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EMERGING GREEN AND DIGITAL SUSTAINABLE MARKETS IN CENTRAL ASIA: A COMPARATIVE ANALYSIS OF KAZAKHSTAN AND UZBEKISTAN WITHIN CHINA'S BRI FRAMEWORK

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Abstract. This study aims to evaluate the evolving dynamics of green and digital sustainable markets in the Central Asian region, with a particular focus on the role of Belt and Road Initiative (BRI) projects. By employing a comparative analysis of Kazakhstan and Uzbekistan—two key players in the region—it seeks to highlight the distinct trajectories, opportunities, and challenges faced by these countries in aligning economic growth with sustainable development goals. The research draws on statistical data from a variety of international institutions to provide a nuanced understanding of regional trends. Special attention is given to the implications of digital technologies and green infrastructure for economic diversification, regional connectivity, and environmental sustainability. The study sheds light on the transformative potential of sustainable market development in Central Asia and its broader geopolitical and economic significance.

The analysis also considers the structural differences in governance, investment frameworks, and policy priorities between Kazakhstan and Uzbekistan, which shape their respective approaches to fostering green growth and digital transformation. While Kazakhstan has advanced renewable energy initiatives and leveraged its integration into global markets, Uzbekistan has placed stronger emphasis on modernization of industries and digital governance reforms. The study explores how both countries balance foreign investments, particularly under the BRI framework, with the pursuit of national sustainability strategies. Furthermore, it examines the role of regional cooperation, technological innovation, and institutional reforms in promoting inclusive and resilient economic pathways.

Key words: Central Asia, regional integration, Uzbekistan, Kazakhstan, digital economy, Belt and Road Initiative (BRI), green markets, digital Silk Road, sustainable development

Introduction

Today, the world is undergoing a period of profound geopolitical transformation, marked by emerging challenges and new opportunities. In this shifting landscape, the revitalization of intergovernmental relations in Central Asia—a region home to approximately 80 million people—has become not only essential but also inevitable.

Central Asia's rich historical, scientific, spiritual, and cultural heritage positions it as a region of strategic importance on the global stage. This is further enhanced by the complementarity of its economies, abundant natural resources, and a growing reservoir of intellectual capital. These factors present a strong foundation for regional cooperation. By consolidating their collective efforts, Central Asian nations can unlock significant synergies, fostering sustainable development, enhancing regional stability, and strengthening their influence in the international arena.

The region's potential lies in its ability to leverage shared opportunities, such as advancing connectivity through infrastructure development, integrating digital and green markets, and promoting innovation. Equally important is its capacity to address common challenges, including economic diversification, environmental sustainability, and regional security amidst shifting global dynamics.

In this context, deeper intergovernmental collaboration is not merely a strategic choice but an imperative for harnessing the collective strengths of Central Asia. Such partnerships have the potential to transform the region into a pivotal hub of economic, cultural, and political influence, contributing to a more balanced and interconnected global order.

Description of Materials and Methods

The methodology employed in this scientific article involves a comprehensive critical review of existing academic literature that explores key findings related to green energy and digital sustainable markets within the Central Asian region, with a particular focus on Kazakhstan and Uzbekistan. Furthermore, the study examines primary adopted documents and concepts relevant to the transition toward renewable energy in the region, supported by the perspectives of prominent green energy scholars. The research approach adopted in this article is a qualitative case study, analyzing theoretical frameworks and documents, while critically evaluating the various arguments put forward in the scholarly literature regarding green energy and digital technologies in Kazakhstan and Uzbekistan.

The research question is "how does Chinese trade initiative (BRI) in the context of green and digital sustainable market influence Central Asian regional economic dynamics and integrational processes in the context of Kazakhstan and Uzbekistan?".

This study based on a critical assessment of various academic literature related to the study of green energy and digital sustainable markets in Central Asia region: Dunne (2024) that provides a comprehensive framework for understanding how global economic structures influence regional sustainability initiatives and how China is becoming major producer of energy Yergin (2022). The production of energy will increasingly be linked to China, making global energy markets more dependent on the country as its demand continues to grow. While China possesses significant coal reserves and is among the worlds leading oil producers, its domestic production is insufficient to meet its needs. As a result, the country imports approximately 75% of its oil. Additionally, China has been expanding its natural gas consumption, leading to a rise in imports. Simultaneously, it is

making significant investments in renewable energy sources, particularly wind and solar power, in an effort to diversify its energy portfolio.

China's BRI has played a critical role in transforming the economic landscape of Central Asia, particularly in fostering green investments. Lall and Lebrand (2019) highlight the differentiated spatial effects of BRI projects, indicating that while some regions benefit from enhanced infrastructure and investment, others face risks of economic dependency. Nedopil Wang (2024) examines BRI investments in 2023, emphasizing China's increased focus on sustainable projects, including renewable energy in Kazakhstan and Uzbekistan.

Both Kazakhstan and Uzbekistan have committed to ambitious renewable energy goals. Ritchie, Roser, and Rosado (2024) provide a global overview of renewable energy expansion, placing Kazakhstan ahead of Uzbekistan in terms of solar and wind power adoption. Filipović (2024) analyze key forecasts for the green transition in Central Asia, identifying regulatory frameworks and financial mechanisms as critical factors. Additionally, Mamatkulov and Auyezov (2024) report on Uzbekistan's $1.3 billion waste-to-energy projects, signaling a shift toward sustainability.

The expansion of digital markets is another crucial aspect of Central Asia's sustainable development. Hillman (2021) discusses China's Digital Silk Road and its role in shaping digital infrastructure in the region. Uzbekistan has made notable progress in e-government services, as evidenced by its ranking improvement in the UN (UN DECA, 2024).

Sustainable financing mechanisms are essential for ensuring long-term growth in green and digital markets. Yue and Nedopil (2025) provide an in-depth analysis of China's green finance trends, outlining investment priorities for Central Asia. Similarly, Nedopil (2025) examines BRI investment patterns in 2024, highlighting a shift toward environmentally conscious projects in Kazakhstan and Uzbekistan.

Sharifli (2024) analyzes China's adaptation strategies within the renewable energy landscape of Central Asia, reinforcing the need for diversified investment sources. One of the trends in Central Asia is the development of regional cooperation. The change of leadership in Uzbekistan in 2016 began to transform the situation Kassenova (2023). The leaders of the region have become more active in discussing issues of food security, energy cooperation and transport corridors, signing several promising agreements, including the Roadmap for the Development of Regional Cooperation for 2022-2024 and the regional program "Green Agenda" for Central Asia.

For this article main provisions of the green and renewable energy, digital sustainable markets strategic documents adopted by the government of the Republic of Kazakhstan "Digital Kazakhstan" (2017) and by the government of Uzbekistan "Digital Uzbekistan – 2030" strategy (2020), also program "Central Asia – 2040" (2024) regional cooperation development concept. Additionally, "Paris Agreement" (2015), "Strategy Kazakhstan 2050: A New Political Course of the Established State" (2012), "Concept for the transition to a green economy", which introduced in (2013). In addition, in Uzbekistan "strategy for

transition to a green economy for 2019–2030" (2019) that is a key pillar of it is a long term economic growth while preserving natural resources and improving environmental quality.

Existing research often treats green energy transition and digital transformation as distinct processes, with limited analysis of their intersection—particularly in Central Asia, where the two increasingly integrated through shared infrastructure and converging policy agendas. Prevailing research on China's BRI tends to focus on Africa, Southeast Asia, and Eastern Europe, often portraying Central Asia as a passive transit corridor rather than an active agent in shaping sustainable and digital development. This study challenges that view by demonstrating how Kazakhstan and Uzbekistan strategically engage with BRI frameworks to advance national objectives. It also addresses the underexplored governance dimensions of Chinese-backed digital infrastructure in the region, including concerns over data sovereignty, surveillance, and cybersecurity.

Results

Globalization, at its core, is an economic phenomenon characterized by the cross-border flows of goods, investments, and information, alongside the increasing interdependence of states within a dynamic and evolving world system. While globalization drives economic growth and fosters interconnectivity, its implications extend far beyond economic domains, influencing social, cultural, and political spheres in ways that are complex and sometimes paradoxical. The global system's evolution cannot be fully explained by the actions of individual states alone, as the proliferation of transnational challenges demands comprehensive solutions and necessitates the creation of institutions capable of shaping effective global public policy [1].

