Our position

Hydrogen as a key energy vector for decarbonisation in hard-to-abate sectors

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Executive summary

The EU has set ambitious decarbonisation goals, positioning itself as a world leader in sustainable development. Hydrogen plays a critical role in achieving these targets, particularly in hard-to-abate sectors and by ensuring energy storage for seasonal supply-demand fluctuations.

To effectively support the hydrogen economy, the EU should focus on the following key points:

- Regulatory framework: Ensure regulatory frameworks allow for the rapid deployment of low-carbon hydrogen technologies.
- Support mechanisms: Simplify and harmonise support mechanisms to balance energy transition, security and cost.
- Technology-neutral approach: Focus on the carbon intensity of hydrogen rather than its production method.
- European Hydrogen Bank: Facilitate the production and adoption of hydrogen based on carbon intensity through effective mechanisms.
- International collaboration: Enhance transatlantic cooperation to access lower-cost low-carbon energy sources, standardise certifications, share best practices and establish international hydrogen trade routes.

By prioritising these areas and leveraging the European Hydrogen Bank, the EU can drive the transition to a low-carbon economy efficiently and effectively, meeting its ambitious climate targets and leading the way in sustainable development.

Introduction

Europe has for many years played a leading role in global energy transition trends and has the most comprehensive set of decarbonisation targets of any region. By 2030, Europe aspires to decrease its greenhouse gas footprint by 55% from the 1990 baseline and recently affirmed its target of 90% by 2040.

These targets signal the need for a radical shift in how industry produces energy and products. Moreover, as industry scales up decarbonisation programmes the simplest-to-decarbonise sectors are decarbonising first, supporting the 2030 ambitions. Electrification is playing a major role in achieving the 2030 targets. Taking the additional step from 55% reduction to a 90% reduction, a staggering 63% increase, requires addressing sectors that are harder to abate. The public and private sectors must not be complacent in this regard, considering that these sectors are significantly more difficult to decarbonise. Furthermore, the timeframe in which to achieve this increased target is significantly shorter than the period leading up to the targeted 55% reduction by 2030. In its recent update to its hydrogen strategy, Germany stated that it will have to import up to 70% of the hydrogen required to meet its targets.

In recognition of the task ahead, the EU is taking tangible steps to support the transition. It has recently adopted key regulatory drivers and will continue developing them in the coming years. The EU has also begun to support commercial applications and recognise industry as a valuable contributor to the solution. By implementing more practical legislation and policies to accelerate commercial deployment of net-zero technologies, as they are classified in the Net-Zero Industry Act, the EU can accelerate the transition to a thriving, low-carbon economy.

To achieve this, the EU needs outcomes-focused policy that prioritises solutions that balance scalability, cost and emissions reduction. At the same time, removing barriers to execution – as is the intent behind the Net-Zero Industry Act – abolishing complex and prescriptive criteria, simplifying and harmonising funding mechanisms and addressing overbearing complexity in the regulatory environment are critical to allow the private sector to play its part in the energy transition.

Below is an analysis of the critical role of hydrogen in decarbonising hard-to-abate sectors, current supply and demand for hydrogen, the necessary regulatory frameworks to support hydrogen projects, the importance of transatlantic collaboration and the need for a technology-neutral approach to hydrogen production and utilisation.

The case for hydrogen as a key energy vector

A molecule like hydrogen is the only currently feasible means of decarbonising some hard-to-abate sectors. Figure 1 below illustrates this point, where initial emissions reductions like energy efficiency improvement and energy reduction have a positive economic outcome. Similarly, it shows that converting vehicles first into hybrids and then into fully electric vehicles is net positive in some cases. As the EU gradually decarbonises hard-to-abate sectors, cost and difficulty increase drastically, making it critical to use solutions such as alternative low-carbon energy carriers like hydrogen.

