Policy brief

Understanding the climate and net-zero transition risks and opportunities in Uzbekistan

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Key messages

Uzbekistan is already experiencing climate change impacts. Climate change projections for the 2050s indicate seasonal and annual shifts in both temperatures and precipitation, as well as increases in the frequency and intensity of extreme events that will affect the country's energy systems.

Uzbekistan has high potential for solar energy that remains untapped. The estimated levelised cost of electricity for solar PV in Uzbekistan is lower than both the global average but also the country LCOEs for gas and coal TPP. The transition to renewable energy could make both public and private markets accessible to investors in Uzbekistan and be utilised to ensure energy mix diversification and a sustainable energy supply.

Such a transition also offers co-benefits in terms of job creation, reducing emissions, reducing climate risk by diversifying generation portfolios and improving the viability of the energy sector. Nonetheless, doing so will require tackling the many policy challenges which impede the transformation of the energy sector.

Uzbekistan's future energy infrastructure must be designed with increasing demand, including that related to economic growth and diversification, climate change, and other threats like cyber-attacks in mind. The country should conduct full semi-quantitative to quantitative all-hazards risk assessments to identify risks over the decades that the infrastructure will operate, and to understand the costs and benefits of mitigation.

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Acronyms

HPP	hydropower plant
LCOE	levelised cost of electricity
RCP	representative concentration pathway
R&D	research and development
RE	renewable energy
TPP	thermal power plant

1 Recommendations

This brief summarises Uzbekistan-specific findings and recommendations from the reports *Opportunities and co-benefits of transitioning to a net-zero economy in Kyrgyzstan, Tajikistan and Uzbekistan*, and *Managing climate risks to protect net-zero energy goals*. Key recommendations as ways forward for transitioning to a net-zero economy and protecting infrastructure investments are highlighted below, and followed by the synopsis.

1. Capitalise on RE potential by introducing a dedicated policy and operational framework, particularly for solar and wind energy with medium- and long-term targets in line with the 'Green Economy' transition strategy 2019–2030 and the new *Uzbekistan Development Strategy 2022–2026*. Infrastructure development for non-conventional RE sources and their integration in the energy system should be prioritised.
2. Ensure integration of energy efficiency and RE generation goals by developing clear guidelines/ strategy to achieve energy efficiency.
3. Facilitation of skills development is needed to create a skilled workforce. Greater support of research and development in RE technologies and processes to ensure coherence with international standards is also needed.
4. Continue strengthening and promoting regional cooperation and rejuvenation of the electricity export market, through mechanisms such as the Central Asia Regional Economic Cooperation Program. Coordinated efforts should be made to establish a dedicated regional cooperation mechanism for RE investments and trade.
5. Energy infrastructure must be designed with climate change, increasing demand and other threats like cyber-attacks in mind. Full semi-quantitative to quantitative all-hazards risk assessments should be conducted to identify risks over the decades that infrastructure will operate, and to understand the costs and benefits of mitigation.
6. Energy sector all-hazards risk assessments require data: the network of automated weather stations, river gauges and glacier monitoring stations should continue to be strengthened, and Uzhydromet should consider joining Coordinated Regional Downscaling Experiment (CORDEX) for high-resolution climate models.

2 Energy Sector

Uzbekistan is a landlocked country in Central Asia, with a semi-arid to arid climate over much of the country. It is hydrocarbon-rich and currently heavily dependent on non-renewable resources. Natural gas and coal-fired thermal power (TPP) are the predominant energy sources, constituting 85% of the total installed generation capacity in 2019. Wind, solar and hydropower constitute less than a third (3,472 MW) of installed capacity; the share of RE excluding large-scale HPP is 2.5%. It has been estimated that Uzbekistan is exploiting only around 30% of its hydropower potential (Khasanov, 2019); newer estimates factoring in the impacts of climate change on potential are not readily available.

Table 1 Installed generation capacity (MW)

Energy source	2017	2021
Gas TPP	8,818	10,429
Coal TPP	1,320	1,320
HPP	1,858	2,052
Solar	—	100

Source: Ministry of Energy, Republic of Uzbekistan (2022)

The average age of TPP and HPP is 60 years. Two utility-scale solar installations, one HPP and one gas TPP have been constructed in the last five years. New HPP, solar and wind projects are planned at multiple locations throughout the country.

