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Research Article

WATER POLICY AND ENERGY TRANSITION OF KAZAKHSTAN: POTENTIAL OF THE HYRASIA ONE PROJECT

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ABSTRACT

Kazakhstan, being the largest landlocked country in the world, faces challenges with water security. The country's geographical location makes it dependent on its neighbors for water resources. Kazakhstan's water policy is still in the development stage, and there are still gaps and problems that need to be addressed. Another important area for Kazakhstan is the energy transition, which has both economic and energy significance. The Hyrasia One project, a joint initiative of Kazakhstan, Germany, and China, can be a good solution in this context. The article examines the potential of the project, its ability to become a stepping-stone to international cooperation, a tool for energy sustainability, and an example of Kazakhstan's capabilities in the field of water efficiency and regulation. The article discusses the risks and benefits that this particular project will bring to Kazakhstan and Central Asia in the economic, energy, and diplomatic sectors.

Keywords: Hyrasia One, Germany, China, Kazakhstan, Water diplomacy, Trans-Caspian route.

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INTRODUCTION

Kazakhstan is a carbon-rich country, but it is limited in terms of water resources within its territory, as most of its water flows originate outside its borders. Since independence, Kazakhstan has been trying to find solutions to water security issues through the development of water diplomacy, as well as seeking effective ways to develop alternative energy sources in order to accelerate the energy transition. The water issue is more related to rational consumption domestically and co-ordination with riparian states externally. Alongside this, the water aspect is also important for an accelerated energy transition. The relevance of this study is reinforced by the interest of the Head of State, President Tokayev, in water issues within the framework of his State-of-the-Nation Address on 8 September 2025 (Ministry of Foreign Affairs of the Republic of Kazakhstan, 2025).

It will be important to produce such an amount of energy that it exceeds domestic consumption and can be exported. Of course, for this, it is necessary to overcome geographic isolation and limited transport routes, both for goods and for energy supplies, that Kazakhstan faces.

In connection with new geopolitical challenges after 2022, Kazakhstan has begun to seek more actively new alternative ways to reduce its logistical dependence. To consider the relationship between water policy and the development of the energy transition, with further prospects, it is useful to examine the Hyrasia One project as a case. This is a joint project of the German company Svevind Energy and the Kazakh company Semurg Invest, within the framework of which it is planned to build a hydrogen plant in the Mangystau region, which is experiencing a shortage of water and where outcomes may also be important for Uzbekistan and Turkmenistan. It also aims to create additional dialogue between the EU, as an alternative route for green energy, and China, as it integrates into the Belt and Road Initiative.

The article's relevance and novelty lie in the scale and location of the project. Hyrasia One is the only hydrogen plant that is planned to be constructed in a water-stressed environment that currently has multiple treaties and agreements protecting water use. The plant will use water as the key ingredient for successful implementation. However, it will only use a small portion of the Caspian water source and should not create an imbalance between the consumption of water and the production of green hydrogen. The topic has been covered by multiple news and business outlets, but it has not yet been comprehensively studied. The opportunity of the project is that it will provide an example of how such a mega-plant interacts in an environment where water is a valuable resource.

Kazakhstan's water policy in the domestic context is based on the Water Code and the Ecological Code (Ministry of Justice of the Republic of Kazakhstan, 2025; 2021). The specialized body has been created in the form of the Ministry of Water Resources and Irrigation (officially established in July 2024). However, the external context is also an integral part of water policy. The relevance of joint external management became obvious immediately after independence. Central Asia entered the 1990s burdened by the catastrophic shrinkage of the Aral Sea, an ecological collapse that symbolized the failure of Soviet planning. Kazakhstan and its neighbors were the first to respond with the 1992 Almaty Agreement, the Agreement between the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Uzbekistan, the Republic of Tajikistan, and Turkmen-

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istan on cooperation in the field of joint water resources management and the protection of interstate sources. This agreement, for the first time, placed the issue of joint responsibility for the use of rivers on the agenda. A year later, the International Fund for Saving the Aral Sea was created, giving institutional form to this responsibility.

