UNECE

March 2024

Tajikistan Policy Brief

Executive Summary

Tajikistani's economy is the least emitting in the region with a CO2, Intensity of GDP roughly 4% higher than the global average. The Tajik energy sector contributes to roughly 75%, 7.4 MT of CO2, of its total GHG emissions, where transport and the production of heat & electricity account for over 60% of total energy sector GHG emissions. Thus, decarbonizing the Tajik energy sector is crucial to achieving the country's ambitious carbon emissions reduction target under the Paris Agreement. Hydropower dominates the energy mix with a share of over 40%, yet industrial and residential coal consumption has significantly increased in the past two decades, meaning that coal now constitutes 25% of the share.

The Tajik Development strategy by 2030 aims to scale up its electricity capacity from 5.1 GW in 2021 to 10 GW to enable 10 TWh of annual electricity export. Consequently, the government aims to achieve this ambition by increasing annual hydropower generation, currently accounting for 90% of total electricity generation, from 18.7TWh to 31.6-41.6 TWh by 2030. Tajikistan's significant solar power potential could be harnessed to enhance energy security and meet several energy-policy goals simultaneously, and the government has recently set a target for non-hydropower renewable energy to provide 10% of generating capacity by 2030.

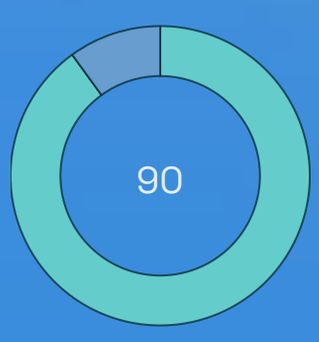
Plans aiming to reconnect he Tajik energy system to the Central Asian Power System, supported by power trading initiatives like CASA-1000, would enhance Tajikistan's energy system resilience. Indeed, integration would maximize hydropower efficiency as well as export, overcome electricity shortages via multilateral energy trade and facilitate the incorporation of variable renewable energy through regional integration and increased cooperation with neighboring countries.

Nevertheless, Tajikistan' energy security is threatened by its aging infrastructure, with many generation and distribution facilities requiring urgent rehabilitation. Investments in energy efficiency are therefore necessary, especially in the residential and industrial sectors which are concurrently the most energy and carbon intensive sectors in Tajikistan. Subsidized energy tariffs, however, constitute a barrier to investments in the energy sector, especially to the deployment of alternative renewable energy technologies and energy efficiency. Modern energy pricing mechanisms and policies are required to incentives investment into the energy sector whilst simultaneously not burdening the livelihoods of the Tajik population.

In addition to its vast hydropower export potential, Tajikistan's hydrogen production potential and reserves of critical raw materials, such as Manganese, Lead, Aluminum and Zinc, should be leveraged to enable Tajikistan's energy transition and to generate novel export revenue streams.

Tracking SDG 7

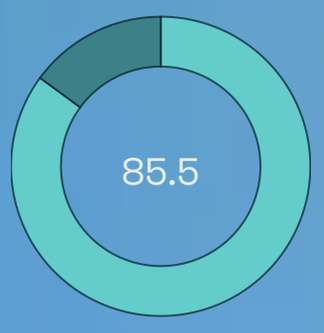
Ensure access to affordable, reliable, sustainable, and modem energy for all



Renewable Electricity
(% of Total Electricity Supply : 2021)

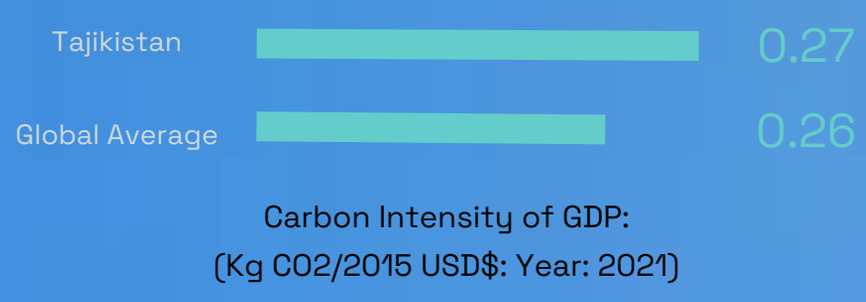
Access Electricity
(% of population with access Year: 2021)

Energy Efficiency:
(MJ/ thousand 2015 USD$ Year: 2021)



Access to Clean Cooking
(% of population with access Year: 2021)

Energy Sector Methane Emissions
(Thousand Metric Tons of CO 2 Equivalent: Year 2020)



Carbon Intensity of GDP:
(Kg CO2/2015 USD$: Year: 2021)

Renewable Energy
(% Total of Energy Supply: Year 2021)

Environmental and Energy Overview

Key Takeaways:

1. Tajikistani's economy is the least emitting in the region with a CO2, Intensity of GDP roughly 4% higher than the global average.
2. The Tajik energy sector contributes to roughly 75%, 7.4 MT of CO2, of its total GHG emissions, where transport and the production of heat & electricity account for over 60% of total GHG emissions.

