UNECE

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Energy Policy Brief : Kyrgyzstan

Executive Summary

Kyrgyzstan's economy is the second least emitting in the region, with a CO2 intensity of GDP roughly 12% higher than the global average. The Kyrgyzstan energy sector contributes to roughly 60%, 9.1 MT of CO2, of its total GHG emissions, where the residential energy consumption and the production of heat & electricity account for over 70% of energy sector GHG emissions. Thus, decarbonizing the Kyrgyzstan energy sector is crucial to achieving the country's ambitious carbon emissions reduction target under the Paris Agreement.

Fossil fuels, notably oil and coal, make up 72% of the country's total energy supply with the remaining 28% being composed of hydropower. Whilst fossil fuel consumption is primarily attributed to transport and heating, 85% of electricity is generated via hydropower. Yet, seasonal shortages caused by alternating river flows occur during the winter. Thus, to maintain energy security, coal consumption has been scaled up, now constituting 13% of total electricity generation. Kyrgyzstan has set plans to scale low-carbon deep electrification via the construction of the 1.9 GW Kambarata hydropower plant. Nevertheless, plans to introduce a 1.2 GW coal fired power plant highlight the country's increasing reliance on coal.

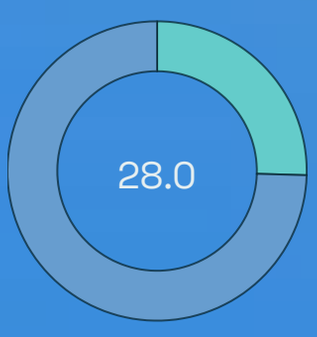
Consequently, to dampen coal reliance and attain its nationally determined contribution, Kyrgyzstan's 2018-2040 National Development Strategy outlines plans to increase renewable energy production, excluding large-scale hydropower, to 10% of the total energy supply by 2040. Hence, to allow for an increased integration of renewable energy and increase energy system resilience, the Central Asian region strengthen energy interconnectivity to enable parallel operations between neighbouring countries. An integrated regional power system would also enable Kyrgyzstan to overcome current seasonal electricity shortages and efficiently exploit summer surpluses in electricity production.

Kyrgyzstan's final energy consumption has roughly doubled in the last decade, growing by 104% between 2010-2021, especially in the residential sector which accounts for 64.5% of energy consumption. Hence, Investments in energy efficiency are essential. This is especially the case in the residential sector where technical energy savings potential of residential buildings is estimated at 90% and transitioning to
more efficient space heating would reduce energy and carbon intensity. Subsidized energy tariffs, however, act as a barrier to investments in energy efficiency, renewable energy production as well as transmission and distribution infrastructure refurbishments.

Although Kyrgyzstan's critical raw material resources are modest compared to other Central Asian countries, Kyrgyzstan's reserves of CRMs could possibly enable national economic development in line with the energy transition.

Tracking SDG 7

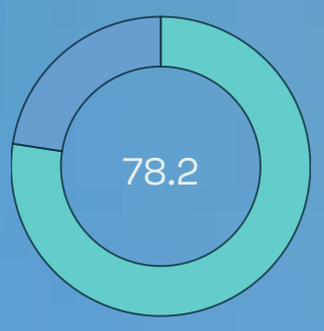
Ensure access to affordable, reliable, sustainable, and modem energy for all



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

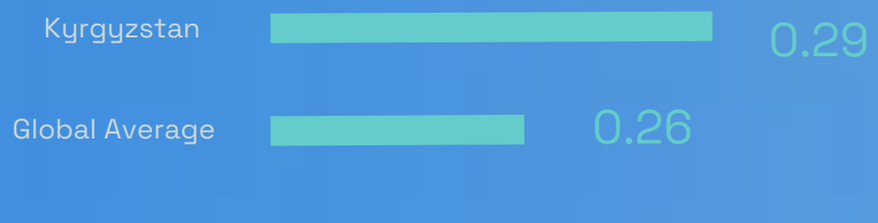
Access to Electricity
(% of population with access Year: 2021)