However, contemporary forms of globalization simultaneously produce tensions, disparities, and competing dynamics within the global system. As a result, fragmentation has become an inherent aspect of globalization, highlighting the difficulties of balancing integration with sovereignty, equity, and cultural identity.

Despite the expansion of transnational challenges such as climate change, public health crises, and cyber threats, which ostensibly call for greater international cohesion, the reality has been a marked divergence of interests among states. The pursuit of competing national objectives often outweighs the incentives for collaboration, creating a global environment marked by conflicts and disunity.

This fragmentation is further exacerbated by the rise of nationalism and protectionism, as states increasingly prioritize sovereignty and domestic agendas over collective global governance frameworks. These tendencies reflect a growing skepticism toward multilateral institutions and global cooperation, driven by geopolitical rivalries and a perceived loss of control over national policies. The tension between economic integration and political fragmentation underscores the duality of globalization: while it fosters economic interdependence, it also challenges the very foundations of international cohesion.

Moreover, the paradox of globalization lies in its capacity to simultaneously unify and divide. On the one hand, it creates shared economic opportunities and interdependent markets, driving technological innovation and the diffusion of ideas. On the other hand, it intensifies competition for resources, power, and influence, often leading to geopolitical instability and heightened tensions among states. The rise of regional blocs and alliances, aimed at safeguarding specific national or regional interests, further illustrates paradoxes of globalization.

In this context, the future of globalization depends on the ability of the international community to navigate these competing forces. Achieving a balance between national interests and collective action requires robust, inclusive, and adaptive governance structures capable of addressing global challenges while respecting the sovereignty and diversity of individual states. The need for innovative approaches to multilateralism, alongside efforts to rebuild trust and cooperation among nations, is paramount in ensuring that globalization serves as a force for collective progress rather than a source of division.

Climate change and digitalization of the global economy are key factors that have a significant impact on international relations and global processes. A rapid pace of change, which requires political actors to adapt quickly and develop appropriate strategies at the global level, characterizes these phenomena.

The study of the green economy and digital technologies can offer integrated solutions that promote long-term sustainability and development. In this context, the "green economy", focused on the sustainable use of natural resources and innovations in the field of environmentally friendly technologies, is an important component in addressing climate change and ensuring sustainable economic growth. Thus, the "green economy" can serve as a strategic response to the challenges associated with global warming and the need to mitigate its consequences, while simultaneously providing conditions for social and economic development in the international arena.

In last sixth Consultative meeting of Central Asian leaders in Astana President of the Republic of Kazakhstan Kassym-Jomart Tokayev highlighted that the transition to a "green" economy is a key strategy for mitigating the negative impacts of global climate change. In this context, Kazakhstan aims to effectively utilize its significant natural potential in renewable energy. Specifically, the country plans to increase the share of renewable energy sources to 15% by 2030 and to achieve carbon neutrality by 2060. The widespread adoption of renewable energy sources will not only have a positive impact on the environment by reducing greenhouse gas emissions, but also enhance energy security and create new job opportunities. An essential factor in the successful implementation of these objectives is the strengthening of cooperation, which can be facilitated through the exchange of knowledge, resources, and advanced technologies in the field of renewable energy [2].

The transition to a "green" economy is a vital step for Kazakhstan in addressing climate change and protecting the environment. By harnessing its

renewable energy potential, the country can reduce its carbon footprint and create a sustainable energy future. The target of 15% renewable energy by 2030 is ambitious yet attainable, showcasing Kazakhstan's commitment to environmental responsibility. Achieving carbon neutrality by 2060 sets a strong example for others. Renewable energy adoption will enhance energy security and reduce reliance on fossil fuels. Additionally, the green energy sector will create new jobs and support economic growth. Strengthening international cooperation will foster innovation and accelerate Kazakhstan's progress in sustainable development.

The economic transformation in Central Asia has been a critical factor in reshaping the region's cooperative dynamics. Both Kazakhstan and Uzbekistan have undertaken extensive economic reforms aimed at market liberalization, reducing state control, and fostering the development of the private sector.

One of the significant developments between the countries was the signing of a decree approving the "Agreement between the Governments of Azerbaijan, Kazakhstan, and Uzbekistan on Strategic Partnership in the Field of Green Energy Development and Transmission". According to the agreement, endorsed by the President of Uzbekistan, Shavkat Mirziyoyev, the green energy produced will be transmitted across the Caspian Sea and integrated with an energy cable connecting the Black Sea. The Ministry of Energy of Uzbekistan has been appointed as the responsible authority for implementing the international agreement.

These reforms are crucial for enhancing the business climate, attracting foreign investment, and facilitating increased cross-border economic interactions. A focal point of their collaboration has been infrastructure development to strengthen regional connectivity. Both nations have actively participated in projects such as the construction of new railways and highways, many of which are part of China's Belt and Road Initiative (BRI). The BRI has become an essential tool for improving trade routes and linking Central Asia to global markets, with Kazakhstan and Uzbekistan strategically leveraging the initiative to improve their economic standing. For example, Kazakhstan acts as a vital transit hub in the transcontinental rail network connecting China and Europe, providing substantial potential for trade and logistical growth. Similarly, Uzbekistan's central location within the region makes it a key player in advancing efforts to improve connectivity and regional trade. Furthermore, energy cooperation continues to be a fundamental pillar of regional integration. Kazakhstan, endowed with substantial energy resources, plays an indispensable role in supplying energy to its neighboring countries. Collaborative ventures in the energy sector—spanning natural gas, electricity, and renewable energy—have reinforced ties between Kazakhstan, Uzbekistan, and other Central Asian states. These partnerships are essential for ensuring energy security and addressing the growing demand for sustainable energy solutions in the region.

To reduce the negative effects of increasing geopolitical and geoeconomic divisions, the governments of Kazakhstan and Uzbekistan have focused on accelerating the development of transport corridors to lessen their reliance on Russian imports [3]. The governments of Kazakhstan and Uzbekistan have implemented a proactive strategy in response to the evolving global political and economic environment. By advancing the development of alternative transport corridors, including new railways, highways, and pipelines, Kazakhstan and Uzbekistan seek to diversify their trade routes and strengthen their connectivity with both regional and international markets. This approach not only bolsters their economic resilience but also fosters deeper cooperation with neighboring states and global powers, thereby mitigating vulnerabilities to external pressures and promoting enhanced economic autonomy.

Uzbekistan is increasingly emerging as a key hub in the transport and logistics network of the Trans-Caspian International Transport Route, also known as the Middle Corridor. This route stretches from the Chinese-Kazakh border, passing through Kazakhstan, Turkmenistan, Azerbaijan, Georgia, and Turkey, ultimately reaching European countries.

The Trans-Caspian International Transport Route (TITR) is of significant importance to Kazakhstan and Uzbekistan, primarily due to its pivotal role in enhancing trade and regional connectivity. As integral transit hubs along the Middle Corridor, all nations of Central Asia region benefit from improved access to international markets, particularly those in Europe and China. TITR offers a more efficient and cost-effective alternative to traditional maritime routes, thereby fostering economic growth, attracting investment and gaining their geopolitical standing. Moreover, the route facilitates greater regional cooperation, contributing to the long-term stability and development of the Central Asia region.

Both the BRI and the TITR are central to improving global connectivity, yet they differ in terms of scope, geographical focus, and specific objectives. The BRI is a global infrastructure and development initiative aimed at promoting economic collaboration, enhancing trade routes, and bolstering geopolitical influence across Asia, Europe, and Africa. It encompasses substantial investments in various infrastructure projects, such as railways, ports, and energy pipelines, with the goal of establishing an interconnected global economic network.

Conversely, the TITR is a regionally concentrated project that operates within the larger context of the BRI framework. It specifically facilitates connectivity between China and Europe through Central Asia, focusing particularly on improving trade routes between China and European markets via Kazakhstan, Uzbekistan, and other Central Asian nations. The primary aim of the TITR is to enhance regional transportation efficiency by providing a land-based alternative to maritime shipping, thus enabling faster and more cost-effective movement of goods.

While the BRI has a more extensive, global reach with the objective of fostering economic integration across multiple continents, the TITR is narrower in scope, concentrating on regional development and positioning Central Asia as a crucial transit hub. Both initiatives, however, place significant emphasis on infrastructure development, economic cooperation, and strategic positioning, with the BRI offering a broader geopolitical framework and the TITR acting as a key regional link within this larger network.

