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Green Energy Cooperation among Turkic States: Perspectives and Challenges

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Abstract

This article examines the economic conditions of the Turkic States focused on green energy production as a means to reduce greenhouse gases that contribute to modern climate change. The study covers Azerbaijan, Kazakhstan, Turkmenistan, Uzbekistan, and Kyrgyzstan. It also addresses the challenges these countries face in collaboration and the growth of green energy investments.

Keywords: Green energy, Turkic Republics, Sustainable energy, Energy

Introduction

The green energy potential among Turkic states is increasingly drawing global attention. As efforts to accelerate the transition to green energy on a universal scale progress, countries are finding themselves insufficient in producing their own energy. This insufficiency is attributed to a lack of adequate labor force, economic capacity, and production infrastructure. Countries are addressing these issues through cooperation with one another. Azerbaijan, Uzbekistan, Kazakhstan, Kyrgyzstan, and Turkmenistan have established joint energy infrastructures derived from natural gas and oil in their collaborations. These include pipelines, energy transmission lines, and electricity grids. The reduction of fossil fuels poses a threat to Turkic states, signaling a need for diversification in energy sectors similar to other nations. The insufficient focus on the transition to green energy until threats emerge is related to long-term trade agreements on oil and natural gas among these Turkic states, profitability from fossil fuels, and the inadequacy of technological infrastructure for transitioning to sustainable energy. What is required is the integration of existing infrastructures with renewable energy sources. However, as the article highlights, there are shortcomings in coordinating and organizing energy resources based on common goals. Over time, this could be enhanced as the European Union also clarifies shared objectives in trade. The notion that the need for oil will decrease encourages countries to move towards green energy in post-oil strategies. Countries should develop their energy portfolios around green energy as investing in renewable energy is a strategic priority that contributes to their economic resilience. New global dynamics present significant opportunities for green energy. Turkic states share a common perspective on transitioning to green energy, focusing on sustainability, energy economics, economic development, technology transfer, the shift to clean energy sources, enhancing energy efficiency, and reducing carbon emissions in the region. Policies aim to minimize the adverse effects of global climate change and support investments in environmentally friendly production through the transition to a green economy. By leveraging their geographical advantages and forming partnerships Turkic states will support each other in the transition to green energy. Furthermore, these initiatives among Turkic states create a significant roadmap for energy exports between Asia and Europe. With the European Union's demand for green energy and emphasis on climate change, this development presents an important cooperation project for Turkish states. Countries investing in renewable energy have the potential to export green energy to the EU. The European Union views the Caucasus as a whole and seeks to operate under a free market system. For Turkic states, this initiative represents the emergence of a new market. This situation also offers the advantage for participating countries to benefit from the commitment to becoming carbon neutral by 2050. Consequently, participating Turkic states should prepare net-zero plans for cities, financial institutions, and companies. This situation indicates a global emission reduction of 45% by 2030. According to the

International Labour Organization (ILO), the path to the EU market for green energy also creates new job opportunities and reduces unemployment levels. Due to their advantageous geographical positions, Turkic states play a notable role in solar energy (Azerbaijan, Kazakhstan, Uzbekistan, Turkmenistan), wind energy (Kyrgyzstan, Kazakhstan), and the Caspian Sea region. The EU has announced its decision to assist Turkic states in producing renewable energy. The Green Book emphasizes creating supply security in response to increased energy demand in the section "Towards a European Strategy for Energy Security." To achieve security, cooperation between countries is necessary. Turkey will utilize important four pipelines in the Middle East—Baku-Tbilisi-Ceyhan (BTC), the Caspian Pipeline, Baku-Supsa, and Baku-Novorossiysk—to transport energy to the Mediterranean and Europe. Ports such as Baku/Alat (Azerbaijan), Aktau/Kuryk (Kazakhstan), and Türkmenbaşı (Turkmenistan) are used for combined transportation in the Caspian transit. The TACIS project, initiated in 1993 (Brussels Declaration), aims to strengthen Azerbaijan, Uzbekistan, Kazakhstan, Turkmenistan, and Kyrgyzstan in trade and transportation, facilitating their integration into the international economy. Through the TACIS agreement, the EU will contribute to Azerbaijan's energy security and infrastructure development. However, South Caucasus struggles to stabilize green energy production, making Azerbaijan strategically significant for the EU in the East-West block. The EU supports green energy projects in Central Asian Turkic states by providing investment funds and grants to help realize these projects. Countries have formed partnerships with the EU, focusing on solar and wind energy with Kazakhstan, solar energy with Uzbekistan, and hydroelectric energy potential with Kyrgyzstan. This collaboration will leverage the EU's new market for energy security, uniting their efforts and infrastructures.

Economic Situation of the Turkic States

When examining the economic situation of the Turkic States, I will begin with an analysis of Azerbaijan. As of the latest data, Azerbaijan's GDP is estimated at $54.6 billion USD, which breaks down into Agriculture: 6.2%, Industry: 51.7%, and Services: 42.1%. According to the data from the Central Bank of Azerbaijan (CBA) and the State Oil Fund of Azerbaijan (SOFAZ), Azerbaijan entered a recovery phase in 2021 following the COVID-19 pandemic, largely driven by GDP growth in the oil and natural gas sectors. The increase in energy prices during 2022-2023 further accelerated this growth; thus, in 2022, real GDP saw an increase of 4.6%, supported by a 9% rise in the construction and transportation sectors. From 2023 onward, inflation began to decline, and the previously rapid growth has slowed. The slowdown in 2023 can be attributed to a decrease in hydrocarbon production. In December 2022, inflation reached an annual rate of 14.3%, and by October 2023, it had improved to 3.9% due to a broad decrease in the prices of food, non-food products, and services, with GDP growth reaching 10.1%. This period reflects not only changes in overall price levels but also a reconfiguration of consumer spending and economic balances.