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

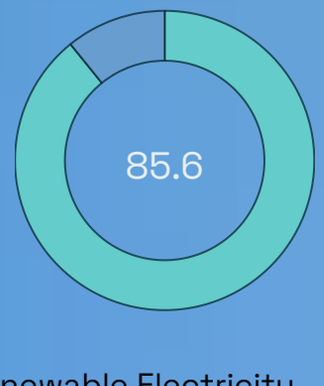


Access to Clean Cooking
(% of population with access Year: 2021)

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



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



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

Environmental and Energy Overview

Key Takeaways:

1. Kyrgyzstan's economy is the second least emitting in the region, with a CO2 intensity of GDP roughly 12% higher than the global average.
2. The Kyrgyzstan energy sector contributes to roughly 60%, 9.1 MT of CO2, of its total GHG emissions, where residential energy consumption and the production of heat & electricity account for over 70% of total GHG emissions.

Paris Agreement NDC

Unconditional Target: 16% reduction in GHG emissions by 2025-2030, relative to the "unconstrained greenhouse gas emissions scenario".

Conditional Target: Subject to international support Kyrgyzstan has pledged to a 36-44% reduction in GHG emissions by 2025-2030, relative to "unconstrained greenhouse gas emissions scenario".

Net Energy Exports

Kyrgyzstan has historically been an energy deficit nation, with net energy exports amounting to 40.6% of total energy supply in 2021.

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Carbon Neutrality Goal

Kyrgyzstan has not yet set carbon neutrality goals.

Pollution

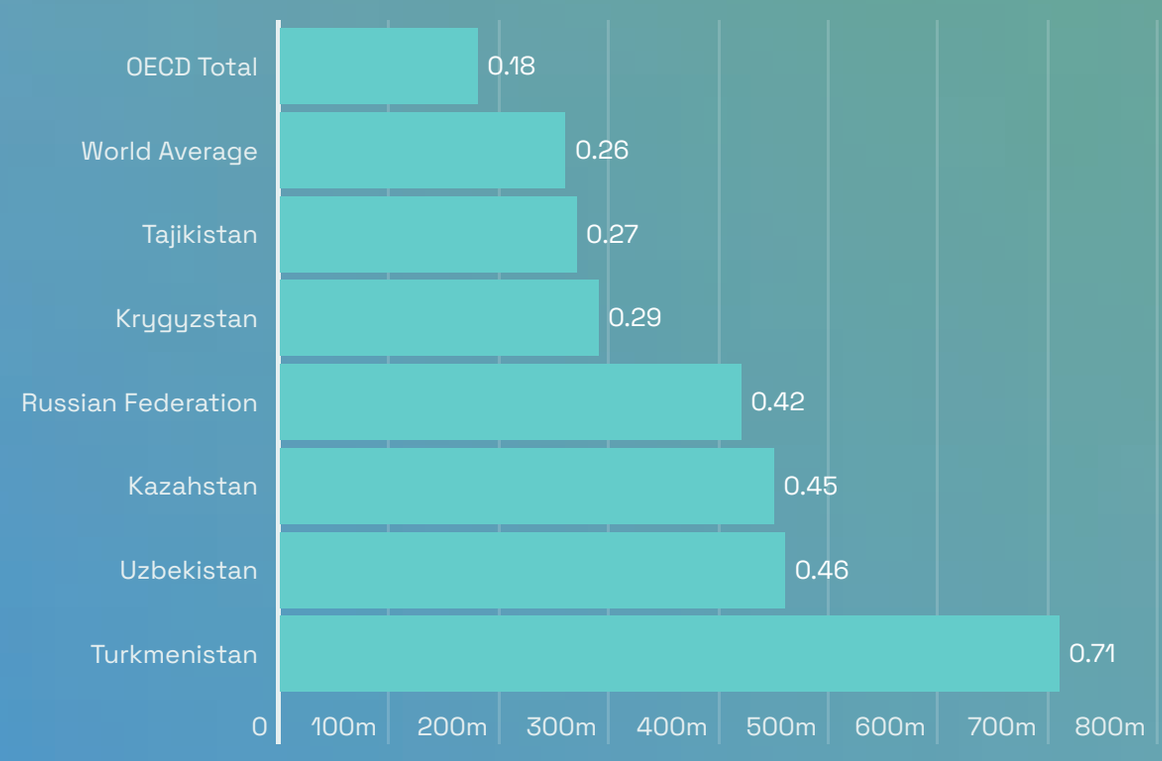
Methane emissions in energy sector (thousand metric tons of CO2 equivalent): 347.8 (2020)

