

# Powering Ahead: Fortifying EU Relations through Hydrogen Trade

This article was reviewed by Timothy Chan



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## Introduction

**E**nergy security, a fundamental pillar of any state's economic and social stability, pertains to the uninterrupted availability of energy resources at an affordable cost (Cherp and Jewell 2014). The concept extends beyond mere availability, encompassing aspects such as energy efficiency, sustainability, and environmental friendliness (Directive 2019/944). As global climate change concerns intensify, achieving energy security increasingly entails a transition from high-carbon to low-carbon resources, a shift that necessitates innovative and sustainable energy solutions.

Hydrogen, a versatile and efficient energy carrier, has emerged as one of the potential answers to this energy conundrum (Steinberger-Wilckens et al., 2017). Characterised by its high energy content and environmental sustainability when produced by using electricity from renewable sources, hydrogen is being eyed as an essential player in the drive towards a low-carbon economy, especially within the European Union (EU). The EU strategy recognises the role of hydrogen in this energy transformation (Hydrogen Strategy, REPowerEU Plan), underlining its importance for meeting the bloc's ambitious climate goals and ensuring long-term energy security.

Central to this approach is the emphasis on clean hydrogen, primarily produced through water electrolysis power only by renewable electricity sources. However, given the EU's diverse energy needs and geographical variances in renewable energy availability, merely producing hydrogen domestically is unlikely to suffice. To ensure a steady and sustainable hydrogen supply, the EU needs to tap into the global hydrogen market, making

international hydrogen trade a cornerstone of its energy strategy. Currently, hydrogen is used most often for transport. Although, technology and regulation are approaching the commissioning of hydrogen as an energy carrier.

The following sections delve deeper into the EU's hydrogen strategy and objectives, potential international partners for hydrogen trade, the benefits, and challenges of this trade for energy security, and recommendations for strengthening the EU's hydrogen trade partnerships. The goal is to provide a comprehensive overview of the role of international hydrogen trade in bolstering the EU's energy security, and to underscore the importance of continued efforts and partnerships in this critical endeavour.

## EU's hydrogen production: expectations vs. reality

By taking the Ukrainian side after the war outbreak in 2022, the EU had to ensure the security of its citizens. Following the declaration of heads of countries on the conflict, there has been a high risk of discontinuity of energy sources supply from the Russian side. Coupled with the economic the COVID-19 pandemic implications, Europeans have been suffering from unstable and constant rise of energy prices.

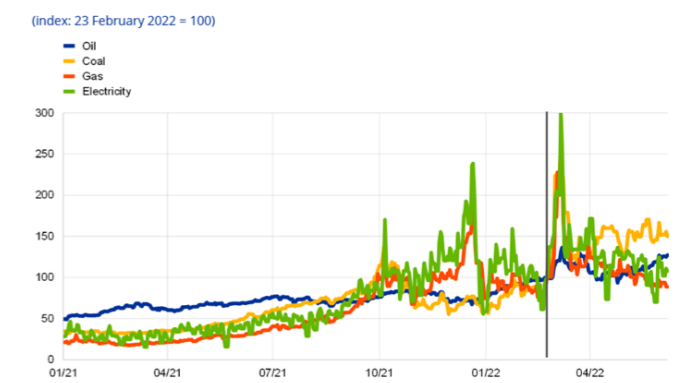


Figure 1: Energy prices (European Central Bank, 2022).

The EU highlighted hydrogen as one of the solutions for the above. The REPowerEU increases the hydrogen production volume almost fourfold compared to the FITFOR55 climate package. The assumed production of hydrogen is 20 million tonnes annually by 2030. The half shall be produced in Member States, the second part shall be distributed from third countries. Aurora states that this target is achievable as expected at the end of the decade. Also, the directions and actions enabling the EU to get as close as possible to its ambitions are already known.

**REPowerEU:** It is a plan for saving energy, producing clean energy and diversifying the European energy supplies. It is backed by financial and legal measures to build the green and decentralised energy sector that Europe needs.

### Potential Partners for Hydrogen Trade for EU

Beyond replacing the conventional energy sources from Russia, the EU aims to reduce its reliance on fossil fuels and transition to a carbon-neutral economy. This done by justifying the vast potential of green hydrogen as a clean energy source in the decarbonisation process. The EU's ambitious Hydrogen Strategy foresees the integration of this renewable energy source into various sectors of the economy such as transport, power, construction or heavy industry. To fulfil these plans, both in the qualitative aspect on the range of sectors in deploying hydrogen and quantitative for produced volumes, the EU seeks to forge strong partnerships with third countries on hydrogen trade. Some of these promising cooperative options are worth exploring.

