The Green Energy Corridor between the EU and the Caspian Sea: Potential and Challenges

Agha Bayramov*

This article investigates the Caspian–European Union Green Energy Corridor, a strategic initiative to bolster energy security and diversification in a tense geopolitical climate. The corridor hinges on large-scale renewable energy projects, like the Black Sea and Caspian Sea Electricity Cables, facilitating green energy exports from Azerbaijan, Kazakhstan, and Uzbekistan to Europe. These projects showcase the Caspian region's potential to contribute to global sustainability through wind, solar, and hydropower resources. However, substantial challenges, including geopolitical instability, technical hurdles, and significant investment needs, threaten the initiative's success. This article explores the current status, potential for, and obstacles to the Caspian Green Energy Corridor.

Keywords: Kazakhstan, Azerbaijan, Uzbekistan, The European Union, Renewable Energy, Green Corridor

* **Dr. Agha Bayramov** is an Assistant Professor in the Department of International Relations and International Organization at the University of Groningen.

Introduction

Since the start of the war in Ukraine, the European Union has been seeking alternative sources for critical raw materials and renewable energy resources. Through its External Energy Engagement Strategy (EEES) and REPowerEU initiatives, the EU is dedicated to decreasing its reliance on Russian fossil fuels, forming sustainable energy partnerships, and fostering a worldwide transition to green energy. Among the regions that can meet these needs is the Caspian Sea, which boasts strong potential for renewable energy and has played a significant role in supplying oil and gas to the EU, particularly through Azerbaijan and Kazakhstan.

Similarly, countries in the South Caucasus and Central Asia have been investing in renewable energy sources and exploring avenues to export green energy to Europe.

Similarly, countries in the South Caucasus and Central Asia have been investing in renewable energy sources and exploring avenues to export green energy to Europe. This effort has seen the signing of several Memorandums of Understanding (MoU) between European and regional countries, as well as among the region's countries themselves. Noteworthy projects include the Black Sea Electricity Cable Project, the Green Hydrogen Project, and the Caspian Electricity Cable Project involving Azerbaijan, Kazakhstan, and Uzbekistan.

Furthermore, Azerbaijan is set to host the Conference of Parties 29 (COP29) in November 2024. In light of these developments, it can be argued that regional countries are investing in the Caspian Green Energy Corridor to make it a more viable reality. This article aims to explore the potential of the Caspian Green Energy Corridor, outline its main projects, and address potential challenges. More specifically, this article aims to answer the following questions: *What are the key projects currently underway in the Caspian Green Energy Corridor, and how do they aim to facilitate the export of green energy to Europe? What are the main challenges faced by the regional countries involved in the development of the Caspian Green Energy Corridor, and how are they being addressed?*

The Black Sea Submarine Cable Project

The Black Sea Submarine Cable Project, also known as the Caspian Sea–European Union Green Energy Corridor, is a significant initiative

to generate green energy from renewable sources in Azerbaijan and export the power to Europe via a subsea cable under the Black Sea.[1] The rationale for the project is that Azerbaijan has significant untapped potential for generating power from onshore and offshore wind farms along its Caspian Sea coast, as well as potential for solar generation.[2] Power generated could be transited across the Black Sea to countries in eastern and central Europe, which are heavily reliant on natural gas and coal.[3]

The concept has been under discussion for some years and was the subject of a World Bank methodology report in June 2020, which concluded that a subsea cable across the Black Sea would generate sufficient economic benefit to warrant further consideration.[4] In 2021, USAID and the United States Energy Association completed a technical assessment and concluded that, with minimal upgrades to the existing power transit grids of Georgia and Romania, the four countries are sufficiently robust to transfer up to 1,000 megawatts.[5]

The project took on a more formal structure on December 17, 2022, when Azerbaijan's President Ilham Aliyev, Georgia's Prime Minister Irakli Garibashvili, Romania's Prime Minister Nicolae Chuke, and Hungary's Prime Minister Viktor Orban signed a 'Strategic Partnership Agreement' committing them all to work together on the project.[6]The agreement was signed in the presence of Ursula von der Leyen, President

1 Staske, S. and Stubbe, R., "Prospects for the Black Sea Submarine Cable", *German Economic Team*, January-February 2024, Available at: https://www.german-economic-team.com/en/newsletter/prospects-for-the-black-sea-submarine-cable/ (Accessed: June 29, 2024).

2 Shah, R., "Bulgaria, Azerbaijan Announce Cable Project", *SubTel Forum*, March 4, 2024, Available at: https://subtelforum.com/bulgaria-azerbaijan-announce-cable-project/ (Accessed: June 29, 2024).