By the end of the decade, cooperation had become pragmatic: the 1998 Syr Darya Agreement created a system under which Kyrgyzstan released water from the Toktogul reservoir in exchange for electricity from Kazakhstan and Uzbekistan. It was an imperfect agreement, but it demonstrated that compromise was possible. As Astana's foreign policy evolved, it sought legitimacy not only in regional agreements but also in global rules. The signing of the UNECE Water Convention in 2001 (United Nations Economic Commission for Europe) marked the adoption of international norms such as equitable utilization and pollution prevention. Kazakhstan operates at several levels of water diplomacy: regional forums such as IFAS (Executive Committee of the International Fund for Saving the Aral Sea, n.d.), bilateral commissions with key neighbors, and accession to global conventions. At the same time, it is implementing these commitments into its domestic legal and political system. The main goal is simple but ambitious — to transform geographic dependence on upstream flows into a sustainable and secure water future.

For Kazakhstan, this is relevant because of the country's water infrastructure: it needs to balance allocations, quality, and seasonal flows of water. For example, a relatively recent flood in April 2024 displaced 120,000 people (Internal Displacement Monitoring Centre, 2025). It showed that some areas are not prepared for environmental disasters and that there are gaps that need to be filled. This directly affected and continuously affect, agriculture and livestock, which depend on stability to provide tangible results for the nation. The government needs to understand the resources it is working with to negotiate effectively and cooperate to avoid ecological and environmental disasters, secure an economic future, and maintain diplomatic balance with neighboring countries and powerful actors. Water diplomacy is not just an environmental policy; for Kazakhstan, it is a strategic pillar of foreign policy, national security, and economic development. Hyrasia One is not just an energy megaproject, but a practical manifestation of Kazakhstan's water diplomacy theories: it secures water sovereignty, strengthens multi-vector foreign policy (Ministry of Foreign Affairs of the Republic of Kazakhstan, 2015), and integrates environmental security into diplomacy.

Kazakhstan is currently seeking the most effective relations with both Russia and China. The implementation of an ambitious project to build a hydrogen production plant near the Caspian Sea could affect existing trade and economic flows between partner countries, as well as states dependent on those Kazakhstan's transit potential. In the long term, the development of hydrogen energy could help transform business activity in the region, potentially changing the existing balance of interests and creating new logistics routes to Europe that are not dependent on traditional supply chains, including Russian ones.

THEORETICAL BACKGROUND AND METHODOLOGY

In this study, the authors attempt to link two important aspects of the current situation in Kazakhstan – water issues and the energy transition — in the context of new realities, through the prism of the potential relevance of the Hyrasia

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One project. This project is the product of a long-term partnership and cooperation between Kazakhstan, Germany, and, more recently, China. The country has proven its reliability, which has allowed the creation of a large-scale project that addresses the core challenge of post-Soviet countries — the development of renewable energy sources. The hydrogen power plant integrates water diplomacy into multi-vector energy diplomacy.

This study also utilizes game theory, specifically the "stag hunt", and will provide a brief scenario analysis of possible project developments and their consequences. Using the game theory "stag hunt" framework, it will demonstrate the potential of the project and water policy itself through cooperation between states, as opposed to the current position, where states prioritize their own interests over regional and lose advantages that could be used for strengthening their energy potential.

The core theoretical foundations regarding water issues here are Hydro-hegemony theory and Water as a Source of Cooperation. Hydro-hegemony theory by Zeitoun & Warner (2006) states that power asymmetries determine how countries negotiate transboundary water use. Hyrasia One requires massive desalination in the Mangystau region. It can shift Kazakhstan's bargaining power by securing fresh water through desalination (the process of removing salts and other minerals from water, making it suitable for human consumption, irrigation, or industrial uses), thereby reducing vulnerability to upstream flows of water. This strengthens its autonomy in the hydro-political balance. Kazakhstan presents the project as a regional cooperation hub that will use green hydrogen and ammonia via the Trans-Caspian Corridor, aligning with a theory (Wolf, 1998) that positions water as a driver of cooperation and Kazakhstan in the front seat as a technological bridge of green diplomacy.