Additionally, between 2021-2022, Azerbaijan's electricity generation capacity averaged 8 GW, of which only 1.3 GW (16.5% of the total) was derived from renewable sources, predominantly hydroelectric (1.2 GW). Wind, solar, and biomass accounted for the remaining 2.5% of the capacity. In 2022, total electricity production reached 28.9 billion kWh, with 1.6 billion kWh generated from hydroelectric plants, while other renewable sources contributed 0.4 billion kWh. Azerbaijan regulates local energy prices to remain significantly below economic and environmental costs, creating a balance where local prices for primary energy products barely meet corresponding supply unit costs; additionally, the gas prices set for residential and electricity generation are also below supply costs. Electricity is priced uniformly for industrial and residential use, and these subsidies account for 1.6% of GDP, raising significant discussions regarding long-term sustainability in the energy market and the need to consider environmental impacts.

Looking at Kazakhstan's economic position, GDP (at current prices in billion USD) is expected to be 225.53 in 2022, 261.42 in 2023, and 296.74 in 2024. The fundamental components of Kazakhstan's economy include natural gas, oil, and mining. Overall, economic growth is primarily driven by the oil sector. Following the COVID-19 pandemic, Kazakhstan's GDP grew by over 4%. In 2022, this growth rate was 3.3%, while in 2023, it is projected to rise to 5.1%. Kazakhstan ranks among the top ten countries globally in coal, iron, and gold mining, and it ranks twelfth in natural gas and oil production.

In examining Kyrgyzstan's economic model, GDP figures show 9.25 billion in 2021, 12.13 billion in 2022, and 13.99 billion in 2023. Per capita GDP for 2023 (current USD) has risen to 1,969.9. The pillars of the Kyrgyz government's economy appear to rely on gold exports, remittances, and agriculture. By increasing production in industrial goods and machinery, the prospects for gold mining have improved, leading to an uptick in exports. Additionally, while the country has room for improvement in its hydroelectric power sector, it currently utilizes only about 10% of its capacity. In the context of GDP comparison, agriculture constitutes 16% of the economy. Kyrgyzstan has significant hydroelectric potential, which could reduce its dependence on fossil fuels and create new export opportunities, thus fostering developments in sustainable energy.

When examining Uzbekistan's economy, GDP analyses (at current prices in billion USD) show that it achieved 117.18 billion in 2021, 123.82 billion in 2022, and is projected to reach 131.23 billion in 2023. The Uzbek economy is largely based on the export of oil and natural gas. In terms of gold mining, Uzbekistan ranks fourth in the world. It also holds 1.3 million tons of copper reserves, making it one of the leading countries in this sector and ranking tenth globally. Overall, Uzbekistan aims for an average annual growth rate of 5-6%. In 2023, the country's imports rose to 29 billion USD, while exports amounted to 18 billion USD.

Finally, examining the economy of Turkmenistan, it is notable that the country possesses the largest natural gas reserves in the world. Current GDP figures for Turkmenistan show 51.41 billion in 2021, 54.6 billion in 2022, and 58.03 billion in 2023. With the socio-economic development plan for 2019-2025, Turkmenistan's president aims to achieve significant growth as these objectives are met. At the end of 2020, the growth rate of the Turkmen economy was 5.9%, which rose to 6.2% by mid-2021. The government is implementing international projects and fundamentally transforming its national production base to facilitate development.

Literature review

In my literature review, green energy sources are identified as natural resources aimed at sustainable use. The article addresses two main aspects: first, it focuses on reducing resource-based costs by supporting green energy, and second, it highlights environmental concerns. The study by Cui & Zhang (2022: 78780) aims to minimize carbon emissions through a circular economy. Urbanization, which consumes nearly two-thirds of energy capacity, generates up to 80% of greenhouse gas emissions, and accounts for 50% of global waste, underscores the importance of using energy-efficient renewable resources. The article on Financial Incentives for Green Energy Use within Sustainable Energy Policies discusses efforts to increase the use of recycled materials and green energy and to develop eco-friendly technologies. As discussed in the article, the growth of renewable energy sources is driven by concerns about greenhouse gas emissions and related environmental issues (Gerger, Şavlı, 2024; Özkan, 2010; Güner, 2016). The results of these studies show that the depletion of fossil fuels poses a global threat to all countries. Additionally, Guliyev's article emphasizes the importance of energy after the first oil crisis in 1973. It discusses renewable energy sources and conducts production analysis among countries, taking into

account production and external costs. The article analyzes energy production levels from 2014-2015 and provides information about oil, including the logistics of its transportation and the routes it follows. Today, the usage rate of non-renewable energy sources is over 95%, leading to forecasts that fossil energy sources like natural gas and oil will be depleted within the next 50 years. Approximately 20% of the energy consumed globally comes from renewable energy sources. However, the article does not provide detailed discussions on the production challenges of renewable energy sources nor does it establish connections between Turkic states. My article, on the other hand, addresses collaborations between Turkic states regarding green energy sources (Guliyev).

The green economy aims to reduce dependence on fossil fuels, promote renewable energy sources, enhance energy efficiency, reduce waste and pollution, and prioritize environmental protection. Growing concerns about the rapid increase in environmental and natural resource degradation and its impact on economic and social stability highlight that these are global issues, necessitating the formulation of sustainable development policies by all nations (Crowther and Islam, 2015). This worsening situation affects all humanity and causes increasingly severe consequences. To improve this, large-scale efforts are being undertaken in many developed countries to efficiently use alternative energy sources and minimize the use of traditional fuel and energy resources (Koriyev and Abdujabborov).