NDC to the Paris Agreement

Unconditional Target: 30-40% reduction in GHG emissions by 2030, relative to 1990 base emissions level.

Conditional Target: 40-50% reduction in GHG emissions by 2030, relative to 1990 base emissions level, subject to:

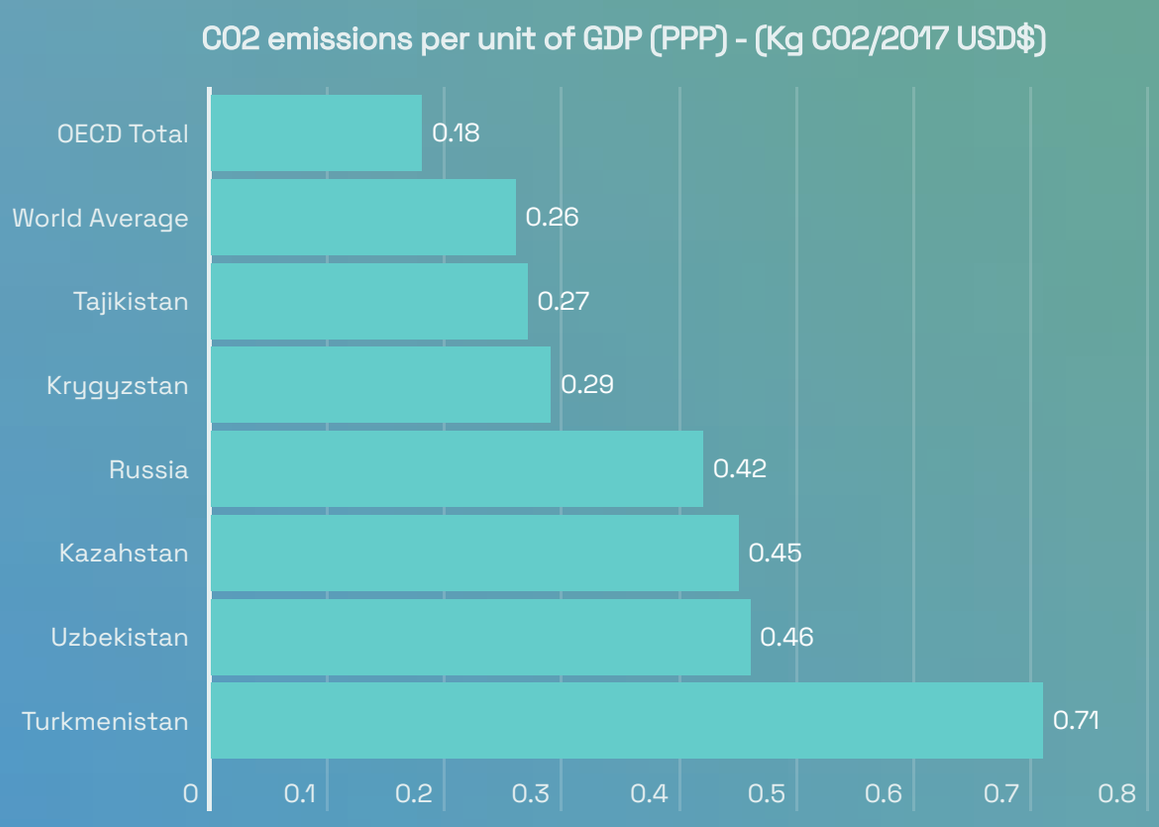
- International investment & grant assistance
- International technology transfer
- International technical cooperation

Carbon Neutrality Goal

Kazakhstan targets carbon neutrality by 2060, aligning with global sustainability efforts.