The project also falls within the WEFE Nexus (Water-Energy-Food-Environment) framework, as it balances trade-offs with ecosystems (International Association of Hydrological Sciences, 2023). Because Hyrasia One uses large amounts of water (for electrolysis) during the implementation period, environmental and ecological problems could arise in an already chronically water-scarce region, deprived of freshwater to the point that Kazakhstan may need to import water from other regions of the country or from abroad. The project compels Kazakhstan to apply the nexus approach in practice: aligning hydrogen exports, water security, food systems, and environmental protection. The advantages and disadvantages of this plant do not outweigh each other. It represents a high-risk but high-reward situation. It fits with game theory as a potential win–win scenario. Success will depend on Kazakhstan's ability to uphold its promises and agreements with its foreign and domestic partners, who have invested millions and in some cases billions of dollars.

METHODOLOGY

The methodology of the research is based on a mixed approach. The paper mainly uses qualitative methods by utilizing official statements, records and documents to establish a coherent picture of the importance of water policy in Kazakhstan and wider in the region, and the role of energy transition through the case of Hyrasia One project. These include documents gathered from open sources of the United Nations, the Ministry of Foreign Affairs of the Republic of Kazakhstan, as well as secondary data materials of the analytical websites and

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think tanks. The resources used provide an analysis of the Hyrasia One project's potential. It was developed by Svevind Energy Group and described as one of the world's largest planned green-hydrogen/ammonia facilities in Kazakhstan, serving as the focal case and therefore justifies an intensive, methodical inquiry. The article also uses approaches such as a case study, as well as elements of scenario analysis, to overview the possible prospects of the project.

The paper includes quantitative research that draws on data provided by the official websites of the companies involved in the project, summary of data gathered from an independent research think tank, and press releases. This includes the electric power input and outage, as well as estimates of production capability of the project, visuals that illustrate the routes of the traffic that will be used for the transport of gathered and harvested materials. The gathered sources create a coherent perspective of the logistics process that involves Kazakhstan as a coupler between Europe and Asia, respectively.

This combined methodological approach allows for a comprehensive assessment of the importance of the presented project both in the context of Kazakhstan's water policy and as a potentially major step in the energy transition.

RESULTS AND DISCUSSION

Hyrasia One is a collaborative project between Svevind Energy Group (Germany) and Semurg Invest (Sarzha Multifunctional Marine Terminal, Kazakhstan), which plans to build a hydrogen plant in the Mangystau region. The plant will be powered by 40 GW of wind turbines and solar power panels to produce up to two million tons of green hydrogen and will use Port Kuryk as a primary terminal for storing, transporting, and exporting the harvested energy via the Trans-Caspian route to the European Union and China, bypassing longer maritime routes (Svevind Energy Group, 2022)

The Trans-Caspian route, whose length exceeds 8,700 km, with a delivery speed of 25 days, passes through the ports of Kazakhstan, Azerbaijan, and Georgia, and was confirmed by Deutsche Bahn Engineering as suitable for transporting 11 million tons of hydrogen to the EU (International Information Group, 2023). "We are confident that this collaboration agreement will help to improve Kuryk Port's growth potential, and Semurg Invest is thrilled to add a new terminal project to the Sarzha MMT portfolio. Semurg Invest's first green hydrogen/ammonia export terminal in the Caspian Sea and along the Trans-Caspian route, together with the Hyrasia One project, will play a vital part in this value chain, putting Kazakhstan on the map of world-scale green initiatives," said Madina Anet, Business Development Director of Semurg Invest (Usmanova, 2023)

Genesis is an engineering company based in London that offers "global advisory services to support [the energy industry] … driving real change in the energy industry. Partners in working towards sustainability for our future" Genesis (2023). The company has been selected to carry out the pre-FEED (Preliminary Front-End Engineering and Design). It will provide Hyrasia One with solar panels and wind turbines that will harvest energy, which will later be used to produce green hydrogen via water electrolysis and converted into ammonia through synthesis plants (Genesis Energy Group 2023).