China is increasing its influence in the Central Asian region, largely due to the abundance of hydrocarbon resources. In this regard, China has developed robust partnerships with Central Asian countries, particularly in areas such as the construction of energy pipelines and mining. This development could potentially spark competition between Russia and China in the region, leading to a new geopolitical and geo-economic rivalry. However, China's approach remains adaptive, responding to the current dynamics in the region. All Central Asian nations are, to varying degrees, participating in China's project.

The BRI broadly mirrors and extends the historical Silk Road along the land route, while also incorporating a maritime component to establish a network of economic corridors spanning Asia, East Africa and Europe. The initiative encompasses a diverse array of activities: infrastructure development, trade-investment and financial cooperation.

Three primary corridors are particularly significant for Central Asia region. First, the New Eurasian Land Bridge, the China-Central Asia-West corridor, and the North-South corridor (China-South Asia) [4]. Central Asia region has the potential to establish itself as a pivotal hub within global supply chains, leveraging its strategic geographic location. However, realizing this potential hinges on overcoming significant challenges, including political instability, infrastructural deficiencies and the divergent interests of major powers. These factors collectively shape the regions ability to capitalize on its connectivity initiatives. The development of key transport and trade corridors highlights Central Asia's increasing strategic relevance amid shifting geopolitical dynamics. Ultimately, the region's success in this endeavor will depend on its capacity to navigate these complexities and foster regional and international cooperation.

The focuses on building physical and digital infrastructure to connect regions, for instance project facilitated the development of essential infrastructure, railways and ports. One of the notable is the China –Pakistan Economic Corridor and the Jakarta –Bandung High –Speed railway in Indonesia. Those are designed to reduce transportation costs and travel times. Also by initiative promotes the construction of critical energy, including oil and gas pipelines. These developments aim to strengthen energy security and improve regional connectivity.

The initiative also encompasses investments in telecommunications, 5G networks and fiber-optic cables that crucial for gaining the digital connectivity and growth of e-commerce and digital economies.

Sustainable development is a key aspect of the BRI, with China prioritizing

green energy initiatives, including solar and wind power objects, to mitigate environmental issues and lower carbon emissions.

In Kazakhstan 2013, Chinese President Xi Jinping announced Belt and Road Initiative (BRI) program that seeks to enhance connectivity between China and Asia, Europe and Africa by establishing six principal transport routes. Central Asia due to its strategic position has emerged as a focus point for BRI investments. Among the different components of the BRI, the promotion of green and digital sustainable markets has received substantial attention. Sustainability within the BRI framework includes environmental, economic, and social components. The environmental focus emphasizes minimizing carbon emissions, fostering renewable energy, and safeguarding natural resources. The digital component entails the integration of information and communication technologies to improve efficiency, transparency, and inclusivity. These aspects strive to develop markets that are economically viable while being environmentally sustainable and socially responsible.

Central Asia, endowed with abundant natural resources, is emerging as a crucial region in the global transition to green energy. The region's extensive reserves of rare earth elements and other essential minerals, coupled with its substantial potential for renewable energy generation, position it as a key player in advancing the realization of a more sustainable future.

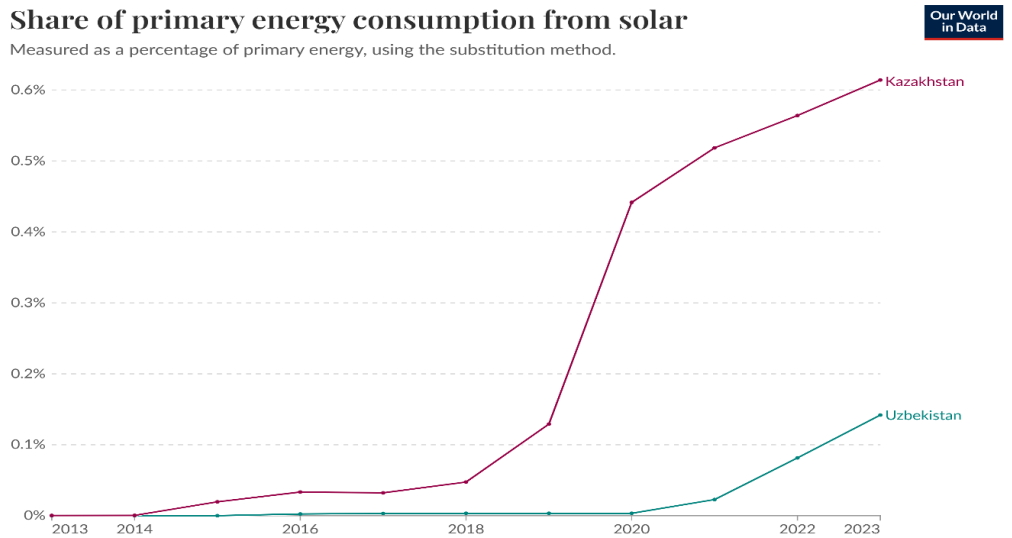

Chart 1- Energy Institute - Statistical Review of World Energy (2024)
By OurWorldinData.org/energy

This chart presents the proportion of total primary energy derives from solar sources in Kazakhstan and Uzbekistan over the period from 2013 to 2023. The Kazakhstan has demonstrated a more rapid and substantial increase in solar energy utilization compared to Uzbekistan. Between 2013 and 2018, Kazakhstan exhibited minimal growth in its solar energy share, remaining below 0.1%. A sharp

increase was observed after 2018, with the share surpassing 0.2% by 2020. Post-2020, the trend continued with a significant rise, reaching approximately 0.6% by 2023. This steep upward trajectory suggests a strong policy shift or investment in solar energy infrastructure. Uzbekistan's progress appears delayed but follows an upward trajectory, suggesting a growing focus on solar energy expansion. Until 2019, Uzbekistan's share of solar energy in primary consumption remained negligible. A modest increase began after 2020, showing a gradual rise. The trend accelerated between 2021 and 2023, indicating increased adoption of solar energy. However, the overall share in 2023 remains significantly lower than that of Kazakhstan. The divergence in trends may reflect differences in governmental policies, investment levels, or infrastructure readiness between the two nations.

This data underscores the increasing role of solar energy in Central Asia, particularly in Kazakhstan. The rapid acceleration of solar energy adoption in Kazakhstan highlights the effectiveness of renewable energy policies and investment strategies. Meanwhile, Uzbekistan's gradual increase suggests emerging but less aggressive engagement in solar energy integration. Perhaps near future the socio-economic and policy factors influencing these trends, as well as the potential for further solar energy expansion in the region [5].

The expansion of solar energy in Central Asia aligns with the BRI, which promotes regional energy cooperation, infrastructure investment, and technological exchange to accelerate the transition to renewable energy sources.

China - Central Asia Summit that held in 2023 May Xi Jinping emphasized the need to expedite the construction of the China –Central Asia natural gas pipeline. It underscores the gaining importance of energy infrastructure in strengthening regional cooperation and ensuring energy security and the project aligns with China's broader goals by BRI. China's energy related investments in 2023 were the most environmentally sustainable since the inception of the BRI reached 7.9 billion USD.

China's enterprises significantly engage in metals and mining, which are especially pertinent to the green transition and batteries for electric vehicles. The substantial investments on it reflects their strategic focus on supporting the worlds transition to green energy and by securing these critical resources China aims to strengthen its position in the growing clean energy market and support the shift toward more sustainable transportation solutions. It is implies China's expenditures in metals and mining, for instance in lithium and electric vehicle batteries, represent a deliberate initiative to gain a competitive advantage in the swiftly advancing green energy sector. Sustainable transportation by controlling supply chain, China not only ensures access to a vital resource but also positions itself as a global leader in the electric vehicle market. This investment is a critical step in reducing dependence on fossil and fuels, driving technological innovation, and strengthening China's influence in the global green energy economy, aligning with it is long term environmental and economic goals.

China's energy related participation in the BRI in 2023 has attained its highest levels of environmental sustainability since the initiatives establishment, in energy engagement and hydropower [6].