Pollution

- Methane emissions in energy sector (thousand metric tons of CO2 equivalent): 226.4 (2020)
- Mortality rate attributed to household and ambient air pollution, age-standardized (per 100,000 population): 203.8 (2019).
- PM2.5 air pollution, population exposed to levels exceeding WHO guideline value (% of total): 100.0 (2017)



Breakdown of Energy GHG Emissions by Sector, 2021

	Co2 Emissions (MT Co2)	Co2 Emissions (% of total)
Electricity & Heat Generation	1.8	24.3
Residential	1.0	13.5
Industry	1.4	18.9
Transport	1.9	25.7
Final Consumption not Elsewhere Specified	1.3	17.6
Total	7.4	100

In 2021, the Tajik energy sector accounted for roughly 75% of the country's greenhouse gas emissions

Energy Exports & Economic Impact

Tajikistan is a energy deficit country, meaning that domestic energy consumption exceeds energy production. Tajikistan's electricity exports, stemming from its vast hydropower resources, amounted to 4.5% ($95 million) of total exports in 2021. Nevertheless, Tajikistan is deficient in oil and gas resources, and consequently, it sources these energy resources via imports from neighboring countries. In 2021, refined petroleum and natural gas respectively accounted for 7.5% ($390 million) and 4.3% ($220 million) of Tajikistan's total imports. Thus, net energy imports in 2021 amounted to 46,632 TJ, roughly 29% of total energy supply. something

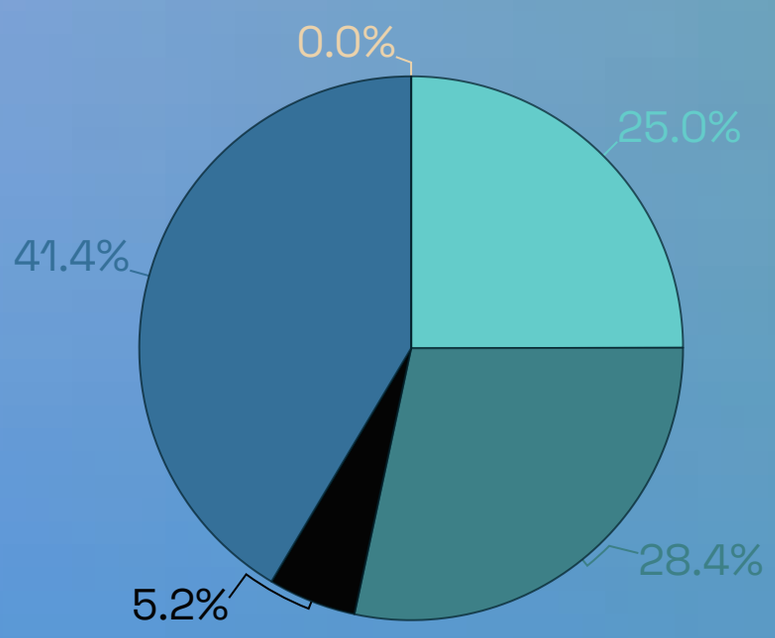
Key Takeaways:

1. Hydropower dominates the energy mix with a share of over 40%, yet industrial and residential coal consumption has significantly increased in the past two decades, consequently constituting 25% of the share.
2. The Tajik Development strategy by 2030 aims to scale up its electricity capacity from 5.1 GW in 2021 to 10 GW, to enable 10 TWh of annual electricity export.
3. The government aims to achieve this ambition by increasing annual hydropower generation, which currently accounts for 90% of total electricity generation, from 18.7TWh to 31.6-41.6 TWh by 2030.

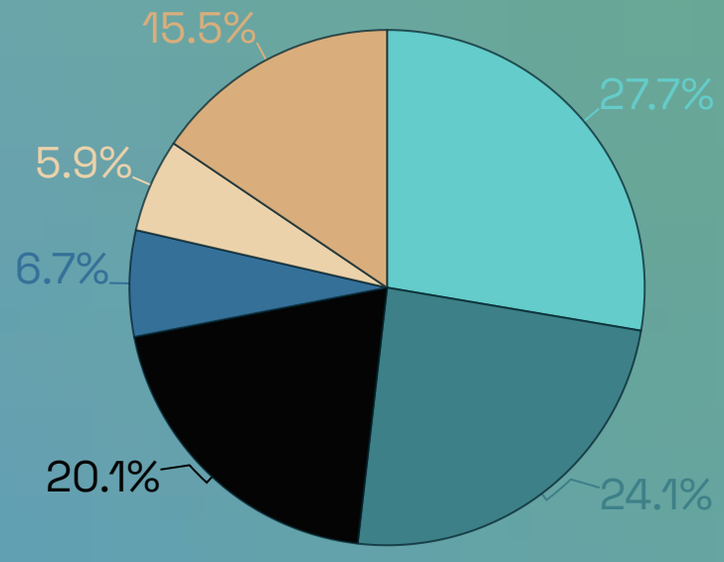
Current

Energy mix

Energy Supply (% Total Energy Supply) (GWh)



Total Energy Consumption by Sector (% Total Energy Supply)