3 Kardaś, S., "Energising Eastern Europe: How the EU Can Enhance Energy Sovereignty Through Cooperation with Ukraine and Moldova", *European Council on Foreign Relations*, March 11, 2024, Available at: https://ecfr.eu/publication/energising-eastern-europe-how-the-eu-can-enhance-energy-sovereignty-through-cooperation-with-ukraine-and-moldova/ (Accessed: June 29, 2024).

4 O'Byrne, D., "Azerbaijan Positioning Itself as Green Energy Exporter", *Eurasianet*, August 9, 2023, Available at: https://eurasianet.org/azerbaijan-positioning-itself-as-green-energy-exporter (Accessed: June 29, 2024).

5 Euronews, *Von der Leyen Heads to Azerbaijan to Secure New Gas Import Deal*, July 18, 2022, Available at: https://www.euronews.com/my-europe/2022/07/18/von-der-leyen-heads-to-azerbaijan-to-secure-new-gas-import-deal (Accessed: June 29, 2024).

6 O'Byrne, *op.cit.*

of the European Commission, representing the European Union, which in July 2022 signed an MoU with Azerbaijan to provide assistance with Azerbaijan's renewable energy plan in return for official Baku agreeing to double gas exports to Europe by 2027.[7]

Meeting in Romania's capital, Bucharest, on July 25, 2023, officials from the four countries signed an MoU to establish a joint venture between their national electricity grid operators to coordinate activities and push ahead with the project.[8] The meeting was also attended by representatives of Bulgaria and the European Commission, both of which have expressed support for the venture.[9] The project agreed between the four states envisages the laying of a 1,200-kilometre cable with a capacity to carry 1,000 megawatts across the Black Sea between Georgia and Romania, as well as expanding the onshore capacities of existing transmission cables in the four countries involved. A fibre-optic cable would be laid alongside to strengthen Internet connectivity between the Caucasus and the EU.[10]

The European Union has also been supportive of the project. As Ursula von der Leyen, President of the European Commission, said at the signing of an MoU in December 2022, "*The project holds a lot of promises. Now it is up to us to deliver on the security of energy supply and on decarbonising our economies*."[11]

On April 5, 2024, during a joint EU–US–Armenia high-level meeting in Brussels, Ursula von der Leyen mentioned that "*we will invest in key infrastructure projects. For example, in the Black Sea electricity cable that is a new transmission route full of opportunities. It can notably bring clean, renewable energy into Europe. We are ready to support it. In parallel, we will continue investing in Armenia's renewable energy production and in better interconnections with Georgia*."[12] This

7 Euronews, "Von der Leyen Heads to Azerbaijan…", *op.cit.*

8 Interfax, *Azerbaijan, Georgia, Romania and Hungary Begin Process of Creating Joint Venture for Black Sea Energy Project*, May 29, 2024, Available at: https://interfax.com/newsroom/top-stories/102758/ (Accessed: June 29, 2024).

9 O'Byrne, *op.cit.*

10 Interfax, "Azerbaijan, Georgia, Romania and Hungary Begin Process…", *op.cit.*

11 European Commission, "Joint EU-US-Armenia High-Level Meeting Supports Armenia's Resilience", *European Commission*, February 2, 2022, Available at: https://ec.europa.eu/commission/presscorner/detail/en/statement_22_7807 (Accessed: June 29, 2024).

12 European Commission, "Joint EU-US-Armenia High-Level Meeting to Support

indicates that Armenia might also join the Black Sea electricity project in the future.

There is a general consensus that the proposed cable would enhance European security and benefit the economies of Azerbaijan, Georgia, and several central and southeastern European nations through which new or expanded transit lines would run. Nonetheless, numerous substantial challenges lie ahead.

Firstly, the Russia–Ukraine war has not only intensified the EU's efforts to secure additional sources of oil, gas, and electricity but has also severely impacted the safety of shipping in the Black Sea due to threats like free-floating mines.[13] The cable itself would be an easy target for potential saboteurs.

Firstly, the Russia–Ukraine war has not only intensified the EU's efforts to secure additional sources of oil, gas, and electricity but has also severely impacted the safety of shipping in the Black Sea due to threats like free-floating mines.

The planned route of the cable would place it less than 150 km from the southern tip of Crimea, which is currently under the control of the Russian Federation, making it easily accessible to the Russian navy from both Crimea and Novorossiysk.[14] The sabotage of the Nord Stream pipeline in September 2022 highlighted the vulnerability of such large-scale infrastructure projects. Analysts in the Baltic region claim that Russia has developed specialized vessels capable of threatening underwater cables.[15] This creates a significant challenge in insuring the project at a feasible rate, without which few credible investors would be willing to provide funding.

