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Reflection Note

Incentivising hydrogen demand: Critical challenges and opportunities for EU policy

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This paper is the result of a collaborative effort stemming from the key insights obtained at the Brussels seminar entitled "Incentivising Hydrogen Demand: Critical Challenges and Opportunities," which took place on the 14th of March 2024. The seminar, organised by the European Roundtable on Climate Change and Sustainable Transition (ERCST), the Oxford Institute for Energy Studies (OIES), and the Research Institute for Sustainability (RIFS), brought together experts from various fields to discuss the challenges and opportunities surrounding the creation of a viable business model for hydrogen in the European Union. During the seminar, participants engaged in in-depth discussions on the critical issues that must be addressed to unlock the full potential of hydrogen in the decarbonisation of EU industry. The paper you are about to read is a comprehensive analysis of these challenges, drawing upon the expertise shared during the event.

1. Introduction

The European Union has emphasized hydrogen as essential to its industrial decarbonisation efforts and to achieving the bloc's ambitious climate goals. It has created funding schemes and financing mechanisms to stimulate research and development of clean hydrogen, introduced hydrogen production subsidies and adopted pioneering hydrogen use quotas in industry and transport from 2030 onward. Despite this, mobilizing demand for hydrogen has proven challenging, for a variety of reasons. Green hydrogen is still far more expensive than fossil fuel alternatives, and cost reductions have been slow to arrive. Stakeholders have widely differing perspectives on the current status and future outlook of hydrogen technologies and some view exclusive support to renewable hydrogen as a significant barrier to investment and, consequently, to the low-carbon hydrogen project cost reductions. Consequently, EU Member States, which are responsible for implementing EU-level legislation on hydrogen, demonstrate very different levels of hydrogen ambition and policy soundness, creating the risk of an implementation gap and market distortions. Additionally, a significant financing and funding gap further complicates the widespread adoption of hydrogen, as investors remain cautious amidst the uncertainty surrounding its commercial viability. This paper explores these challenges, examining the complex landscape of hydrogen adoption and identifying critical issues that must be addressed to unlock its full potential in the decarbonization of EU industry.

2. Challenges of creating a business model for hydrogen

The willingness of companies to invest in new technologies hinges on the realistic expectation of achieving profitable returns. However, the current landscape for hydrogen, particularly renewable hydrogen, presents significant challenges that hinder the development of a viable business model. Renewable hydrogen production is currently between four to ten times more expensive than hydrogen derived from fossil fuels, particularly impacting hard-to-abate sectors. Moreover, the low maturity level of renewable hydrogen technologies increases the technology risk, further hindering the development of a viable business model. Despite the EU's introduction of green hydrogen use mandates in industry, there is no downstream demand for green hydrogen-based products or readiness to pay a green premium for them. Such demand could be stimulated by the adoption of mandatory targets for certain categories of such products, which also necessitates the development of clear definitions and standards. With these crucial elements missing, industry, as of now, is left without clear incentives to adopt green hydrogen. Also, there is no support for other low-carbon technological alternatives, such as hydrogen produced using carbon capture and storage (CCS) or nuclear energy and a definition of low-carbon hydrogen - to be adopted as part of delegated acts to the Hydrogen and Decarbonised Gas Package - is still to be developed.

3. Carbon Contracts for Differerence (CCfDs) as a tool to overcome market uncertainty

Technical and commercial risks also pose significant barriers. Renewable hydrogen technology is not yet ready for deployment at the volumes required by hard-to-abate sectors, leading to high technical risks. Commercial risks, in turn, are amplified by the lack of liquidity in the hydrogen market and the absence of robust contractual and legal securities. International competition requires a level playing in these early stages and mechanisms like the Carbon Border Adjustment Mechanism (CBAM) may not sufficiently mitigate the disparities.

In this context, a promising risk mitigation mechanism to stimulate demand could be (Carbon) Contracts for Difference (CfDs). These financial instruments can help mitigate risks for both producers and consumers of hydrogen. By establishing a fixed price for hydrogen over a specified period, CfDs enable both parties to manage their exposure to price volatility more effectively. This stability is particularly crucial given the significant fluctuations in hydrogen prices, which can otherwise deter investment and consumption. Moreover, CfDs facilitate the alignment of interests among investors, project developers, and off-takers over the long term. By providing predictable returns and reducing financial uncertainties, these contracts can encourage investments and support hydrogen demand especially if priority is given to terms that promote flexibility and serve as a hedge against regulatory uncertainty.

4. Low technology readiness levels and competition from other decarbonisation technologies

While hydrogen has been in the focus of attention for its potential to decarbonise hard-to-abate sectors, it faces many technical challenges. One of them has to do with the level of technology readiness in many areas of application. The other challenge is linked to competition from alternative decarbonisation pathways that are being explored in parallel in several key sectors. The continued uncertainty regarding the commercial viability and scalability of hydrogen technologies keep many companies hesitant about investing in hydrogen-driven decarbonisation. In combination, these factors translate into low levels of hydrogen demand at present.