Oil

- Oil Products Imports: 99.7% of total oil products final consumption in 2021
- Crude Oil Imports: 11.3% of total crude oil supply in 2021
- Import Countries: Russia, Kazakhstan
  Total Proven Reserves: 120 Mt
- Stocks: No emergency oil stocks, highly exposed to oil supply disruptions and price volatility.
- Emissions Contribution: 42% in 2021
  Sectoral Consumption: Transport (56.2%), non-Specified (41.3%), non-Energy Use (1.6%), Industry (0.9%)

Gas

- Domestic Reserves: 762,000 cubic meters in 2021
- Gas Supply: 99.7% of Tajikistan's total gas supply in 2021 was supplied by imported gas from neighboring
  Uzbekistan.
- Gas Imports: 0.23 billion cubic meters (bcm) in 2020.
  Emissions Contribution: 6% in 2021
- Consumption by Sector: Industry (99.3%), other not specified (0.7%)
- Gas Developments: Dushanbe-3 power plant would increase natural gas imports from Uzbekistan to 1.0 bcm.

Coal

- Total Proven Reserves: 3.6 billion tons of anthracite, bituminous coal & lignite.
- Annual Coal Production: 2.6 Mt in 2021
  Net Coal Imports: 2.9% of total coal supply in 2021
- Future Trends: forecasted increase in annual coal production to 10.4 Mt by 2030 and 15 Mt by 2040.
- Consumption by Sector: Industry (49.7%), Residential (45.9%), non-specified (4.1%)
- Emissions Contribution: 52% in 2021

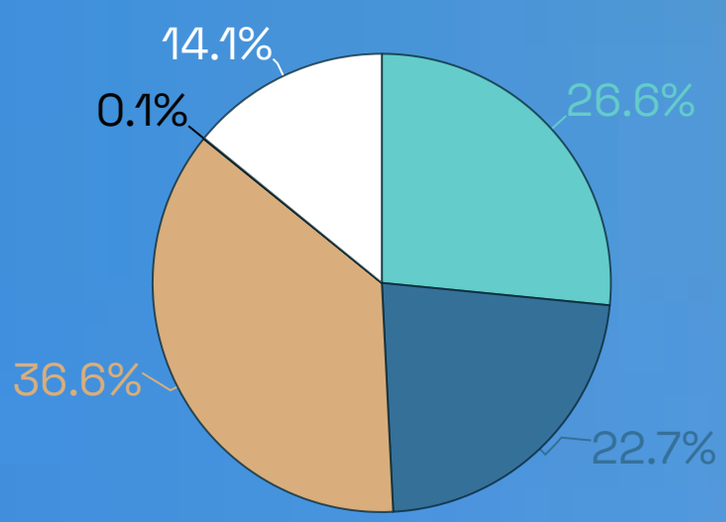
Hyrdopower

- Hydropower Potential: 527 TWh/annually.
- Current Production: 18.7 TWh, 3.5% of Hydropower potential
- Current Installed Capacity: 5.2 GW 2030 National Development
- Strategy: Increase hydropower generation by 2030 to 31.6-41.6 TWh per year.
- Hydropower Developments: The Rogun HPP will have a capacity of 3.6 GW by 2032 and will eradicate winter shortages.

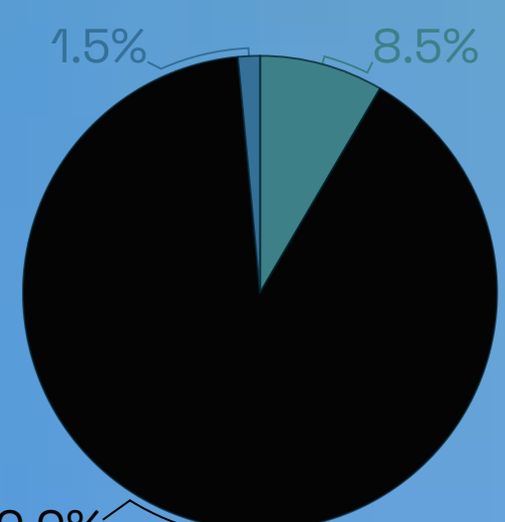
Electricity

- Available Generation Capacity: 5.1 GW in 2021 (installed capacity in 2020 was 6.1 GW)
- Price: $0.05/kWh for industrial consumers, $0.02/kWh for personal consumers
- Net Exports: 11.7% of total electricity production (2.4 TWh) in 2021
  Transmission Losses: 14.2% in 2020
- Peak Demand: Seasonal peaks occurring in the winter, mainly for heating, and summer months, mainly for crop irrigation.
- 2030 National Development Plan: Achieve 10 GW of installed capacity, 10 TWh of annual electricity export, 10% share of non-hydropower electricity,
  10% fall ii transmission losses.

