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“Green” hydrogen for Kazakhstan and CA countries in the era of decarbonisation

Main Findings

- The Republic of Kazakhstan has natural advances regarding to other CA countries in production of “green” hydrogen;
- The Republic of Uzbekistan has more developed regulatory system and governmental support for studying and implementation of hydrogen using;
- The Kyrgyz Republic and the Republic of Tajikistan are planning to develop hydrogenation and do not considering the hydrogen as the way of decarbonisation;
- There are no information about Turkmenistan’s government attitude regarding hydrogen development.

Introduction

Climate change has become a major topic in the global community. At the World Economic Forum in 2021, a forecast for the development of the world economy was presented [1]. According to it, if the temperature rises by 3.2°C by 2050 the global GDP level will decrease by 18% below the potential. Many research works in the field of climate change claim that the main cause of the temperature increase is the rise of the CO2 concentration in the atmosphere, therefore, decarbonization is part of the UN Sustainable Development Goals.

In 2016 the Paris Climate Agreement entered into force. On July 14, 2021, the EU announced a plan to reduce emissions by 55% by 2030, followed by a transition to a zero balance of greenhouse gas emissions by 2050 – the "Green Deal" - the European economy decarbonization program. Other large economies also started their transition to the “green” economy, since environmental restoration programs and the promotion of "green" strategies in the economy are not just a trend, but also a factor of economic competitiveness[2,3].

Renewable energy sources and hydrogen technologies are the most important driver of the global decarbonization of the world economy. The forecast of the International Renewable Energy Agency (Irena) suggests that by 2050, 8% of the global gross energy consumption will be provided by "green hydrogen", and 16% of all electricity generated will be used for its production. In mid-2021, the list of world-scale projects included 26 projects with a capacity of up to 260GW.

The Central Asia countries are implementing strategies for transferring to carbon neutrality. All countries announced goals of GHG emission by 2030, however, the decrease level is varied from state to state. The goals of each country are presented in Table 1.

Table 1. Intended Nationally Determined Contributions of the CA countries

State	Intended Nationally Determined Contributions
Republic of Kazakhstan	15% reduction in GHG emissions by 2030 compared to the base year
Kyrgyz Republic	16.63% reduction in GHG emissions by 2030 compared to the base year by 2025 and 15.97%
Republic of Tajikistan	60–70% reduction in GHG emissions by 2030 compared to the 1990
Turkmenistan	could achieve zero emission increase and may even achieve a reduction by 2030
Republic of Uzbekistan	35% reduction in GHG emissions by 2030 compared to the 2010

Source: Proskuryakova, L., & Ermolenko, G. (2022). Decarbonization prospects in the Commonwealth of Independent States. Energies, 15(6), 1987. https://doi.org/10.3390/en15061987 [4]

Moreover, in order to maintain the competitiveness of the economy, in December 2020, the President of Kazakhstan K.K. Tokayev announced the goal to achieve carbon neutrality by 2060. The government of the Republic of Uzbekistan intends to pass to zero carbon dioxide emissions by 2050.

All countries have strategies for decreasing the level of emissions however, not all of these strategies include “green” hydrogen development. For the Kyrgyz Republic and Tajikistan, hydrogenation is the most available and suitable way for decarbonisation of their energy systems. There are no information about Turkmenistan’s government attitude regarding hydrogen development. Uzbekistan and Kazakhstan, both are assessing their opportunities to develop a hydrogen industry that requires the creation of new infrastructure and supply chains. In addition, “green” hydrogen industry allows Kazakhstan to decrease the dependence of the country’s economy on fossil fuel as energy source of and for export.

Policy issues

The “green” hydrogen production is new for Kazakhstan’s industry. Comparing with other CA countries, the country has large opportunities in the field of production of “green” hydrogen however, it lacks available and approved technologies as well as updated standards. According to the German company "Svevind Group"[1], it is possible to produce 3 million ton of “green” hydrogen in Kazakhstan’s western region using energy of sun and wind. In this way, Kazakhstan could become one of the biggest suppliers of “green” hydrogen in the world. However, academia and manufacturing sector lack data and research on the impact of hydrogen manufacturing and transportation on the local level. However, beginning from 2020 Uzbekistan conducted several steps toward developing hydrogen industry for decreasing their dependence on fossil fuel and, in particular, declining the negative anthropogenic impact on the environment from growing industrialisation.

There are lack of standards of production, testing, standards of transportation, storage and even the use of "green" hydrogen in Kazakhstan and Uzbekistan. It is necessary to determine in which areas there is the greatest demand in modern standards. In fact, here we are talking about technologies that should be developed first of all. For example, standardization of technologies related to the use of "green" hydrogen in the energy sector or as fuel for public transport and cars is very relevant.

[1] Svevind is a privately owned group of companies in the renewable energy industry, based in Weißenbrunn (Germany), Piteå (Northern Sweden), Dresden (Germany) and Almaty (Kazakhstan). The Svevind group plans, develops, designs, sells, and operates onshore wind power and solar PV as well as green hydrogen projects.