Agriculture continues to play a strong economic role, but it is heavily dependent on irrigation water drawn from the Syr Darya and Amu Darya rivers and smaller basins. One-third of irrigated land uses pump irrigation, with high energy consumption of up to 14% of country annual energy demand (Hamidov et al., 2022). It is estimated that energy peak demand during heat waves could increase by up to 25% over base load.

Table 2 Demand, historic and projected (TWh)

2000	2010	2022	2030
43.8	41.8	65.4	106.9

Source: Ministry of Energy, Republic of Uzbekistan (2022); IEA (2022)

The Ministry of Energy was established in 2019 and is focused on diversifying the country's energy mix by introducing RE sources. Some key 2030 targets for RE include: reducing specific greenhouse gas emissions per unit by 10% of the 2010 level; doubling energy efficiency indicators; reducing the carbon intensity of GDP; and further developing RE by raising their share in the total electricity generation to more than 25% by 2030.

3 Renewables potential

RE potential remains untapped in Uzbekistan, and it could be utilised to ensure energy mix diversification and a sustainable energy supply. Uzbekistan has the highest potential for solar energy when compared to Kyrgyzstan and Tajikistan, with some 80% of the country suitable for solar PV outputs of 1,400 to 1,600 kWh/kWp/year.

Levelised cost of electricity (LCOE) – the price at which the generated electricity should be sold for the system to break even at the end of its lifetime – continues to decrease for renewables globally, and RE is now competitive with conventional fossil-fuel electricity generation. The estimated LCOE for solar PV in Uzbekistan is about $18/MWh, significantly lower than the global average of $57/MWh in 2020. It is also lower than the country LCOEs for gas and coal TPP, which stood at $29.6/MWh and $44.5/MWh respectively in 2020 (Ministry of Energy, Republic of Uzbekistan, 2022).

The transition to RE could make both public and private markets accessible to investors in Uzbekistan. An increased RE share in the energy mix can significantly increase Uzbekistan's generation capacities. Transition also presents an opportunity to integrate renewables and energy efficiency goals that could have a mutually advantageous impact on policy development to address climate change. A combined portfolio of renewables and energy efficiency technologies could reduce emissions by one-third to one-half.

However, some key policy challenges are slowing the transition to a net-zero energy system. These include:

1. **Low financial support of RE sources.** Currently there are no specific financial support mechanisms in place, including tariffs and taxes, to encourage the use of RE sources.
2. **Most energy sector projects are upstream oil and gas, with too little investment into RE sources.** Current investment in electricity generation continues to focus mainly on TPP, with over 60% of planned power generation projects as LNG TPP.
3. **Lack of skilled personnel.** There is a shortage of qualified workforce, including local experts, who possess the skills and knowledge to install, operate and repair RE technologies.
4. **Low level of public awareness.** The lack of public understanding on the opportunities of transitioning to RE and the use of RE technologies could result in opposition towards new infrastructure developments.
5. **Outdated energy infrastructure.** Aged and worn generation, transmission and distribution infrastructure slow the pace of implementing large-scale reforms in the energy sector.
6. **Regional and geopolitical challenges could hinder energy sector reforms.** There has been recent domestic unrest in Kazakhstan over LPG price increases as well as the Russia–Ukraine war and its negative consequences on the economy due to remittance dependency.

4 Climate risks to energy infrastructure

Infrastructure investments need to be resilient to a number of rapidly changing threats related to climate change, increasing demand and cyber-attacks. The expected lifetime of solar PV installations – the current type of planned solar – is 25 to 40 years; for wind farms it is around 20 years (NREL, 2022). Infrastructure built now or before 2030 will have to contend with projected changes in the 2050s. Hydropower and thermal power plants have longer lifetimes and must be prepared to handle the climate of 2100.

High-resolution climate change projections for the 2050s indicate shifts in both temperatures and precipitation on a seasonal and annual basis, as well as in the frequency and intensity of extreme events. Mean annual maximum temperatures are projected to increase by 1.8°–2.2°C by the 2050s across Tajikistan, Uzbekistan and Kyrgyzstan, under Representative Concentration Pathway (RCP) 2.6 and RCP4.5.[1] In the same timeframe, under RCP2.6, most of Bukhara and a swath extending from southern Navoi eastward are projected to experience 60+ days exceeding 33°C between July and September. Under RCP4.5, the areas impacted extend further north and more than half of Uzbekistan faces heat waves. The intensity and frequency of 24-hour extreme rainfall events is projected to increase, with formerly 1-in-100-year precipitation events becoming 1-in-20-year events in some locations, such as Jizzakh (see Opitz-Stapleton et al., 2022).