Electricity Consumption by Sector (% of Total Consumption) (GWh)



Electricity Generation (% Total Electricity Generation)



Key Takeaways:

1. In addition to hydropower, Tajikistan's significant solar power potential could be harnessed to meet several energy-policy goals simultaneously, and the government has recently set a target for renewable energy to provide 10% of generating capacity by 2030.
2. Nevertheless, subsidized energy tariffs constitute a barrier to investments in transmission/distribution infrastructure, renewable energy production and energy efficiency.

Low-carbon Energy

Technologies Potential

Energy Tarrifs

Energy Tariffs, notably electricity and heating tariffs, are subsidized in Tajikistan to alleviate poverty. Indeed, nearly 50% of Tajik families live below the poverty line. Yet, tariffs have also been subsidized for large industrial consumers such as the aluminum producer TALCO and for the agricultural sector.

Energy Tariffs as an Investment Barrier:

According to the ADB, energy prices do not cover the costs of providing energy services and consequently lead to underinvestment in renewable energy deployment, energy infrastructure as well as increased transmissions & distribution losses and power outages. This is especially problematic for Tajikistan given that their most abundant energy source is hydropower which is very capital-intensive and prone to technical and cost risks. Additionally, subsidized tariffs disincentive household investment into more efficient equipment (i.e., lighting and appliances) and reduces the implementation of energy efficiency policies to drive down end-use energy demand.

Recent Pricing Mechanism Developments:

Tajikistan's government is currently establishing an independent tariff regulator and developing a new tariff methodology intended to incrementally increase energy tariffs, ultimately internalizing costs of production, transmission and electricity distribution whilst also not burdening the livelihoods of Tajikistan's population.

Hydrogen

Electricity Intensity of Hydrogen Production: 55 kWh/kg H2 of electricity

Hydrogen Production Potential (Thousand Tons per Annum): Minimum Scenario: 9, Maximum Scenario: 204

Potential Hydrogen Costs: $6-8 per kg of H2 assuming electricity prices of $0.1kWh. Current prices of electricity for Tajik industrial consumers amount to $0.05/kWh, at this price hydrogen costs would amount to $3.5-5 per kg.

Potential Consumption: transport sector given that it accounts for roughly 20% of total final energy consumption.
Potential Export: China through the upcoming D-Line.
Importance: Given Tajikistan's national coal strategy, aiming to increase coal consumption from 2.6Mt in 2021 to 15 Mt by 2040, the introduction of CCUS will be imperative to mitigating fossil fuel emissions.

CCUS

No current data on Tajikistan's CCUS potential is available. Energy Potential: 97 billion tons of oil equivalent (toe), comparable to Kazakhstan's oil and gas resources

Wind

There is limited potential for wind energy in Tajikistan.

Promising Wind Energy Potential Areas: Pamir Mountains, Turkestan Range, Vakhsh Range.

Feasible Territories: Only the Turkestan Range, with average wind speeds of 9 m/s is deemed as feasible, since it is the sole territory located in close vicinity to the electricity grid.

Solar

Average Theoretical Solar Potential: 4.3 kWh/m2 or 25 TWh/year.
Averge Days of Sunshine: 300/365
PV Coverage Needed to Supply Current: Electricity Demand: 0.074% of the country's territory.
LCOE Costs: Estimated at $0.1/kWh.
Current Projects: 2,450 solar PV units with a total capacity of 88.7 kW were installed in 13 remote regions between 2009-2014 to provide electricity to residential and public facilities

Energy Interconnectivity

Key Takeaways:

1. Re-integrating the Tajik energy system to the Central Asian Power System, would enhance energy system resilience and enable the trade of energy resources across the region to overcome energy shortages and efficiently exploit surpluses in energy production.
2. Cross regional integration under the CASA-1000 project would further enable Tajikistan to exploit its surplus hydropower production and generate new revenue streams.

Integrated Energy Systems

Tajikistan's power system, constructed during the soviet era, is integrated with the Central Asian Power System (CAPS) via neighboring Uzbekistan, consequently enabling the flow of electricity between member-states during surpluses and shortages in electricity supply. Cross border transmission lines have also been developed with Afghanistan.

Disconnection from CAPS

Since December 2009, Tajikistan has been disconnected from the Central Asian Power System (CAPS) due to operational violations, straining its energy security. Previously, it relied on parallel operations with Uzbekistan to mitigate winter electricity shortages. In response, Tajikistan developed the National Development Plan on Coal, increasing coal's share from 4.1% in 2009 to 25% in 2021. Reconnecting to CAPS is now a government priority, with financial support from the Asian Development Bank, and parallel operations are expected to resume in 2024.