Mortality rate attributed to household and ambient air pollution, age-standardized (per 100,000 population): 124.9 (2019)

PM2.5 air pollution, population exposed to levels exceeding WHO guideline value (% of total): 97.4 (2017).

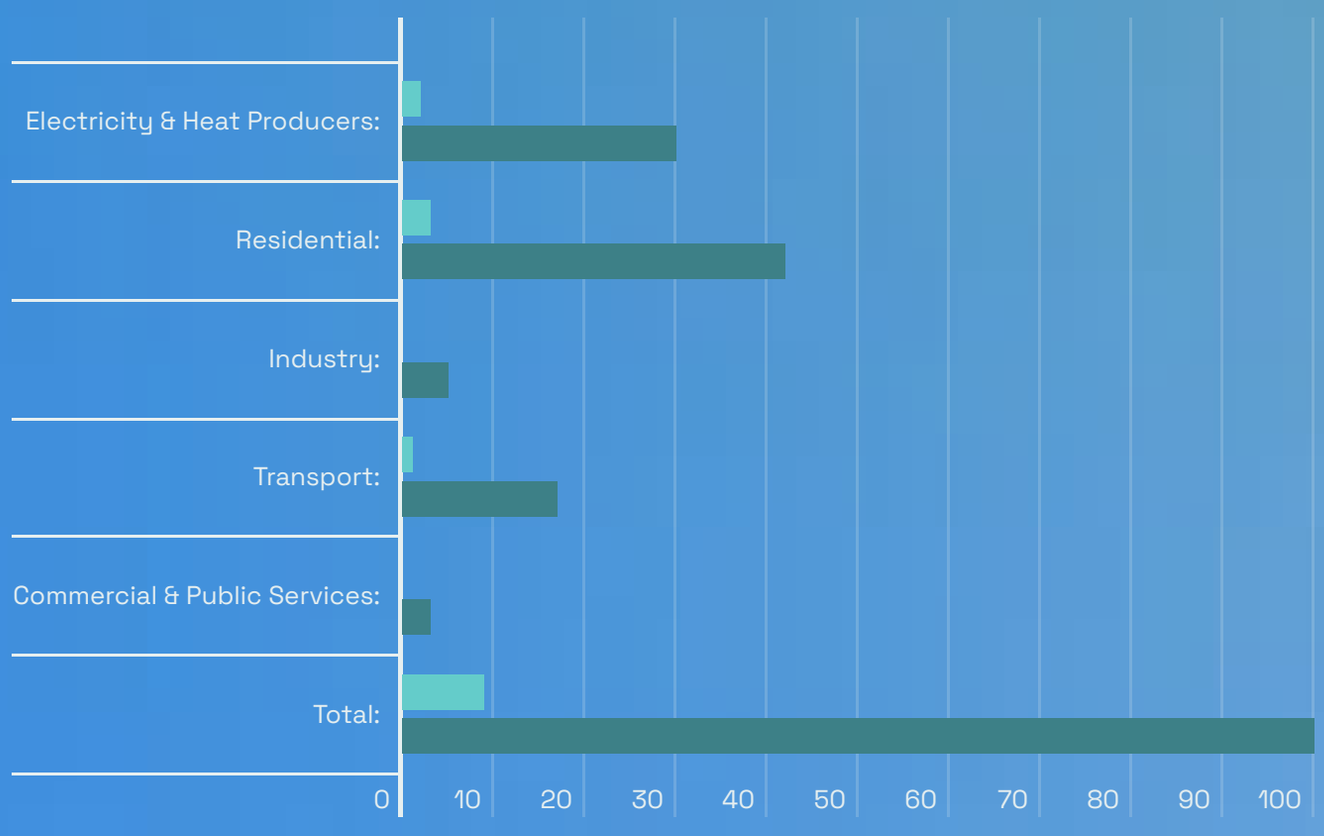
CO2 emissions per unit of GDP (PPP) - (Kg CO2/2017 USD$)

Kyrgyzstan's energy Intensity of GDP, 2021



The Kyrgyzstan energy sector accounts for roughly 60% of all greenhouse gas emissions in Kyrgyzstan.