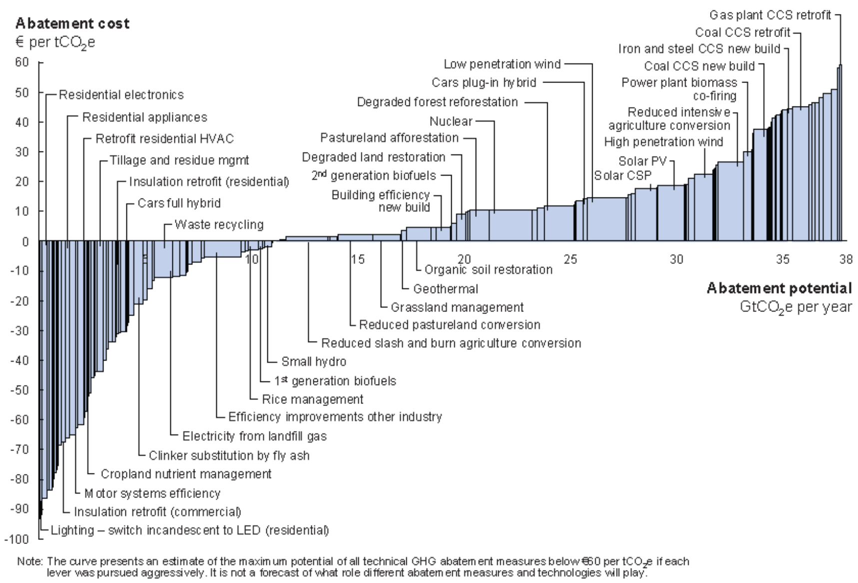

Figure 1 CO_2 abatement cost curve. From: Marginal Abatement Cost Curves: A Call for Caution. Kesicki and Ekins, 2012.

For many sectors – including steel, cement, chemicals and refining, heavy transportation, aviation and high temperature processes – electrification is not always a viable option, either technically or economically. In addition, the EU must ensure that as the availability of renewable energy increases, it is applied first to sectors that are more easily electrified, as depicted on the left-hand side of Figure 1.

Hydrogen presents one of the most promising options from a very limited list to decarbonise the above industries and other hard-to-abate sectors. Additionally, for the electrical sector itself, there is a longstanding recognition that renewable energy does not lend itself well to provision of baseload supply, which is critical to ensure a stable electrical grid across the EU. Though battery energy storage is a key enabler, and longer duration energy storage is being commercialised, these solutions still do not represent an answer to the seasonal storage required in Europe, nor do they fully address baseload provision.

To address seasonal energy demand and supply fluctuations, Europe currently relies on underground storage of natural gas, in the order of 500 TWh of storage capacity. Here again, hydrogen is critical to substitute and gradually replace this fossil storage capacity with a low-carbon alternative that can be used on demand. In this way, current natural gas storage can buffer feedstock for on-demand hydrogen production, with storage increasingly leveraged for direct storage of low-carbon gas such as hydrogen.

Current supply and demand for hydrogen

Figure 2 shows one projection of demand growth for hydrogen based on the critical industries that will need hydrogen to decarbonise. The figure shows that for 2020, 90 Mt of hydrogen is predominantly used for traditional, unabated industries, making it into the so-called grey hydrogen. The first step to addressing this is by decarbonising existing production to convert unabated hydrogen into a low-carbon molecule, using commercially available, large-scale CO_2 capture technologies. This is a daunting task that will require up to several thousand projects. Reaching 2030 targets will require a more than 50% capacity expansion by means of new, larger-scale facilities. Recent facilities can remove several million tons of CO_2 individually by using low-carbon hydrogen production. The need will drastically accelerate towards 2050, with an estimated demand of up to 660 Mt of hydrogen per year.

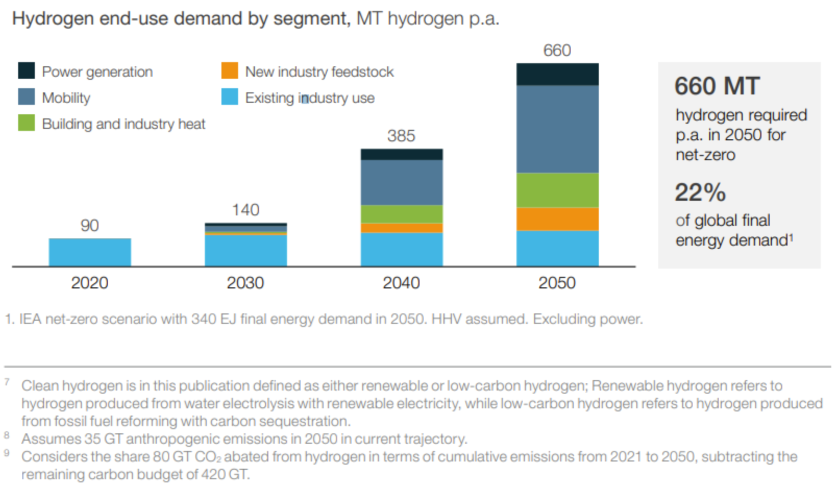

Figure 2 Global hydrogen demand by segment until 2050. Hydrogen Council and McKinsey & Company, 2021