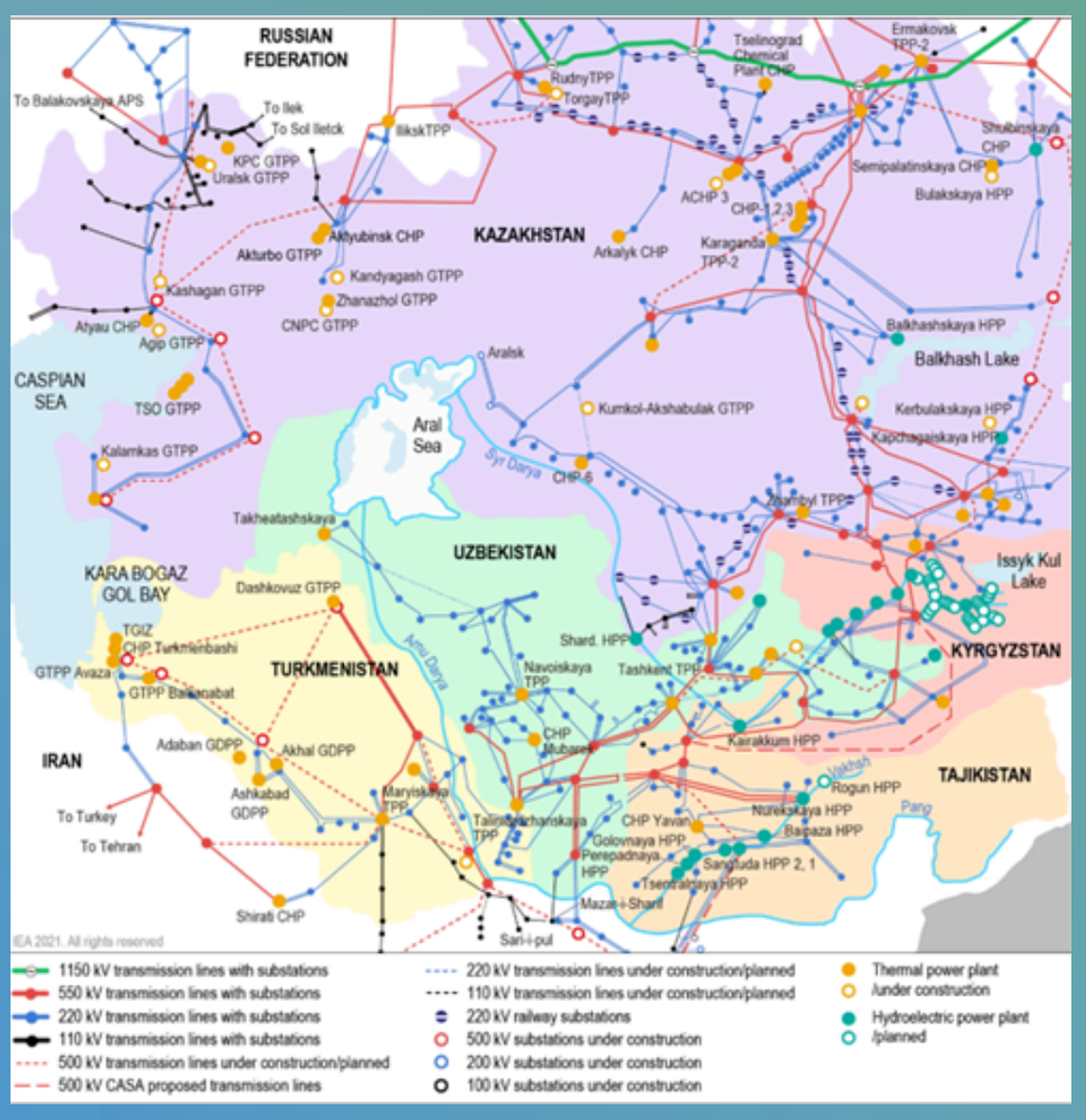
CASA - 1000

The Central Asia Electricity Transmission and Trade Project (CASA-1000), funded by the World Bank, aims to help Tajikistan and Kyrgyzstan export surplus summer electricity to Kazakhstan, Uzbekistan, Afghanistan, and Pakistan. The project involves constructing 500 kV DC facilities in Tajikistan, Afghanistan, and Pakistan, interconnected with Kyrgyzstan and Tajikistan. Once operational, this network will integrate the power systems of Central and South Asia, creating a regional electricity market and enhancing energy system resilience through parallel operations.