In addition to these geopolitical risks, there is the formidable task of constructing the Black Sea Submarine Cable Project. The average depth

Armenia's Resilience", European Commission, April 5, 2024, Available at: https://neighbourhood-enlargement.ec.europa.eu/news/joint-eu-us-armenia-high-level-meeting-support-armenias-resilience-2024-04-05_en (Accessed: June 29, 2024).

13 International Maritime Organization (IMO), "Maritime Security and Safety in the Black Sea and Sea of Azov", Available at: https://www.imo.org/en/MediaCentre/HotTopics/Pages/MaritimeSecurityandSafetyintheBlackSeaandSeaofAzov.aspx (Accessed: June 29, 2024).

14 Gutbrod, H., "The Black Sea Submarine Cable Project: Update from Tbilisi", *German Economic Team*, May-June 2023, Available at: https://www.german-economic-team.com/en/newsletter/the-black-sea-submarine-cable-project-update-from-tbilisi/ (Accessed: June 29, 2024).

15 Kaushal, S., "Stalking the Seabed: How Russia Targets Critical Undersea Infrastructure", *Royal United Services Institute*, May 25, 2023, Available at: https://rusi.org/explore-our-research/publications/commentary/stalking-seabed-how-russia-targets-critical-undersea-infrastructure (Accessed: June 29, 2024).

of the Black Sea exceeds 1,000 metres, and recent incidents, such as the naval mine that washed ashore and exploded on a Georgian beach in February 2023[16] demonstrate the unpredictable dangers of the area. For approximately 700 km, the submarine cable would lie at around 2,000 meters below sea level, posing an extra challenge for any necessary repairs. Consequently, some experts believe that the project's cost could exceed the currently estimated €2.3 billion.[17]

Another major issue is whether the EU or other international funding bodies would be willing to finance or guarantee loans for the project.

Broader energy sector development is also a crucial factor. Will the region have enough energy to export by the early 2030s when the cable is expected to be completed? In Georgia, at least, there are doubts. The capacity of hydroelectric power plants (HPPs) in Georgia is up to 3,500 MW. In contrast, the total installed capacity of wind farms is only 21 MW, and solar power plants are not yet operational. Additionally, the construction of major reservoir HPPs, such as Khudoni, Nenskra, and Namakhvani, is currently suspended.[18] Furthermore, Kvaratskhelia and Mukhigulishvili argue that a significant portion of the Georgian population lives in energy poverty, meaning that they are unable to adequately heat their homes.[19] Domestic energy consumption is projected to grow faster than generation, and investors in the sector have faced numerous setbacks, including local resistance (mainly to HPP construction). For example, activists protested against the construction of the Namakhvani Hydropower Plant, leading to its suspension by the Georgian government. The protests highlighted significant environmental and social concerns, prompting the government to halt the project and engage in further discussions.[20] Although the government

16 The Maritime Executive, *Video: Floating Naval Mine Explodes on a Beach in Georgia*, February 14, 2023, Available at: https://maritime-executive.com/article/video-floating-naval-mine-explodes-on-a-beach-in-georgia (Accessed: June 29, 2024).

17 Gutbrod, *op.cit.*

18 Tutana Kvaratskhelia and Giorgi Mukhigulishvili, "Georgia's Energy Transition: Challenges and Opportunities," Heinrich Böll Foundation, March 2024, Available at: https://ge.boell.org/sites/default/files/2024-03/georgias_energy_transition_3.pdf (Accessed: June 29, 2024).

19 Kvaratskhelia, T., and Mukhigulishvili, G., "Georgia's Energy Transition: Challenges and Opportunities", *Heinrich Böll Foundation*, March 2024, Available at: https://ge.boell.org/sites/default/files/2024-03/georgias_energy_transition_3.pdf (Accessed: June 29, 2024).

20 Civil.ge, *Government Suspends Namakhvani HPP Construction Following Protests*,

has expressed eagerness for more energy generation, observers are still waiting for a significant acceleration in the sector.