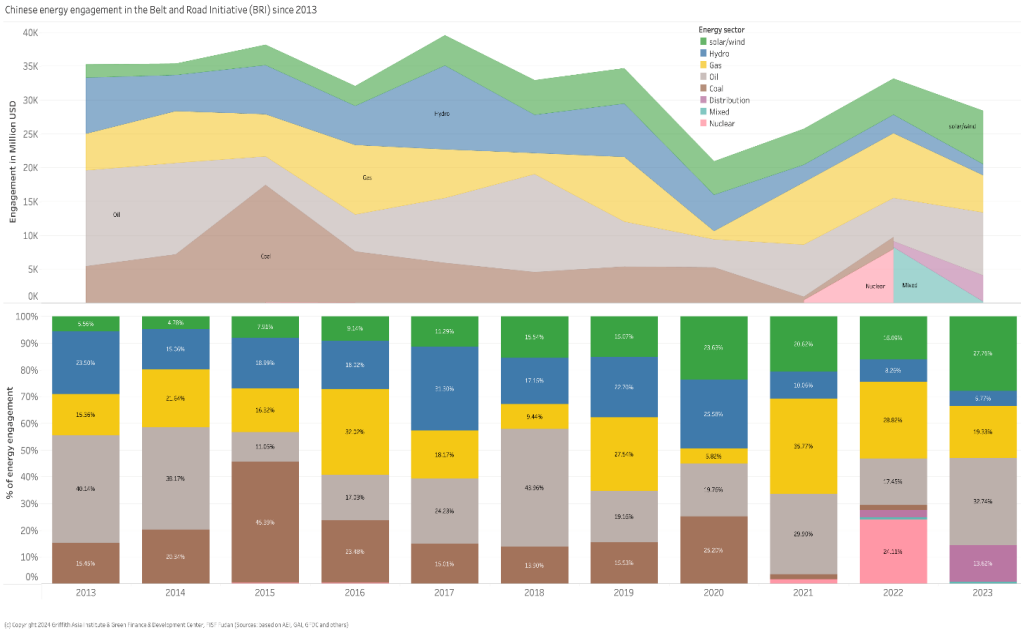

Chart 2 - Chinese total energy engagement in the Belt and Road Initiative (BRI) 2013-2023
By Green Finance & Development Center 2023

The chart illustrates fluctuations in investment levels over time, influenced by shifts in China's strategic priorities, global economic conditions and geopolitical dynamics. According the chart shows a peak in energy investments around 2016-2018, corresponding with the early phase of the BRI when China made substantial investments in energy infrastructure, including oil, gas and renewable energy projects.

After 2018, there appears to be a decline in investment, possibly due to global economic slowdowns, rising concerns over debt sustainability in BRI countries and growing scrutiny of projects. However, the chart indicates a recovery in investment in recent years, likely reflecting China's renewed emphasis on green energy and sustainable development within BRI. The post 2020 recovery may be attributed to China's shift toward green energy projects, aligning with global sustainability goals and reducing dependence on fossil fuels.

The decline in investment after 2018 underscore the challenges related to debt sustainability and the environmental impact of BRI, which has led to more cautious investment strategies. Moving forward, it will be essential to adopt a balanced approach that prioritizes sustainability, transparency and mutual benefits to ensure the long –term success of BRI energy projects.

Table -1: Power generation capacity and emissions in Kazakhstan and Uzbekistan 2000-2030

CATEGORY	KAZAKHSTAN	UZBEKISTAN
Total capacity (MW)	1,652 MW	622 MW
In operation (MW)	842 MW	615 MW
Under planning (MW)	710 MW	5 MW
Under construction (MW)	100 MW	2 MW
Main energy sources	Gas (38%), Coal (26%)	Gas (63%), Coal (24%)
Annual CO_2 emissions		
- Gas	630 K Ton	1,562 K Ton
- Coal	636 K Ton	150 K Ton
- Renewables (Hydro, Wind, Solar)	570 K Ton	121 K Ton
Share of total emissions	81%	19%

By https://www.bu.edu/cgp/

Kazakhstan has significantly larger power generation capacity compared to Uzbekistan, reflecting it is more extensive energy infrastructure. Both countries are investing in new projects, with capacity under planning and construction. According to the dates, gas is the primary energy source in both states, contributing 38% of Kazakhstan's and 63% of Uzbekistan's energy mix. Coal is the second largest source, particularly in Kazakhstan and this heavy reliance on fossil fuels drives high emissions.

Kazakhstan is responsible for 81% of total emissions, primarily due to it is extensive energy capacity and heavy reliance on coal. In contrast, Uzbekistan, with more limited energy capacity, contributes 19% of emissions, largely stemming from natural gas powered plants. Therefore, renewable energy sources (hydro, solar, wind) make up a modest portion of the energy mix, accounting for 34% Kazakhstan and 12% of Uzbekistan's total energy. Although, these sources churn out minimal emissions, their current usage remains limited, highlighting significant potential for growth.

The data emphasizes the urgent need for both Kazakhstan and Uzbekistan to expedite their transition to low-carbon energy systems. Although natural gas is less polluting than coal, it continues to present notable environmental challenges. Both countries could benefit from greater investment in renewable energy technologies, such as wind and solar, to diminish their dependence on fossil fuels and reduce their carbon emissions. Furthermore, the limited contribution of nuclear energy indicates that nuclear power could be considered as a complementary low-carbon energy option. It is necessary to prioritize investment in green economy and explore cleaner technologies to meet their climate goals and ensure sustainable development.

China's expanding economic involvement in Central Asia, particularly through the BRI, has played a crucial role in reshaping the region's geopolitical and economic dynamics. This transformation has been particularly evident in

Uzbekistan's post-Karimov era, as the country strives to reassert itself as a key regional actor through economic modernization and strategic engagement [7]. While the BRI has facilitated infrastructure development and trade expansion, further research is needed to assess its long-term sustainability and impact on Central Asia's economic sovereignty. This requires strategic policymaking, diversification of foreign investment sources, and the development of stronger local industries to ensure long-term economic independence.

China's strategic expansion of global digital infrastructure through the DSR, a key component of the BRI, represents a significant step in strengthening its technological and geopolitical influence. As part of this initiative, China actively invests in telecommunications, undersea cables, satellite systems, cloud computing, and artificial intelligence, aiming to secure a leading position in the global digital space.

However, alongside the country's economic expansion, this strategy raises concerns regarding the potential technological dependence of participating countries, cybersecurity risks, and the reinforcement of digital authoritarianism. China's leadership in digital infrastructure has the potential to reshape the international order, challenging the dominance of Western technology powers and altering the balance of power in the global economy and politics [8]. Meanwhile, it should emphasize policy diversification, risk mitigation strategies, and regional cooperation to ensure that region and especially Kazakhstan and Uzbekistan can navigate these transformations without compromising their economic sovereignty, political stability, and digital autonomy. It is essential that both nations balance foreign investment with domestic capacity building to secure a sustainable and independent path toward development.

Discussion

Digitalization in Central Asia offers significant opportunities for economic growth, modernization and integration into the global digital economy. However, countries of the region – Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan and Turkmenistan – encounter obstacles that impede the shift to a digital economy and restrict equal access to digital resources.

Albeit, according to recent studies, digital development and the provision of digital government services are widely advanced. At the same time, in Central Asia, there is a significant amount of initiative, such as the implementation of e-government. One of the key aspects of the digital economy is the accessibility of online services, the development of telecommunication infrastructure.

In Kazakhstan, the "Digital Kazakhstan" program has been adopted, aimed at accelerating the development of the Kazakhstani economy and improving the quality of life for citizens. The goal of the program is to create conditions for the transition of the economy to a fundamentally new trajectory – the digital economy of the future. The program provides additional momentum for the technological modernization of the country's flagship industries and created conditions for large-scale and long-term productivity growth. The program includes five key areas: digitalization of economic sectors, the transition to a digital government, the

creation of an innovative ecosystem, the development of human capital, and the implementation of the Digital Silk Road. Major projects include the digitalization of industry, transportation, and logistics, the development of e-commerce and online payments, as well as agribusiness [9].

One of the aspects of transportation and logistics is multimodal transportation, where automation of cargo transportation processes across all modes of transport implemented. The development of electronic technologies and cashless payments includes mechanisms such as the Fulfillment Center. This center allows online stores to store goods, process and package orders, ship them to customers, and handle returns. It will also reduce the speed and cost of delivering goods to customers.

An e-commerce center serves as a communication platform for representatives of online and offline businesses, a support center for enhancing the competencies of SMEs in electronic commerce, and a center providing comprehensive delivery services for goods.

One of the digitalization implementations is the model for remote identity verification using databases from government and commercial companies, including those based on various biometric indicators. This will enable the creation of a universal digital environment for interaction and communication between financial institutions, clients, government agencies, and organizations.