The low level of technology readiness limits the scaling potential of hydrogen that industry desperately needs. For instance, the size of the largest electrolyser currently under construction is only 200 MW, which is insufficient for rapidly scaling up green hydrogen production in Europe in the amounts that are needed by industries like oil refining and fertiliser production. Similarly, in the maritime shipping sector, only one ammonia-powered engine is available, reflecting the fact that hydrogen adoption in maritime transport is still in its infancy. This means that currently and in the near future, even if there is no supply shortage for clean hydrogen, its potential off-takers may not be ready to consume it in the previously anticipated high volumes.

In the chemical sector, the transition to renewable hydrogen also presents significant technical challenges. Many integrated chemical production processes rely on the carbon feedstock supplied by natural gas. Renewable hydrogen cannot simply replace grey hydrogen in these processes due to the essential role of this carbon, which further complicates the integration and uptake of green H2 in the sector. That is also why competition from alternative decarbonization technologies is particularly pronounced in the oil and gas sector. Firms in the industry are exploring various strategies to lower their carbon footprint, including large-scale development of carbon capture and storage (CCS).

Overall, while hydrogen holds promise as a part of the broader decarbonization strategy, it is clear that it is important to recognise limitations of the current state of technology development to make informed decisions about investments and policy directions. Therefore, embracing a diverse set of decarbonization technologies is likely to be essential to address the unique challenges of different industries effectively and ensure a comprehensive transition to a low-carbon future.

5. Demand-side policy in the EU: implementation gaps and the need for long-term targets

In principle, the European Union has agreed on mandates for renewable hydrogen use in transport and industry that should drive significant demand for renewable hydrogen by 2030 and beyond. According to the recently updated Renewable Energy Directive (REDIII), EU member states are responsible for ensuring that 42 percent of hydrogen used in industry should come from renewable sources by 2030 (and 60 percent by 2035). In addition, 29 percent of energy use in transport should come from renewable sources, with at least one percent coming from renewable hydrogen-based renewable fuels of non-biological origin (RFNBO). This translates into demand for approximately 4.5 Mt of renewable hydrogen with the potential to fulfil a significant share of the EU's hydrogen targets in the REPowerEU Plan.

However, the implementation of these targets remains the exclusive responsibility of the member states. Industrial consumers will have to rely on the actions of their respective governments to create the enabling conditions to secure the needed amounts of renewable hydrogen to reach the targets. Current policy and market developments seem to indicate that these conditions will not be in place in a significant number of member states by 2030. If RFNBO targets for industry are to be met, urgent action is needed to ensure the deployment of policies and financial incentives to enable investments in renewable hydrogen production and use across the EU. In a range of countries, it is unlikely that this will be possible without EU-level support schemes to reduce the costs of renewable hydrogen in the early phase of renewable hydrogen.

Another challenge are the relatively short-term horizons of the RED III targets on RFNBOs, which reach only until 2035. Yet the profitability of hydrogen projects is not evident during their early stages, typically becoming clear only after approximately 20 years of operation. Therefore, setting a clear target for 2040 is crucial for hydrogen projects as it aids in investment planning and reduces uncertainty, helping investors commit to the significant initial costs. This long-term goal also

enhances market visibility, promoting economies of scale that lower production costs and make hydrogen more competitive.

6. Need for lead markets for green industrial products

In the early phases of market development, replacing fossil fuels with renewable hydrogen in industrial processes will impose additional costs on producers. Absent some form of subsidisation, this will increase the cost of resulting industrial products, with implications for the competitiveness vis-à-vis imported "grey" products. While certain products, like ammonia-based fertilizers, will be subject to the carbon-border adjustment mechanism (CBAM), this only accounts for the price of CO2 emission certificates. It does not cover requirements to account for the share of renewable feedstocks in imported goods. This could have the effect that targets to increase the share of renewable hydrogen in industry leads to the displacement of production rather than an increase in demand for renewable hydrogen.

While the provision of subsidies could dampen the impact on costs, it is unlikely that cost differentials can be fully absorbed by government budgets. Instead measures will be needed to create the framework conditions for so-called lead markets that can absorb the higher cost of renewable hydrogen production and act as a driver of demand among end-consumers. While public procurement might offer one avenue for this, this would also shift the burden to public sector budgets and can only represent a partial answer. Voluntary labelling schemes for green industrial goods could add further demand. However, experience in other sectors has shown their limitations in driving significant demand for higher cost green products. An important third avenue to consider is the development of mandatory quotas or standards for selected end-products that exhibit a high price-elasticity, i.e. where end-consumers have the ability to absorb higher costs of production during the ramp-up phase. An example might include quotas for the use of green steel in high-end passenger vehicles.