The Caspian Sea Electricity Project

In line with the Black Sea Submarine Cable Project, another ambitious green energy initiative is the Caspian Sea Electricity Project involving Azerbaijan, Kazakhstan, and Uzbekistan. On May 2, 2024, the energy ministers of these three countries signed an MoU to explore their joint electricity export potential by harnessing primarily wind and solar power. The MoU that Azerbaijan signed with Kazakhstan and Uzbekistan builds on a 2023 agreement with the EU states, including Hungary and Romania, to export electrical power across the Black Sea via an underwater cable with a capacity of 1,000 megawatts.[21] According to Kazakhstan's Energy Minister Almassadam Satkaliyev, this agreement envisions the laying of a 'high-voltage cable' on the Caspian Sea's seabed, with technical specifications for the transmission line already developed.[22] Stkaliyev mentioned that the tripartite memo is a significant step towards interconnecting the energy grids of Azerbaijan, Kazakhstan, and Uzbekistan and linking their energy systems.[23] A proposed business model will be developed to establish international transmission corridors, addressing financing, revenue flow, ownership, and the sale of green energy to the European Union countries.[24]

The three countries have swiftly moved to advance this plan. Satkaliyev informed journalists that the EU has expressed an interest in purchasing clean electricity from the consortium.[25] A feasibility study is underway

June 9, 2021, Available at: https://civil.ge/archives/421830 (Accessed: June 29, 2024).

21 The Astana Times, *Kazakhstan, Azerbaijan, and Uzbekistan Sign Agreement on Energy Interconnection*, May 2, 2024, Available at: https://astanatimes.com/2024/05/kazakhstan-azerbaijan-and-uzbekistan-sign-agreement-on-energy-interconnection/ (Accessed: June 29, 2024).

22 Kucera, J., "Azerbaijan, Kazakhstan, and Uzbekistan Press Ahead with Ambitious Electricity Export Plan", *Eurasianet*, May 14, 2024, Available at: https://eurasianet.org/azerbaijan-kazakhstan-and-uzbekistan-press-ahead-with-ambitious-electricity-export-plan (Accessed: June 29, 2024).

23 The Astana Times, "Kazakhstan, Azerbaijan, and Uzbekistan Sign Agreement…", *op.cit.*

24 Kucera, *op.cit.*

25 The Astana Times, "Kazakhstan, Azerbaijan, and Uzbekistan Sign Agreement…", *op.cit.*

to detail construction and financing aspects, with preliminary estimates expected by the end of the year. However, it is still too early to determine the project's cost or the exact volume of power exports involved.[26]

The objective of exporting electricity to the EU aligns with the renewable energy expansion plans of Azerbaijan, Kazakhstan, and Uzbekistan. These countries aim to leverage their vast renewable energy resources, such as wind and solar, to generate clean electricity. For example, Azerbaijan is actively developing its renewable energy production to export green energy and increase gas supplies to Europe. Azerbaijan's President Ilham Aliyev highlighted that his country aims to produce more renewable energy than it needs domestically. The primary goal is to export this surplus while maximizing the use of renewables for electricity production. This strategy would allow Azerbaijan to save natural gas for export, particularly to European countries that currently have high demand for energy resources.[27] Uzbekistan, in particular, aims to generate an additional 20 gigawatts (GW) of renewable energy by 2030, raising the country's total renewable capacity to 27 GW. In April 2024, the government signed agreements with several international energy companies to develop wind and solar facilities projected to produce 12 GW and, in May, it entered contracts for another 6 GW.[28]

The objective of exporting electricity to the EU aligns with the renewable energy expansion plans of Azerbaijan, Kazakhstan, and Uzbekistan. These countries aim to leverage their vast renewable energy resources, such as wind and solar, to generate clean electricity.

The EU's previous experience with electricity trade agreements, such as that with Norway, provides a relevant model that could be applied to both the Caspian Sea and Black Sea regions. The existing electricity projects in operation illustrate the potential for similar initiatives to succeed in these new contexts.

For instance, several notable projects connecting Norway with other European countries are already in operation. The NorNed cable, with a

26 Kucera, *op.cit.*

27 Interfax, *Azerbaijan Developing Renewable Energy Production for Export to Europe*, June 24, 2023, Available at: https://interfax.com/newsroom/top-stories/103638/ (Accessed: June 29, 2024).

28 Gazeta.uz, *Uzbekistan podpisal kontrakty na stroitelstvo solnechnykh i vetrovykh elektrostantsiy na 12 GVt*, May 6, 2024, Available at: https://www.gazeta.uz/ru/2024/05/06/investments/ (Accessed: June 29, 2024).

capacity of 700 MW, links Norway to the Netherlands. The NordLink cable connects Norway to Germany and boasts a capacity of 1,400 MW, while the North Sea Link (NSL), also with a capacity of 1,400 MW, connects Norway to Great Britain.[29] All these projects use direct current (DC) technology and are currently operational.