As part of the program, the portal egov.kz introduced. The "e-government" is a portal that provides access to government services in an online format and became possible through the provision of electronic digital signatures (EDS) to citizens free of charge. EDS allows individuals to receive necessary government services and certificates without leaving their homes. Today, over 6 million people are users of the portal. Through its infrastructure, 760 electronic services and offerings implementing.

The global pandemic has significantly increased the importance of digital technologies, emphasizing the necessity of digital transformation, particularly for developing countries, including Uzbekistan. In response, on October 5, 2020, the President of the Republic of Uzbekistan issued a decree approving the "Digital Uzbekistan – 2030" strategy. This strategic document outlines the implementation of two key directions: the digitalization of regions and industries, as well as the development of a "roadmap" for its phased implementation from 2020 to 2022.

Uzbekistan has implemented a unified portal of interactive government services my.gov.uz, designed to provide citizens and businesses with efficient and convenient access to government services through a centralized digital platform. This portal consolidates electronic services offered by various ministries and state agencies, thereby enhancing the efficiency of administrative processes.

The platform facilitates a range of services, including the renewal of driver's licenses, verification of monthly salaries, assessment of tax liabilities, and access to pension account information, among others. According to data from the United Nations department of economic and social affairs, Uzbekistan has advanced six positions in the EGDI, achieving a classification among countries with a very high EGDI. Given that, the country had previously risen 18 positions in the

preceding ranking cycle, Uzbekistan's cumulative progress over two-evaluation period's amounts to 24 positions, underscoring substantial advancements in the development of digital governance.

Central Asian countries have superficially adopted green transition policies, lacking comprehensive legislation and actionable plans. Despite possessing significant renewable energy potential, their progress depends on strengthening legal frameworks, socio-economic development, and active participation in international initiatives [10]. Countries of the region have embarked on initiatives to harness their renewable energy potential, exemplified by Uzbekistan's recent announcement of a $1.3 billion investment in waste-to-energy projects. This ambitious endeavor aims to process 4.7 million metric tons of solid waste annually, generating approximately 2.1 billion kilowatt-hours of electricity by 2027 [11]. Such projects not only address waste management challenges but also contribute to sustainable energy production.

Furthermore, international collaborations are playing a pivotal role in the region's green transition. China's Belt and Road Initiative has facilitated investments in renewable energy infrastructure across Central Asia. Notably, a significant wind farm project in Kazakhstan has been financed through these collaborations, underscoring a shared commitment to sustainable energy development [12].

To fully realize their green transition potential, Central Asian countries must enhance their legal and institutional frameworks, promote socio-economic development, and actively engage in international environmental initiatives. This comprehensive approach is essential for achieving sustainable energy development and addressing the multifaceted challenges posed by climate change.

Central Asia is rapidly establishing itself as a significant player in the global technology sector. In recent years, particularly during 2022-2023, the region has witnessed a growing influx of multinational corporations relocating their operations, positioning Central Asia as an emerging hub for international business and technological innovation [13]. The increasing presence of multinational corporations in Central Asia reflects the region's growing importance in the global technology landscape. Several factors contribute to this trend, including strategic geographic positioning, favorable economic policies, and a skilled labor force. One perspective is that the region's expanding digital infrastructure and investment-friendly environment have attracted international businesses seeking new growth opportunities. Additionally, geopolitical shifts and economic diversification efforts have encouraged multinational firms to establish operations in Central Asia as an alternative to traditional markets. However, challenges such as regulatory complexities, infrastructure gaps, and potential political instability may affect the sustainability of this growth.

In recent years, the delivery of goods from China to Kazakhstan has significantly improved. In this context, Chinese online platforms such as Taobao, 1688, and Pinduoduo have become widely utilized in Kazakhstan for both wholesale and retail purchases. These platforms offer an extensive range of products, from everyday essentials to unique items. Consumers can find virtually

anything on these websites, including clothing, electronics, household appliances, auto parts, cosmetics, and more. These platforms bear similarities to the Russian Wildberries marketplace.

So far, many Kazakhstani entrepreneurs procure goods from 1688 and Taobao for resale, enabling small businesses to grow without the need for large warehouses or significant production capacities. The popularity of Chinese platforms in Kazakhstan did not emerge randomly; rather, it driven by several key factors that facilitated their successful integration into the market.

The expansion of e-commerce closely linked to the development of the digital economy and the increasing number of internet users, which has simplified access to Chinese marketplaces. In this regard, AliExpress was initially the dominant platform, laying the groundwork for this transformation. Several factors contributed to the rise of these services, with the most significant being the growth of the digital economy, online payment systems, and e-commerce.

The post-pandemic period witnessed a surge in online shopping platforms, which further accelerated the popularity of Chinese marketplaces. This trend has accompanied by improvements in logistics infrastructure and reductions in delivery costs. Moreover, state policies toward China have played a crucial role in fostering these developments. The BRI has been both a contributing factor and a result of the broader transformation in e-commerce, reflecting a combination of digital trade expansion and international economic cooperation.

In Uzbekistan, the popularity of these platforms attributed to several key factors that have made them highly sought after among both ordinary consumers and entrepreneurs. In recent years, the country has been actively developing its digital economy and online payment systems.

The emergence of local delivery and payment services such as Uzcard, Humo, Payme, and Click has significantly facilitated the purchasing process. This has enabled the growth of small businesses without the need for large warehouses or extensive production facilities.

As previously noted, Uzbekistan is also actively strengthening its economic ties with China under the framework of the BRI. Improvements in logistics infrastructure, free trade agreements and Chinese investments in Uzbekistan's economy have contributed to the growth of Chinese imports, further enhancing the accessibility and affordability of goods from Chinese e-commerce platforms.

The rapid expansion of e-commerce platforms and the increasing adoption of digital payment systems have profoundly reshaped Uzbekistan's digital ecosystem. The acceleration of digital transformation, spurred by the COVID-19, alongside the implementation of the digital Uzbekistan 2030 strategy, has been instrumental in driving this shift. Government initiatives, advancements in digital infrastructure, and the growth of e-commerce platforms have contributed to the expansion of cross-border trade, the proliferation of digital transactions, and the empowerment of small businesses within online marketplaces. Furthermore, the strategic collaboration between the Uzbekistan export promotion agency and Alibaba has reinforced the nation's integration into the global digital economy, facilitating broader participation in international trade networks.

Under the guidance of the Ministry of Ecology and Environment of China, the Center for International Cooperation and Exchange, in collaboration with various domestic and international institutions, officially launched the Belt and Road Low-Carbon Services Partnership on December 8, 2024, in Nansha, Guangzhou. The initiative aims to promote green and low-carbon development among countries participating in the Belt and Road Initiative and to contribute to global climate governance.

Moreover, fostering collaboration in e-commerce is crucial through the establishment of the "China-Central Asia E-Commerce Cooperation Dialogue Mechanism" and the advancement of the "Silk Road E-Commerce" initiative.

Additionally, it is imperative to expedite the integration of digital infrastructure while enhancing cooperation in the areas of the digital economy, technological innovation, and sustainable green technologies.

Recently, the China Development Bank, in collaboration with the Foreign Economic Bank of Uzbekistan ("Uzbek Foreign Economic Bank"), issued the initial loan for the second phase of a project focused on bus procurement through refinancing. The project is structured into two phases. In the first phase, the allocated loan was fully utilized by June 2023, facilitating the acquisition of 1,000 new energy-efficient and natural gas-powered buses by Tashkent Bus Company. Currently, all required vehicles have been delivered, playing a crucial role in enhancing the frequency of existing routes, replacing outdated public transport, and establishing new routes. Furthermore, this initiative has made a substantial contribution to the transition towards a greener and low-carbon public transportation system in Uzbekistan.

The "Bash" wind power plant, currently under construction in the Gobi Desert, represents the largest wind energy project in Central Asia. As a global co-leader of this initiative, the Shanghai branch of the Bank of China has played a pivotal role as a financial liquidity provider, facilitating the structuring of financing for the 1 GW wind energy project in both the Bash and Zankeldi regions. Upon completion, the 158 wind turbines at these two sites are expected to generate 3.59 billion kilowatt-hours of electricity annually, accounting for 7% of Uzbekistan's total yearly electricity production. This renewable energy will be distributed across the country via the national power grid.