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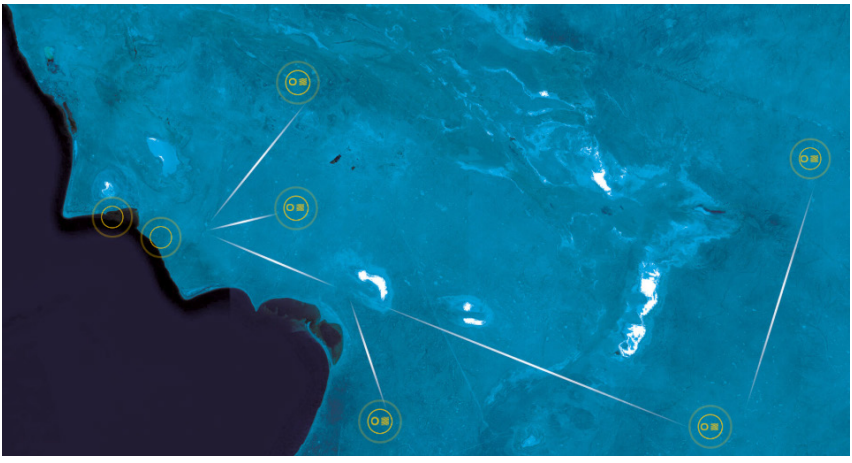
Figure 1

Location of the Hyrasia One Project (taken from interactive map from Hyrasia One Official Website)



Source: About Hyrasia One. (2025). Svevind Energy Group. Retrieved from https://hyrasia.one/?page_id=23813270

Hyrasia will generate energy using electrolysis, which will break down water into its basic components: hydrogen and oxygen. Oxygen will be released, while hydrogen will be kept as a resource. After that, hydrogen can be converted into green ammonia via synthesis plants, as a carrier (Svevind Energy Group, 2022). This map shows the planned routes, due to be operational in 2032, for ammonia exports to China and Europe, respectively.

Figure 2

Hyrasia One Project Source: Ammonia Energy Association, 2023

Source: Atchison, J. (2023). About Hyrasia One. Retrieved from https://hyrasia.one/?page_id=23813270

The Memorandum of Cooperation was signed by Svevind's Wolfgang Kropp and the First Deputy Prime Minister of Kazakhstan, Roman Sklyar, in the presence of the President of Kazakhstan, Kassym-Jomart Tokayev, and the President of the European Council, Charles Michel, on 27 October 2022 (Bhambhani, 2022). A Memorandum of Understanding was signed in Egypt on 7 Novem-

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ber 2022 during the United Nations Climate Change Conference by the Prime Minister of Kazakhstan, Alikhan Ismailov, and the President of the European Commission, Ursula von der Leyen (European Commission, 2022). The details and statements surrounding these signings symbolize the EU's willingness to co-operate by facilitating easier communications and procedures in the future.

Ilias Bakytzhan, Vice Minister of Energy of the Republic of Kazakhstan, stated on 24 June 2025 that the project is expected to create up to 1,800 jobs and that the preliminary engineering study has been completed. He stressed that Kazakhstan is partnering with China Energy Corporation, which has shown interest in localizing hydrogen production (Omirgazy, 2025).

According to Svevind's representatives, the forecast annual output of green hydrogen could reach up to two million tons in its first years of production, with potential to increase once the plant is fully operational. Production of green ammonia could exceed 10 million tons. "The primary goal of producing such a substantial amount is to meet growing demand in both European and Asian markets, as well as domestic demand in Kazakhstan… Construction will commence in 2026 and is expected to be completed in 2032" (Svevind Energy Group, 2025).