According to Richardson (2013), the green economy is a renewable, fair, and profitable economic model aimed at reducing dependence on fossil fuels, promoting social equity, and ensuring the socioeconomic well-being of all individuals by fostering a just distribution of wealth and justice. It is defined as an economy that creates new job opportunities under the term “green jobs,” enhances resource efficiency, reduces greenhouse gas emissions, promotes low-carbon technologies, decreases economic inequalities, and preserves natural capital (Mundaca & Markandya, 2016: 1372). The International Energy Agency (IEA) defines energy security as “access to uninterrupted energy sources at affordable prices.” Sustainable development supports economic growth without harming the environment by conserving natural resources and reducing waste, encourages the development of environmentally friendly technologies and green job creation, and aims to enhance human well-being (Yüce, 2024). Sustainable development requires strategic, coordinated, and integrated planning to reduce poverty and ensure green economy benefits. Collaborative efforts by governments and increasing environmental awareness among society are crucial for encouraging individuals and groups to adopt sustainable energy solutions (UNDESA, 2012). Climate summits involving many countries aim to limit the emissions of greenhouse gases that cause global warming and air pollution, and efforts are made to reduce the carbon dioxide levels released into the atmosphere. These summits facilitate joint collaborations and ensure that Central Asian Turkic states support each other to progress in a coordinated manner (Özkan, 2010; Güner, 2016).

When we integrate this data with the main topic and review research conducted on countries, we observe that despite the rich green energy resources of the Central Asian Turkic Republics, their utilization remains inadequate according to the World Bank’s Development Indicators Database (WDI). This results in differences in economic performance, development levels, and geographic locations, leading to varying green energy production among the countries. We compare these differences and evaluate which country can produce certain green energy sources more abundantly. Additionally, we can understand their plans for developing green energy resources over time and the progress made in agreements and collaborations (Central Asia Energy Report, 2022: 24).

As indicated in Mustafa İlbaş's article, each state has evaluated its own domain within the cooperation process. When comparing the workforce of the Central Asian Turkic Republics, we observe that member and observer countries such as Hungary and Turkey contribute to the production industry, Kyrgyzstan and Uzbekistan to human resources potential, and Kazakhstan, Azerbaijan, and Turkmenistan to energy resource production, thereby forming a comprehensive whole. States with energy resources supply products demanded by major global players. The article suggests that strategic projects advancing regional energy cooperation among Turkic Republics could be supported with appropriate credit facilities. It provides a foundation for understanding the energy strategies of the Turkic World and the dynamics of global competition and cooperation. Additionally, the article highlights the importance of the Turkic Council's perspective on energy cooperation and its significant role in shaping regional and global energy policies. Türkiye's position between the energy markets of the Turkic Republics in Central Asia and the Caucasus and those in Europe further enhances the importance of this cooperation. Unlike other articles, it addresses Türkiye's potential to become an energy hub and facilitate the delivery of energy resources from other Turkic Republics to the European market. Subsequently, recommendations and strategies have been developed, such as the Trans-Caspian Project (TCP), which can strengthen energy cooperation within the Turkic World and play a significant role in regional and global energy dynamics. This cooperation enables Turkic Republics to utilize their energy resources more efficiently and enhance energy security while supporting their economic development. The proposed strategies provide a roadmap for maximizing this potential and advancing energy cooperation (İlbaş, 2023).

Hekimoğlu's article addresses research on natural gas reserves within the borders of Turkmenistan and offers commentary on Turkmenistan's energy reserves (HEKİMOĞLU, 2012). Information regarding Kazakhstan's energy reserves can also be found in Syzdykova's research paper. This paper analyzes the transportation of energy, the status and advantages of Kazakhstan's green energy, and its energy transmission system, including all transformer centers and stations. It provides a comprehensive overview of Kazakhstan's energy resources. The REN21 report is examined, and the analysis continues using numerical data. Kazakhstan possesses significant solar energy potential due to its vast open spaces and high solar irradiation. Particularly, the northern regions of the country have substantial wind energy potential, offering suitable conditions for wind power. With several major rivers and dam systems, Kazakhstan also has potential for hydroelectric energy. In coastal regions, the utilization of wind and solar energy is competitive with fossil fuels. These energy sources are described as potentially advantageous even without accounting for externalities. Technological and financial advancements have increased the use of renewable energy sources, reducing the costs of electricity production. Wind and solar energy, in particular, have become more competitive due to these developments. According to data from the Pap region in the Namangan area (www.kun.uz, 2017), theories and methods for utilizing wind energy have been developed. The article covers a broad range of topics from the environmental impacts of traditional energy sources to the use of renewable energy sources and associated reforms and investments. Encouraging renewable energy sources and implementing large-scale projects aim to enhance their effective use in electricity production. The article also mentions that due to the abundance of solar energy in the southern regions of Uzbekistan, photovoltaic solar power plants have been constructed there. The conclusion drawn from the article indicates that solar energy is obtained more intensively in Uzbekistan compared to other green energy sources (Aziza Syzdykova, 2020). After providing historical information on Azerbaijan's renewable and non-renewable energy sources, the article details the processes of utilizing these resources and their economic significance. It also addresses the relationship between the European Union's energy security and Azerbaijan, as well as the benefits of establishing the Europe-Caucasus-Asia Transport Corridor. Additionally, data on Uzbekistan's green energy sources and production stages are analyzed (Koriyeva & Abdujabborov, 2022).