### A. North African Countries: Morocco, Algeria & Egypt

Morocco, Algeria, and Egypt, all hold significant promise as potential hydrogen producers due to their abundant renewable energy potential, particularly solar and wind energy. Intense sunlight and steady wind speeds are comfortable conditions for the operation of plants powered by these two natural energy sources (van Wijk and Wouters, 2021). These countries have been progressively focusing on hydrogen (Hydrogen Strategy of Morocco, Algeria National Hydrogen Roadmap, Egypt Hydrogen Strategy), mainly driven by the potential economic benefit from the EU. In the year 2050, the global hydrogen trade may generate approximately USD 100 billion per year in North Africa (Deloitte, 2023).

With a robust renewable energy sector in particular, solar energy amounting to 740 MG installed capacity (North Africa Post, 2023) and proximity to Europe, Morocco is a viable candidate for supplying green hydrogen to UE. In the case of Algeria and Egypt, both oil and gas-producing countries, hydrogen projects are based not only on renewable electricity but also on gas with carbon capture and storage. Algeria National Hydrogen Roadmap, disclosed in March 2023, sets a goal to generate and export between 30-40TWh of hydrogen as well as H<sub>2</sub> derivatives by 2040. It's worth noting that a million tonnes of hydrogen equate to about 33TWh of energy. The strategic plan entails efforts to attract foreign investment and grants, alongside establishing global strategic collaborations.

Despite the promising outlook, North African countries still have a long way to go before it can fully export green hydrogen. The major obstacle appears to be the not fully developed

gas network connections with Europe. At present, North Africa has two infrastructure routes to supply hydrogen. In the western part, there are two electricity grid inter-connectors between Spain and Morocco, each 700 MW. Additionally, gas infrastructure allows transporting hydrogen from Algeria via Italy. There is a need to construct a third transportation pipeline. The most convenient plan is to extend the second pipeline to Greece, which could unite the existing infrastructure with the Middle East (van Wijk, Wouters Rachidi and Ikken, 2019). Furthermore, water scarcity in the dry region presents a challenge, as the production of green hydrogen through electrolysis requires substantial amounts of water. Removing existing barriers and providing a sufficient hydrogen flow between two continents requires time. Significant investments in renewable energy infrastructure such as desalination plants to mitigate insufficient water supply, and technical expertise are still needed for this vision to become a reality.



Figure 2: Hydrogen infrastructure in North Africa (Van Wijk, Wouters, Rachidi and Ikken, 2022).

### B. Chile

Chile is another potential partner for the EU in hydrogen trade. In its ambitious National Green Hydrogen Strategy, Chile aims to produce the world's lowest-cost hydrogen of USD 1,5 per kg by 2030. It also assumes Chile becoming one of the top three hydrogen exporters by 2040.

The modernised EU-Chile trade agreement concluded in 2023 provides a framework for

this promising collaboration. The agreement ensures non-discriminatory access to the Chilean hydrogen market and fosters harmonisation of certification schemes for renewable fuels. Various European institutions, such as the European Investment Bank and KfW Development Bank, are already supporting Chile's growing renewable hydrogen industry through substantial investments. However, Chile also has a problem with direct transport to the EU. Yet, there is a possibility to learn from the experience of supplying hydrogen to Japan. In the case of the Asian recipient, Chile uses ammonia as a hydrogen storage by combining atmospheric nitrogen and hydrogen at relatively high pressures and temperatures (Fúnez Guerra et al., 2020).

### C. Norway

With its well-established hydrogen production and export infrastructure, Norway is a vital partner in international hydrogen trade for the EU. Hydrogen production currently stands at 225,000 tonnes, primarily sourced from natural gas for industrial utilisation. Producing grey hydrogen by steam reforming results in substantial CO<sub>2</sub> emissions. Carbon dioxide capture equipment needs to be installed, thus the conversion of class hydrogen as usable and tradeable among European standards.

Norway produces the most affordable energy from renewable resources (van Wijk and Wouters, 2021). It implies reasonable LCOH (Levelized Cost of Hydrogen) by using water electrolysis. Thus, cooperation with Norway can ensure stable green hydrogen prices, partly given the long-term expertise in hydropower generation. Compared to the other described countries, Norway appears also to be a more secure option due to the democratic political system.

