Norwegian Ministry of Foreign Affairs

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RENEWABLE ENERGY SOURCES IN CENTRAL ASIA: WHAT SHOULD BE ON THE AGENDA NOW?

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The editorial preparation was carried out by Nargiza Muratalieva, editor of the regional analytical platform CABAR.asia. The publication provides a troubling analysis of the development and implementation of renewable energy sources in Central Asia.

The work is meant for young experts and consultants, researchers, decision makers, and for the wide readership interested in issues involving the energy sector and public administration in Central Asia.

The opinions expressed in this document do not necessarily reflect those of the analytical platform CABAR.asia.

The Institute of War and Peace Reporting (IWPR) is an international non-profit organization that supports independent media and civil society in transition countries. It works in 28 states and began operations in Central Asia in 1999.

Financial support from the Government of Norway made this publication possible. The opinions expressed in the work do not reflect the official position of the government of Norway.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The primary objective in developing renewable energy in Central Asia is to transform the energy sector, providing access to more diverse resources while also ensuring that economic growth leaves a minimal carbon footprint. This is the long-term goal, though renewable energy can also be impactful now in providing energy to those who are disconnected from central power grids or who face recurrent and extended outages. The state, as well as the population, faces a difficult dilemma.

ENSURING DOMESTIC ENERGY CONSUMPTION BY INCREASING COAL USE HAS AGGRAVATED ENVIRONMENTAL PROBLEMS ACROSS CENTRAL ASIA.

It is necessary to identify and prioritize actions that will encourage renewable energy development in Central Asia on a large scale, even though this will require adopting comprehensive measures.

KEY FINDINGS

- a mechanism for resource exchanges will make it possible to use hydropower resources and fossil fuels more rationally in Central Asia, allowing additional time for the phased introduction of renewable energy into the region's energy sectors. This mechanism is particularly vital given the formerly unified energy system that powered Central Asia.

- it is necessary to invest in modernizing existing infrastructure and finance new systems of renewable energy that enjoy numerous advantages over fossil fuels.

- government support via guaranteed purchases might drive the development of renewable energy in its early stages, but significant diversification of energy sources will require the participation of all stakeholders, including the state, private sector, and individual consumers.

- it is vital not to underestimate the importance of off-grid wind and solar farms, rooftop solar panels, and small and mini hydroelectric power plants in providing electricity to remote areas.

- climate change that disrupts the hydrological cycle in upstream countries may limit access to the drainage required for exploiting hydropower potential. It is therefore important to initiate small-scale hydropower projects now.

- priority should be given to renewable energy projects with thorough technical and environmental assessments, as the efficiency coefficient of any renewable energy source is directly related to comprehensive research.

INTRODUCTION

A priority task for the Institute of War and Peace Reporting in Central Asia (IWPR) is to strengthen regional cooperation and the sustainable development of Central Asian economies while also encouraging superior public administration.

CABAR.asia is one of the few sites that provides Central Asian researchers and experts the opportunity to publish their analytical works, many of which examine issues related to alternative energy development and green economies in the region. Striving to promote green solutions and clean energy, IWPR and CABAR.asia have held numerous expert meetings on these vital, expansive topics while also continuously publishing articles, reviews, and materials.[1]

With 5.5% of the world's hydropower potential, primarily in Tajikistan and Kyrgyzstan, Central Asia is well positioned to create a sustainable energy sector. Kazakhstan, Uzbekistan, and Turkmenistan enjoy 3000-3600 hours of solar radiation per year on average, and the wind potential at the Dzungar gate alone is 1.3 trillion kWh.[2]

Renewable energy accounts for only a small share of electricity generation in the region despite this potential, though there are large hydroelectric power plants (HPPs) with capacities of 40 MW or more. The lack of attention to renewable energy on the part of the authorities as well as private entities is rooted in the region's excessive dependence on fossil fuels. There are also various technical and financial barriers, though risks to the environment and energy security are now forcing Central Asian authorities to rethink their energy policies and to prioritize renewable energy.

Potential for creation of a sustainable energy sector in Central Asia

[1] Kyrgyzstan by Means of Mountain Forests?" *CABAR.asia*, June 5, 2019, https://cabar.asia/ru/kak-spasti-ledniki-kyrgyzstana-s-pomoshhyu-gornogo-lesa/; Asror Komilov and Farrukh Numanov, "Barriers to the Development of Renewable Energy Sector in Uzbekistan," *CABAR.asia*, May 13, 2019, https://cabar.asia/ru/barery-na-puti-razvitiya-sektora-vozobnovlyaemyh-istochnikov-energii-v-uzbekistane/.

[2] Romen Zakhidov, "Central Asian Countries Energy System and Role of Renewable Energy Sources," *Applied Solar Energy* 44, no. 3 (2008), 218–223.

Once imagined to be the "energy of the future," renewable resources are increasingly becoming the "energy of the present." There is a transition underway, with countries across the world embracing renewable resources, what the International Renewable Energy Agency (IRENA) terms "energy obtained from biofuels, geothermal energy, hydropower, ocean energy, and solar and wind energy that is intended to foster sustainable development, energy security, and environmentally responsible growth and prosperity."[3]

Renewable energy will allow Central Asian states to:

a) meet the rapidly growing energy needs that population growth causes

b) reduce the environmental impact of fossil fuels ;

c) resolve matters of energy security, particularly in those areas with limited connections or no connection to central power supply networks.

Available evidence suggests, however, that no Central Asian country, apart from Kazakhstan, has made measurable progress in introducing renewable energy.

It is vital that renewable energy transform the energy sectors of Central Asia. Most importantly, it needs to help vulnerable populations disconnected from the central grids or who face recurring and extended outages. Hence the importance of off-grid solar and wind farms, rooftop solar panels, and small and mini hydroelectric plants should not be underestimated. However, Central Asian countries routinely neglect these sustainable energy sources. The transition to diversified energy in Central Asia, and to a system in which renewable energy covers most consumption, is a long-term initiative; it will require wide-ranging, comprehensive change.