In Bekkari's article, the details of energy production, particularly the production of oil and gas in Azerbaijan and its impact on GDP ratios, are examined. The article focuses on three components: the accessibility of supply security, low costs, and uninterrupted service (sustainability). It discusses the construction of the Baku-Tbilisi-Ceyhan (BTC) pipeline in 2006 and Azerbaijan's energy exports via this and other pipelines. However, it is noted that the scale of current renewable energy resources does not align with long-term goals. Despite this, the article argues that Azerbaijan has strong potential in renewable energy. The study is divided into three sections: the first addresses the history of energy in Azerbaijan, the second covers Azerbaijan's energy resources including oil, natural gas, and others, and the third explores the relationship between the European Union's energy security and Azerbaijan. Various plans such as the "Europe-Caucasus-Asia Transport Corridor" (TRACECA) and the "Intergovernmental Program for the Transportation of Oil and Natural Gas to Europe" (INOGATE) are examined. The article comprehensively analyzes the impact of Azerbaijan's energy resources and its relationship with the EU on energy security. The sources analyzed offer a broad range of information from the conceptual framework of energy supply security to Azerbaijan's energy sector and the EU's energy strategies (Bekkari, 2023).

Another article reviewed discusses the savings obtained from energy produced by countries, the energy transfer rates with other countries, and the extent to which harmful emissions are prevented from entering the atmosphere. It describes Uzbekistan's hydroelectric potential and the existing hydroelectric plants and capacities. The article highlights that a significant portion of Uzbekistan's resources remains untapped, and recent years have seen the first serious steps towards effective utilization of existing capacity (Koriyeva & Abdujabborov, 2022). This development leads to changes in international relations and prompts the formation of new energy policies. The increasing focus on green energy resources necessitates countries to reshape their energy strategies and policies in line with sustainability principles. This shift can affect power dynamics and geopolitical strategies in international relations. Emerging new dynamics in international energy cooperation and trade relationships are driven by green energy investments and sustainable energy policies, encouraging the creation of new energy policies aimed at enhancing energy security and environmental protection goals. It is emphasized that Central Asian Turkic states, including Azerbaijan, Kazakhstan, Kyrgyzstan, Uzbekistan, and Turkmenistan, need to increase investments in renewable energy, reshape their energy policies in accordance with sustainability principles, and strengthen international collaborations. The article also examines the average daily costs and profits of thermal power plants in the Marmara region. Literature reviews have included SWOT analyses of thermal power plants, with sources such as Çağlar et al. (2008), DPT (2007), Elmacı et al. (2009), TÜBİTAK (2003), Atılgan (2008), and the Turkic Economic Institution (2003). These analyses highlight the strengths, weaknesses, opportunities, and threats of thermal power plants. The insufficient energy production of the Central Asian Turkic states is noted as a risk to the future of their economies (Aktaş and Alioğlu, 2012; Bayrak and Esen, 2014; Güner, 2016: 21). The discussion emphasizes the need for long-term, goal-oriented support for domestic energy production and the analysis of how this can be achieved. It explores the use of alternative internal energy sources to meet energy consumption while achieving economic growth targets. The general description of energy sources is provided, covering both fossil and renewable energy sources. Güner highlights the negative health impacts of fossil fuel use and the diseases associated with it. The article provides a detailed examination of energy needs, resource potential, environmental impacts, and sustainable development (Etürk et al., 2015; Güner, 2016: 21). The article by Ertürk and Önder emphasizes the need for increased resource diversity and adequate allocation for R&D, reducing external dependency in energy use, and efficient utilization of domestic resources. It also stresses that further support for renewable energy sources is required to maximize benefits, noting that current support levels are insufficient (Ertürk, 2006: 118; Önder, January 2018).

The Importance of Green Energy

Green energy refers to energy types that are used to replace fossil fuels and are aimed at reducing environmental impacts. UNESCAP describes green growth as the development of environmentally friendly economic processes by reducing carbon dioxide. Green energy involves methods that minimize environmental impacts and are typically derived from renewable sources. These energy sources are continuously replenished, come from nature, and have very low depletion rates. Today, the use of renewable energy is critically important as we face the depletion of fossil fuels and climate change. Countries struggle with transitioning to green energy due to their easier access to carbon fuels. They lack sufficient production capacity and infrastructure. However, Turkic -speaking countries are placing emphasis on green energy production during this transition. Green energy sources include solar, wind, hydroelectric, and geothermal energy. These types of green energy produce low carbon emissions, reduce or eliminate greenhouse gas emissions during energy production, do not leave harmful waste, and do not damage ecosystems. They are crucial for slowing global warming and climate change. Therefore, transitioning to the use and production of green energy improves air quality and reduces health problems. The continued consumption of carbon fuels may lead to irreversible consequences for humanity due to climate change. Utilizing renewable energy is one of the best options for maintaining climate balance. Unlike fossil fuels, which are imported, renewable energy sources are locally available and only require management. This expansion of energy supply helps control fluctuations in the global energy market and enhances national energy security. This article primarily focuses on Turkic states. The Turkic states have advantageous geographical positions in Central Asia. The region's vast and sunny terrains provide a suitable basis for solar energy projects. Similarly, windy areas offer potential for wind energy projects.

