

European hydrogen market and its potential for Russian business

Aybika Beksultanova^{1*}, *Sergey Valeev*², and *Elmira Amirova*^{3,4}

¹Chechen State University named after A. A. Kadyrov, 32, Sheripova A. st., Grozny, 364024, Russia

²Kazan National Research Technological University, 68, Karl Marx street, Kazan, 420015, Russia

³Kazan Federal University, 15/25, Kremlevskaya str., Kazan, 420111, Russia,

⁴Kazan State Agrarian University, 65, K.Marx st., Kazan, 420015, Russia

Abstract. In this article, the author explores the European hydrogen market and its potential for Russian business. Hydrogen is becoming increasingly important in the pursuit of sustainability and environmental cleanliness. The author discusses the opportunities that open up for Russian companies in the European hydrogen market and highlights their expertise and experience in the production and supply of hydrogen. The results of the study indicate the prospects and potential for Russian business in this area and offer recommendations to develop this market and strengthen the positions of Russian companies.

1 Introduction

All countries of the world to one degree or another suffer from global and local environmental problems. They are solved by supranational institutions such as the UN and its subordinate structures, national governments, non-profit organizations, as well as private companies [15].

The issues of global sustainable development are attracting more and more attention of the world community and international organizations, they are recorded in the documents of the OECD, IMF, World Bank, WTO and in the reports of corporations. [16]

Many countries around the world consider the development of the hydrogen economy as one of the major development of the global energy market. Hydrogen is becoming the primary means of energy storage, which allows storing and moving "green" energy derived from renewable sources over long distances, even thousands of kilometers, from regions with abundant energy resources to energy-intensive regions. One of the main reasons why hydrogen has a promising demand is related to the desire to reduce the negative impact on the environment and climate. Countries around the world, including Commonwealth countries, are worried about reducing their ever-increasing carbon emissions. [1]. Governments adopt strategic documents and action plans to support the development of a new economy segment. For example, the European Union adopted the Hydrogen Strategy, which aims to use hydrogen "to reduce carbon emissions in industrial processes and sectors of the economy where reducing carbon emissions are urgently needed and difficult. These

* Corresponding author: adamovaaybika@mail.ru

factors make hydrogen important in meeting the EU commitment to achieve carbon neutrality by 2050 year, as well as for global efforts under the Paris Agreement and the pursuit of zero emissions"[2]. To implement this strategy, an appropriate legal framework has been developed both at the level of the European Union as a whole and at the level of the governments of individual European countries. Companies engaged in "green" projects in this area can count on significant financial support and increase their attractiveness to local and international investors.

The second motive to expand the use of hydrogen is the desire for energy independence. There is significant dependence on a small group of exporting countries that control most of the world's fossil fuel reserves. The experience of energy crises in the 1970s showed that energy resources can easily become an instrument of political pressure. Therefore, countries that are forced to import oil and gas fear for their energy security in the event of political disagreements with the main suppliers of energy resources. In light of today's geopolitical environment, most European states are seeking to reduce their dependence on Russian energy resources. This has the potential to revolutionize the European energy market and stimulate the development of green energy sources, including hydrogen. [3].

2 Materials and methods

The research materials contain the results identified in the published reports and analytical materials of international organizations, specialized analytical publications, data from foreign and Russian news agencies, as well as interviews and articles by leading analysts and experts.

The following research methods were used in the work:

- Comparative approach.
- Classification.
- Generalization.

3 Results and Discussion

The European hydrogen market [4] has a flexible infrastructure and available technologies that provide significant opportunities for investors [5]. Experts predict that the demand for hydrogen in Europe might grow to 1000-2500 TWh by 2050 and the total market volume will be from 50 to 125 billion US dollars. Pure hydrogen production in Europe will reach 5.1 million tons by 2030, and autonomous electrolyzers will play an important role [6].

Germany, the Netherlands and Poland show the greatest demand for hydrogen, with annual volumes of 1.6 million, 1.3 million and 765 thousand tons (Figure 1) [7]. The demand structure may differ from country to country (Figure 2). The largest consumers are countries with developed chemical and oil refining industries, as well as developed transport infrastructure. A significant amount of hydrogen is produced in Spain, Italy, France, Belgium and the UK in addition to Germany, the Netherlands and Poland.

As shown in fig. 7, the supply of "green" hydrogen in Europe is less than 1% of the total production. Even for the largest European manufacturers, the proportion of hydrogen produced by water electrolysis is very low. At the same time, the methane reforming method accounts for almost 85% of the total hydrogen production in Europe. However, water electrolysis ranks second in terms of the number of installations (95 installations) [8]. This indicates that Europe is increasing its green hydrogen production capacity and plans to increase its production in the future.