Today there are only two standards in Kazakhstan regarding hydrogen:

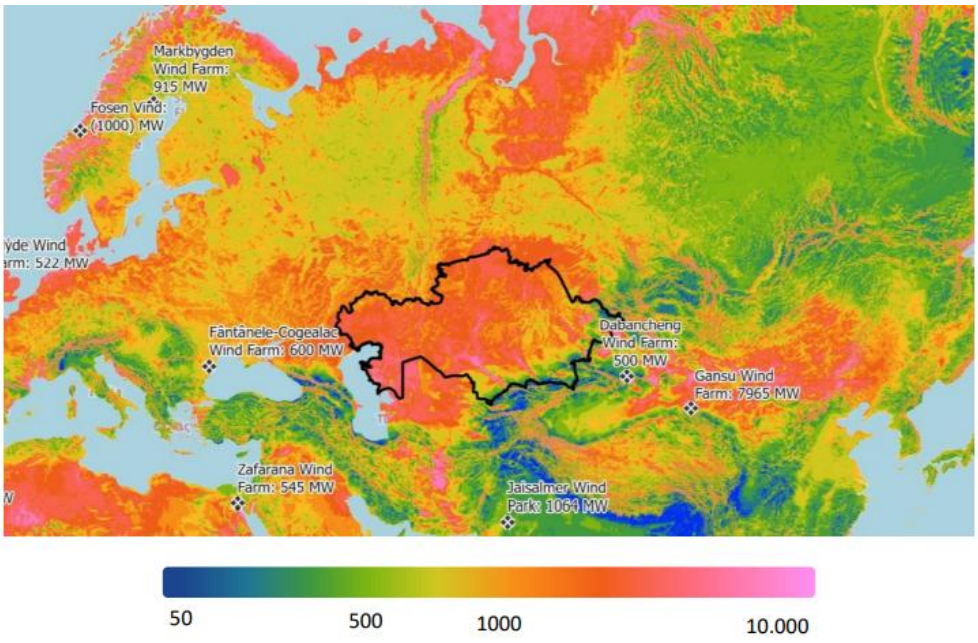
- ISO/TS 20100:2008 "Gaseous hydrogen. Refuelling stations";
- GOST 3022-80 "Technical hydrogen. Technical conditions". [5]

And in 2016 the CA countries ratified interstate standard GOST ISO 13984-2016 “Liquefied hydrogen. Joints of car refueling systems” that was developed by Russian Non-profit Partnership "National Association of Hydrogen Energy".[6]

The standards are necessary for the development of an action plan for the introduction of hydrogen filling stations in the urban environment, as well as the development of the most optimal supply chain, i.e. the application of methods of analysis of urban logistics. The development of the layout of such filling stations is especially important for large cities like Almaty, Tashkent and Nur-Sultan, where population growth due to the influx of population from rural areas has averaged 4% over the past 10 years. At the same time, there is a high level of gas pollution in urban areas, in particular in the city of Almaty, which is associated with a high number of cars. At this stage, it is enough to say that within the portfolio of available options for solving environmental and energy security problems, hydrogen is considered as one of the main alternative fuels for future road transport.

Since Kazakhstan is not ready for creating the complete “green” hydrogen production cluster that will include production facilities, academia, equipment suppliers, services, it is possible to develop a competence centre that starts to establish suitable and available for Kazakhstan technologies of production, develop standards, prepare necessary workforce since sustainable research only works with sustainable and qualified staff.

Figure 1: Wind power, W/m2



The impact of the development of “green” hydrogen on Kazakhstan’s economy, logistics and ecology can be modelled in the LogCenter of the Kazakh-German University (DKU). The LogCenter, which wa founded in 2019, was equipped with advanced hardware and software systems that allow to run innovative processes and technologies in production, to carry out construction and organization of supply chains, to apply modern approaches to business process management in manufacturing and transport and logistics companies. Moreover, the facilities of the LogCenter allow to model and visualize

Table 2. Hydrogen supply chain

Supply chain block	Events
"Green" hydrogen production	• Establish research to define suitable and available technologies for Kazakhstan; • Develop and/or adapt current known production technologies; Develop standards for production technologies and processes;
"Green" hydrogen delivery	• Assess the transportation system of Kazakhstan, its readiness for "green" hydrogen delivery; • Develop optimal ways of delivery; Develop standards for delivery;
"Green" hydrogen consumption	• Establish research to define potential consumers; Develop standards according to research done;
All	• Audit the current regulatory on its readiness for support and development of "green" hydrogen; • Develop strategy or roadmap for "green" hydrogen; Create "green" hydrogen competence centre.

the map of optimized routes for hydrogen stations' location in Almaty.

In April 2021 the President of Uzbekistan signed Resolution "On measures for the development of renewable and hydrogen energy in the Republic of Uzbekistan". According to the document, Research Center for Hydrogen Energy and Laboratory for Testing and Certification of Renewable and Hydrogen Energy technologies was created. The goals of this Center are:

- conducting fundamental and applied research and developing innovative projects;
- study and implementation of effective ways of using hydrogen in high-tech spheres and sectors of the economy by converting the energy received into electrical and thermal energy;
- development of draft regulations and regulatory documents in the field of technical regulation on the production, supply and use of hydrogen and (or) bringing it into compliance with the requirements of international (interstate, regional) standards.

However, both Kazakhstan and Uzbekistan lack technologies, standards of production, transportation and consumption. Regarding to Uzbekistan, RoK has no comprehensive strategy for development and implementation of "green" hydrogen into the economy. Therefore, it needs to start development in this direction through increasing competences of specialists, creating pilot projects, establishing new standards and developing a special strategy for "green" hydrogen production industry.

Recommendations

1. Create a "green" hydrogen competence centre involving all stakeholders;
2. Establish a pilot project for "green" hydrogen production in CA;
3. Audit the current regulatory on its readiness for support and development of "green" hydrogen;
4. Assessment of the transportation system of CA countries, its readiness for "green" hydrogen delivery;
5. Development of a roadmap of "green" hydrogen implementation in the energy system and logistics;
6. Development standards of transportation, storage and the use of "green" hydrogen;
7. Allocate grants for "green" hydrogen technologies development.

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