Green Energy Shortage in Central Asia

Although the Central Asian Turkic states are not yet developed in terms of green energy, they are emerging countries. However, they are also among the leading countries in coal, gas, and oil globally. Kazakhstan and Turkmenistan, rich in oil and gas reserves, are located in the Caspian Sea basin. The countries in the region each have different characteristics regarding energy resources. Kazakhstan is the world's 12th largest oil producer and also a significant natural gas producer, while Turkmenistan is known for its vast natural gas reserves, and Uzbekistan is also a significant natural gas producer. These fossil fuels meet a large portion of regional energy needs. Energy poverty is high in Kazakhstan, Turkmenistan, and Uzbekistan, and overcoming this in the short term is challenging. While these Central Asian Turkish republics have abundant fossil fuel reserves, two of the countries stand out for their water resources, renewable energy sources, hydroelectric potential, and various minerals. In Kazakhstan, the development of solar energy systems is hampered by its high-speed winds, which affect production. Therefore, wind energy plants play a more significant role in production. Despite recent developments, Central Asian Turkic states still have insufficient energy production, and rapid development is hindered by inadequate economies. Energy poverty has significant impacts on quality of life, so improving these countries is crucial. This issue is not only an urgent call for Turkic states but also aligns with the United Nations

Sustainable Development Goals, which address renewable energy and decreasing inequalities. As these countries do not yet have sufficiently developed foundations in green energy, it is highly unlikely they will completely abandon fossil fuels by the 2040 timeframe outlined by the Turkic World (TDT) plan.

Green Energy Cooperation Among Turkic States: Perspectives

According to the 1987 Brundtland Report, there is a need for development in renewable energy sources, as the increasing population growth indicates a trend towards energy poverty. The responsibility for advancing renewable energy sources lies with the states. It supports the implementation of development policies concerning sustainability and the development of policies related to environmental protection. International cooperation and financial support are crucial, especially for developing countries, in helping them achieve sustainable development goals. The 2012 Rio+20 Summit aimed to enhance international coordination and improve the institutional framework by presenting the vision and priorities of green economy/growth as one of its two main themes.

From 2014 to 2018, the importance of the term "Sustainable Green Energy" increased in the 5th and 10-year development plans, thereby enhancing attention to green energy through the protection of nature and increased competition, as well as encouraging countries to enter the green economy race. This is because the environment is continuously undergoing change and is under threat, necessitating its protection. Without protection, the system's own functioning and sustainability will be hindered. With the transition to green energy, job opportunities with good employment rates are being created without harming the environment, in alignment with societal well-being. The Turkic States have adopted the green energy transition process in their declarations and decisions.

I am examining the perspectives of the states individually:

Kyrgyzstan has accelerated energy efficiency improvements and begun implementing green energy principles. The country, seizing opportunities to develop in hydro energy, has provided constructive recommendations and solutions during the transition process. Kyrgyzstan's forward-looking programs focus on investing in newly established solar energy plants and water resources. However, due to the low electricity tariff, this process will take many years. The "Green Economy Development Program" for 2019-2023 aims to enhance the well-being of the population, effectively use resources, and protect the country's ecosystem (Ekoavrasya, 2024). In 2018, Kyrgyzstan adopted the 2018-2040 National Development Project, advancing in environmentally friendly investments and circular economies. The Kyrgyz government is aware that strategic planning in resource use is essential for the country to gain benefits.

In Azerbaijan's green energy perspective, there has been a growing focus on developing sustainable energy to avoid environmental damage, excluding oil. Since 2018, Azerbaijan has accelerated digital transformation and technological innovations in green energy. Notably, in a 2020 meeting, Energy Minister Shahbazov emphasized the development and improvement of

green energy infrastructure in the reclaimed Karabakh. Azerbaijan has demonstrated its commitment to green energy globally by establishing Socar Green. Since 2021, Socar Green has been working to reduce carbon footprints and produce green hydrogen, contributing to environmental protection. However, Azerbaijan is not fully transitioning to green energy due to its belief that oil and gas reserves will not deplete within the century, though progress is being made (Pekgöz, 2024).

In Kazakhstan's green energy perspective, the President implemented a green economy transition concept in 2013. This aims to prepare the country to be among the top 30 developed countries in the world. The importance of green energy for Kazakhstan includes minimizing environmental damage, conserving energy, and enhancing digital development through the "Smart Data Government" project, which has improved technological capabilities. A green infrastructure plan is being developed, with efforts to accelerate green infrastructure development, reduce CO2 emissions, and ensure waste recycling between 2020 and 2030. From 2030 to 2050, the goal is to transition to the principles of sustainability and renewability, known as the third industrial revolution.

Turkmenistan, lacking sufficient energy resources, has made progress in establishing extensive wind and solar energy systems around the Turkmen Lake within its geographic constraints. In the city of Mary, the State Energy Institute has established a research center focused on the development of energy resources, continuing the country's advancement in green energy. Additionally, Turkmenistan is engaged in efforts to minimize methane gas emissions, demonstrating its commitment to green energy and environmental protection (Turkmenportal, 2024).

Uzbekistan's green energy perspective, Uzbekistan is diligently working on reforms and demonstrating its openness to development in the field of renewable energy. Its primary goal, as outlined in the Nationally Determined Contribution (NDC), is to reduce greenhouse gas emissions and combat climate change by 2030. However, due to the relatively low per capita emissions, a substantial reduction is not anticipated. In addition to this effort, Uzbekistan is expanding its resources in wind and solar energy through legal and policy reforms aimed at increasing energy efficiency.

The country is making regulatory adjustments to enhance existing grids, adapt them for green energy, and establish new transmission lines. These measures are designed to attract investors, thereby supporting Uzbekistan's economic development in the renewable energy sector. The major projects planned include increasing solar and wind energy capacity to 20 GW by 2030.