Kazakhstan and Azerbaijan are poised to play a facilitating role in the power export arrangement. Kazakhstan's renewable goals are relatively modest compared to Uzbekistan's. Kazakhstan currently generates about 2.9 GW of power from renewable sources and aims to add at least another 5 GW by 2030, according to Energy Minister Almassadam Satkaliyev.[30] Much of this capacity may be needed domestically, as Kazakhstan faced a power deficit in 2023 that turned it into a net importer of electricity.[31]

Azerbaijan, while having high potential for renewable energy sources, does not yet fully employ its renewable potential in domestic energy production or consumption. Azerbaijan's technical potential for onshore renewable energy is 135 GW, and its offshore potential is 157 GW. The economic potential is estimated at 27 GW, including 3,000 MW of wind energy, 23,000 MW of solar energy, 380 MW of bioenergy, and 520 MW from mountain rivers.[32] To diversify its energy consumption and exports, Azerbaijan targets generating 5 GW of solar and wind power by 2030. Relevant laws and normative legal acts have been adopted to develop the renewable energy sector, including the law on renewable energy sources approved in 2021. In 2023, renewable energy accounted for 7% of Azerbaijan's total electricity production.[33] In other words, Azerbaijan remains significantly dependent on natural gas, which provides over 90% of its electricity.

29 TenneT, *NorNed*, Available at: https://www.tennet.eu/projects/norned (Accessed: June 29, 2024).

30 Prime Minister of the Republic of Kazakhstan, *Ministry of Energy works out measures plan for electric power industry development. 26 GW of new generating capacities to be commissioned*, January 16, 2024, Available at: https://primeminister.kz/en/news/ministry-of-energy-works-out-measures-plan-for-electric-power-industry-development-26-gw-of-new-generating-capacities-to-be-commissioned-26978 (Accessed: June 29, 2024).

31 Kucera, *op.cit.*

32 Ministry of Energy of Azerbaijan, *The Use of Renewable Energy Resources in Azerbaijan*, March 6, 2024, Available at: https://minenergy.gov.az/en/alternativ-ve-berpa-olunan-enerji/azerbaycanda-berpa-olunan-enerji-menbelerinden-istifade (Accessed: June 29, 2024).

33 Ministry of Energy of Azerbaijan, "The Use of Renewable Energy…", *op.cit.*

Similarly, Kazakhstan aims to generate 15% of its electricity from renewable energy sources by 2030, excluding large hydropower.

However, several challenges need to be addressed. Customer preference for renewable energy over fossil fuels should be increased in Azerbaijan, Kazakhstan, and Uzbekistan. This can be achieved by providing tax incentives or subsidy measures to make renewable energy more attractive to the public. Public awareness of the benefits of transitioning away from fossil fuels needs to be enhanced to expand the deployment of renewables. Additionally, both Azerbaijan and Kazakhstan have significant fossil fuel subsidy systems that make renewable energy investments less attractive by keeping fossil fuel prices artificially low.[34] According to a World Bank report, from 2016–2021, explicit energy subsidies averaged US$2.3 billion, or 5.1 per cent of GDP, in Azerbaijan.[35] On the other hand, Kazakhstan's fossil fuel subsidies amounted to approximately 6% of its 2021 GDP, placing it among the top 25 countries in terms of the magnitude of such subsidies.[36]

Kazakhstan plans to invest 50 billion tenge ($110.7 million) in renewable energy in 2024.[37] This includes nine billion tenge ($19.9 million) for wind power stations, 13 billion tenge ($28.7 million) for solar power stations, and 28 billion tenge ($62 million) for hydroelectric power stations.[38] Renewable energy capacity in Kazakhstan has shown steady growth, increasing over 16 times from 178 MW in 2014 to 2,868 MW in 2023.[39] In 2023, renewable energy facilities generated 6.675 billion kilowatt-hours (KWh) of electricity, accounting for 5.92% of total electricity

34 International Energy Agency, "Energy Efficiency Policy in Azerbaijan: A Roadmap", 2023, Available at: https://origin.iea.org/reports/energy-efficiency-policy-in-azerbaijan-a-roadmap/setting-the-scene-energy-efficiency-in-azerbaijan (Accessed: June 29, 2024).

35 World Bank, "Project Information Document (PID): Concept Stage - P179048", 2023, Available at: https://documents1.worldbank.org/curated/en/099112723161524095/pdf/P17904806938f5083093a707fa0352e87a5.pdf (Accessed: June 29, 2024).

36 World Bank, "Empowering the Future of Kazakhstan's Energy Sector", January 5, 2024, Available at: https://www.worldbank.org/en/news/feature/2024/01/05/empowering-the-future-of-kazakhstans-energy-sector (Accessed: June 29, 2024).

37 Nakispekova, A., "Kazakhstan to Allocate Over $110 Million Investment in Renewable Energy in 2024", *Astana Times,* February 26, 2024, Available at: https://astanatimes.com/2024/02/kazakhstan-to-allocate-over-110-million-investment-in-renewable-energy-in-2024 (Accessed: June 29, 2024).