Both Figure 2 above and Figure 3 below – versions of the future energy mix developed by the Hydrogen Council and the International Energy Agency, respectively – show a sharp increase in the need to decarbonise hydrogen in critical, hard-to-abate industries like power, refining, industry (steel, cement, chemicals and others) and transportation (heavy transport, shipping and aviation).[1] Figure 3 further emphasises the importance of decarbonising existing hydrogen production in the context of 2030

[1] For transportation, hydrogen is required in several different forms, pure liquid / gaseous hydrogen, as part of eFuels / RFNBOs and as part of production of advanced biofuels and Sustainable Aviation Fuel.

targets. The current regulatory framework in the EU, however, does not support the systematic decarbonisation of existing production, as the Renewable Energy Directive does not recognise the role of this critical lever.

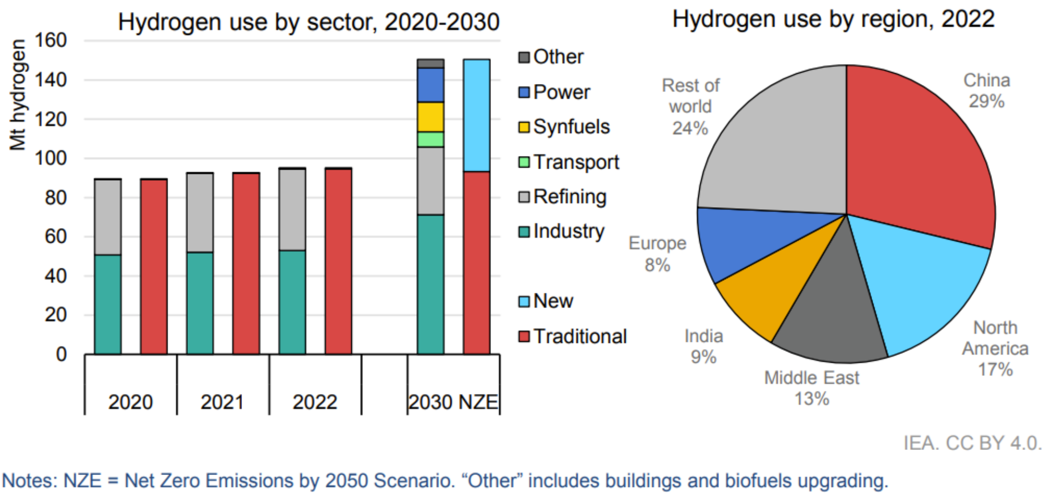

Figure 3 Hydrogen use by sector and region. IEA NZE scenario. IEA. 2022.

This great need is overshadowed by the currently constrained criteria for supporting hydrogen, combined with the overbearing cost and lack of scalability of the primarily supported renewable hydrogen. Though the EU has already made great strides, to reach 2030 and even 2040 ambitions, it will need all forms of low-carbon hydrogen. EU criteria must emphasise the carbon intensity of hydrogen, as opposed to colour, to enable large-scale decarbonisation, while fully renewable supply chains develop and scale for the future. It will also be crucial for the EU to provide long-term assurance for parties interested in non-renewable, low-carbon hydrogen investments that their assets will not become stranded before the end of their useful lifetime.

In summary, the current need for hydrogen greatly outweighs the global capacity to produce renewable hydrogen in the short to medium term. A fully inclusive, outcomes-focused approach is critical to even come close to closing the supply and demand gap and enabling the EU’s climate targets for 2030, 2040 and beyond. There is simply no room for selective application of production routes. The EU must support and prioritise all forms of low-carbon hydrogen that will reliably and permanently reduce carbon.