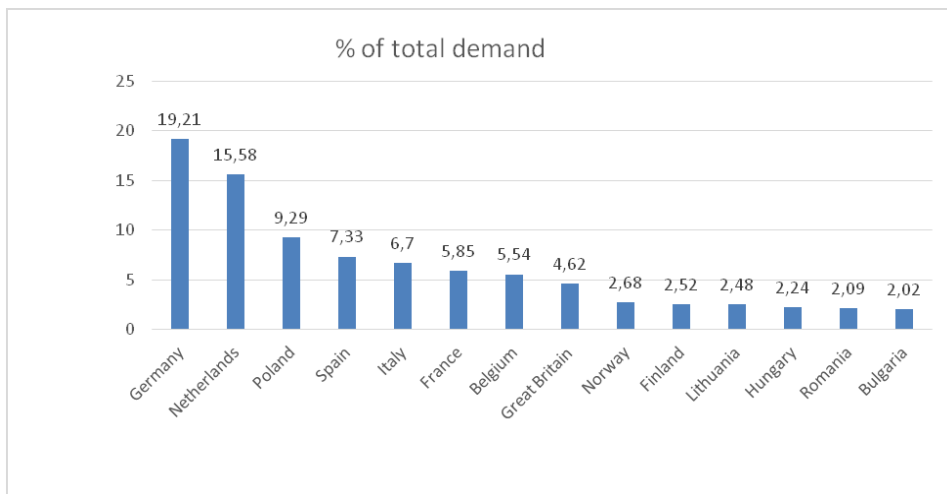


Fig. 1. The demand structure for hydrogen in Europe according to countries. Data source: Hydrogen Demand. FCH Observatory.

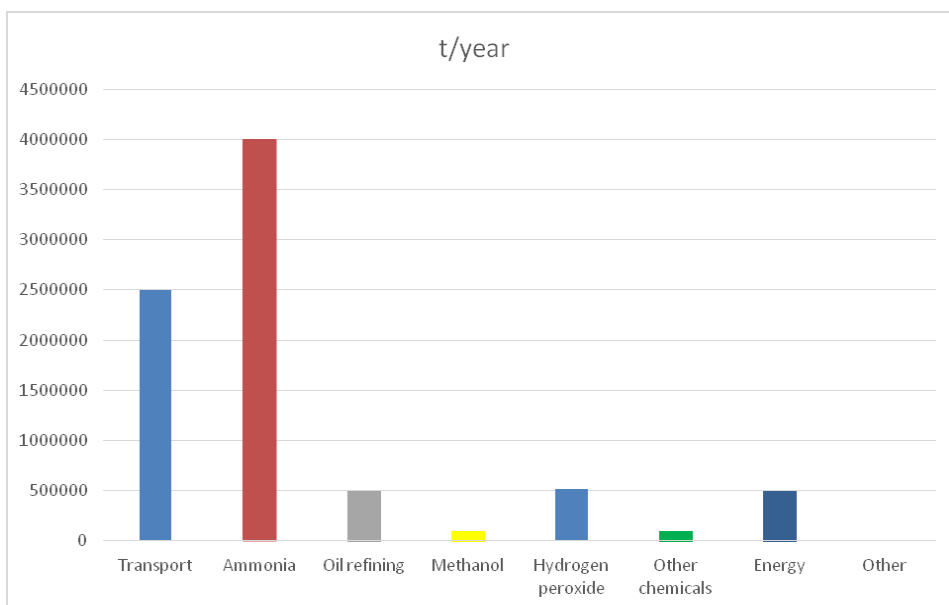


Fig. 2. The demand structure for hydrogen in Europe according to industries. Data source: Hydrogen Demand. FCH Observatory.

By now, in 2023, the demand for hydrogen in Europe is 24 thousand tons per day, with an installed production capacity of 33 thousand tons per day. However, if methane reforming is not taken into account, the hydrogen production capacity is only 4.8 thousand tons per day [9].

In line with the zero-emission policy and environmental agenda, more efficient and less carbon-intensive technologies are displacing methane conversion. However, methane-reformed hydrogen does not solve the problem of the European Union's dependence on energy imports, since its production requires the use of natural gas. Thus, despite the growing number of green hydrogen plants, their capacities remain critically insufficient to

meet demand, and the costs of production processes remain high. Therefore, green hydrogen imports could play a crucial role for Europe in achieving carbon neutrality by 2050.

IEA data indicate that the production costs of renewable hydrogen in Russia exceed them in Latin America and Australia. However, Russia has significant renewable resources such as wind, solar, hydro and geothermal energy. Every region of Russia has economically viable and technically feasible sources of renewable energy [10].

The southern regions have high potential for the development of solar energy, while the northern, southwestern and eastern regions have great potential for the use of wind [11]. The large-scale development of renewable energy sources, accompanied by a gradual reduction in the cost of energy obtained from wind and solar, can make Russian "green" hydrogen more competitive in the European market.

Nevertheless, the current focus is on methane reforming technology. Russia has a large infrastructure for transporting natural gas, which can be adapted to transport hydrogen. The cost of hydrogen produced using this technology is relatively low in Russia, ranging from 0.9 to 3.3 US dollars per kilogram, and a carbon capture process increases the cost by about 0.6 US dollars [12]. This hydrogen production method, although economically justified, fail to comply with European countries' clean energy policies.