Realign Hydropower Interests

Regional integration is imperative because river flow regulation and agricultural water use in Kyrgyzstan, Uzbekistan, and Kazakhstan have implications on Tajikistan's hydropower output. Indeed, reintegrating Tajikistan in the CAPS would increase the level of mutual trust and cooperation between member states and consequently realign national interests towards maximizing Tajikistan's hydropower efficiency, output and consequential export to neighboring member-states.

Map of Electricity Interconnections in Central Asia



SourceL USAID (2015), Central Asia Electric Grid.

Increase Efficiency & Overcome Shortages

According to the Ministry of Energy, annual idle discharges of water from hydropower equal energy potential loses amounting to 5-6 TWh of electricity. Thus, power system integration would increase Tajik electricity exports consequently eliminating energy potential loses and use hydropower resources more efficiently.

Inversely, parallel operations with the CAPS would help balance and provide baseload flexibility to Tajikistan during electricity shortages (i.e., winter), consequently redistributing power from surplus areas which would otherwise remain unused.

Transmissions Challenges

Tajikistan's domestic transmission and distribution infrastructure is ageing, with transmission losses averaging 15.5% in the past two decades and amount to 14.2% in 2020.

Hence, grid refurbishment is urgent and significantly important for interconnectivity with neighboring countries to mitigate the risks of interregional power blackouts.

UNECE's Contribution

UNECE's report on Energy Connectivity in Central Asia showcases an inventory of existing national energy systems and pathways for further developing interconnectivity to build regional energy system resilience.

Key Takeaways:

1. Investments in energy efficiency and system refurbishments are imperative as maintaining current capacity would require refurbishments to roughly 80% of Tajikistan's Hydropower power stations.
2. Simultaneously, addressing sectoral energy efficiency, notably in the residential, industrial and transport sectors is required. system flexibility remains a major barrier towards enabling energy system resilience and decarbonization, yet integrated energy systems and electricity interconnectivity can constitute viable solutions.

Energy Efficiency - Decarbonizing Buildings, Industry & Transport System Flexibility

Transport

In 2021, Tajikistan's transport sector contributed 25.7% of energy-related GHG emissions and 20.0% of final energy consumption. Dependent on imported oil products, it faces risks from supply shocks and price volatility, lacking oil reserves.

Short-term strategies to boost energy resilience include developing oil stocks, securing long-term oil supply agreements, and introducing energy efficiency standards. Long-term solutions involve electrifying the transport sector to reduce GHG emissions, with plans already in place for electric public transport. For freight, Tajikistan could utilize its hydrogen potential if a hydrogen economy develops lacks flexible generating capacity. Its baseload capacity is dominated by large coal-fired power plants which cannot be rapidly powered up or down in response to large, unexpected fluctuations in demand as well as the intermittent nature of renewables. The shortage of flexible capacity is likely to become an increasing challenge as more intermittent renewables are added to the system.

Buildings

New and retrofitted buildings in Tajikistan must meet energy efficiency standards, reviewed every five years, and include metering in energy passports. Energy usage in multifamily dwellings is estimated to be double that of Germany, indicating high efficiency potential. However, implementation is hindered by deteriorating buildings, insufficient funding, lack of measures and legislation, and poor coordination among authorities.

The UNECE Action Plan for Energy-efficient Housing in the UNECE Region provides a framework to overcome barriers to energy efficiency investments and to move progressively toward a low energy and carbon neutral housing sector. energy systems, constructed during the soviet era, are largely interconnected with neighboring Russia, Uzbekistan, Tajikistan and Kyrgyzstan as well as China in the case of oil & gas.

Industry

In 2021, Tajikistan's industry sector accounted for 18.9% of energy GHG emissions and 24.0% of final energy consumption. Industry consumes 49.7% of energy produced by coal, 99.3% of energy produced by gas and 28.5% of total electricity supply. Coal is predominantly consumed in the non-metallic mineral subsector whilst most gas is used in the non-ferrous metal sub-sector.

TALCO, the largest electricity consumer and aluminum plant, uses 25-40% of Tajikistan's electricity. An audit revealed a potential energy saving of over 20%, but subsidized tariffs have discouraged investment in energy efficiency. Decarbonizing aluminum production, a challenging task, may benefit from long-term low- and zero-carbon technologies like CCUS and hydrogen.

District Heating

Efforts to enhance residential energy efficiency in Tajikistan are linked to district heating, available only in Dushanbe, home to 9% of the population. The expansion of district heating was needed due to a 200% increase in winter electricity demand, rising from 5 million kWh in summer to 15 million kWh and causing shortages. District heating is generated by burning coal (78%) and gas (22%) in the Dushanbe 1 and 2 co-generation plants. New buildings must connect to this system, and all radiators must be restored to use it. A third-co-generation plant is planned by 2030 to meet rising demand. While this reduces winter electricity shortages, it increases fossil fuel dependence, locking the residential sector into a high-carbon pathway.