Green Energy Collaborations Among Turkic States

Despite Central Asia's abundant fossil fuel reserves, the environmental impacts and depletion risks associated with these resources are encouraging regional countries to diversify their energy

strategies. Green energy projects have the potential to enhance energy independence for these nations and support energy security. They strengthen and solidify economic and cultural ties between countries. While fostering economic growth, these projects also promote the proliferation and advancement of alternative energy sources. Each country's geographical context is considered, and the collaborative process assesses each state's specific area of involvement. The workforce potentials of Turkic states in Central Asia indicate that Kyrgyzstan and Uzbekistan's human resource capacities complement Kazakhstan, Azerbaijan, and Turkmenistan's energy production capabilities, creating a cohesive whole. These collaborations aim to ensure the long-term sustainability of energy systems and meet societal needs. The green energy sector, with its broad scope and labor requirements, seeks to create new job opportunities, reduce unemployment to its lowest levels, and stimulate economic growth. It opens new job opportunities in technology development, construction, and maintenance, while sociologically expected to positively impact the countries' development and their citizens' economies.

The green economy aims for economic growth without harming the environment by conserving natural resources and reducing waste. It is viewed as a renewable, fair, and profitable economic model that maintains socioeconomic welfare through equitable distribution of justice and wealth for all people (Richardson, 2023). Local and renewable energy sources reduce energy dependence and ensure energy security for countries through the use of energy-saving renewable resources.

Members with sustainable energy resources provide products needed by strong industry actors to the global market, laying the foundations for global trade and aiming for greater collectivization. However, the Turkic States face economic challenges in green energy development. Recommendations include providing credit support for strategically important projects that could overcome these economic issues and further enhance regional energy cooperation (İlbaş, 2023).

Azerbaijan and Green Energy

The "Azerbaijan 2030: National Priorities for Social and Economic Progress" document’s fifth section details how renewable energy based on "green energy" principles will be utilized across all economic sectors to address climate change and related issues. Azerbaijan is developing as a green energy producer, with support from Türkiye for renewable energy projects in the country. In the 2012-approved "Azerbaijan 2020 Vision for the Future" development plan, President Ilham Aliyev emphasized the importance of addressing climate change's potential impacts on the country’s social and economic life and developing political measures for this purpose. Active renewable energy sources are located in regions such as Pirallahı, Surahanı, Sumgayıt, Nakhchivan, Oghuz, and Aghjabadi, with the largest renewable energy sources found in Karabakh. This includes regions such as Jebrayil, Fuzuli, Hojavend, Aghdam, Khojaly, Terter, Shusha, and Khankendi. Terter has a robust infrastructure for hydroelectric energy, while the southern part of Karabakh and Nakhchivan are of significant importance for solar energy systems, followed by Fuzuli, Jebrayil, and Zangilan. The solar radiation in these regions ranges from 1600-1700 kWh per square meter. Fuzuli, Kelbajar, Zangilan, Jebrayil, Lachin, and Gubadli are also significant for solar energy projects. Azerbaijan currently has 13 solar energy plants, three of which are hybrid stations. The region also possesses wind energy potential, with average annual wind speeds reaching 10 m/s in Kelbajar and Lachin, bordering Armenia.

Overall, the wind energy potential in Karabakh's mountainous areas is estimated to be 500 megawatts. Additionally, Kelbajar has thermal water resources of 3,093 m^3/day, and Shusha has 412 m^3/day. The initiation of renewable energy projects in Karabakh aims to reduce dependence on fossil fuel-based electricity. Following liberation from occupation, the potential use of these thermal resources for energy purposes is also under consideration. Azerbaijan has partnered with Turkic firms for wind energy projects in Lachin and Kelbajar, cities liberated after the Karabakh war on September 27, 2020. The use of renewable energy sources in the liberated areas is expected to play a significant global role in Azerbaijan's green energy sector. The majority of renewable energy production in the Karabakh region is observed through hydroelectric dams. Kelbajar has daily thermal water resources of 3,093 m^3, and Shusha has 412 m^3. The implementation of renewable energy projects in Karabakh is intended to reduce Azerbaijan's dependence on non-renewable fossil fuels and strengthen the economy (Mammadov, 2021).

Kyrgyzstan and Green Energy

Climate change, which poses global challenges, is also a significant threat to Kyrgyzstan, as it is to other countries. Consequently, Kyrgyzstan has accelerated its actions towards sustainable development since the 2012 Rio Agreement. The Sustainable Development Conference has provided Kyrgyzstan with a significant opportunity to reaffirm global commitments and expedite progress. By reducing greenhouse gas emissions through renewable energy sources, Kyrgyzstan aims to minimize future CO2 emissions, thus reducing environmental pollution while achieving economic development. Research indicates that Kyrgyzstan has substantial hydroelectric production potential due to its abundant water resources, estimated at 142 billion kW. Currently, Kyrgyzstan's annual electricity production is approximately 15 billion kW. The country operates seven major hydropower stations: Toktogul, Krupskaya, Shamaldı Say, Taş Kömür, Üç-Korgon, Kambarata-2, and At Başı. Despite its significant hydroelectric potential, Kyrgyzstan utilizes only 7.7% of its total hydroelectric capacity. Electricity production in Kyrgyzstan is almost entirely managed by the Electric Stations Joint Stock Company (Elektriçeski Stansii), accounting for 98% of the country's production. Kyrgyzstan possesses potential alternative energy sources, including 490 million kW for heating purposes from solar energy, 22.5 million kW for electricity generation, 44.6 million kW from wind energy, 8 million kW from small river hydropower stations, and 1.3 million kW from biomass sources. However, despite its extensive green energy potential, Kyrgyzstan is currently underdeveloped in the production phase (T.C. Ticaret Bakanlığı, 2023). Kyrgyzstan, being the only country in Central Asia with water resources originating within its own territory, has a distinct advantage in terms of its hydrological characteristics.