Europe already has significant domestic hydrogen production capacity through methane conversion, so the European market needs not only to import hydrogen, but also to replace "grey" hydrogen with "green" hydrogen. Despite having vast oil and gas resources that allow Russia to produce hydrogen at minimal cost, the country also has significant potential to produce clean hydrogen through nuclear and hydropower.

The most promising type of hydrogen production is the use of electricity generated at hydroelectric power plants. This is due to the fact that the electricity cost obtained from such stations is the lowest compared to nuclear and thermal power plants.

The agreement concluded between RusHydro and H₂ Clean Energy in 2021 confirms the plans for the development of hydrogen production using hydropower in the Kamchatka, Magadan and Murmansk regions [13]. Another example is the En+ project aimed at producing 18,000 tons of hydrogen at hydroelectric power plants in Siberia and Karelia [14].

Thus, the use of already existing hydropower capacity to produce renewable hydrogen represents a potential opportunity for Russia in the near future. However, the long-term development of this market will require significant investments in wind and solar energy, which will help reduce the cost and increase the competitiveness of Russian "green" hydrogen in the European market. It is also necessary to take into account the rapid growth in the construction of renewable energy facilities in China, India, the European Union and Australia, which contributes to cost savings through the scaling effect.

Hydrogen can play an important role in solving the problem of storing and transporting renewable energy, which in turn can significantly reduce the carbon footprint in industry and transport. Europe (and also China), as the largest energy importer, supports the development of renewable energy sources not only to achieve zero emissions, but also to ensure energy independence. The current hydrogen production capacity in Europe can meet domestic demand, which is defined primarily by industry rather than the energy transition. However, more than 70% of the hydrogen is obtained by reforming methane ("grey" hydrogen) that does not correspond to the stated goals and strategies of the energy transition. Green hydrogen production capacity remains low, at less than 1%, and cannot meet ever-increasing demand, in part due to the limitations of available renewable energy capacity. Besides, regulatory restrictions and lack of available land resources for renewable energy construction require the import of renewable hydrogen. Russia and other CIS

countries would have the opportunity to compete for their share of the European market. However, there are significant limitations associated with the relatively high cost of producing "green" hydrogen with insufficient volumes of solar and wind generation (which in Russia are about 100 times less than in China), as well as competition from Australian and Brazilian hydrogen.

Russian hydrogen is opening up prospects due to vast renewable resources and large areas of free land resources. In addition, the existing large-scale gas transportation infrastructure can be adapted to transport hydrogen. The development of hydro and nuclear energy in Russia can also become the foundation for the success of Russian hydrogen in the European market. However, despite the objective interest of the European Union countries in Russian hydrogen, this interest is unlikely to be realized in the short term. However, these restrictions might not apply to other member countries of the Commonwealth of Independent States (CIS). However, these countries also face restrictions on available green generation capacity. Moreover, for the countries of Central Asia, water resources can become a limiting factor for large-scale production of hydrogen by electrolysis.

4 Conclusion

Thus, the European hydrogen market is a promising development, which is rapidly gaining momentum. This market offers significant opportunities for business development, including Russian business supported by the governments and European organizations.

One of the main reasons for the growing interest in hydrogen is its potential as a clean energy source. Hydrogen can be produced from renewable energy sources such as solar and wind power and used in various sectors including transportation, industry and energy. Hydrogen technologies have significant potential to reduce greenhouse gas emissions and combat climate change.

The European Hydrogen Strategy, which plans to create an infrastructure for the production, storage and distribution of hydrogen, creates opportunities for Russian business. Russian companies with experience and expertise in the production and supply of hydrogen can take advantage of the growing demand for this resource and participate in the development of the European market. Hydrogen related projects can become a source of new opportunities to export and cooperate with European companies.

However, in order to successfully enter the European hydrogen market, Russian companies have to take into account the market features and meet high quality and environmental safety standards. It is important to have sustainable and competitive solutions for the production, transport and use of hydrogen.

In conclusion, the European hydrogen market represents a significant opportunity for the Russian business. Russian companies with technologies and resources in the field of hydrogen can take advantage of the growing demand for this resource and participate in the development of clean energy in Europe. However, it is necessary to take into account its peculiarities and meet high quality and safety standards in order to successfully enter this market. With the right approach, cooperation between Russian business and the European hydrogen market can become an important factor in the development and economic growth of both parties.

However, the European cross-border carbon tax, due to its uniformity and strong support, seems like a worthy solution for the European Union in the field of carbon regulation and recovery from the global epidemic. At the same time, significant changes and negative consequences from the introduction of these measures may occur in the Russian economy[18].

Achieving sustainable economic development on a global scale will require wise use of resources, technology, economic incentives and strategic policy planning at the local and national levels[17].

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