Breakdown of the Energy GHG Emissions by Sector in 2021



Co2 Emissions (MT CO2)

Co2 Emissions by Sector, % of Total (MT Co2)

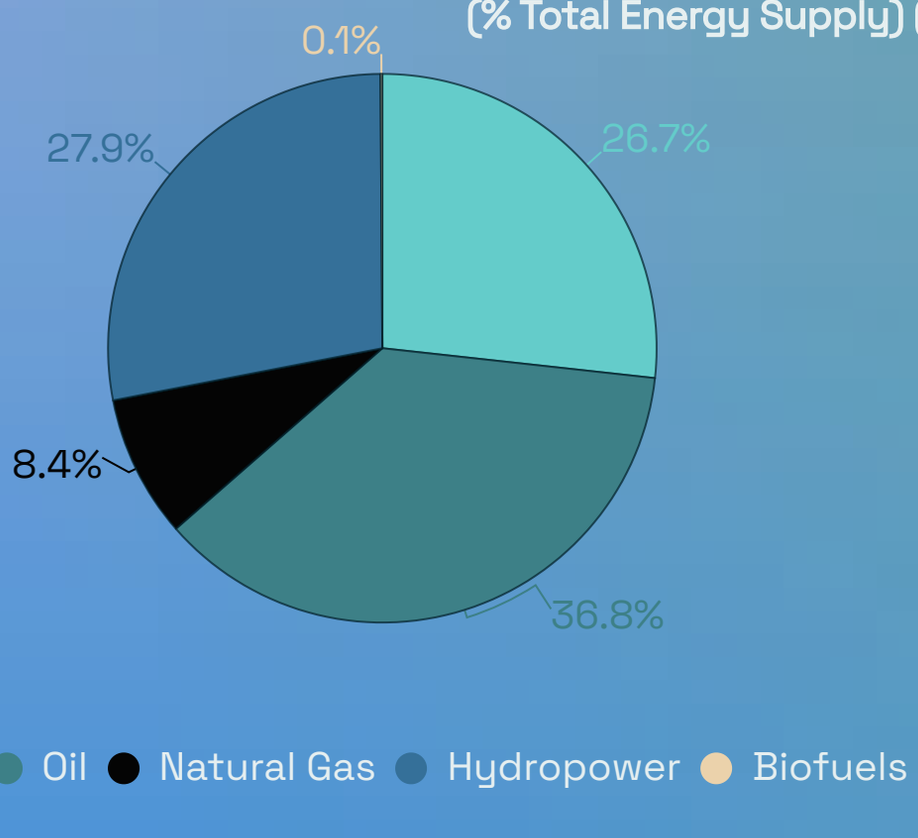
Key Takeaways:

1. Fossil fuels comprise 72% of Kyrgyzstan's energy mix, predominately oil (37%) and coal (28%)with hydropower accounting for the remaining 28%.
2. 85% of electricity generation is produced via hydropower. Yet, seasonal shortages stemming from alternating river flows occur during the winter. Thus, coal consumption has been scaled up, now constituting 13% of total electricity generation, to fill the gap.
3. Kyrgyzstan has set plans to scale low-carbon deep electrification via the construction of the 1.9 GW Kambarata hydropower plant. However, plans to introduce a 1.2 GW coal fired power plant highlight the country's increasing reliance on coal.