The function of this policy brief is to draw attention to policy measures that necessitate an urgent, immediate response and to stimulate the development of renewable energy in Central Asia. It examines renewable energy development in Central Asia from three parallel perspectives:

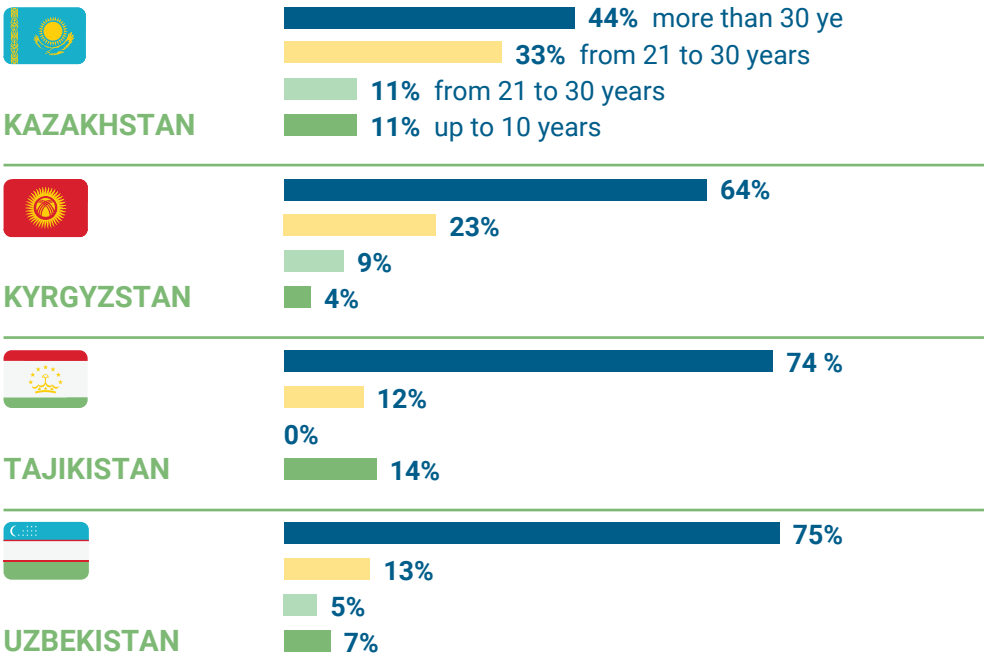
- restoring internal trade in electricity among Central Asian states to maximize hydropower potential in the region;
- constructing large solar and wind power plants to supply electricity directly to the central energy system;
- creating autonomous sources of renewable energy for settlements disconnected from the central power system or with persistent, lengthy outages.

[3] "Roadmap for Renewable Energy Future," *IRENA*, 2016, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_REmap_summary_2016_RU.pdf.

INVESTMENTS IN NEW INFRASTRUCTURE SHOULD BE DEVOTED TO RENEWABLE ENERGY

Outdated energy infrastructure leads to significant electricity losses in almost all Central Asian countries. This is compounded by the unwillingness in the region to maintain production facilities and power lines from the Soviet era. It is vital to modernize the existing infrastructure and to invest in creating new infrastructure. As noted in an Asian Development Bank report, most electricity facilities in Central Asia are operating beyond their service life, jeopardizing the reliability of the electricity supply. The below data on aging infrastructure would reflect existing realities if another ten years were added.

OUTDATED ELECTRICAL ENERGY INFRASTRUCTURE[4]



THE CHOICE BETWEEN RENEWABLE ENERGY AND FOSSIL FUELS IS OBVIOUS GIVEN THE FALLING COSTS OF RENEWABLE ENERGY TECHNOLOGIES. THEY HAVE DROPPED SIGNIFICANTLY OVER THE PAST DECADE.

[4] Asian Development Bank, *Technical Assistance Consultant, Central Asia Regional Economic Cooperation: Power Sector Regional Master Plan* (Metro Manila: Asian Development Bank, Report no. 43549, 2012), http://adb.org/sites/default/files/projdocs/2010/43549-01-reg-tar.pdf.

2016 was a watershed year, with the costs of generating energy from renewable energy sources and fossil fuels finally reaching parity. Renewable energy is no longer the expensive alternative. The costs of building solar power plants fell by 83% from 2010 and 2018 according to the International Renewable Energy Agency, which calculated the decrease as a worldwide average.[5]

Experts frequently compare the electricity prices of existing coal-fired thermal (CHP) or large hydroelectric plants with newly built wind farms or solar infrastructure, highlighting the higher prices of the latter. The price of renewable energy, however, needs to be measured in returns, with investments in innovative technologies paying for themselves within 15 to 20 years, on average.

Renewable energy facilities will remain operational for an additional 50 years, at least, with costs close to zero, excluding maintenance. Building new fossil fuel facilities, in contrast, is far more expensive in the long term.

THE ROLE OF RENEWABLE ENERGY WILL EXPAND THROUGHOUT CENTRAL ASIA AS A RESULT.

Where to start and how to accelerate the transition process is still a pressing issue, however. This brief provides a detailed analysis of the priorities that should inform this transition.

INTEGRATED ENERGY SECTORS AS A FACTOR IN SUSTAINABLE DEVELOPMENT

There would be no need to accelerate the transition to renewable energy if all five Central Asian states embraced regional energy cooperation and worked to maximize the benefits of the now moribund Unified Energy System of Central Asia, an infrastructure that was efficient and integrated. Central Asian countries possess substantial energy resources in addition to comparative advantages in developing certain types of energy.

Tajikistan and Kyrgyzstan together possess 5.5% of the world's hydropower potential. Kazakhstan has significant oil resources in addition to proven coal reserves. Uzbekistan is the largest natural gas producer in the region with significant gas processing capacity. Turkmenistan is the largest exporter of natural gas in Central Asia and ranks fourth in the world in gas reserves.

[5] "Renewable Energy Generation Cost in 2018," *IRENA*, 9, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/May/IRENA_Renewable-Power-Generations-Costs-in-2018.pdf.

The energy sectors of Central Asia were designed to operate within the framework of the Unified Central Asian Energy System, which ensured the sufficiency and sustainability of energy supplies through various types of energy exchanges. As part of these exchanges, Tajikistan and Kyrgyzstan, located in the upper reaches of the Amu and Syrdarya rivers, supplied clean hydropower to downstream Uzbekistan, Kazakhstan, and Turkmenistan, with these countries providing fuel and thermal power in return. This mechanism met energy needs while minimizing the impact of heavy fossil fuel industries on the environment.