Alternative Heating

District heating is not available outside of the capital, where 91% of the population resides. Consequently, as per the World Bank, 74% of households rely on coal or solid biomass (i.e., fuelwood) stoves as their main source of heat supply, followed by electricity (18%), boilers and CHS. The 2016 Household Energy Consumption Survey estimated that biomass consumption, notably fuelwood, was comparable to the total energy supplied by hydropower.

Thus, according to the WHO Tajikistan is among the 25 countries with the highest indoor air pollution morbidity rates, with ambient air pollution attributed to solid fuels being the third highest cause of death.

Key Takeaways:

1. Tajikistan's reserves of CRMs can be leveraged to ensure national security of CRM supply and to generate export revenue streams capable of promoting economic development under the green energy transition.

Critical Raw Materials

CRM Importance

Currently many countries are considering objectives to increase their self-sufficiency on critical raw materials (CRMs) which are prerequisites for a just energy transition, with renewable energy national targets of up to 30%. Many of these CRMs are now essential components in high-tech sectors. These components include rare earth metals, as well as other metals like lithium, indium, tellurium, gallium, and platinum group elements.

According to IEA: "today's supply and investment plans for many critical minerals fall well short of what is needed to support an accelerated deployment of solarpanels, wind turbines and electric vehicles/batteries."

CRM Reserves

Tajikistan is endowed with a plethora of critical raw materials which are crucial to the development of renewable energy. Indeed, Tajikistan ranks first amongst central Asian states in terms of reserves of lead and zinc and second in terms of antimony reserves. Additionally, deposits of non-ferrous and rare-earth metals in Tajikistan include aluminum, beryllium, copper, molybdenum, strontium tungsten and tin. The deposits of ferrous metals include iron ore and manganese.

Despite its vast mineral resources, many are not mined, or are mined primitively. However, as future demand for critical raw materials increases amidst developments in the global energy transition, Tajikistan's mining industry holds much untapped potential.

Tajikistan's Proven Reserves of Raw Materials Critical to the Manufacture of Renewable Energy Technologies

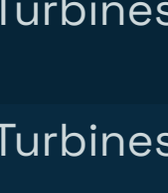
Critical Material	% of Proven Global Reserves	Uses (as Components)
Mnganese	11.0	Wind Turbines, EVs, Batteries/Storage
Lead	7.7	Solar Panels, Wind Turbines, EVs, Batteries/Storage
Aluminum/Bauxite	4.3	Solar Panels, Wind Turbines, Evs, Batteries/Storage
Zinc	2.7	Solar Panels & Wind Tubines
Iron Ore	0.1	Solar Panels, Wind Turbines, Ev's, Batteries/Storage
Copper	0.02	Solar Panels, Win Turbines, Evs, Batteries/Storage

Coal Mines & Just Transition

Coal currently significantly contributes to Tajikistan's energy mix. Nevertheless, recent hydropower developments, notably the Rogun HPP project, would limit Tajikistan's coal requirements. Thus, to ensure a just transition in energy and safeguard the livelihoods of those involved in Tajikistan's coal industry, alternative livelihood avenues must be established. Given that many coal mines in Tajikistan also contain substantial quantities of Critical Raw Materials (CRMs), repurposing these mines for CRM extraction could protect the interests of coal industry stakeholders, create new business opportunities and drive economic growth.

The United Nations Economic Commission for Europe's Group of Experts on Coal Mine Methane and Just Transition stands ready to assist Tajikistan in reducing and managing methane emissions from active, closed, and abandoned coal mines. They can also aid in repurposing existing coal mines to exploit their CRM resources while providing support for mine closures.

Policy options for Securing Access to CRMs in Tajikistan



Promoting Circular Economy

Fostering Innovation and Cooperation

Strengthening Governance and Transparency

Increasing Investment

Diversifying Primary Sources

Frameworks for CRM Management

UNFC UNFC and UNRMS play crucial roles in promoting the sustainable and responsible development of CRMs. Considering the intricate interplay between the production, utilization, and recycling of CRMs and their impact on society, the environment, and the economy, comprehensive systems like UNFC and UNRMS are imperative for effective and integrated natural resource management. Currently, the UN framework for resource classification (UNFC) is not applied in the Republic of Tajikistan. However, the UNECE reports that the organizations responsible for subsoil use in the Tajik republic are interested in adopting the UNFC in the future.