The development of the Hyrasia One project is a symbolic example of game theory's stag hunt scenario. Kazakhstan needs to convince neighboring and partner countries that, instead of competing to develop their own energy solutions and blocking the production of this hydrogen plant, they should assist in procuring the necessary resources and equipment. This would result in a larger collective payout of green, sustainable energy for the whole region at a lower cost than if countries attempted to develop such projects individually. The "win" of the game is the full development of the project: forging strong ties with project partners and creating a robust alliance in the energy and transit sectors. In the long run, this would contribute to energy balance, reducing reliance on finite natural resources. It also presents business opportunities and the creation of jobs in both the sector and the wider geographic region (Sagers et al., 2023). Thus, countries do not necessarily need to abandon existing agreements but instead create new arrangements that benefit all parties.

The construction of hydrogen plants can be compared to the production of electric vehicles (EVs). As with EVs, there may be ecological trade-offs. EV factories create a more environmentally friendly mode of transport in the long term compared to petrol-powered alternatives. However, the production of EVs requires lithium, cobalt, nickel, and other minerals, which indirectly contribute to deforestation and water pollution (Lakshmi, 2023).

For a hydrogen plant to be operational, it requires significant volumes of water for electrolysis, which risks exacerbating water scarcity in an already severely stressed region. At the same time, it creates sustainable energy that can supply power to multiple areas of the country. Another challenge is transparency and governance. Large, ambitious projects that combine advanced engineering, science, and business inevitably raise concerns among the general population. It is therefore the duty of the government to explain the project's purpose clearly and to provide information openly. If managed well, the venture could provide a long-term, sustainable future. In the case of Hyrasia One, it may not be the perfect solution, but it represents a viable alternative given the current circumstances.

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At the present stage, there are currently no documents or official statements from the neighboring states about the perception of this project and its consequences to the neighboring states, but having the glance from Kazakhstan's perspective, it could be stated that due to the Kazakhstan's upper stream geographical location, the neighboring countries hypothetically could in near future be opposed to the creation of the project when it will be in the building phase, as it will be located in the most water scarce region, and therefore create tensions in the geographical infrastructure. Hence, neighboring states may be motivated to obstruct the process or withhold water if the project consumes more than initially estimated. Despite these concerns, Kazakhstan could gain trust and strengthen its relations with neighbors by providing hydrogen energy in the form of ammonia via railway routes. This would create an equivalent exchange — water for energy — that partner countries could use for their own domestic needs. It would also support the negotiation of updated treaties and trade agreements.

Although the project is still in the development stage, and many factors and variables will influence its success, there are clear trends and indicators pointing towards the direction in which the involved and interested parties are moving. To create a truly beneficial environment around the project, however, Kazakhstan will need to undertake substantial efforts.

First, Kazakhstan can use this case as an example of diversifying its water and energy policy, marking a new chapter in its future energy transition. Kazakhstan can promote this project as a continuation of China's Belt and Road Initiative, and thus benefit from energy trade even after its completion (Mikovic, 2024).

Even though China maintains a strong alliance with the Russian Federation, it also demonstrates some distance. At present, any contact with Russia, especially regarding energy development that could be used against other countries, risks attracting additional sanctions. Kazakhstan can present the project as an alternative, thereby creating a direct path to Europe without the fear of sanctions, and potentially securing access to the European market.

Secondly, Kazakhstan needs either to revise the current drafts of the treaties and agreements it holds with organizations that protect the Aral and Caspian Seas, as well as with individual countries that are members of those organizations, or to ensure that construction of the project complies fully with all regulations. This includes the Environmental Impact Assessment (EIA), which will serve as a benchmark for the European Union.

Thirdly, Kazakhstan needs to reassure its neighbors that the project will not disrupt the current balance in the region, but rather expand upon it. Moreover, it could draft and present an agreement between the countries, focusing specifically on the project and its contribution to their shared goals of sustainability and stability.