RESTORING IT, AND REVITALIZING THE ENERGY SWAPS IT MANDATED, MUST BE AN INTEGRAL PART OF ANY SUSTAINABLE DEVELOPMENT INITIATIVE IN THE REGION.

Central Asia and its hydropower potential[6]

	Installed capacity (MW)	Targeted expansion (MW)	Production in 2018 (TWh)	Theoretical potential (TWh annually)	Technical operational capacity (TWh annually)	Current use (%)
KAZAKHSTAN	2,372	170 (by 2020)	6.940	198.6	61.9	**15%**
KYRGYZSTAN	3,091	178 (by 2025)	13.320	163.0	99.0	**13%**
TAJIKISTAN	5,190	-	18.740	527.0	317.0	**5%**
TURKMENISTAN	1	-	0.003	23.9	4.8	**0%**
UZBEKISTAN	1,889	938 (by 2030)	10.950	88.5	27.4	**39%**

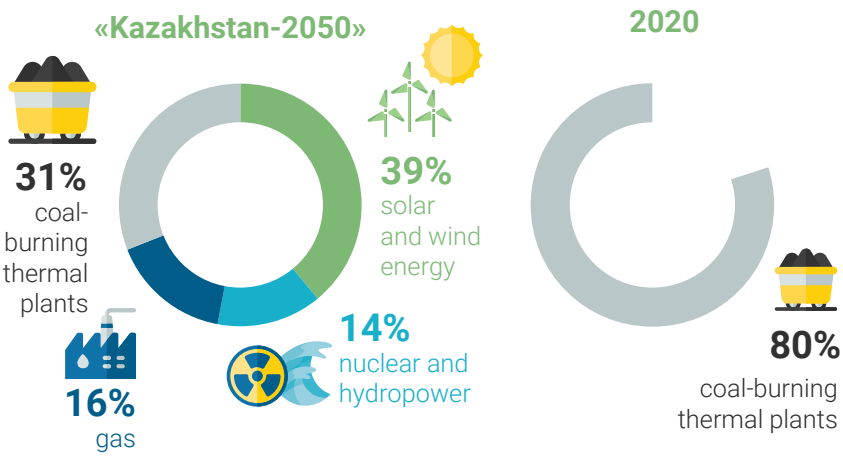
The countries of Central Asia became increasingly dependent on fossil fuels with the collapse of the Unified Central Asian Energy System in 2009. Tajikistan and Kyrgyzstan both increased coal production for domestic consumption and power generation despite their extensive hydro power resources. A primary source of CO 2 emissions in Central Asia, coal constitutes a significant environmental threat. It is common to associate diversification of energy consumption with green solutions, though in Central Asia it is the exchange of fossil fuels and hydropower that can ensure sustainability in the short to medium term. That said, energy swaps in the region should not preclude the development of renewable energies. They are not mutually exclusive, with both being vital to sustainable development.

[6] Bahtiyor Eschanov et al. "Hydropower Potential of the Central Asian Countries," *Central Asia Regional Data Review* 19 (2019), 1–7, http://www.osce-academy.net/upload/file/Hydropower_Potential_CADGAT_Report_19.pdf.

IS KAZAKHSTAN AN EXAMPLE TO FOLLOW OR IS ITS DEVELOPMENT OF "GREEN ENERGY" AN ILLUSION?

Kazakhstan is unique in the region for having adopted a long-term strategy – the "Kazakhstan-2050" plan – that prioritizes diversification in total energy consumption. The administration intends to increase the share of renewable energy sources to 50% by 2050, with solar and wind energy comprising 39%, nuclear and hydropower 14%, gas 16%, and coal-burning thermal plants constituting 31%. Kazakhstan will need to invest at least 1% of GDP, or 3 to 4 billion USD each year, to achieve this, though its recent financial difficulties might impede the transition process.[7] Achieving these goals will be problematic if there is no effort to involve all stakeholders, including those in the public and private sectors.

Diversification in energy consumption, according to the «Kazakhstan-2050» strategy



Few experts are willing to predict what Kazakhstan's energy sector might look like in 30 years. Most are skeptical about its ability to achieve its goals, including the targeted 50% increase in renewable sources in total energy consumption. Though there has been some progress to date, coal-powered thermal plants still produce 80% of the country's electricity. Kazakhstan is rich in coal, an inexpensive fossil fuel, with 33.6 billion tons or 4 % of the world's reserves, though it is detrimental to the environment.[8] The country has enough coal for the next 250 years at current levels of consumption, but this is not sustainable environmentally. Kazakhstan pledged to reduce its CO2 emissions by 25% when it signed the Paris accord, agreeing to achieve this reduction by 2030. The country's Green Economy initiative is even more ambitious, with targets to reduce carbon dioxide emissions by 40% by 2050.[9]

[7] Elena Butyrina, "Fuel-Free Energy. A Sensible Alternative to the "Energy Tradition"," *Kazenergy*, 2013, http://old.kazenergy.com/ru/2012-06-20-08-42-46/2012-06-20-13-01-53/12558--l-r.html. [In Russian]

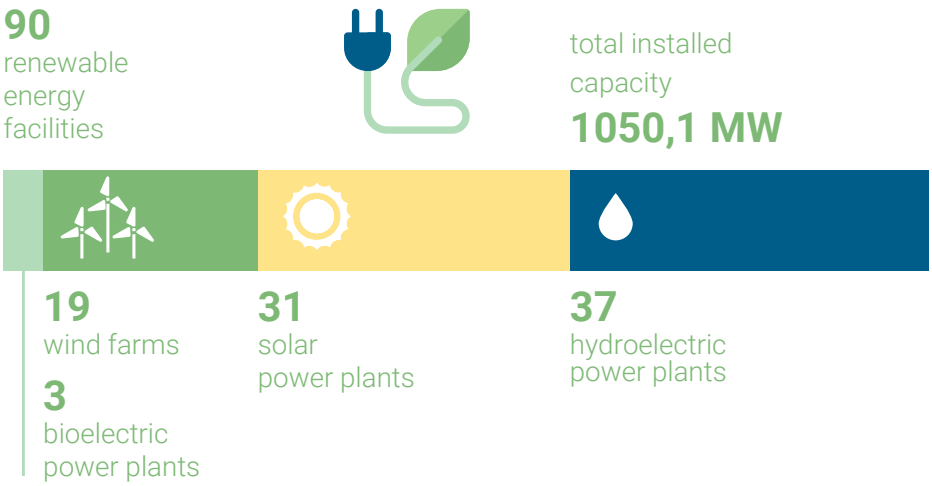
[8] "Kazakhstan Energy Oil Sector," *EITI*, https://eiti.org/kazakhstan.