Kazakhstan and Green Energy

Kazakhstan has demonstrated a heightened sensitivity towards sustainable energy production since signing relevant agreements in 2009. In line with its commitment to support production, the

country has intensified efforts to reduce coal usage, a fossil fuel, through various measures initiated in 2013. By 2050, Kazakhstan aims to transition to green energy and a green economy in accordance with the National Concept, in collaboration with Turkic -speaking countries. In 2018, the country shifted to an open bidding system to enhance incentives for renewable energy producers supplying electricity to the grid.

Kazakhstan's energy system is divided into three special regions: 1) Hydroelectric power in the North region, 2) Oil and gas reserves in the West region, and 3) Energy transfers in the South region.

Hydroelectric power is one of Kazakhstan's most significant and abundant green energy sources, producing 8-9 billion kWh annually, though it has the capacity to generate up to 170 billion kWh per year. Wind energy facilities also represent a highly efficient energy source for Kazakhstan, with an average annual production of 920 billion kWh. The largest wind power plant in the country is Astana EXPO-2017, which benefits from ice detection systems imported from Europe, allowing for year-round production. This results in a reduction of 270,000 tons of greenhouse gas emissions annually. Wind energy production exceeds solar energy by 30%. It has been confirmed that the country can produce 1 trillion kilowatt-hours of wind energy annually. Solar energy production is carried out in South Kazakhstan and Kyzylorda, while the bioenergy potential is estimated at 300 MW. The Qazaq Green Foundation plays an active role in the transition to green energy, having signed over 60 agreements. The government continues to advance its policy objectives by fostering interest in renewable energy through new regulations and public awareness campaigns.

Uzbekistan and Green Energy

In recent years, Uzbekistan has made significant strides in the green energy sector. According to research, solar and wind energy production levels are currently low in Uzbekistan. As a country facing energy shortages, Uzbekistan plans to increase its solar energy potential by 2025, with the Ministry of Energy targeting the development of solar and wind power projects with a total capacity of 20 GW by 2030, backed by an investment of $4.8 billion. Energy expert Alisher Hudaynazarov has noted that while Uzbekistan has high potential for solar and wind energy production, the country currently utilizes only 10% of its renewable energy potential. To address this, new projects are being developed (Ekoavrasya et al., 2024). Solar and wind energy plants with a combined capacity of 2.6 GW have been established in the cities of Bukhara, Jizzakh, Kashkadarya, Navoi, Samarkand, and Surkhandarya, with 14 additional projects expected to be developed by 2024. However, the drying of the Aral Sea is anticipated to negatively impact the efficiency of wind and solar energy projects. The gross wind energy potential is estimated at 2.2 million tons of oil equivalent (TOE), with an average power of 70 GW or 551 W per square meter for wind turbines at 100 meters height. Strengthening wind energy will significantly benefit the country's agricultural and industrial development through the changes it will bring to industry and irrigation systems.

Turkmenistan and Green Energy

Turkmenistan is recognized for having some of the lowest energy tariffs globally; however, the country aims to enhance its efficiency in the renewable energy sector. Turkmenistan is pursuing a strategic policy to increase its energy sector independence and ensure energy supply security. To mitigate the impact of energy price fluctuations, Turkmenistan is placing significant emphasis on renewable energy projects. This approach is expected to play a critical role in modernizing Turkmenistan's energy sector and helping the country achieve its sustainable energy goals.

The extensive sunny desert areas in Turkmenistan offer significant potential for solar energy production. Regions such as Ahal, Balkan, Daşoguz, Lebap, and Mary, known for their resource efficiency, could enable the country to transition to 100% renewable energy by 2050. The "Observed Best Policy Scenario" forecasts a potential capacity of 76% from solar photovoltaics and 8.5% from wind energy. At the 27th International Turkmenistan Oil and Gas Conference (OGT-2022), discussions took place on the development of open blocks in the Caspian Sea, aiming to reduce methane gas and CO2 emissions. Turkmenistan completed the Mary-3 Combined Cycle Power Plant Project, the highest capacity power plant in Central Asia with 1,574 MW, in 2019 (Çalık Group, 2020). By 2030, Turkmenistan has adopted the Renewable Energy Development Strategy and the "Renewable Energy Sources" Law, focusing on the development of hydrogen energy, which plays a crucial role in the transport, development, and storage of renewable energy sources. Economic reforms enacted by the President of Turkmenistan include large-scale modernization of industrial facilities, ensuring a reliable and dynamic advancement of the national economy (Penjiyev, 2024).

Green Energy Collaborations among Turkic States

Türkiye and Azerbaijan are engaged in joint efforts on solar and wind energy projects. Turkic companies have established various solar power plants and wind turbines in Azerbaijan. The Shirvan Solar Power Plant benefits from Türkiye’s expertise and technology in solar energy.

There are several collaborative projects between Türkiye and Azerbaijan aimed at developing energy infrastructure and integrating renewable energy technologies. One such project is TANAP (Trans Anatolian Natural Gas Pipeline), which aims to transport gas from Azerbaijan's Shah Deniz 2 Gas Field and other natural gas fields in the Caspian Sea to Türkiye and subsequently to Europe. TANAP, in conjunction with the South Caucasus Pipeline (SCP) and the Trans Adriatic Pipeline (TAP), forms the Southern Gas Corridor. Although not a direct renewable energy project, the role of natural gas in the energy transition process can indirectly promote the use of renewable energy sources.

Azerbaijan and Kazakhstan are also establishing strategic partnerships in the green energy sector. Kazakhstan receives technology and engineering support from Azerbaijan for solar power plants, while Azerbaijani experts play an active role in Kazakhstan's wind energy projects. This

cooperation includes providing technological support and engineering services for wind energy projects in Kazakhstan.