The end result of the project may increase and strengthen Kazakhstan's presence as a key player in Central Asia, as well as position it as a strong partner of the European Union in the field of green energy and sustainability. It will open multiple opportunities for investment in harvesting, distribution, and logistics, bringing in billions of USD in foreign investment. In turn, this will boost the economy, create thousands of jobs, and, within a few years of becoming opera-

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tional, foster the development of experts specializing in green energy who can supply power to both the region and the country.

Table 1
Risks and benefits of the Hyrasia One project

Type	Risks	Benefits
Political	– Could be seen as a shift in current relations – Risk of being blocked from essential resources needed to complete the project – Russia could perceive it as a threat to its energy dominance in the region – History of non-compliance with standard international regulations	– Creates an updated agreement regarding water import–export treaties that benefits the countries involved – Opportunity to become a leader in the fast-paced sustainable energy transition in the region – Strengthens cooperation and partnership with the European Union
Economic	– Risk of being blocked or obstructed by uncooperative countries – Potential to create tensions in Kazakhstan's complex geopolitical environment	– After completion, generates major export revenue – Creates opportunities for foreign investment – Promotes diversification away from oil and gas
Ecological	– Potential harm to existing ecosystems, including habitats of endangered fauna – Risk of overuse of water resources	– Desalination process included in the original development could improve water availability across the region

Source: Authors' own data

However, despite all that the project could achieve to benefit the region and the country, there remains the matter of ecological security. According to Pokidaev (2025) and Jha (2025), the construction of the plant could damage the region's ecosystem. Ecology experts have urged that the €50 billion plant be relocated to decommissioned oil and gas fields. According to the secondary sources of news articles, in the view of these experts, who are members of the Public Council under Kazakhstan's Ministry of Ecology and Natural Resources. Pokidaev (2025). The project will intersect with the habitat and migratory routes of the goitred gazelle, which is listed in Kazakhstan's national Red Book of endangered fauna. The development also risks affecting several protected areas, such as the Ustyurt Nature Reserve near the borders of Uzbekistan and Turkmenistan, South Ustyurt National Park, Kyzylsai Nature Park in Uzbekistan, and the Kaplankyr Reserve in Turkmenistan. Members of the Public Council under Kazakhstan's Ministry of Ecology and Natural Resources have also raised legal and procedural concerns, alleging that land allocations for the project were made without proper oversight, and that public consultations during the Environmental Impact Assessment (EIA) process were inadequate. Formal objections and findings were submitted to the Presidential Administration, the Government of Kazakhstan, and regional authorities in Mangystau.

According to the vision of the German partners, many of the above problems can be avoided. Before and during the construction process, Kazakhstan should comply with ESIA standards (Environmental and Social Impact Assessment),

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which involve an analysis of the potential effects of an activity on the environment and social conditions. Otherwise, the project will not be implemented, there will be no investments, and no export agreements will be signed. Whether Kazakhstan will fulfill these requirements remains uncertain.

Another object of controversy is the Caspian Sea Convention. Kazakhstan is a party to the 2018 Convention on the Legal Status of the Caspian Sea, together with Russia, Iran, Azerbaijan, and Turkmenistan (United Nations Environment Program, 2008). It covers environmental protection and marine biodiversity. Desalination for Hyrasia could generate brine discharge into the Caspian. If improperly managed, this could damage marine ecosystems, risk violation of environmental obligations, and sparking disputes with Russia and Turkmenistan in particular.

Nevertheless, if proper management practices are implemented, Kazakhstan has the potential to establish itself as a regional benchmark for efficient water use. Achieving this goal would require substantial investment in state-of-the-art brine management technologies, which could, in turn, enhance the country's compliance with the 2018 Convention on the Legal Status of the Caspian Sea. Such compliance would not only reinforce cooperative regional ties but also transform a potential source of conflict into a platform for joint environmental monitoring and technological exchange.