[9] Xingyu Want, "Kazakhstan's CO emissions in the post-Kyoto Protocol era: Production- and consumption-based analysis," *Journal of Environmental Management*, Vol 249 (2019), 2.

Thermal power plants are nevertheless the primary cause of CO 2 emissions in the country. It is necessary to start diversifying this energy imbalance.

Kazakhstan managed to achieve the 3% balance in energy consumption it projected for 2020, this despite most experts agreeing that its goals on sustainable energy were overly ambitious. Forecasts predict that renewable energy will generate 3.5 billion kWh in 2020 or roughly 3.5% of average annual consumption. The Ministry of Energy reports 90 renewable energy facilities with a total installed capacity of 1,050.1 MW: 19 wind farms (283.8 MW), 31 solar power plants (541.7 MW), 37 hydroelectric power plants (222.2 MW) and 3 bioelectric power plants (2.42 MW). Kazakhstan opened the largest solar power plant in Central Asia in 2019, the Saran installation, which has a capacity of 100 MW. The country expects to commission 18 additional renewable energy facilities, bringing green power generation capacity to 1,655 MW.[10]

Renewable energy facilities in Kazakhstan for 2020



THE RECIPE OF KAZAKHSTAN'S SUCCESS

Kazakhstan created the Settlement and Financial Center to purchase clean electricity, a mechanism central to the development of renewable energy sources in the country. Green energy is still expensive; the average price for renewable electricity in Kazakhstan, for example, is 34 tenge/kWh as compared to the wholesale cost of 7-8 tenge/kWh. It is five times more expensive. When concluding purchase agreements with the Settlement and Financial Center, investors commit to buying the entire volume of clean electricity for 15 years at auction prices. These are indexed annually, starting from the second year of electricity generation.[11]

[10] Rashid Gaisyn and Galymbek Kereibaev, "What Can Investors in the Field of Renewable Energy Count On?" *Kapital.kz*, April 1, 2020, https://kapital.kz/economic/85622/na-chto-rass-chityvat-investoram-v-sfere-vie.html. [In Russian]

[11] Bakytzhan Kazhiev, "KEGOC: The State Aims to Create All Conditions for the Development of Renewable Energy," *Kapital.kz*, March 13, 2020, https://kapital.kz/economic/85395/ao-kegoc-gosudarstvo-natseleno-na-sozdaniye-vsekh-usloviy-dlya-razvitiya-vie.html. [In Russian]

THE GOVERNMENT, PRIVATE SECTOR, AND INDIVIDUAL CONSUMERS ARE ALL IMPORTANT

Government support makes the development of renewable energy in Kazakhstan possible, though diversifying the energy balance will require the participation of all stakeholders: the state, the private sector, and individual consumers. Yerlan Kasym, an energy policy specialist from Nur-Sultan, recently asked, in an article for CABAR.asia, whether Kazakhstan still has the same opportunities it did five years ago to develop a sustainable economy, Oil revenues drive government initiatives in Kazakhstan, including support for developing renewable energy sources and energy efficient technologies. Declining global oil and gas prices might negatively impact the transition to a green economy in the country.[12] The "Green Plan" for 2015-2045 will require an investment of 96.2 billion USD to meet growing electricity demand.[13] The government cannot sustain this transition alone; the active participation of all stakeholders is requisite to the development of renewable energy in the country.

AUTONOMOUS SYSTEMS OF RENEWABLE ENERGY WILL REPLACE COAL

Though they have added 3 billion kWh of clean electricity to the grid, renewable energy initiatives have not impacted the most vulnerable populations. The largest settlements in Kazakhstan are connected to a centralized power supply, though there are areas, especially remote rural regions, with no access to this system.[14] All renewable energy facilities in the country are plugged in to the central power grid, mixing clean electricity with power derived from other resources. Residents in remote villages or in settlements not connected to the system often need to burn coal to solve domestic energy shortages, with all the attendant environmental damage this causes. 84% of coal consumers in the country live in rural areas. Autonomous renewable energy facilities – independent from the central power system—could help replace coal in these remote regions and mitigate the environmental impact of being overdependent on coal.[15]

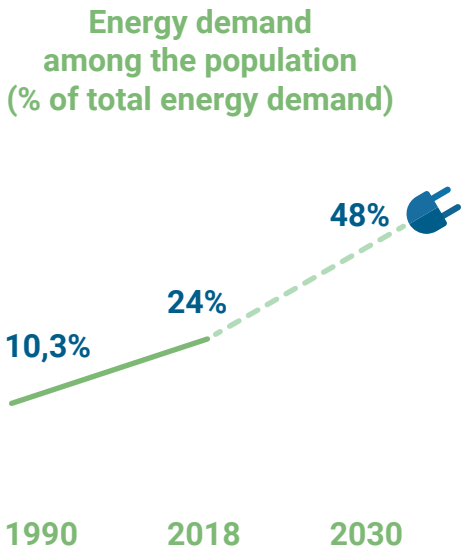
[12] Yerlan Kassym, "Kazakhstan and Green Economy: A Paradigm Shift or an Attempt to Give Out Desirable for Valid?" *CABAR.asia*, June 3, 2019, https://cabar.asia/ru/zelenaya-ekonomika-kazahstana-smena-paradigmy-ili-popytka-vydat-zhelaemoe-za-dejstvitelnoe/.

[13] Mirlan Aldayarov, Istvan Dobozi, and Thomas Nikolakakis, "Stuck in Transition: Reform Experiences and Challenges Ahead in the Kazakhstan Power Sector," *International Bank for Reconstruction and Development / The World Bank* (2017).