Azerbaijan, Uzbekistan, and Kazakhstan have formed a trilateral green energy partnership with the primary aim of emphasizing the importance of green and clean energy in global climate action. The partnership promotes mutual cooperation in renewable energy, energy efficiency, green hydrogen, and green ammonia, with the goal of achieving rapid, deep, and sustainable reductions in greenhouse gas emissions (Damyan, 2024). On November 28, 2021, an annual natural gas swap agreement of 1.5-2 billion m^3 was signed between Azerbaijan and Turkmenistan at the OIC meeting in Ashgabat. The agreement stipulated that Turkmenistan's cheaper natural gas would be more cost-effective for Azerbaijan, reflecting the supportive nature of their cooperation. On January 21, 2021, a friendship treaty was signed between Azerbaijan and Turkmenistan, establishing Azerbaijan as a reliable partner and laying a solid foundation for energy cooperation. Additionally, on November 21, 2021, the Turkic States Organization developed forward-looking plans for "Green Technologies and Smart Cities in the Digital Age." The meeting focused on legal, institutional, and advanced level work, as well as increasing energy sector exports and fostering intensive cooperation. The member states emphasize their commitment to inclusivity and efficiency in reducing greenhouse gas emissions, particularly in low-carbon development areas such as industry, agriculture, energy, transportation, and alternative energy sources. During the summit, the President of Kyrgyzstan proposed joining the Central Asia-South Caucasus Platform, highlighting the importance of mutual dialogue and partnership.

At the 9th Summit of the Turkic States in Tashkent, the "InnoWeek Uz-2021" on November 23, 2021, and the "InnoWeek Uz-2022" program from October 17-21, 2022, focused on "Green Innovations for Sustainable Development." This agenda emphasized the role of green energy development in information technology and aimed to advance the technological capabilities of the participating countries.

Uzbekistan's electricity system is part of the Central Asia Electrical Network, with connections to Kazakhstan, Kyrgyzstan, and Turkmenistan via 220 kV and 500 kV transmission lines (Ataman, 2024).

In 2020, Turkish company Çalık Enerji and Turkmenistan's Türkmenenergo initiated the New Fleet Maintenance Project, emphasizing the importance of economic collaborations.

In 2021, Turkmenistan and Kazakhstan signed a Solar Energy Project Agreement aimed at the joint development of solar energy projects and fostering cooperation in this field. This project focuses on the installation of solar power plants and technological collaboration.

In 2022, the Turkmenistan-Kyrgyzstan Wind Energy Cooperation Agreement was signed, focusing on the establishment of wind energy power plants and the effective use of wind energy.

As seen, the Turkic States continue to support each other and develop future-oriented goals. These collaborations strengthen both economic and friendly ties between the states.

Countries	2018	2019	2020	2021
Azerbaijan	1890Kvt	1714.4Kvt	1212.6Kvt	1423.9Kvt
Kazakhstan	531MW	1050.1MW	1634.7MW	2010MW
Kyrgyzstan	12.5Twh	12.7Twh	112.3Twh	12.4 Twh
Turkmenistan	0.03Twh	0.05	0.1Twh	0.15Twh
Uzbekistan	0.1Twh	0.1-0.2Twh	0.1Twh	0.15tWH

Graph 1. Green Energy Production of Countries from 2018 to 2021

Conclusions and Recommendations

It is evident that the Central Asian Turkic States are in a favorable position regarding their geographical location for transitioning to green energy. However, the implementation of necessary restrictions during the transition process will facilitate and mandate the shift more effectively. One of the initial steps should be to restrict coal factories and prevent the establishment of new ones. A key point to address is that while governments are developing renewable energy, they must also improve the economic conditions according to local circumstances, thereby enhancing their ability to transition to clean energy and procure the associated costly equipment. The cost aspect is divided into two categories: the initial investment cost, which relates to the acquisition of equipment needed for the plant's setup, and the operational investment cost, which pertains to the ongoing expenses of running the plant, including chemical supplies, administrative costs, and labor expenses.

While pursuing these developments, it is crucial for governments to maintain stability and be more persistent and demanding in obtaining the necessary legal permits. By 2023, governments should have encountered legal issues due to economic shortcomings following the implementation of their projects. Additionally, the rapidly changing construction processes and interest burdens are challenging governments economically. Escalation rates are constantly fluctuating, making accurate calculations difficult. Furthermore, governments should benefit from Feed-in Tariffs (FIT), Power Purchase Agreements (PPA), and tax exemptions to support renewable energy initiatives. If states receive tax exemptions or are supported with optimal tax reductions, the transition to green energy projects will accelerate. Moreover, while providing tax reductions, it is essential to identify and increase taxes on those who pollute the environment. Additionally, planning for training programs to advance technological developments and manage new projects is necessary, enabling rapid development and social progress in these countries.

To foster the development of sustainable green energy, it is observed that the World Bank provides funding, and economic cooperation among the Central Asian Turkic States is taking place. This collaboration should integrate strategies to combat climate change. Most importantly, bureaucratic obstacles must be reduced, requiring necessary legal reforms.

Examining the joint decisions made among Turkic states and reviewing the budgetary support received in agreements between these states highlights their collaborative efforts in promoting green energy. The transition to green energy among Central Asian Turkic States is supported in a mutually encouraging manner, increasing interactions and, consequently, diversifying energy sources and ensuring more equitable energy distribution. Adhering to international treaty provisions will also contribute to a reduction in poverty and inequality. It is evident that Central Asian Turkic States are taking concrete steps in the field of sustainable green energy and are actively working to achieve their goals.

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