In recent years, Norway and Germany have signed several agreements to enhance cooperation in hydrogen production and trade. Norway and Germany on 5th January signed joint declarations to increase the production of renewable energy and develop (green) hydrogen as they both seek to both cut their CO2 emissions and wean Germany from its reliance on Russian gas. The declarations outlined steps for cooperation in the areas of hydrogen, battery technology and offshore wind, as well as carbon capture and storage. Besides cooperation at the government level, local companies have ambitious development plans and invest in hydrogen technologies. Norwegian energy company, Equinor, aims to invest in clean hydrogen projects for export to the EU, with initial low-emission hydrogen production capabilities of 2 GW by 2030, increasing to 10 GW by 2038. This hydrogen would feed into a proposed pipeline to Germany, which is currently being evaluated. On the other side, RWE, a German multinational energy company, has signed an agreement with Equinor to cooperate in developing the hydrogen economy. RWE intends to purchase and utilise blue hydrogen transported by Equinor. In addition, the two companies plan to collaborate on projects producing green hydrogen from offshore wind energy sources. Moreover, the announcement of a new hydrogen production plant's development in the partnership between Provaris and Norwegian Hydrogen (Provaris Energy) propels Norway to the limelight as it's set to become one of the biggest green hydrogen producers in the Scandinavian region. The proposed hydrogen facility is expected to reach a total capacity of 270 MW once fully operational, capable of producing up to 40,000 tonnes of green hydrogen each year. So far, a capacity of 20 MW has been approved, and an additional application for a further 250 MW capacity is currently under review. Furthermore, the project will employ Provaris' innovative solution for the storage and transportation of compressed hydrogen to various parts of Europe. The planned installation could potentially mitigate over 500,000 tonnes of CO2 emissions annually.

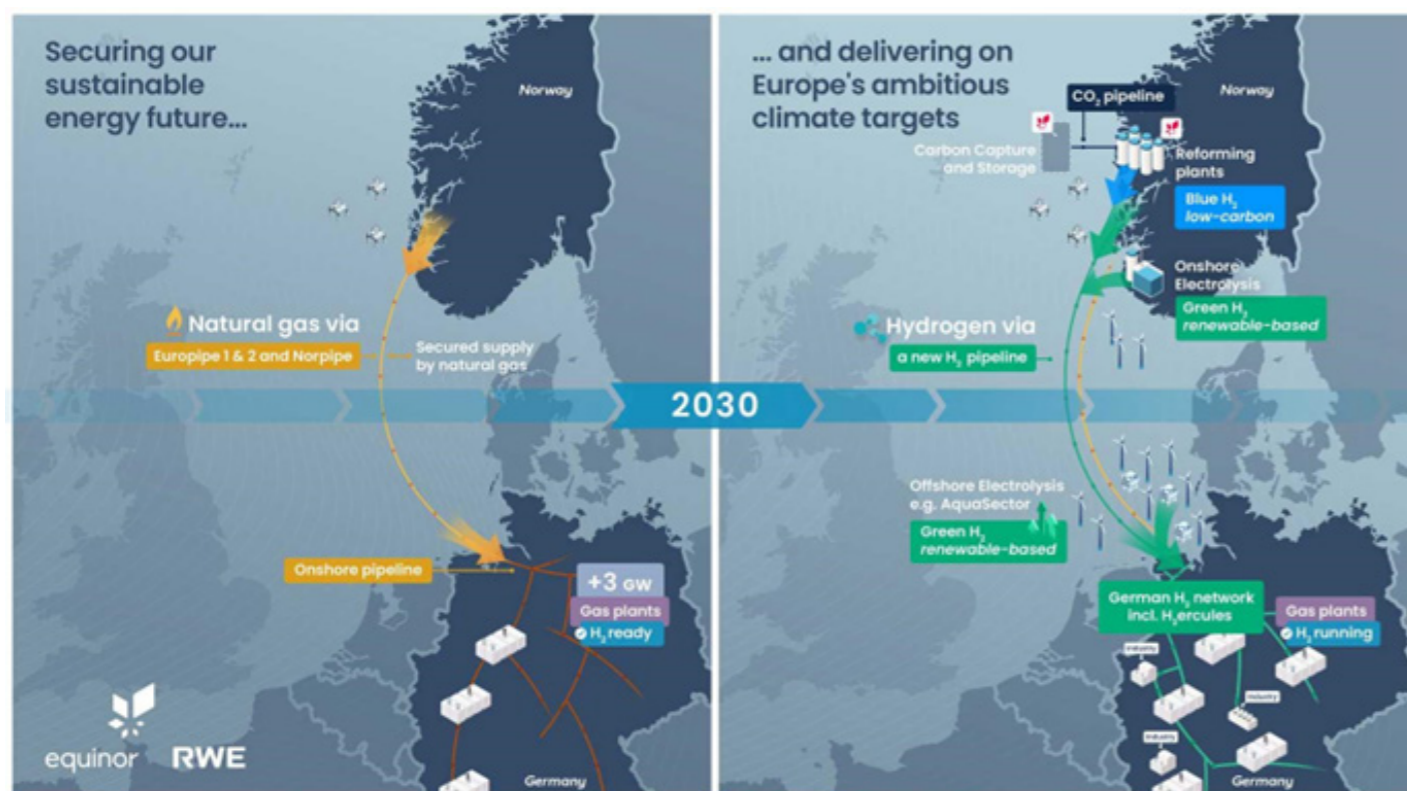


Figure 3: Equinor and RWE to cooperate on energy security and decarbonization (Equinor, RWE, 2023)

## Benefits and challenges of International Hydrogen Trade

As hydrogen can be produced in a wide variety of geographic locations where there's a supply of renewable energy and water, it has the potential to significantly diversify the EU's energy portfolio. This diversification reduces the reliance on specific countries or regions for energy supplies, decreasing geopolitical risks and enhancing energy security (Stringer, 2008).