[14] Ravil I. Mukhamediev et al., "Multi-Criteria Spatial Decision Making Supportsystem for Renewable Energy Development in Kazakhstan," *IEEE Access*, vol. 7, pp. 122275-122288 (2019).

[15] Peter Howie and Zauresh Atakhanova, "Household Coal Demand in Rural Kazakhstan: Subsidies, Efficiency, and Alternatives," *Energy and Policy Research*, 4:1 (2017), 55.

IF UZBEKISTAN WANTS TO DEVELOP RENEWABLE ENERGY, IT NEEDS TO BE A RELIABLE PARTNER



Uzbek energy experts noted in a recent article for CABAR.asia that "Uzbekistan's massive capacity for renewable resources means it can satisfy demand using only clean energy."[16] Energy demand is constantly growing in the country, especially among the population, which accounted for more than 24% of total consumption in 2018, a 14% increase over consumption levels in 1990. This growth is projected to continue, with demand for electricity expected to double to 105 billion kWh by 2030.

AUTHORITIES ARE CONSIDERING VARIOUS OPTIONS TO PROVIDE CONSUMERS WITH CLEAN, UNINTERRUPTED ENERGY, THOUGH THEIR VIABILITY WILL REMAIN UNCERTAIN UNTIL UZBEKISTAN BUILDS RELIABLE RELATIONSHIPS WITH FOREIGN INVESTORS.[17]

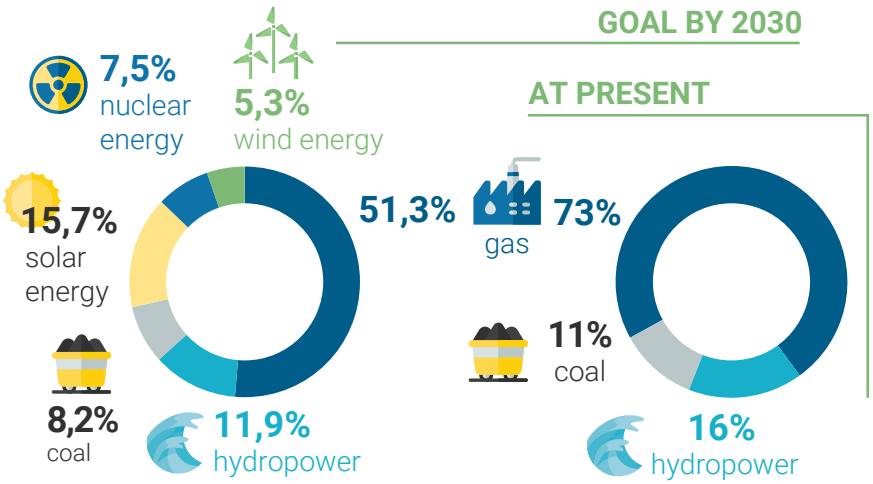
Uzbekistan's current total capacity is 12.6 GW, with electricity production divided among natural gas, which generates 73%, and hydropower and coal, which produce 16 and 11%, respectively. Authorities plan to diversify the structure of the country's energy balance to ensure sustainable electricity supplies, with a scheme to make renewable energy comprise 21% of total energy consumption by 2030. The strategy mandates adding 19.2 GW in generating capacity, or 31.8 GW in total, with an energy balance involving natural gas at 51.3%, hydropower at 11.9%, and coal at 8.2%,

[16] Asror Komilov and Farrukh Numanov, "Barriers to the Development of Renewable Energy Sector in Uzbekistan," *CABAR.asia*, May 13, 2019, https://cabar.asia/ru/barery-na-puti-razvitiya-sektora-vozobnovlyaemyh-istochnikov-energii-v-uzbekistane/.

[17] Bahodir Turaev, "Long-term capacity expansion planning of renewables," *IRENA*, March 2019, https://www.irena.org/-/media/Files/IRENA/Agency/Events/2019/March/7--Bahodir-Turaev--Ministry-of-Economy-and-Industry-Uzbekistan.pdf?la=en&hash=709C391782785555B715E80C398FBEE8DEAF3D8C.

with solar energy providing 15.7% of total consumption, and nuclear and wind 7.5% and 5.3%, respectively.[18] The share of renewable energy at present is negligible despite the significant technical potential of renewable sources (biomass 800 MW; solar 593,000 MW; wind 1600 MW; small hydropower 1800 MW), with the sole exception of hydropower.[19] Going from near zero to 21% in only 10 years will be daunting.

Energy balance diversification plans of Uzbekistan



The Uzbek government plans to invest 314.1 billion som (81 million USD) from its own funds to develop hydropower, solar, and wind energy, with plans to attract an additional 20.5 trillion som (5.3 billion USD) from foreign sources by 2025.[20]

GIVEN THE ANTICIPATED FINANCIAL BURDEN, THE MOST IMPORTANT STEP AT THIS STAGE IS TO ESTABLISH RELIABLE AND TRUSTING RELATIONSHIPS WITH POTENTIAL INVESTORS, THOUGH UZBEKISTAN'S EFFORTS TO DATE HAVE NOT BEEN SUCCESSFUL.

[18] Europe-Uzbekistan Council on Economic Cooperation, "Uzbekistan Energy Overview," *Uzbek Review Market Insight Report*, October 7, 2019.

[19] United Nations Development Program, "Renewable Energy Snapshot," http://www.eurasia.undp.org/content/dam/rbec/docs/Uzbekistan.pdf.

[20] Asror Komilov and Farrukh Numanov, "Barriers to the Development of Renewable Energy Sector in Uzbekistan," *CABAR.asia*, May 13, 2019, https://cabar.asia/ru/barery-na-puti-razvitiya-sektora-vozobnovlyaemyh-istochnikov-energii-v-uzbekistane/.