Addressing the scale of efforts through regulatory frameworks

The EU’s ambitions to reduce greenhouse gas emissions as part of the Green Deal, as well as the global push for decarbonisation, has led to hydrogen emerging as a pivotal energy vector. These changes are welcome as the rapid decarbonisation of the economy – in line with the Paris Agreement – will require all available decarbonisation technologies and pathways, including those based on carbon capture and storage and nuclear energy. However, as concluded above, this endeavour demands substantial investments not only in the manufacturing capacity of electrolysers and renewable hydrogen production but also in the deployment of dedicated low-carbon hydrogen production capacity, intricately woven into a resilient power grid. Regulatory frameworks must evolve to support this transition.

That said, the transposition of adopted EU directives and Member States' complementary delegated acts may introduce added complexity for implementing hydrogen projects. The EU must prioritise support for effective transposition and interpretation of its legislation by national governments to eliminate barriers to project development. Hydrogen projects, especially those pertaining to renewable hydrogen but also for infrastructure, are likely to encounter challenging and protracted permitting procedures due to the absence of a suitable legal framework, limited experience and technical capacity for hydrogen projects in public administration, and the lack of established procedures. Despite these challenges, some sectors – particularly the oil, gas and chemicals sectors – have experience with hydrogen permitting, since this is where the majority of hydrogen consumption currently occurs. Leveraging these experiences and sharing best practices are the best ways to build the necessary capacity to facilitate the permitting process for hydrogen projects.

Furthermore, the significance of upcoming rules for low-carbon hydrogen will influence the availability of hydrogen within the region. Consistent certification of hydrogen and its derivatives is fundamental for investment decisions. Closing the gap in permitting and authorisation procedures is also essential to expedite project development, requiring more agile processes. Well-designed permitting procedures and hydrogen policies, for both supply and demand, are paramount for enabling the faster deployment of both low-carbon and renewable hydrogen projects alike.

Transatlantic collaboration

Enhanced international co-operation is needed across the board but especially for standards, best practice sharing and cross-border infrastructure. The EU must monitor and report on hydrogen production and use on a regular basis to track progress towards long-term goals.

By building on current policies, infrastructure and skills, mutually supportive opportunities can help scale up infrastructure development and enhance investor confidence. They can also lower costs by making the most of existing industrial ports and turning them into hubs for lower-carbon hydrogen. Existing gas infrastructure can help spur new clean hydrogen supplies and/or establish new shipping routes to kick-start international trade in hydrogen.

Member States are gradually identifying the need for large-scale hydrogen import because of the limiting factors for local production. This translates into a greater need for global trade and collaboration via pipeline transport, as well as support for hydrogen carrier solutions, among them liquid organic hydrogen carriers, ammonia and liquid hydrogen, to supplement what is currently possible. The long-standing cross-Atlantic partnership can help meet these challenges and create much-needed clean energy growth opportunities. By leveraging high emissions control standards in the EU and the US, true low-carbon hydrogen can support the decarbonisation needs on both sides of the Atlantic. A cross-recognition of certification methodologies would also be a meaningful enabler of transatlantic trade in hydrogen and its derivatives.

The momentum imperative

Not all steps in the low-emission hydrogen value chain are operating at commercial scale today. This is especially true for renewable hydrogen, where scalability and costs will remain a challenge in large parts of the EU in the coming years. However, low-carbon alternatives could be put in place at large scale. A two-pronged approach would enable the EU to meet critical targets over the next two decades, while future proofing energy systems by scaling up renewable hydrogen as technology and market dynamics become more favourable over time. Developing low-carbon hydrogen production at scale will also be a key element to justify and finance the large infrastructure investments needed.

The EU must initiate changes and build momentum to implement low-carbon emission hydrogen solutions as soon as possible and at a significant scale. There is much that the US can learn from the EU's approach, and it is clear that it sees Europe as the golden standard. The EU should, however, similarly draw inspiration from the US approach, emphasising the importance of implementing large-scale initiatives and iteratively improving upon them, rather than waiting for a perfect process. By doubling down on industrial-scale implementation for all low-carbon emission hydrogen alternatives, the public and private sector can drive the transition towards hydrogen-based energy solutions in hard-to-abate sectors where hydrogen needs to play a critical role.