Further, green hydrogen provides an opportunity to move away from a heavy reliance on fossil fuels. As the world pushes towards a carbon-neutral future, the use of green hydrogen as an alternative fuel source could play a crucial role in achieving climate goals. Most importantly, to reduce EU greenhouse gas emissions by 55% by 2030 compared to 1990 and achieving climate neutrality by 2050 (FITFOR55). In the face of disruptions to fossil fuel supply or price volatility, green hydrogen could serve as a reliable alternative, enhancing the resilience of the EU's energy supply.

In addition, the growth of the global hydrogen market could stimulate competition and drive innovation in hydrogen production, transportation, and usage technologies. It would encourage a variety of players to enter the market, creating a competitive environment that could lead to lower prices, improved services, and other advancements that make the use of hydrogen more efficient and cost-effective.

Despite the significant potential benefits, the international trade of hydrogen also presents several challenges and barriers. Hydrogen's low energy density by volume makes its transportation and storage technically

challenging and costly. The assumed costs are USD 9 trillion of cumulative investments in the global hydrogen supply chain, including USD 3.1 trillion in developing economies (Deloitte, 2023). Another crucial aspect is the certification of hydrogen quality (European Clean Hydrogen Alliance, 2023). Different methods of hydrogen production have varying levels of environmental impact, so clear certification is necessary to ensure that green hydrogen is indeed produced sustainably and diligently. Developing these standards on a global scale will be a complex process, requiring international cooperation and consensus.

Lastly, there are also challenges associated with ensuring fair and open market access. As the hydrogen market grows, it will be necessary to ensure it does not become dominated by some large players, and that access to the market is fair for all potential producers and consumers (IEA, 2021). This is crucial for maintaining competition and avoiding price manipulation or supply monopolies.

Taking into consideration the realities above, the EU shall desire its currency, the euro, to play a significant role in the global green hydrogen trade (Leonard et al., 2021). To decrease the financial risks associated with cross-border hydrogen transactions, it's crucial to support the development of a structured international hydrogen market based on euro transactions. Achieving this would require the EU to continue investing in green hydrogen projects, increase demand from end consumers in member countries, and conduct transactions in euros. As the hydrogen market is still emerging, the European Commission should develop an index for euro-denominated transactions related to green hydrogen, which would ultimately increase market

liquidity and strengthen the euro's position as the dominant currency in future hydrogen trade.

## Summary

International hydrogen trade presents multiple benefits for energy security. Firstly, it allows for the diversification of the energy mix, reducing dependence on a single resource and thereby mitigating the risks associated with supply disruptions. Additionally, it supports transition to a more resilient and envi-

ronmentally friendly energy system by reducing reliance on fossil fuels. Lastly, it aligns with global decarbonisation efforts, further bolstering the EU's position as a leader in climate action. Looking at the situation in the EU, with certainty, the organisation has recognised the potential of green hydrogen for a sustainable en-

ergy transition and securing the good as is energy to its citizens. The hydrogen bolsters the EU's position as a leader in climate action.

Simultaneously, it's crucial to recognise that international hydrogen trade isn't without its challenges. Technical issues related to hydrogen transportation and storage, standardisation of hydrogen quality and certification, market fairness, and cross-country policy coordination can all act as potential barriers. Nonetheless, these hurdles are not insurmountable, and with robust strategies and international cooperation, the EU can harness

the potential of global hydrogen trade. However, the feasibility of exporting hydrogen remains questionable due to high production and transportation costs. The above makes green hydrogen more expensive than hydrogen produced from fossil fuels, although this is expected to change as technology improves and the cost of renewable energy continues to fall. Building the necessary infrastructure will be a significant undertaking, requiring large-scale investment and international co-operation. EU Member States have varied

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capabilities for renewable hydrogen production, and a fair, competitive market with unhindered cross-border trade could bring significant benefits in terms of competition, price accessibility, and green hydrogen supply security.

The EU, as a long-standing net importer of energy, will continue to be

so also in the context of a green hydrogen economy. Hydrogen could become part of the EU's international, regional, and bilateral diplomatic efforts in line with its energy and climate policy. The development of the EU's green hydrogen market provides new geopolitical opportunities in the form of international energy partnerships, when the EU is the central hub. Given the natural resources, physical interconnections, and technological developments, priority suppliers should be the countries of North Africa and Norway.

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