Planned renewable energy projects in Uzbekistan[21]

Company	Project/Timeline	Outlook/Investments
MASDAR MUBADALA (UAE)	100 MW Solar power plant/2021	900 MY capacity / 800 million USD
TOTAL EREN (UAE)	100 MW Solar power plant/2021	150 million Euro
ASIAN DEVELOPMENT BANK	100 MW Solar power plant/2021	1000 MW capaci-ty/800 million USD
MASDAR MUBADALA (UAE)	Wind park 500 MW	500 million USD
ACWAPOWER (SAUDI ARABIA)	Wind park 1500 MW	-
LIAONING LEADER POWER ELECTRONIC (CHINA)	Wind park 2000 MW	-
SIEMENS GAMESA (GERMANY)	Wind park 100 MW	-
ETKA CO ENERJI (TURKEY)	Wind Park 600 MW	-
ASIAN DEVELOPMENT BANK	24 MW Small hydropower facility/2023	60 million USD
EUROPEAN BANK	Refurbishing 4 small hydropower plants	100 million USD

[21] Europe-Uzbekistan Council on Economic Cooperation, "Uzbekistan Energy Overview," *Uzbek Review Market Insight Report*, October 7, 2019.

The most recent setback was a deal worth 1.3 billion USD with SkyPower Global in 2018. It entailed creating solar energy production facilities throughout Uzbekistan. This was the largest agreement involving foreign investment in the country and the first to purchase electricity on this scale. That said, CEO Kerry Adler noted in an interview with Voice of America that his company is still awaiting payment guarantees from Tashkent two years after entering Uzbekistan and is unable to initiate projects.[22]

Uzbekistan frequently terminates agreements or postpones project start dates unilaterally to pursue more attractive proposals. It terminated agreements with Siemens Gamesa and Etka Co Enerji one year after they were signed and ended or indefinitely postponed plans to build five solar power plants with the Asian Development Bank, which provided financial support. There was a wait and see tactic in each case. There were initial feasibility studies and project calculations, but technologies either advanced or became cheaper while the approval and allocation process dragged on. Authorities would invariably announce a new tender, canceling the previous one, with the entire process then repeating itself. Uzbekistan will not be able to achieve its renewable energy goals while waiting for price decreases or new technologies; it needs to invest and act now.

Investors want clear rules and expect their rights to be protected by law, as Uzbek experts Asror Komilov and Farrukh Numanov have noted in an article for CABAR.asia. This is problematic in Uzbekistan, as there is no transparent legal regime to protect the rights of investors. It is also not clear what conditions independent companies have to fulfill to connect to the energy network, something they need to do sell energy and see a return on their investment.[23]

IT IS UNWISE TO COUNT ON THE REALIZATION OF LARGE-SCALE RENEWABLE ENERGY PROJECTS (WORTH BILLIONS OF DOLLARS) WHEN THERE IS NOT A SINGLE PRECEDENT FOR SUCCESSFUL COOPERATION.

Uzbekistan needs to prioritize ties with potential investors and institute appropriate protection mechanisms if it is serious about developing renewable energy.

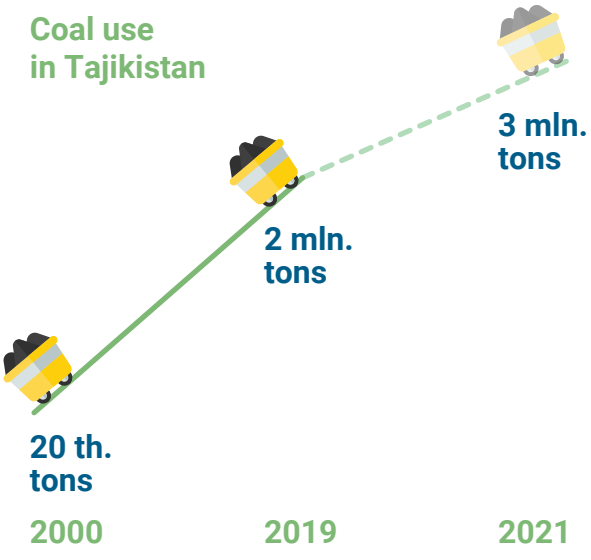
[22] Navbahor Imamova, "What happened to SkyPower's $1.3 bln FDI in Uzbekistan?" Voice of America, February 28, 2020, https://www.amerikaovozi.com/a/5301906.html.

[23] Asror Komilov and Farrukh Numanov, "Barriers to the Development of Renewable Energy Sector in Uzbekistan," *CABAR.asia*, May 13, 2019, https://cabar.asia/ru/barery-na-puti-razvitiya-sektora-vozobnovlyaemyh-istochnikov-energii-v-uzbekistane/.

THE PRIORITY OF SMALL HYDROPOWER PLANTS IN TAJIKISTAN AND KYRGYZSTAN

Uzbekistan and Kazakhstan relied heavily on fossil fuels until recently. Efforts in Kyrgyzstan and Tajikistan to increase coal usage to provide domestic energy consumption, especially in winter, worsened environmental problems. The problem of overconsuming coal will only be solved at the country level by expanding large hydropower facilities and restoring energy swaps in Central Asia, though small and mini-hydroelectric power plants, as well as solar panels, might have a more significant impact in the short-term, especially on those populations living off the grid in remote mountainous regions. Prolonged outages are routine in these areas. Authorities at both the local and national levels need to take the initiative in developing these autonomous systems of renewable energy. Successful programs would stimulate interest among the local population and encourage them to more actively participate in renewable energy development programs.

THE DILEMMA OF SUSTAINABLE DEVELOPMENT: ENERGY SUPPLY OR CLEAN ECOLOGY



Decision makers face a difficult dilemma when deciding between a clean environment and burning coal to produce additional energy resources. It is naïve to think that either the government or the population will limit coal consumption for the sake of environmental sustainability. Coal use reached 2 million tons in 2019 in Tajikistan, a hundredfold increase over levels of consumption in 2000. It may increase to 3 million tons per year by 2021, though there are possible measure to brake its use, as Anton Timoshenko, director of the Little Earth environmental organization, noted in an interview with CABAR.asia: “Providing the rural population with coal and dealing with coal on an industrial scale are two different things.

Energy problems at the village level can be solved with thermal insulation for buildings or by introducing economical stoves and other energy-efficient equipment. At the same time, there should be efforts to develop local renewable energy sources."[24]

DEVELOPING SMALL HYDROPOWER WITHIN A STABLE HYDROPOWER SYSTEM

ALONG WITH LARGE POWER-GENERATION FACILITIES, TAJIKISTAN AND KYRGYZSTAN SHOULD PRIORITIZE SMALL AND MINI HYDROPOWER PLANT CONSTRUCTION IN THE DEVELOPMENT OF THE ENERGY SECTOR, EVEN THOUGH THIS HAS LARGELY BEEN IGNORED IN THE LAST TWO DECADES.