A technology-neutral approach

Reducing emissions via the use of hydrogen requires a fair and unbiased approach to technology that does not favour specific production methods. Both renewable and low-carbon hydrogen are essential elements to cut emissions in the short and medium term, especially as the widespread use of renewable hydrogen will take more time in certain parts of the EU. Successful industrial decarbonisation depends on ongoing investments in renewable and low-carbon sources, which must be seamlessly integrated into energy systems. This integration should be carefully managed to avoid causing divisions in the European energy market or wider interconnected energy networks. Smoothly and seamlessly incorporating renewable and low-carbon gases will help successfully transition to cleaner energy.

European Hydrogen Bank

Support mechanisms should be crafted with simplicity in mind to increase investor confidence, reduce administrative and legal complexities and diminish the financial burden associated with capital-intensive projects. The pilot auctions under the EU Hydrogen Bank can deliver this simplicity. However, restricting auctions to only renewable hydrogen diminishes the bank's effectiveness.

For the international pillar, the mechanism must prioritise simplicity, shielding importers and offtakers from potential risks related to volume and price shocks. A fit-for-purpose and speedy approach for implementing the international segment of the Hydrogen Bank could involve leveraging existing and legally sound instruments such as H2Global.[2] By adopting this strategy, the EU could draw inspiration from an established legal entity within the European market, facilitating the purchase and resale of hydrogen and its derivatives in Europe based on the needs of participating Member States in global auctions.

Furthermore, the primary purpose of the EU Hydrogen Bank and other funding and cost support mechanisms should be to enable production and adoption of hydrogen based on the molecule's carbon intensity, not the colour, through a contract-for-difference (CfD) pricing mechanism. CfDs are an effective tool to scale new investments in production pathways while ensuring industrial competitiveness. They have been proven effective in the electricity sector in over 200 auctions across multiple European countries. The EU should leverage this experience for the hydrogen sector in

[2] H2Global uses the 'double-auctions model,' bridging the difference between the high prices at which hydrogen is currently being traded on the global market and the lower prices at which it can be sold on and be used in economically viable ways at the regional level.

combination with industry-specific hydrogen procurement mandates. Support for scalable lower-carbon hydrogen, in whichever format, is critical for the EU to meet the required targets. At the same time, it must ensure the most efficient application of public funds to achieve this at the lowest cost to society.

Conclusion

Hydrogen is clearly a pivotal energy vector for decarbonising hard-to-abate sectors. The growing need for low-emission hydrogen and renewable hydrogen necessitates a swift and scalable adoption, as well as an approach that is inclusive to ensure cost-effective implementations can be brought to market in the timeframe required to meet the EU's energy goals. Carbon intensity outcome, not the colour of hydrogen, should be the governing factor in considering support for projects and technology, recognising that many varieties of hydrogen, including low-carbon hydrogen, can provide the drastic carbon reductions required by the EU's climate framework.

Regulatory frameworks, especially within the EU's Green Deal, play a vital role, demanding substantial investments and addressing permitting challenges. By enabling a multipronged approach to hydrogen, the EU can help decarbonise the hardest-to-abate sectors quickly. It should allow for the use of large-scale low-carbon hydrogen, while future proofing the energy sector with a parallel scale up for renewable hydrogen alternatives.

Although the demand for renewable hydrogen will increase, all forms of hydrogen require similar infrastructure. Now is the time to leverage ready-now solutions to scale this infrastructure to help enable the hydrogen revolution.

All forms of hydrogen require similar infrastructure. The opportunity to leverage ready-now solutions to scale such infrastructure and create the much-needed momentum for help enable the hydrogen revolution, which includes an increasing share of demand of renewable hydrogen in future.

In addition, transatlantic collaboration provides a great opportunity for EU industry to access lower-cost low-carbon energy sources from the US. There are great opportunities for enhanced international cooperation on standards, cross-recognition of certification methodologies, best practice sharing to enable trade in low-carbon intensity hydrogen and derivatives. Leveraging existing infrastructure, skills and policies can significantly contribute to scaling up infrastructure development, enhancing investor confidence and lowering costs, particularly by establishing hubs for lower-carbon hydrogen and initiating international hydrogen trade.

Lastly, the establishment of the Hydrogen Bank is a meaningful step to enable a bustling hydrogen economy. More than ever before, it needs to support ready-now, scalable projects based on carbon intensity. Simplifying and harmonising the multitude of support mechanisms that the EU has put in place will ensure the most efficient and expedient use of funds and other resources to strike the right balance between energy transition, energy security and energy cost.