7. Creating conditions for e-fuel imports

The need to decarbonize the dynamically growing aviation and shipping sectors could potentially become an important driver of demand for hydrogen-based e-fuels. In 2023, the EU adopted legislation introducing mandates for renewable fuels in these sectors from 2030 onward. The ReFuelEU Aviation Regulation sets progressively increasing targets for the share of sustainable aviation fuels (SAF) supplied at European airports, including sub-targets for hydrogen-based e-kerosene (1.2% by 2030, 35% by 2050). In turn, the FuelEU Maritime Regulation requires large vessels calling at European ports to progressively reduce their carbon intensity and also introduces a 2% renewable fuels usage target by 2030. Voluntary demand is expected to play an important role as well, as leading airlines and shipping companies adopt increasingly stringent climate policies.

Yet demand-side mandates only make sense if the supply side is addressed as well. As of now, despite the expected rise in future demand for e-fuels in the EU, it remains unclear where the supply will come from. There are 25 industrial-scale e-fuel projects announced in the European Economic Area, with plans to supply some 1.7 mt of e-kerosene by 2030[1], but none of them have reached the final investment decision (FID).[2] As a result, a sizable share of the European demand for e-fuels may be covered by imports. One early mover with plans to target the European market is HIF Global, a company that launched an e-fuel demonstration production facility in Chile in December 2022 and is expanding to other locations globally. Many other potential large players, however, have adopted a wait-and-see approach, citing the lack of investment certainty as a key obstacle preventing them from committing billions of USD to capital-intensive projects.

There are several key challenges hindering imports of renewable fuels into the EU. The first one is regulatory complexity. To find offtakers in Europe, imported e-fuels will have to comply with the EU's highly complex RFNBO regulations on the origin of renewable electricity, which may not be easily applicable to the realities of the energy systems of third countries. In any case, at the moment there is no way for e-fuels to be certified as such, due to the lack of an approved certification body in the EU. The second challenge is finding a sustainable CO2 source. Biogenic CO2 is scarce, while the direct air capture (DAC) technology, the Commission's prioritised pathway, is expensive and not technologically mature yet. The most straightforward option - capturing CO2 from industrial sources - may in principle be used until 2041. The decisive precondition, however, is that such CO2 may only come from industrial facilities covered by a carbon pricing scheme, which is obviously not the case in most prospective exporter countries.

A different challenge is the absence of a book-and-claim system for e-fuels in the EU regulatory framework. Physically moving e-fuels across large distances to be put into aircraft or sea tankers is costly and increases their environmental footprint. Industry leaders are thus advocating the introduction of a well-designed book-and-claim system that would allow offtakers around the world to purchase SAF irrespective of their physical location and claim the climate attributes. Furthermore, a book-and-claim system would be helpful whenever it is not feasible to set up a separate sustainable production value chain for e-fuels (e.g. in the case of existing integrated production facilities at the South African flagship company, Sasol). In a book-and-claim system, sustainable feedstock (e.g. green hydrogen) is introduced into the existing production process to substitute a share of conventional feedstock. Based on the total input, the sustainability attribute is then calculated and assigned to the corresponding share of end products, allowing them to be certified and marketed as sustainable. Such an approach would allow integrated producers to gradually increase the share of renewable feedstock within the system.

[1] https://www.transportenvironment.org/articles/e-fuels-for-planes-with-45-projects-is-the-eu-on-track-to-meet-its-targets

[2] https://www.transportenvironment.org/articles/e-fuels-for-planes-with-45-projects-is-the-eu-on-track-to-meet-its-targets#_ftn1

8. Conclusions

- EU and Member States support schemes and new financing mechanisms are essential for addressing the current funding gap in the hydrogen sector, reducing the high costs of renewable hydrogen, and developing a successful business model. Alongside a conducive regulatory framework, these tools are crucial for facilitating the implementation and transposition of EU RFNBO targets at the national level.

- Embracing a diverse set of decarbonization technologies is likely to be essential for addressing the unique challenges of various industries and ensuring a comprehensive transition to a low-carbon future.

- Carbon Contracts for Difference (CCfDs) can be a valuable tool to stimulate hydrogen demand by providing price stability. This stability helps mitigate fluctuations in hydrogen prices and ensures predictable returns, which currently deter investments.

- The creation of lead markets for green industrial products can incentivize demand for green hydrogen, mitigate the cost difference between green and grey hydrogen, and limit the displacement of green hydrogen production.

- Incorporating a book-and-claim system for e-fuels into the EU regulatory framework would enable global offtakers to purchase Sustainable Aviation Fuel (SAF) and claim its climate benefits, regardless of their physical location. This system would facilitate the scaling of SAF markets by simplifying transactions and ensuring that the environmental benefits of SAF are tracked and attributed, promoting greater adoption and investment sustainable fuels.