Their negative impact on the environment is minimal and they have the additional benefit of providing electricity to hard-to-reach areas. They also require less investment and offer earlier returns. The consequences of climate change in Tajikistan and Kyrgyzstan are impacting water availability in the entire region, however. Tajikistan's glaciers provide 10-20% of water flow to all large rivers (40-60% of all water resources) in Central Asia, a percentage that increases to 70% in dry seasons. These glaciers are rapidly receding, together with those in Kyrgyzstan, which has lost more than 30% of its glaciers in the last 50 years. It is at risk of losing more than 80% by the end of this century. Both countries are highly vulnerable to climate change as it impacts the hydrological regime of watercourses, making it extremely important to conduct thorough technical and environmental assessments when building small hydropower plants. Tajikistan built 90% of the small and mini hydropower plants it planned for 2012-2016, though few work properly and more than 60%, having been set up to draw water from sources that are now dry, no longer function. It is important to strengthen research into renewable energy development to avoid these failures.

[24] Timur Idrisov, "Tajikistan's Coal Dilemma," *CABAR.asia*, March 10, 2020, https://cabar.asia/ru/ugolnaya-dilemma-tadzhikistana/.

[25] Nailya Mustaeva et. al., "Tajikistan: Country Situation Assessment," *CAREC Working Paper*, August 2015, 30, https://carececo.org/upload/02/eng_CSA_Tajikistan.pdf.

[26] Azamat Temirkulov, "How to Slow Down Melting of the Glaciers in Kyrgyzstan by Means of Mountain Forests?" *CABAR.asia*, June 5, 2019, https://cabar.asia/ru/kak-spasti-ledniki-kyrgyzstana-s-pomoshhyu-gornogo-lesa/.

Small and mini hydropower in Tajikistan[27]

Regions	Total capacity (MW)	Functional capacity (MW)	Electricity production (kWh)	Non-operating capacity (MW)
TOTAL IN TAJIKISTAN (155 UNITS)	12.2 MW	4.7 MW	2,328,340	7.5 MW
Distribution by region				
GBAO (35 UNITS)	3.4	0.7	497,785	2.7
KHATLON (8 UNITS)	2.2	-		2.2
SOGD (38 UNITS)	1.9	1.0	460,336	1.7
REGIONS (74 UNITS)	4.7	3.0	1,370,219	1.7
Distribution within regions				
NUROBOD (9 UNITS)	0.2	0.2	23,269	0.1
VAKHDAT (24 UNITS)	1.7	1.1	468,720	0.6
TAVILDARA (8 UNITS)	0.1	0.1	59,024	-
BARZOB (8 UNITS)	1.0	1.0	599,974	-
JIRGITAL (7 UNITS)	0.3	0.2	99,820	0.1
GISSAR (3 UNITS)	0.2	0.2	82,026	-
SHAKHRINAV (1 UNITS)	0.5	-	-	0.5
TURSUNZODA (1 PIECE)	0.5	-	-	0.5
TAJIKBOD (6 UNITS)	0.1	0.1	21,700	0.1
RASHT (11 UNITS)	0.1	0.1	15,686	0.1

[27] Bahtiyor Eschanov et al. "Hydropower Potential of the Central Asian Countries," *Central Asia Regional Data Review* 19 (2019), 1–7, http://www.osce-academy.net/upload/file/Hydropower_Potential_CADGAT_Report_19.pdf.

INVESTING IN NEW SMALL AND MINI HYDROPOWER PLANTS IN KYRGYZSTAN

The economic potential of small hydropower exceeds the combined potential of all other renewable resources in Kyrgyzstan. The potential of small rivers alone makes it possible to build 92 new mini-hydroelectric power plants with a total capacity of about 178 MW, while the total hydropower potential of the country, based on a survey of 172 rivers, is 1600 MW. A number of technical, economic and institutional reasons currently limits the use of energy from small rivers, however. Energy consumption increased fourfold among the population from 1990 to 2018, from 16% to over 60%. 60% of the population live in rural areas in which foothills and mountainous make supplying traditional fuels difficult, hence the benefit of renewable energy sources independent of existing grids.[28]

THE SMALL AND MINI HYDROPOWER PLANTS LISTED BELOW ARE ALL CONNECTED TO THE CENTRAL POWER SYSTEM AND FAIL TO MEET THE NEEDS OF THE MOST VULNERABLE CONSUMERS.

They are almost all past their operational cycle, which impacts their efficiency. Authorities should prioritize developing autonomous small and mini-hydroelectric power plants as part of the state energy agenda to alter this.

Energy consumption among the population (% of total consumption)

[28] Shamil Dikambaev, "National Sustainable Energy Action Plan of the Kyrgyz Republic," *United Nations*, 2019, https://www.unece.org/fileadmin/DAM/project-monitoring/unda/16_17X/E2_A2.3/NSEAP_Kyrgyzstan_ENG.pdf.

Small and mini hydropower in Kyrgyzstan[29]

Project	Region	Capacity (MW)	Year
SMALL HPP ALMADINSKII (HYDROELECTRIC POWER PLANT)	Chui oblast	0.4	1928
SMALL HPP-1 ALMADINSKII	Chui oblast	2.2	1945
SMALL HPP-2 ALMADINSKAIA	Chui oblast	2.5	1948
SMALL HPP-3 ALMADINSKAIA	Chui oblast	2.1	1951
SMALL HPP-4 ALMADINSKAIA	Chui oblast	2.1	1952
SMALL HPP-5 ALMADINSKAIA	Chui oblast	6.4	1957
SMALL HPP-6 ALMADINSKAIA	Chui oblast	6.4	1958
SMALL HPP BYSTROVSKAIA	Chui oblast	8.7	1954
SMALL HPP LEBEDINOVSKAIA	Chui oblast	7.6	1943
SMALL HPP KALININSKAIA	Chui oblast	1.4	1953
SMALL HPP YSYK ATINSKAIA	Chui oblast	1.4	1960
SMALL HPP NAIMANSKAIA	Osh oblast	0.6	2005
SMALL HPP MAR'IAMSKAIA	Chui oblast	0.5	2011
SMALL HPP KSK	Osh oblast	1.0	2012
SMALL HPP KYRGYZSKO-ATINSKAIA	Osh oblast	0.2	2016
SMALL HPP TEGIRMENTINSKAIA	Chui oblast	3.0	2017

[29] Bahtiyor Eschanov et al. "Hydropower Potential of the Central Asian Countries," *Central Asia Regional Data Review* 19 (2019), 1–7, http://www.osce-academy.net/upload/file/Hydropower_Potential_CADGAT_Report_19.pdf.