Moreover, according to the Caspian Policy, a positive impact of the project is that it can attract investment as well as create jobs: On 5 May 2023, the Akimat of the Mangystau Region announced plans to implement large-scale projects worth more than 900 billion tenge (approximately USD 2.02 billion) over the next seven years, projected to create more than 2,500 jobs. This includes eight projects scheduled for launch in 2023, with a combined value exceeding USD 292 million, and a further 17 projects worth over USD 440 million planned for commissioning in 2024. The Akimat also reported that between 2019 and 2022, land grants were allocated for projects totaling USD 72 million, expected to generate approximately 2,000 jobs. Among these, six projects are related to tourism, four to education, three to warehousing and transport, three to healthcare, and thirteen to other sectors of the economy (Spooner, 2023).

Thus, by analyzing the potential opportunities of the project, we can highlight the following problematic aspects and propose three brief scenarios for how the situation might develop during the implementation of the project. First, there is the risk of a shift in the balance of current diplomatic ties with neighboring countries and existing trade and partnership agreements that the project may affect in both the short and long term. Because Hyrasia One is still in the pre-development stage, actual data cannot yet be obtained. Therefore, the following forecast is speculative, but it should nevertheless be highlighted and carefully monitored.

If Hyrasia One increases Kazakhstan's demand for freshwater (either directly or indirectly by reallocating water from agriculture to industry), some bordering neighboring countries like Kyrgyzstan and Uzbekistan may hypothetically accuse Kazakhstan of violating the spirit of existing equitable-use agreements. Currently, Kazakhstan already faces tensions with the People's Republic of China over the Ili and Irtysh rivers. If domestic stress worsens due to Hyrasia One, Astana may seek greater flows from China, which would strain otherwise

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friendly bilateral relations. On the other hand, the project could diversify into renewables. Kazakhstan could reduce its heavy dependence on Russian transit routes and create new export channels, thereby enhancing its bargaining power with Moscow and signaling that it has a strategic alternative. Kazakhstan could also invite China to cooperate and contribute to water-efficient infrastructure, thereby strengthening ties with Beijing.

Secondly, credibility is at stake. Kazakhstan positions itself as a leader in IFAS (the International Fund for Saving the Aral Sea). The European Union is a major partner in the green hydrogen initiative that safeguards projects and commitments. Therefore, if during production, multiple credible sources were to allege water mismanagement, the EU would pressure Kazakhstan to pause or revise agreements, damaging its green-energy credibility and forcing it to spend additional, unnecessary funds to realize the project. However, the EU is actively seeking a reliable green alternative to Russian energy supplies. If Kazakhstan provides a transparent EIA, conducts stakeholder consultations, and sets clear sustainability standards, Hyrasia One could become a flagship EU–Kazakhstan energy diplomacy project, positioning the country as Central Asia's bridge to Europe in renewable supply chains.

Thirdly, if Hyrasia is seen as prioritizing industrial water use over essential needs such as agriculture, Uzbekistan, Kyrgyzstan, or Tajikistan could interpret Kazakhstan's actions as undermining trust in cooperative initiatives. Kazakhstan cannot afford such scrutiny, given the multiple bilateral and multilateral agreements that may be at risk. A possible solution would be a strategic rearrangement that places Kazakhstan in a leadership position, while at the same time not diminishing the importance of its partners and neighbors.

Brief scenario analysis

In a pessimistic scenario, if Kazakhstan begins constructing a hydrogen plant without ensuring proper compliance with established regulatory and environmental standards, this could provoke strong criticism from both the domestic public and the international community. Violations during project implementation would become the subject of discussion at various international forums, conferences, and negotiations. Such developments could lead to the withdrawal of European partners, including Svevind and European Union institutions, from participation in the project due to non-compliance with obligations. As a result, Kazakhstan risks losing its reputation as a reliable partner, which would entail a revision or tightening of the terms of existing international agreements, as well as a decrease in the country's investment attractiveness. In the long term, this could have a significantly negative impact on the political and economic stability of the state.

