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CENTRAL ASIA WITH DIVERSE TOPOGRAPHY AND HYDROLOGIC CONDITIONS, HYDROPOWER POTENTIAL

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ABOUT ARTICLE

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Abstract: Central Asia is a region with a large theoretical potential for electricity generation from hydropower. For decades, electricity generation from hydropower has been playing a significant role especially in the upstream countries. However, the region has failed to harness its full hydropower potential. Tajikistan has only developed 4 percent of its total capacity, while Kyrgyzstan has exploited just 10 percent. If Tajikistan and Kyrgyzstan were to fully capitalize on their topography, they would have a surplus of electricity to export to their fossil fuel-dependent neighbors.

INTRODUCTION

Several roadblocks have stalled Central Asia's hydropower development. But through investments in Central Asia's energy infrastructure and by fostering new dialogue on transboundary water management, the United States and European Union (EU) can help unlock much of Central Asia's potential and forge stronger ties to the region.

Barriers to development

The majority of Central Asia's hydropower infrastructure was built during the Soviet era and is not equipped for today's challenges. The dated technology is unable to generate and distribute electricity at a scale needed to support rising demand in the region.

Climate change has compounded these problems. Central Asia is warming faster than most regions in the world, and recent cases of extreme heat have increased electricity demand while depleting water flows, plunging the region into darkness.

In addition, advancing new projects in Central Asia has been difficult. Historically, hydropolitics has hindered regional cooperation. Downstream republics, including Uzbekistan, Kazakhstan, and Turkmenistan are dependent on the flow of water for cotton and wheat production, which account for 5 percent of Kazakhstan's GDP and nearly 25 percent of Uzbekistan's. Uzbekistan's former president even threatened the use of military force against Kyrgyzstan and Tajikistan over proposed dam projects in 2012.

A glimmer of hope

Since then, however, new leadership has engaged in more constructive dialogue on shared resources in Central Asia. This newfound willingness to cooperate has opened the door for new hydroelectric dam projects. Projects that were shelved for decades are advancing to new stages of development. The Rogun and Kambar-Ata Dams, once points of contention between upstream and downstream republics, now provide hope for Central Asia's hydropower sector.

In 2016, Tajikistan restarted construction of the Rogun Dam, and now the early stages of the future world's tallest dam sit on the Vakhsh River. With the technical assistance of an Italian company, Webuild, the Rogun Dam is expected to become fully operational by 2032, with a capacity of 3,600 megawatts (MW), doubling Tajikistan's installed electrical generation capacity. Even though the project has endured significant delays, the Rogun Dam can transform the region with clean baseload energy.

The Kambar-Ata Dam is another beneficiary of the hydropolitics détente in Central Asia. In January of 2023, Kyrgyzstan, Kazakhstan, and Uzbekistan agreed to a roadmap for the project, which will have an installed capacity of 1,860 MW. Nonetheless, the project remains in the early stage of development and needs additional financing before its completion.

Latest developments

Uzbekistan

Total installed capacity stands at around 12,500 MW, of which hydropower contributes about 1,900 MW. Currently, there are 21 plants with a capacity of 10 MW or larger in operation, and 75% of the capacity is more than 40 years old. In May 2017, a new state-owned hydropower producer and developer, UzbekHydroEnergo, was formed and entrusted with implementing a five-year program for the development of the hydropower sector. The program envisages the construction of 42 new plants and the modernization of 32 operating plants. In addition, the importance of pump storage power plants is growing.

It was announced that 250 micro-hydropower projects would be completed in the coming years. The Government anticipates there are 17 projects with a total capacity of 197 MW scheduled to be commissioned in 2023. There are 50 micro-hydropower projects with a capacity of 438 MW set to commence shortly. Construction of the Yavan Hydropower project has begun with a ceremony that was attended by the Presidents of Tajikistan and Uzbekistan for the 140 MW new project.

Kamolot, Chirchik Bozsu Canal, Uzbekistan, 8.8 MW © ANDRITZ

Kazakhstan

Kazakhstan set ambitious goals for the development of renewable energy including hydropower. Achieving these goals requires overcoming its dependence on cheap domestic coal and addressing its lack of flexible generating capacity, which provides ample opportunity for foreign hydropower investments. Although Kazakhstan has an estimated technically feasible annual hydropower potential of about 62,000 GWh, only 13% of this potential has been developed so far. To meet future demand and address ambitious targets to increase the share of renewables to about 50% by 2050, the country needs to increase investment in the sector. Measures regarding decentralized electricity, trading markets, and new tariffs are beginning to show results, but more energy market reforms are required.

Kyrgyzstan

As of the end of 2019, total installed capacity stands at 3,800 MW, of which hydropower is about 80% (11.5 TWh p.a., 10% of gross hydro potential). The government also launched a privatization program to develop the small and mini hydro sector projects up to 30 MW output.

The largest hydropower stations in the country are Toktogul (1,440 MW), currently under modernization, and Kurpskaya (800 MW). In addition, the government plans several new hydropower stations, i.e. Upper Naryn Cascade (237 MW), Kambarata 1 (1,860 MW) and the Kazarman Cascade (1,160 MW). For all these new facilities, international investors are presently being sought.

In October, the President of Kyrgyzstan took part in the ceremony celebrating construction commencing at Kulanak hydropower project, and in March 2023 the European Bank for Reconstruction and Development (EBRD) agreed to contribute financially to the project. Additionally, EBRD agreed to finance modernisation of hydropower projects in Kyrgyzstan, with Chakan GES, the state-owned hydropower operator of nine small hydro power plants, to receive a financial package of US$13.8m. The money will help finance the rehabilitation and modernisation of the Lebedinovskaya project, which has an installed capacity of 7.6 MW.

Tajikistan

In Tajikistan, the Nurek hydropower project's rehabilitation progressed after operation began of the first unit rehabilitated. The completion of the unit – the first of nine expected to be rehabilitated – was a major milestone. The new turbine extends the economic life of the unit by 35 years and increased the installed capacity by 40 MW to 375 MW. The Nurek HPP, with an installed capacity of over 3,000 megawatts, generates about 50 per cent of total annual energy demand in Tajikistan.

Nurek hydropower plant, Tajikistan. Credit: ANDRITZ.

The World Bank approved US$15m in grant financing for the Technical Assistance for Financing Framework for the Rogun hydropower project in late 2022. This comes six months after the European Investment Bank expressed interest in financing the 'world's tallest dam.' The World Bank grant will include hiring of experts in dam safety and environmental and social frameworks, and the Rogun project will have a benefit-sharing mechanism to ensure that socio-economic programs receive a portion of the revenues. Total installed capacity stands at some 6,000 MW of which hydropower is about 95%. From the impressive technical potential of more than 400 TWh, only 5% has been developed so far.

Tajikistan is pursuing efforts to harness its vast hydro resources to address electricity shortages in winter and ensure security of power supply in the long term. The government has now prioritized eight projects with a combined capacity of 6,045 MW, including the 3,600 MW Rogun hydro project, project, which is currently under construction.

The largest hydropower stations in operation are Nurek (3,000 MW), Baipaza (600 MW), Golovnaya (250 MW) and Qairokkum (126 MW), which are all part of big modernization programs financed by international financial institutions.

Turkmenistan

There are only three small hydro plants in operation, totaling 5 MW of capacity. It is estimated that about 57 MW of hydropower could be developed, mainly by retrofitting existing water infrastructure.

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