38 Nakispekova, *op.cit.*

39 *Ibid.*

production.[40] When large hydroelectric power stations are included, this figure reached 13.7%. To achieve a 15% share of renewable energy by 2030 and 50% by 2050, Kazakhstan plans to conduct annual auctions and implement large-scale projects with strategic investors.

Uzbekistan is also making significant strides in renewable energy. Uzbekistan's Minister of Energy, Zhurabek Mirzamakhmudov, announced plans to increase the share of renewable energy in power production at Energy Week (UEW 2024) in Tashkent on May 14, 2024.[41] The goal is to achieve an 18% share of renewable energy by the end of the year and 40% by 2030, primarily from solar and wind energy.[42] By 2030, Uzbekistan plans to operate 25 GW of solar and wind power plants. In 2023, new installed capacity enabled Uzbekistan to reach 18% solar and wind generation during the daytime. By the end of the year, the country aims to commission 2,000 MW of solar power plants, 600 MW of wind power stations, and 300 MW of energy storage systems.[43]

The next phase of Uzbekistan's energy reforms will focus on attracting private investors into the electricity distribution grid and doubling energy efficiency. Uzbekistan, along with Azerbaijan and Kazakhstan, plans to export green energy to Europe, including Hungary and Romania. Uzbekistan plans to increase the volume of its green energy production to 13 billion kWh by 2024, aiming for a 15% share in the country's overall energy balance.[44]

At a meeting in February, Uzbekistan's President Shavkat Mirziyoyev expressed dissatisfaction with the pace of alternative energy projects and ordered the expedited launch of 14 solar and wind power plants and the initiation of two pumped storage station projects.[45] This underscores the urgent need for reform and investment to meet the ambitious renewable energy targets set by Uzbekistan, Azerbaijan, and Kazakhstan.

---

40 *Ibid.*

41 Tashkent Times, *Share of Uzbekistan Renewable Energy Sources Will Reach 18% by the End of 2024, Says Energy Minister*, June 25, 2024, Available at: https://tashkenttimes.uz/national/12987-share-of-uzbekistan-renewable-energy-sources-will-reach-18-by-the-end-of-2024-says-energy-minister (Accessed: June 29, 2024) .

42 Tashkent Times, *Share of Uzbekistan Renewable Energy Sources…*, *op.cit.*

43 *Ibid.*

44 *Ibid.*

45 Tashkent Times, *Share of Uzbekistan Renewable Energy Sources…*, *op.cit.*

The Case of Green Hydrogen

Finally, the third ambitious green megaproject is the hydrogen production initiative by Kazakhstan and Azerbaijan. Both are exploring the potential of green hydrogen as part of their broader efforts to diversify energy sources and meet global sustainability goals. By leveraging their abundant renewable energy resources, both countries aim to produce green hydrogen, which can be used domestically and exported to international markets.

Although Azerbaijan has mentioned its green hydrogen intention,[46] it has not announced any projects yet. Azerbaijan, Kazakhstan, and Uzbekistan are actively investigating the potential of green hydrogen within their strategic frameworks for energy diversification. This initiative is part of their commitment to enhancing energy security and aligning with global sustainability objectives. Nevertheless, Kazakhstan, a pivotal energy player in the region, is embarking on ambitious plans to emerge as a major exporter of hydrogen energy. In October 2022, in the presence of President of Kazakhstan Kassym-Jomart Tokayev and President of the European Council Charles Michel, representatives of SVEVIND Energy Group and the Government of Kazakhstan signed a green hydrogen deal in Astana.[47] The final investment decision for this project, worth around US$40–50 billion, will be made in 2026.[48] Subsequently, in November 2022, at COP27 in Egypt, the European Union signed an MoU with Kazakhstan on cooperation on green hydrogen and critical raw materials.[49]

Leveraging the country's abundant solar and wind resources, the Hyrasia project aims to produce 2 million tons of green hydrogen annually by 2032, capitalizing on Kazakhstan's extensive expertise in the energy

46 COP29 Azerbaijan, *Green Hydrogen*, Available at: https://cop29.az/en/pages/green-hydrogen (Accessed: June 29, 2024).

47 Bayramov, A., "Kazakhstan Has to Balance Its Green Hydrogen Mega-Project with Domestic and Ecological Constraints", *Commonspace*, May 2024, Available at: https://www.commonspace.eu/analysis/analysis-kazakhstan-has-balance-its-green-hydrogen-mega-project-domestic-and-ecological (Accessed: June 29, 2024).