Within a neutral scenario project implementation may be accompanied by internal contradictions and public criticism, particularly in connection with potential compromises in the fields of ecology and agriculture. Compliance with Environmental Impact Assessment (EIA) procedures could result in delays during the implementation phase, thereby slowing progress. At the same time, regional states, including China, Uzbekistan, and Kyrgyzstan, may adopt a wait-and-see attitude, observing the project's progress until tangible results emerge and its potential is demonstrated. As the prospects for hydrogen production become clearer, these countries may express their willingness to cooperate. Among the

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potential supporters of the project could be the Russian Federation, which is interested in new energy sources. However, Russia's participation might create tension with European partners, given the current level of political confrontation. Despite this potential discomfort, Kazakhstan, with its strategic position and backing from China, could contribute to a re-evaluation of approaches and a softening of political rhetoric, thereby helping to ensure the project's sustainability.

Under an optimistic scenario, the project could achieve sustainable success if Kazakhstan ensures full compliance with all regulatory requirements and environmental standards, while simultaneously investing significant resources in acquiring modern, high-tech components and power plants capable of operating long-term with minimal maintenance costs. In this situation, the European Union would likely express a strong interest in further developing cooperation with Kazakhstan, opening new opportunities for strengthening trade and economic ties and expanding forms of interaction. In addition, Kazakhstan could promote an updated draft regional agreement on the distribution of water resources, which would help reduce tensions among the countries of the region over water supply issues, while consolidating Kazakhstan's role as a leading actor in sustainable and "green" energy. A further significant achievement would be the development of the Trans-Caspian route, which could become a key platform for the export of environmentally friendly energy across the Eurasian space.

In reality, the complete implementation of one of the above scenarios is unlikely. A hybrid scenario is more probable, although the optimistic outcome remains quite possible. However, given the complex external context, the project may face delays or temporary suspension. Its implementation would nonetheless be important for Kazakhstan in several respects, including economic, environmental, and geopolitical.

CONCLUSION

Thus, the potential implementation of the project in Kazakhstan is important and demonstrates a wide range of possible outcomes, reflecting both internal and external challenges that the initiative may face. At the same time, the optimistic scenario, highlighting strong prospects for Kazakhstan through a comprehensive and responsible approach to the project's implementation, is of the greatest research and strategic interest.

Compliance with international standards, investment in modern technologies, ensuring environmental sustainability, transparency of processes, and effective water management can not only strengthen the trust of key foreign economic partners, such as the European Union, but also significantly enhance Kazakhstan's status as a reliable participant in the global energy transition. In this context, the country's water policy focused on the sustainable use of transboundary water resources, as well as the development of water diplomacy as a tool for preventing conflicts and strengthening regional cooperation within the framework of international obligations, including the 2018 Convention on the Legal Status of the Caspian Sea which is of particular importance. The green hydrogen production project could become not only an economic but also a geopolitical asset, providing Kazakhstan with a leading position in the field of renewable energy in the Eurasian region. The complex interaction of energy and water policies is

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becoming a key condition for the project's sustainability and its integration into the international agenda.

Additionally, the development of transport and logistics infrastructure within the Trans-Caspian route, together with the intensification of dialogue with partners, opens new markets for Kazakhstan and expands opportunities for export diversification. Timely implementation of these opportunities would allow potential challenges to be transformed into points of sustainable growth, turning the project into a model of successful international cooperation in the context of the transition to a low-carbon economy.

Thus, the implementation of the hydrogen plant project could become a key element of Kazakhstan's sustainable development strategy, contributing to the strengthening of its international role, promoting water diplomacy, and shaping a new technological and environmental image for the country.

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Ethical Commission Approval

This study did not require approval from an ethics committee as it did not involve human participants, animals, or sensitive personal data. All data used in this research were obtained from publicly available sources.

Conflict of Interest Statement

There is no conflict of interest with any institution or person within the scope of this study.

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