Climate risks to energy infrastructure result from the combination of vulnerability (e.g. specific operational requirements for water, sensitivities to temperature or demand loads during extreme heat), exposure (e.g. the location of the infrastructure in a hazard-prone area) and shifts in the frequency, intensity, duration and location of climate hazards. Climate risks have to be considered not only to individual infrastructure, but also for the energy system as a whole. Some climate risks to HPP, solar and wind projects in Uzbekistan are outlined in Table 3.

1 RCP2.6 is a lower-emission scenario that is in line with Paris Agreement goals of no more than 2°C. RCP4.5 is in line with the emission totals of current NDC pledges and would amount to mean global warming greater than 3°C.

Table 3 Climate risks to energy systems*

Hazard	Risks
Higher day and night temperatures in all seasons with increases in mean annual day temperatures of 0.9 to 2.2°C; 60+ days of extreme heat during July–Sept for nearly half the country	Direct risks: higher water temperatures for cooling TPP decreases generation capacity; efficiencies of solar PV decreases; transmission lines sag Cascading risks: generation declines; demand and peak demand increases trigger load balancing issues; short-circuiting of transmission lines spark wildfires
Decreases in July–Sept precipitation of -10 to -50% in parts of country. Overall annual decreases in precipitation of up to -8% for areas around Navoi, Surkhandarya and Bukhara	Direct risks: hydrological, agricultural and socioeconomic impacts; impacts may be magnified by concurrent heat wave; water availability and quality decline Cascading risks: energy demand for irrigation pumping increases; generation declines; load shedding; socioeconomic impacts
Extreme rainfall events: 1-in-100-year 24-hour precipitation event becoming 1-in-20-year event in Jizzakh and Tashkent	Direct risks: flooding, particularly in late winter and spring; increased sedimentation in rivers and reservoirs Cascading risks: normal operating levels on HPP reservoirs held lower for flood routing, reducing downstream water availability; storage maximum capacity of smaller reservoirs breached by excess runoff; infrastructure damage

*This is a summary. See full report, Opitz-Stapleton et al. (2022)

5 Co-benefits of transition

There are a number of benefits that arise from transitioning to a net-zero economy. The estimates used below for potential job creation and the economic value of potential benefits are from Jacobson et al. (2017) and IRENA statistics. More details are available in Panwar et al. (2022).

1. **Meeting future demand:** Scaling up the use of renewable energy will help offset increases in energy demand as Uzbekistan's economy grows and diversifies, though greater energy efficiency will also be necessary. Using additional non-conventional renewable energy capacities will also diversify the current energy mix and support the move toward a more sustainable energy supply.
2. **Job creation:** Transitioning to a net-zero economy could stimulate economic output and create employment. At present, the energy sector accounts for less than 1% of total jobs. In a full (100% RE) transition scenario, RE could generate over 266,000 jobs by 2050. This would add nearly $15 billion a year to Uzbekistan's economy.
3. **Reducing energy sector costs:** Conventional energy production is costly; switching to RE could generate savings in the long term considering a declining trend in the cost of RE. Uzbekistan is projected to avoid up to $181 billion in carbon-based energy production costs per year by 2050 if it transitions to 100% RE.
4. **Emissions reduction commitments:** Increased use of RE sources can substantially reduce CO2 emissions. Electrification and RE sources alone could deliver up to a 75% reduction in global energy-related emissions, the kind of reduction necessary for Uzbekistan to meet its NDC emission reduction targets.
5. **Health benefits:** Transition to 100% RE could avoid an estimated 19,000 deaths per year by 2050. The marginal co-benefits of avoided mortality could be $50–380 per tonne of CO2 (West et al., 2013; Vandyck et al., 2018).

Achieving these co-benefits and protecting energy investments will require additional steps on the part of the government, investors and energy companies, and cooperation with other countries on the regional grids. Some of these recommendations are outlined at the start of this brief. Full recommendations can be found in both reports.

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