48 Hyrasia One, *Hyrasia One Press Release*, April 2024, Available at: https://hyrasia.one/wp-content/uploads/2024/04/221027_press-release_IA_HYRASIA-ONE.pdf (Accessed: June 29, 2024).

49 European Commission, "Strategic Partnership between the European Union and Kazakhstan on Sustainable Raw Materials, Batteries and Renewable Hydrogen Value Chains", November 8, 2022, Available at: https://single-market-economy.ec.europa.eu/news/strategic-partnership-between-european-union-and-kazakhstan-sustainable-raw-materials-batteries-and-2022-11-08_en (Accessed: June 29, 2024)

sector.[50] However, transitioning to hydrogen energy in the Caspian Sea region presents several challenges. How can Kazakhstan bring green hydrogen to Europe? And what are the potential challenges?

The Hyrasia One Hydrogen Project

The Hyrasia One Hydrogen Project, to be located in Kazakhstan's Mangystau region, will use electricity from solar panels and wind turbines to produce 2 million tons of hydrogen annually by 2032, with production beginning in 2030.[51] Founded by Wolfgang Kropp and headquartered in Dresden, Germany, the project will install millions of solar panels and thousands of wind turbines in the vast steppes of southwestern Kazakhstan, generating about 40 gigawatts of renewable electricity.[52] This energy will be transported to a location near Kazakhstan's coastal city of Kuryk to produce green hydrogen via water electrolysis in a process known as power-to-gas. According to the SVEVIND Energy Group, hydrogen from the project can be used locally in Kazakhstan, for steel and aluminium production, or exported to European markets.[53]

However, several limitations hinder the deployment of hydrogen energy in Kazakhstan and Azerbaijan, including (1) the need for research and development (R&D) investment to decrease technology costs and build local capacity, (2) environmental issues, (3) lack of domestic demand, and (4) transport issues.

Domestic awareness

The lack of domestic demand for green hydrogen is a significant issue. Currently, Kazakhstan primarily uses unabated hydrogen in its three refineries (located in Atyrau, Pavlodar, and Shymkent) and as a feedstock for ammonia production in the fertilizer industry.[54] In this regard, local

50 Hyrasia One, *The Project*, accessed July 1, 2024, Available at: https://hyrasia.one/the-project (Accessed: June 29, 2024)

51 Hyrasia One, *The Project*, *op.cit.*

52 *Ibid.*

53 Energy Connects, "Svevind to Build World's Largest Green Hydrogen Plant in Kazakhstan", *Energy Connects*, June 27, 2021, Available at: https://www.energyconnects.com/news/renewables/2021/june/svevind-to-build-world-s-largest-green-hydrogen-plan-in-kazakhstan/ (Accessed: June 29, 2024).

54 Konrad Adenauer Stiftung (KAS), „EU-Kazakhstan Green Hydrogen Partnership", November 7, 2023, Available at: https://www.kas.de/documents/d/guest/eu-kazakhstan-

private actors' readiness to invest in green hydrogen technologies currently remains low.

Limited R&D

Although there are a limited number of small-scale ongoing demonstration projects, including the First Molecule project implemented by the Kazakh company Green Spark Limited, there is insufficient local R&D. Studies report that, at the domestic level, there is widespread unawareness in Kazakhstan regarding the transformative potential of green hydrogen or its practical applications that would benefit local communities.[55]

Water scarcity

In essence, initiating a green hydrogen economy in Kazakhstan will inevitably lead to an increase in water consumption, as water is the key component in green hydrogen production. However, water scarcity is a major concern in Kazakhstan, particularly in the southern and western regions, where the population heavily relies on irrigation for agriculture.[56] According to the UNEP, by 2040 the country may face significant shortfalls, amounting to 50 per cent of its needs.[57] Kazakhstan has eight water basins, seven of which lie in transboundary territories. More than 44 per cent of Kazakhstan's river flow originates on the territory of other countries, so the deficit will arise primarily due to intensive water use in neighbouring countries.[58]

Given the impending challenge of water scarcity in the country, careful analysis of the water balance must be carried out by clearly outlining how much water would be consumed by each sector. Developing hydrogen energy may be achieved at the cost of water security, which is an undesirable outcome.

Furthermore, the Aral Sea crisis, a significant ecological disaster that resulted from the diversion of rivers for irrigation purposes, had a severe

green-hydrogen-partnership (Accessed: June 29, 2024).

55 *Ibid.*

56 *Ibid.*

57 United Nations Development Programme (UNDP), "The Climate Change Impact on Water Resources in Kazakhstan", October 26, 2021, Available at: https://www.undp.org/kazakhstan/stories/climate-change-impact-water-resources-kazakhstan (Accessed: June 29, 2024).

