They intend to do so while installing new renewable hydrogen capacity and scaling up electrolyser manufacturing. Increasing production during this phase ensures that the proceeding phases can be supplied with the required components for broader deployment. However, during this phase hydrogen transportation and distribution systems will be somewhat limited. Hence, hydrogen usage will remain limited to local applications.

The second phase (2025-2030) builds off the steps taken in phase one. However, the EU will shift its focus to scaling up a broader deployment. This entails a dramatic increase of installed electrolyser capacity of up to at least 40GW of installed capacity by 2030 (EC, 2020). Such deployment will be possible because the phase one investments are intended to help push down the price of components. However, even as renewable hydrogen supply becomes cost-competitive with fossil-based hydrogen, the EU still argues that strong demand-side policies are essential to establishing a functioning market. Amongst a wide range of industrial applications, renewable hydrogen is also expected to begin playing a role in balancing intermittent renewable power systems. This will be made possible by the EU's broader commitment to establish a Europe-wide network of producers that can supply and distribute hydrogen across the continent. As the network expands, the EU will establish a trans-EU hydrogen market to coordinate the bloc's supply and demand.

From 2030-2050 the EU's hydrogen strategy will go through its third and final stage. At this point, the technologies required to produce renewable hydrogen should be widely deployed and mature. There should be significant volumes of installed production capacity and an established distribution network to deliver the hydrogen to consumption centres. Hydrogen should also be experiencing deeper penetration into the last sectors of the economy, such as aviation. However, such a large-scale deployment of electrolysers will indefinitely consume a significant supply of renewable electricity. The Commission projects that by 2050, green hydrogen production may consume upwards of 25% of all renewable electricity consumed by the bloc (Ibid.). To meet this huge demand, the EU is expected to implement a considerable increase of renewable capacity dedicated explicitly to hydrogen production during this period.

Questioning a Biased Roadmap

The Commission's hydrogen roadmap to 2050 shows significant promise and has set the EU as one of the most ambitious players committing to hydrogen deployment. However, despite the EU’s ambition, the plan is biased towards renewable hydrogen. The EU is calling for – and prepared to use public finance to help reach – up to EUR 470 billion of investment into renewable hydrogen projects by 2050. Such large investment is partially explained by the fact that green hydrogen is nowhere near cost-competitive with other production processes and that significant resources will be required to bring costs down. Investing in electrolysers' production is part of the solution, but the cost and supply of renewable electricity is the most significant barrier for a plan based on green hydrogen. The price of renewable electricity is still the single most considerable cost of green hydrogen (IRENA, 2020). So much so that even if electrolysers cost nothing, green hydrogen would still be more expensive than blue and grey sources (Ibid.).

In theory, the EU can address this by focusing its efforts on ramping up renewable electricity production capacity to increase supply and reduce costs. However, this kind of logic pushes the idea that new renewable electricity capacity should be used to power electrolysers. This is inherently counterproductive to the grand strategy of decarbonization because it pulls renewable power that could otherwise be removing a greater volume of carbon from other sectors. As Ralf Dickel argues, “renewables are best used to decarbonise the power sector, where their decarbonisation effect is at least twice that of their transformation into green hydrogen” (2020, p. 1). This is because in countries like Germany or Poland, the power sector is still dominated by coal generation, and every MWh of renewable electricity removes its energy equivalent of coal from the system. At the same time, renewable electricity converted to hydrogen experiences a degree of conversion losses from the electrolysers.

Furthermore, hydrogen as gas has very few ways to replace coal; most of its applications remove oil and or gas which have a considerably lower emission intensity than coal. It is also possible for scenarios where there is insufficient renewable energy available to power the electrolysers. In which case, they would consume whatever source of generation is powering the grid at the given moment in time. If we consider the EU’s current generation capacity, we can see that it would likely be coal or gas. While hydrogen would still be produced, the notion of green would be somewhat meaningless because, in the end, it still left a carbon footprint. To this end, it seems apparent that green hydrogen production en masse – while possible – comes at the expense of other decarbonization initiatives.

Another Way Forward

In hydrogen's case, the EU’s Hydrogen Map is undoubtedly setting an important example for other countries to follow. However, the bias towards green hydrogen is a critical weakness that undermines other efforts to decarbonize. For this reason, this author suggests that the EU take a more pragmatic approach and avoid picking any one technology as a strategic champion. Every low carbon technology should be given an equal chance to compete. Technologies should be implemented based on their ability to reduce emissions in an economically feasible way while not undermining other decarbonization efforts. A policy that is too driven by preference is bound to unleash unexpected or otherwise avoidable consequences. The case of over-supporting green hydrogen is such an example. To this end, the EU should consider incorporating greater support for other forms of hydrogen – notably blue hydrogen – in the midterm. Such a decision can diversify the EU’s hydrogen portfolio and reduce the heavy consumption of renewable electricity that can be better used to decarbonise other sectors.

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