These sectors not only enhance efficiency and economic development but also play a pivotal role in fostering regional integration within Central Asia. The harmonization of digital governance frameworks can streamline cross-border trade, labor mobility, and regulatory cooperation, enabling businesses and individuals in both nations to operate with greater ease. The mutual recognition of digital identities can further simplify administrative processes, thereby facilitating trade, education, and tourism.

Collaborative efforts in cybersecurity and data protection can strengthen digital trust, ensuring the security of online transactions and information exchanges between the two countries. Additionally, advancements in logistics infrastructure and the integration of cross-border digital payment systems can reduce trade barriers, granting kazakh and uzbek enterprises greater access to expanded consumer markets.

The establishment of a unified digital trade zone between Kazakhstan and Uzbekistan has the potential to serve as a model for regional integration, encouraging other Central Asian nations (such as Kyrgyzstan, Tajikistan, and Turkmenistan) to adopt similar digital transformation strategies. Furthermore, joint investments in digital infrastructure could position Central Asia as a competitive digital hub, reducing economic dependence on external markets.

Enhancing regional cybersecurity cooperation would also be crucial in mitigating risks associated with cross-border digital transactions, ensuring a secure and reliable digital ecosystem across the region. Ultimately, the success of Kazakhstan-Uzbekistan digital collaboration could attract foreign investment and global technology firms, further strengthening Central Asia's technological advancement and global competitiveness.

The BRI fosters digital connectivity through projects such as the Digital Silk Road, which seeks to enhance telecommunications and e-commerce infrastructure in the participating nations. The Digital Silk Road (DSR) holds substantial potential to advance technological development, economic diversification, and regional integration within Central Asia, particularly in Kazakhstan and Uzbekistan. A fundamental objective of the DSR is to enhance digital connectivity through the establishment of sophisticated telecommunications infrastructure, including fiber optic networks, 5G technology, and satellite communication systems. Given their strategic positions as key transit and trade hubs, both Kazakhstan and Uzbekistan stand to benefit from digital infrastructure investments that facilitate access to global markets.

The DSR can incorporate green finance by using digital technologies it enhance the transparency, accessibility, and effectiveness of sustainable investments. As China's green finance framework becomes more comprehensive and increasingly aligned with international standards, the country is poised to take on a more influential role in shaping global norms and advancing sustainable investment worldwide. This strengthened position enables China to contribute significantly to the development of green finance standards and to expand its leadership in environmentally responsible overseas investments [14]. It could enhance global coordination in green investment, particularly in emerging markets where financing gaps for sustainable projects remain substantial.

In 2024, China's energy-related investments under the BRI reached their highest levels since the initiative's inception, totaling $11.8 billion, which shows a 60% of increase compared to 2023. Additionally, investments in technology and manufacturing also reached record highs, amounting to nearly 30 billion, with a strong emphasis on high-tech sectors such as batteries.

According to the report in 2025, China's BRI engagements expected to stabilize further, with a continued emphasis on partnerships in renewable energy, mining, and related technological advancements. The primary areas of future investment remain consistent across six key sectors: new technology manufacturing, renewable energy, trade-enabling infrastructure, information and communication technology, resource-backed agreements and large-scale strategic projects for instance, railway infrastructure [15]. It means that China's

investments reflect a strategic pivot towards sustainable energy and high-tech manufacturing, marking a significant evolution from earlier infrastructure-heavy engagements. An increase in energy-related investments underscores China's commitment to renewable energy and resource security, aligning with global decarbonization trends. However, while these investments signal progress, concerns remain regarding debt sustainability in partner countries and the geopolitical ramifications of China's expanding economic footprint. The focus on resource-backed agreements may raise questions about the equitable distribution of benefits, potentially leading to economic dependency. Moving forward, the stability of these investments in 2025 will depend on China's ability to foster transparent, mutually beneficial partnerships while balancing economic interests with environmental and social considerations.

According to Daniel Yergin, nowadays China is heavily investing in electric vehicles to reduce its reliance on oil, address climate concerns, and gain a competitive edge in the global automotive market. By focusing on EV technology, China aims to surpass traditional car manufacturers and has already become a major exporter of electric cars, particularly to Europe [16]. Now, in the context of the popularity of electric cars in Central Asia, there is a widespread use of electric cars from China. Affordable EV models are widely available in the region, providing consumers with more choices at lower prices.

In Uzbekistan, the government actively supports the growth of the e-commerce sector through various policies and initiatives. Within this framework, the Digital BRI holds significant potential to facilitate cross-border e-commerce, enhance market expansion, and contribute to the overall development of e-commerce in the country [17]. A conjunction with the opportunities provided by the Digital BRI, offer substantial prospects for economic expansion. By facilitating cross-border trade and broadening market access, these measures have the potential to strengthen digital connectivity and integrate Uzbekistan more effectively into the regional e-commerce ecosystem. However, to fully realize these benefits, it is essential to address challenges related to regulatory frameworks, digital infrastructure, and cybersecurity.

Indeed, green innovation offers the dual benefit of fostering economic growth while ensuring environmental sustainability. It serves as a crucial mechanism for advancing economic transformation and acts as a key driver in achieving high quality, sustainable development. The pressing nature of global environmental challenges, combined with the swift progress of digital transformation, has made green innovation a vital strategy for attaining sustainable development [18].

China has already implemented fiber-optic corridors throughout Central Asia, linking major economic centers in Kazakhstan and Uzbekistan to international digital networks. The expansion of 5G technology and broadband accessibility has the capacity to bridge the digital divide in both urban and rural regions, fostering broader participation in the global digital economy. Additionally, the integration of intelligent logistics systems along principal trade corridors, such as the China-Kazakhstan-Uzbekistan route, enhances supply chain efficiency and promotes the growth of cross-border e-commerce.

The DSR fosters technological collaboration and innovation by encouraging the adoption of emerging technologies, including artificial intelligence. Chinese corporations, such as Huawei and ZTE, play a crucial role in supporting ICT infrastructure development, thereby contributing to data-driven economic planning and the growth of digital entrepreneurship ecosystems. Moreover, the DSR provides both geopolitical and economic advantages for Kazakhstan and Uzbekistan, reinforcing their positions as technological intermediaries connecting China, Europe, and the Middle East.

The initiative also supports economic diversification by reducing reliance on conventional energy exports and facilitating integration into China's digital trade networks. Furthermore, participation in the DSR enhances these nations' attractiveness to international technology investors and multinational enterprises, generating increased financial support for startups, technology incubators, and digital education initiatives. The expansion of digital infrastructure through the DSR further strengthens regional cooperation by fostering shared technology policies among Central Asian states, ultimately contributing to a more cohesive economic bloc driven by digital trade and innovation.

Overall, the DSR represents a transformative initiative for Kazakhstan and Uzbekistan, promoting regional connectivity, technological progress, and economic modernization. By capitalizing on DSR-driven digital infrastructure, the growth of e-commerce, and cross-border innovation, these countries can position themselves as central actors in Central Asia's evolving digital economy. Additionally, deeper regional integration through the DSR may serve as the foundation for a digitally interconnected Central Asia, contributing to long-term economic resilience and enhancing the region's geopolitical influence in the global arena.

Kazakhstan ranks 33rd in the Green Future Index, reflecting its moderate progress toward a low-carbon future [19]. This country still relies heavily on high-emission energy sources. Overall, the rankings reflect Kazakhstan's ongoing transition, with significant potential for improvement in the areas of energy transition and green societal integration.

Table 2: The Green Future Index

Category	**Ranking Kazakhstan**
Overall Ranking	33rd
Carbon Emissions	39th
Energy Transition	65th
Green Society	70th
Clean Innovation	21st
Climate Policy	23rd

By https://www.technologyreview.com/2021/01/25/1016648/green-future-index//

This data from China investment global tracker that published by American Enterprise Institute where shows investments flows in Kazakhstan and Uzbekistan by project BRI from 2013-2024 [20].