58 *Ibid.*

impact on the country's water resources. Rural areas face challenges in terms of accessing clean water and adequate sanitation facilities. In addition, the Ural River's levels have been decreasing since the 1970s.[59]

Agriculture is the largest consumer of water. Heavy irrigation is essential for crop cultivation because of the vast arid and semi-arid regions.

Moreover, the falling level of the Caspian Sea is a sign of a critical situation that requires immediate action. The rate at which the sea level is falling has accelerated in recent years. For example, the average rate of decline over the past three years is about 23.3 cm a year. In June 2023, the local Aktau authority declared a state of emergency over the critically low level of the sea.[60] A green hydrogen economy will exert further stress on water capacity, highlighting the need to prioritise water in Kazakhstan's environmental management policies.

Transport challenges

Because of its landlocked geography, Kazakhstan faces limited options for exporting green hydrogen or ammonia to Europe. One option is to construct hydrogen pipelines across the Caspian Sea, the Caucasus, and Türkiye to reach southern Europe. The marine transport industry is represented on the Caspian Sea by the ports of Aktau, Kuryk, and Bautino. Transit shipping in the Caspian Sea includes routes from Aktau to Baku (475 km), Turkmenbashi (550 km), and Bandar Anzeli (700 km).[61]

Recently, the volume of transportation along this corridor has increased by 86% to reach 2.8 million tons, up from 1.5 million tons in 2022. This is a substantial increase compared to just 586,000 tons in 2021.[62] Nevertheless, the transport capacity of Kazakhstan's ports is currently limited. Additionally, hydrogen transport via the Caspian Sea would not directly reach target export destinations, but only transit countries such as Azerbaijan, the Russian Federation, and Iran. Furthermore, it needs to be transported via terrestrial transportation modes such as pipeline, railway,

59 KAS, „EU-Kazakhstan Green Hydrogen Partnership", *op.cit.*

60 UNDP, "The Climate Change Impact on Water Resources in Kazakhstan", *op.cit.*

61 CAREC Institute, "Ports and Logistics Scoping Study in CAREC", Volume II, 2021, Available at: https://www.carecprogram.org/uploads/Ports-and-Logistics-Scoping-Study-in-CAREC-Vol-II_4th-proof.pdf (Accessed: June 29, 2024)

62 Nakispekova, A., "Kazakhstan to Allocate Over $110 Million Investment in Renewable Energy in 2024", *Astana Times,* February 26, 2024, Available at: https://astanatimes.com/2024/02/kazakhstan-to-allocate-over-110-million-investment-in-renewable-energy-in-2024 (Accessed: June 29, 2024).

or truck. Additionally, because of the Russian invasion of Ukraine, using Russia as a transit route to the EU is no longer feasible.

Conclusion

Despite significant investments and ambitious goals in renewable energy, Azerbaijan, Kazakhstan, and Uzbekistan face substantial challenges in their transition away from hydrocarbons. Azerbaijan remains heavily reliant on natural gas for over 90% of its electricity, which could hinder its renewable energy targets.[63] Kazakhstan, while advancing its renewable capacity, still grapples with a domestic power deficit and modest renewable goals compared to Uzbekistan. Uzbekistan has set ambitious targets, but achieving these will require overcoming significant financial and infrastructural hurdles. Despite this, considering the green megaprojects described, it can be argued that Azerbaijan, Kazakhstan, and Uzbekistan are exploring the potential of green hydrogen as part of their broader efforts to diversify energy sources and meet global sustainability goals.

Furthermore, there is a heavy reliance on international expertise and technology, which limits the development of domestic capabilities. Public awareness of and preference for renewable energy remain low, necessitating enhanced education and workforce development programmes. Financial and regulatory environments need to be improved to attract private investment and make renewable energy technologies more affordable and sustainable.

The focus on large-scale projects might also overlook the potential benefits of smaller, community-based initiatives. Moreover, while the exploration of green hydrogen is innovative, it remains in its nascent stages globally, presenting high costs and technological challenges.

Overall, while these nations are making strides towards integrating renewable energy, a more diversified approach, enhanced local expertise, improved public awareness, and a supportive investment climate are crucial for achieving a sustainable energy transition.

63 Ministry of Energy of Azerbaijan, *The Use of Renewable Energy Resources in Azerbaijan*, March 6, 2024, Available at: https://minenergy.gov.az/en/alternativ-ve-berpa-olunan-enerji/azerbaycanda-berpa-olunan-enerji-menbelerinden-istifade (Accessed: June 29, 2024).