IT IS TIME FOR TURKMENISTAN TO OFFICIALLY RECOGNIZE THE IMPORTANCE OF RENEWABLE ENERGY

Turkmenistan has the fourth largest natural gas reserves in the world with the capacity of 17.5 trillion cubic meters. The country prioritizes the gas sector in its development agenda, which is more environmentally friendly in comparison to oil and coal, though it still negatively impacts the environment. Its only renewable energy facility is the 1.2 MW Gindikush hydroelectric power station, which celebrated its 100th anniversary in 2013.[30] Turkmenistan's power sector is completely reliant on gas-fired thermal plants. There is an urgent need in the country for decentralized renewable energy systems to offset the socio-economic problems the population faces, including a basic lack of access to electricity sources.

All countries in the region possess clear targets for expanding renewable energy capacity except for Turkmenistan. Kazakhstan and Kyrgyzstan have introduced feed-in tariffs, while Kyrgyzstan and Tajikistan are trading renewable energy certificates. Turkmenistan has not outlined a renewable energy development policy of any kind.[31] It is important for Turkmen authorities to officially recognize the potential contribution of renewable energy in improving the living standards of the population, especially in those regions that are off -grid. Including renewable energy in the government's agenda would drive development of a sustainable energy strategy to ensure clean and abundant electricity.

[30] "Electric Power Sector of Turkmenistan," CIS Report, 182, http://energo-cis.ru/wyswyg/file/Turkmenistan.pdf.

[31] Bahtiyor Eschanov et al. "Renewable Energy Policies of the Central Asian Countries," Central Asia Regional Data Review 16 (2019), 1–4, http://www.osce-academy.net/upload/file/RE_Policies_CADGAT_Report_16.pdf.

Renewable Energy Regulation Policy

GOAL	ELECTRICITY QUOTAS	PREFER-ENTIAL RATES	THERMAL MANDATES	NET METERING	TENDER PROCURE-MENT	RENEWABLE ENERGY CERTIFICATES	
✓	✗	✓	✗	✓	✗	✗	KAZAKHSTAN
✓	✗	✓	✗	✗	✗	✓	KYRGYZSTAN
✓	✗	✗	✗	✗	✗	✓	TAJIKISTAN
✗	✗	✗	✗	✗	✗	✗	TURKMENISTAN
✓	✗	✗	✗	✗	✗	✗	UZBEKISTAN

RECOMMENDATIONS

As our analysis has shown, renewable energy is vital to ensuring the electricity supplies that industry demands. More importantly, it is critical in improving the living standards of the most vulnerable consumers and in meeting their energy needs and additionally solves present electricity shortages without punishing future generations. There are several particularly essential policy measures that each of the Central Asian countries must undertake to stimulate the development of renewable energy. Authorities need to address these matters with urgency.

THERE WOULD BE NO NEED TO ACCELERATE THE TRANSITION TO RENEWABLE ENERGY IF ALL FIVE CENTRAL ASIAN STATES EMBRACED REGIONAL ENERGY COOPERATION AND WORKED TO REVITALIZE THE UNIFIED ENERGY SYSTEM OF CENTRAL ASIA, AN INFRASTRUCTURE THAT OPERATED EFFICIENTLY.

If upstream Central Asian states exported surplus electricity in the summer months, downstream countries would be able to diversify their energy mix, enabling them to utilize fossil fuels more efficiently and to reduce their greenhouse gas emissions. Restoring intraregional trade should be central to any sustainable development initiative in the region. Central Asian countries should revitalize intra-regional energy trades while also cultivating renewable energy sources. Each of these countries is at a different point in the transition to sustainable energy. Turkmen authorities need to start by officially recognizing the potential contribution of renewable energy to the development of individual territories, while Uzbekistan needs to begin implementing the projects it has already planned. Tajik and Kyrgyz authorities should highlight small and mini-hydroelectric power plant development as a priority in state energy policy, while Kazakhstan needs to involve all stakeholders in the implementation of green economy initiatives.

Kazakhstan has stimulated renewable energy development by guaranteeing purchases of electricity at fixed, higher prices, though financial difficulties related to falling global oil and gas prices might slow down its transition to sustainable energy. The participation of all stakeholders, including the state, the private sector, and the population, will be necessary to realize a green economy and to make renewable energy 50% of the total consumption balance.

Uzbekistan has outlined ambitious plans for diversifying the energy balance and tilting it toward renewable sources, though these initiatives assume a massive financial burden on the part of external investors. Given this, the most critical step at this stage is to establish reliable and trusting relationships with potential investors. To do this, authorities will need to work out a legal regime to protect investor rights and outline the conditions allowing independent energy companies to connect to the network and sell electricity.

Experts often refer to renewable energy development as a "tipping point" in transforming entire energy sectors, though its real value is its ability to improve local living standards. Power shortages are still acute in remote villages and settlements disconnected from the power grid.

IF THEY ARE DECENTRALIZED, RENEWABLE POWER GENERATION FACILITIES CAN REDUCE COAL DEPENDENCE IN RURAL AREAS AND SERVE THE MOST VULNERABLE POPULATIONS.

Central Asia is susceptible to the effects of climate change, especially the hydrological regimes of its watercourses, which are vital to small hydropower development. It is critical to conduct technical and environmental assessments of small river streams when building small and mini hydroelectric power plants to ensure the long-term viability of their water sources. At the same time, there needs to be a mechanism to protect the interests of both investors and local consumers, something that would further stimulate development of renewable energy in rural areas.

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