Table 3: BRI investment in Kazakhstan and Uzbekistan: sectoral focus and investment trends (2013-2024)

Data	***Company name***	***Sector***	***Kazakhstan (amount $)***	***Company name***	***Sector***	***Uzbekistan (amount $)***
2014	Geo-Jade Petroleum, China Petroleum and Chemical (Sinopec)	Energy	530m, 1090m			
2015	Geo-Jade Petroleum, China General Nuclear	Energy	470m, 130m			
2016	China Energy Engineering	Real Estate	180m			
2017	China International Trust and Investment (CITIC)	Finance	110m	Ming Yuan Silu, Xin Zhong Yuan, China National Petroleum Corp. (CNPC)	Real estate, energy	110m, 150m, 190m
2018	Qifeng New Material	other	160m			
2019	Jiangxi Copper, China General Technology (Genertec), State Power Investment, Universal Energy	Metals, Transport, Energy	240m, 560m, 110m, 110m	Anhui Conch, Huaxin Cement	Real estate	150m, 150m
2020	-	-	-	-	-	-
2021	China General Nuclear	Energy	440m	Anhui Conch, China Energy Engineering	Real estate	260m, 350m
2022	China Petroleum and Chemical (Sinopec)	Energy	120m	State Administration of Foreign Exchange (SAFE)	Energy	130m
2023	State Power Investment	Energy	120m	China Energy Engineering, Datang, China Energy Engineering	Real estate, energy	120m, 150m 400m

2024	China Petroleum and Chemical (Sinopec)	Energy	2300m	China Energy Engineering, Universal Energy, China Energy Engineering, Southern Power Grid, First Auto Works	Energy, Energy, Energy, Energy, Transport	140m, 480m, 110m, 460m, 100m

By https://www.aei.org/china-global-investment-tracker/

The table above presents a detailed comparison of foreign investments in Kazakhstan and Uzbekistan, specifically focusing on the period from 2014 to 2024. The investments are categorized by sector, investor, and the amount invested, which provides a comprehensive overview of the types and scales of foreign investments both countries are attracting and it highlights key patterns and provides insights into the investment climate in each country based on the data.

The energy sector remains the dominant recipient of foreign investment in both Kazakhstan and Uzbekistan. In Kazakhstan, investments in the energy sector, particularly oil and gas, account for a large portion of the foreign investments, with notable entries like China Petroleum and Chemical (Sinopec) and Geo-Jade Petroleum. Large-scale projects in this sector reflect Kazakhstan's reliance on its extensive natural resource base and the attraction of foreign capital for resource extraction and infrastructure development.

In Uzbekistan, energy investments are also significant, especially from China Energy Engineering, and other energy-related firms. However, while Uzbekistan does receive substantial energy investments, the overall volume of investment in this sector is smaller in comparison to Kazakhstan. This indicates that while energy is critical for Uzbekistan, the scale of investment in this area remains less extensive than in Kazakhstan, possibly due to differences in the resource endowment or the stage of development of the energy sector.

Uzbekistan demonstrates a growing trend toward attracting foreign investment in the real estate sector. A number of real estate projects from investors such as Anhui Conch and China Energy Engineering illustrate the country's emphasis on urban development and infrastructure modernization. The consistency of investments since 2017, particularly in the energy and real estate sectors, suggests a growing interest in Uzbekistan as a stable investment destination. This attributed to the country's recent economic reforms, improvements in the business climate, and efforts to attract foreign capital into infrastructure and development.

In the aftermath, these investments reflect China's broader geopolitical ambitions in Central Asia and its role in driving economic integration through infrastructure connectivity. The investments from Chinese companies in

both countries highlight the central role of the BRI in shaping the investment landscape in Central Asia. We can clearly comprehend, while Kazakhstan continues to attract large-scale energy investments due to its resource-rich economy, Uzbekistan is positioning itself as an emerging market with a focus on economic diversification, infrastructure development. This trend suggests a shift in Uzbekistan's development priorities, reflecting its evolving role in the regional economic landscape.

The data also highlights the broader regional dynamics, with both countries benefiting from strong Chinese investment, which further consolidates Central Asia's position in the global economic network as part of the Belt and Road framework. Future investment trends will likely continue to follow these patterns, with a focus on renewable energy, infrastructure, and urban development in both countries.

In the aftermath we can say, that the both Kazakhstan and Uzbekistan acknowledge the urgency of energy transition due to their reliance on fossil fuels and the impact of climate change. Kazakhstan has a more advanced regulatory framework for renewable energy development, largely due to its early commitment through the Green Economy Concept. It has implemented feed-in tariffs, renewable energy auctions, and incentives for foreign direct investment, attracting Chinese firms under the BRI. Uzbekistan has recently accelerated its green energy projects, particularly in solar and wind energy, through agreements with China and other international players. In terms of the digital market cooperation, it is growing, yet fragmented. Kazakhstan and Uzbekistan both aim to integrate into the DSR, enhancing their digital economies and technological ecosystems. Kazakhstan and Uzbekistan exhibit both alignment and divergence in their engagement within the BRI's green economy and digital market sectors. While their cooperation potential is significant, structural barriers—regulatory misalignment, geopolitical considerations, and institutional inefficiencie—hinder seamless collaboration. Greater policy synchronization, regional energy trade frameworks, and cybersecurity agreements could enhance BRI-related cooperation between the two nations, fostering a more integrated and sustainable economic future.

Conclusion

This comparative analysis of Kazakhstan and Uzbekistan within the framework of China's BRI reveals a complex and evolving picture of regional transformation. Both countries exhibit notable advances in developing green and digital sustainable markets, yet structural asymmetries and external dependencies continue to shape their trajectories. The key driving forces—such as energy transition, digital innovation, and regional infrastructure connectivity—are accelerating, but remain constrained by institutional fragmentation, governance gaps, and the geopolitical influence of external actors.

Kazakhstan leads the region in terms of solar energy deployment, digital infrastructure, and regulatory frameworks for renewable energy investment. Its proactive approach, supported by policies like "Digital Kazakhstan" and the "Green Economy Concept," has positioned it as a regional frontrunner. In contrast, Uzbekistan, while progressing, is still catching up—though its recent acceleration in energy diversification and digital governance shows strong political intent under President Mirziyoyev.

BRI investments in solar, wind, and digital connectivity infrastructure are transforming Central Asia's economic landscape. Although BRI-linked projects offer opportunities for modernization, they can inadvertently reinforce external control if not balanced by regional coordination and domestic capacity-building.

The Digital Silk Road (DSR) represents a turning point for regional cooperation, but also presents challenges related to cybersecurity, data sovereignty, and regulatory harmonization. Kazakhstan and Uzbekistan are actively engaging in digital transformation, but without synchronized standards and legal interoperability, the digital divide within Central Asia may deepen. Similarly, the uneven commitment of countries like Turkmenistan and Tajikistan to multilateral frameworks further complicates the realization of a cohesive regional digital ecosystem.

A key insight is that while Kazakhstan and Uzbekistan serve as anchors for regional integration, their cooperation remains largely bilateral and project-based. A lack of formal regional institutions, fragmented green and digital policies, and insufficient alignment in regulatory frameworks hinder the region's ability to harness synergies and scale up innovation collectively. Furthermore, while green energy adoption is progressing, fossil fuels still dominate energy mixes in both countries. This calls for accelerated action on regulatory reform, public-private partnerships, and innovation financing to meet long-term climate and development goals.

Table 4: SWOT evaluation: BRI-driven sustainable market transitions in Central Asia

STRENGTHS	**WEAKNESS**	**OPPORTUNITIES**	**THREATS**
Kazakhstan and Uzbekistan are regional leaders with geopolitical centrality, political stability, and economic size, enabling them to shape regional norms and attract investment.	Absence of institutionalized regional governance structures limits coordination, monitoring, and enforcement of shared green and digital policies.	Emerging global demand for green technologies and digital connectivity opens avenues for diversified partnerships and new trade relationships.	Geopolitical rivalries (e.g., between China, Russia, the West) risk fragmenting the region and politicizing economic cooperation.

Their growing bilateral cooperation on green energy, digitalization, and infrastructure sets a foundation for functional regionalism and strategic alignment.	Development asymmetry between Kazakhstan and Uzbekistan could create imbalances and reduce policy harmonization potential across Central Asia.	Multilateral platforms (e.g., C5+1, SCO, Consultative Meetings) can evolve into formal mechanisms for policy coordination and conflict resolution.	BRI projects, while beneficial, may result in financial dependency or technological overreach, particularly in digital surveillance infrastructure.
China's BRI investments have accelerated modernization of critical infrastructure and energy sectors, improving interconnectivity and regional	High dependence on Chinese technology and financing raises concerns over digital sovereignty, economic vulnerability, and geopolitical leverage.	Regional cooperation in climate adaptation and digital transformation could unlock shared innovation ecosystems and transboundary infrastructure projects.	Persistent environmental crises (e.g., water scarcity, Aral Sea degradation) remain unresolved due to lack of binding regional environmental governance.
Adoption of national strategies like Kazakhstan's 'Green Economy Concept 2050' and 'Digital Uzbekistan' reflect commitment to innovation and sustainability-focused development.	Civil society and private sector actors are underrepresented in policymaking, weakening accountability, innovation diversity, and local	Rising global focus on sustainability provides a window to attract green finance, including climate bonds and multilateral development funding.	Political instability could disrupt ongoing integration efforts and reverse recent diplomatic and economic gains.

The comparative analysis of Kazakhstan and Uzbekistan within the BRI framework illuminates a fundamental paradox at the heart of Central Asia's transformation: while these states are undeniably making progress in cultivating green and digital markets, their advancement remains deeply entangled in structural dependencies, asymmetrical partnerships, and a lack of systemic regional integration.

China's involvement through the BRI has served as both a developmental accelerant and a geopolitical constraint. Infrastructure, energy, and digital investments have filled longstanding gaps in state capacity, yet the terms of engagement-financial, technological, and regulatory- heavily skewed in favor of the investor.

Moreover, while Kazakhstan and Uzbekistan emerge as leading voices in the regional development discourse, their bilateral cooperation has not yet translated into a cohesive regional vision. The absence of institutionalized multilateral mechanisms for coordinating green and digital policies—whether in the form of a regulatory alliance, joint innovation fund, or environmental compact—means

that opportunities for synergy are underexploited, and policy fragmentation persists. Integration, in this sense, is occurring horizontally across borders but not vertically through institutions. The lack of regional legal harmonization undermines the very sustainability the green and digital transitions are supposed to achieve.

The internal political structures of both countries also matter. While President Mirziyoyev's reforms in Uzbekistan have opened space for regional diplomacy and market modernization, both Kazakhstan and Uzbekistan still operate under centralized political systems.

For Kazakhstan and Uzbekistan—and indeed, for Central Asia as a whole—the path to meaningful regional integration lies not in the passive adoption of external agendas but in the strategic internalization of sustainable and digital transformation goals. This requires:

• Diversification of partnerships beyond China, involving the EU, South Korea, Japan, and regional financial institutions;

• Institutionalization of regional governance, with legally binding mechanisms for climate action, digital cooperation, and joint innovation strategies;

• Development of indigenous innovation ecosystems, including green startups, digital entrepreneurship, and academic research hubs;

• Inclusive policymaking, where civil society and local communities participate in shaping the digital and green futures being imagined for them.

In conclusion, Kazakhstan and Uzbekistan are not merely recipients of investment or conduits of geopolitical ambition—they are potential architects of a sustainable, digitally connected, and regionally coherent Central Asia. However, to fulfill this role, their leadership must move from pragmatic bilateralism to principled, inclusive, and visionary regionalism—one that resists dependency, empowers domestic capacity, and redefines what it means to be "developed" in the 21st century.

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ФОРМИРУЮЩИЕСЯ ЗЕЛЕНЫЕ И ЦИФРОВЫЕ УСТОЙЧИВЫЕ РЫНКИ В ЦЕНТРАЛЬНОЙ АЗИИ: СРАВНИТЕЛЬНЫЙ АНАЛИЗ КАЗАХСТАНА И УЗБЕКИСТАНА В РАМКАХ ИНИЦИАТИВЫ КИТАЯ ОДИН ПОЯС, ОДИН ПУТЬ

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Аннотация. Данное исследование направлено на оценку динамики развития экологически чистых и цифровых устойчивых рынков в Центральноазиатском регионе с особым акцентом на роль проектов инициативы «Один пояс, один путь». Используя сравнительный анализ Казахстана и Узбекистана — двух ключевых игроков в регионе, — автор стремится выделить различные траектории, возможности и проблемы, с которыми сталкиваются эти страны при приведении экономического роста в соответствие с целями устойчивого развития. Исследование опирается на статистические данные различных международных организаций, что позволяет лучше понять региональные тенденции. Особое внимание уделяется влиянию цифровых технологий и экологически чистой инфраструктуры на диверсификацию экономики, региональную взаимосвязанность и экологическую устойчивость. Исследование проливает свет на преобразующий потенциал устойчивого развития рынка в Центральной Азии и его более широкое геополитическое и экономическое значение.

В анализе также рассматриваются структурные различия в управлении, инвестиционных рамках и приоритетах политики между Казахстаном и Узбекистаном, которые определяют их соответствующие подходы к стимулированию зеленого роста и цифровой трансформации. В то время как Казахстан продвигает инициативы в области возобновляемых источников энергии и усиливает свою интеграцию на мировые рынки, Узбекистан уделяет больше внимания модернизации отраслей и реформам цифрового управления. В исследовании рассматривается, как обе страны сочетают иностранные инвестиции, особенно в рамках инициативы «Один пояс - один путь», с реализацией национальных стратегий устойчивого развития. Кроме того, в нем рассматривается роль регионального сотрудничества, технологических инноваций и институциональных реформ в продвижении инклюзивных и устойчивых экономических путей.

Ключевые слова: Центральная Азия, региональная интеграция, Узбекистан, Казахстан, цифровая экономика, инициатива «Один пояс - один путь», зеленые рынки, цифровой Шелковый путь, устойчивое развитие

ОРТАЛЫҚ АЗИЯДАҒЫ ДАМУШЫ ЖАСЫЛ ЖӘНЕ ЦИФРЛЫҚ ТҰРАҚТЫ НАРЫҚТАР: ҚЫТАЙДЫҢ БІР БЕЛДЕУ, БІР ЖОЛ ШЕҢБЕРІНДЕГІ ҚАЗАҚСТАН МЕН ӨЗБЕКСТАНҒА САЛЫСТЫРМАЛЫ ТАЛДАУЫ

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Аңдатпа. Бұл зерттеу «Белдеу және Жол» бастамасының жобаларының рөліне ерекше назар аудара отырып, Орталық Азия аймағындағы тұрақты жасыл және цифрлық нарықтардың дамып келе жатқан динамикасын бағалауға бағытталған. Қазақстан мен Өзбекстанның—аймақтың екі негізгі ойыншысының салыстырмалы талдауын қолдана отырып, ол экономикалық өсуді тұрақты даму мақсаттарымен үйлестіруде осы елдердің алдында тұрған нақты траекторияларды, мүмкіндіктер мен қиындықтарды бөліп көрсетуге тырысады. Зерттеу аймақтық тенденциялар туралы егжей-тегжейлі түсінік беру үшін әртүрлі халықаралық институттардың статистикалық деректеріне негізделген. Цифрлық технологиялар мен жасыл инфрақұрылымның экономиканы әртараптандыруға, аймақтық байланыстарға және экологиялық тұрақтылыққа әсеріне ерекше назар аударылады. Зерттеу Орталық Азиядағы тұрақты нарықты дамытудың трансформациялық әлеуетіне және оның кең геосаяси және экономикалық маңыздылығына жарық түсіреді.

Талдау сонымен қатар Қазақстан мен Өзбекстан арасындағы басқарудағы, инвестициялық шеңберлердегі және саяси басымдықтардағы құрылымдық айырмашылықтарды қарастырады, бұл олардың «жасыл» өсу мен цифрлық трансформацияға ықпал етудегі тиісті тәсілдерін қалыптастырады. Қазақстан жаңартылатын энергия көздері саласындағы бастамаларды ілгерілетіп, оның әлемдік нарықтарға интеграциялануын пайдаланған кезде, Өзбекстан салаларды жаңғыртуға және цифрлық басқару реформаларына көбірек көңіл бөлді. Зерттеу екі елдің де шетелдік инвестицияларды, әсіресе бастама шеңберінде, ұлттық тұрақтылық стратегияларын жүзеге асыру арқылы қалай теңестіретінін зерттейді. Сонымен қатар, ол инклюзивті және тұрақты экономикалық жолдарды ілгерілетудегі аймақтық ынтымақтастықтың, технологиялық инновациялардың және институционалдық реформалардың рөлін зерттейді.

Тірек сөздер: Орталық Азия, аймақтық интеграция, Өзбекстан, Қазақстан, цифрлық экономика, «Бір белдеу, Бір жол» бастамасы, жасыл нарықтар, цифрлық Жібек жолы, тұрақты даму

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