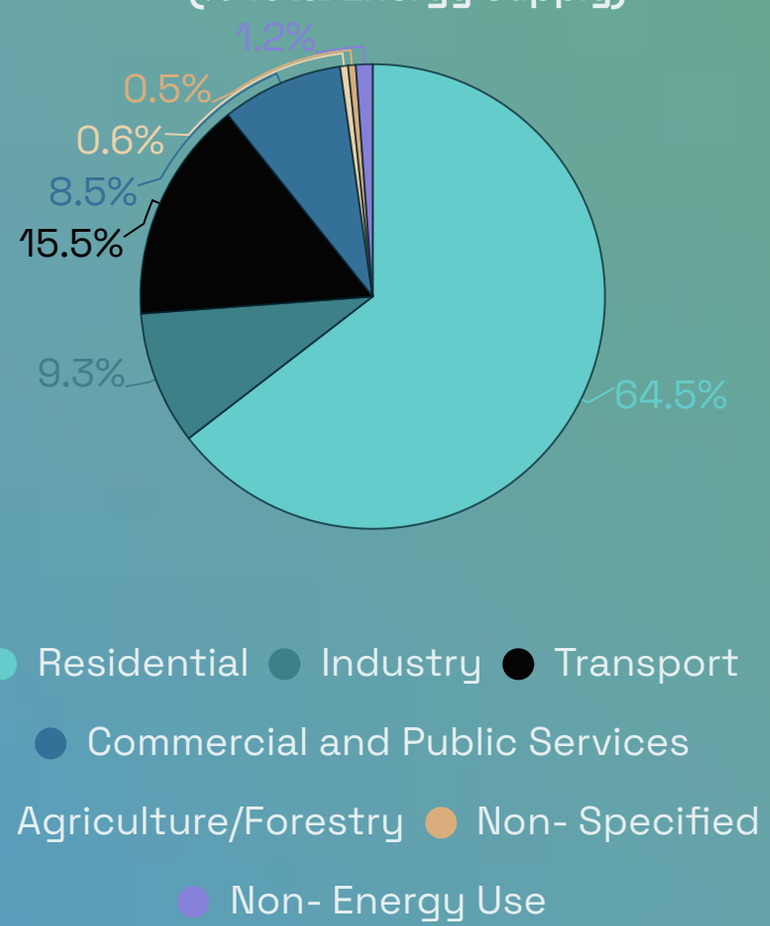
Current

Energy mix

Energy Supply (% Total Energy Supply) (GWh)



Total Energy Consumption by Sector (% Total Energy Supply)



Coal

- **Total Proven Reserves:** 5.7 billion tons in 2020.
- **Annual Coal Production:** 2.7 Mt in 2020.
- **Net Coal exports:** 1% of total coal production in 2021.
- **Exporting Countries:** Uzbekistan (95.6%), Tajikistan (4.0%), Kazakhstan (0.4%).
- **Trends:** No official coal vision has been made since 2015. The government plans to expand coal production to 3 Mt by 2025 and plans to build a 1.2 GW coal plant to generate baseload electricity.
- **Consumption by Sector:** Residential (61.8%), Industry (19.3%), Commercial & Public Services (17.5%) non-specified (0.8%), Agriculture/Forestry (0.6%) Emissions Contribution: 46.2% in 2021.

Oil

- **Total Proven Reserves:** 40 million barrels, 2.2 million tons in 2020.
- **Annual Oil Reserves:** 88.5 Mt in 2020 of which 11.2 Mt are recoverable.
- **Domestic Annual Production** 0.24 million tons in 2020.
- **Domestic Annual Consumption:** 40 thousand barrels a day, 14,600,000 barrels annually in 2021.
- **Oil Produts Imports** 89% of final consumption in 2021.
- **Crude Oil Export:** 1.5% of total crude oil production in 2021.
- **Import Countries:** Russia (95%), Kazakhstan (2%) .

  Emission Contribesidential: 46.1% in 2021.

  Oi-Products Secoral Consumption: Residential (56.9%), Transport (38.0%), Non- Energy Use (2.9%), Industry (1.8%), Commercial & Public Serbices (0.4%).

Gas

- **Domestic Reserves:** 6 billion cubic meters (bcm) in 2021.
- **Domestic Annual Production:** 22 million cubic meters (mcm) in 2020

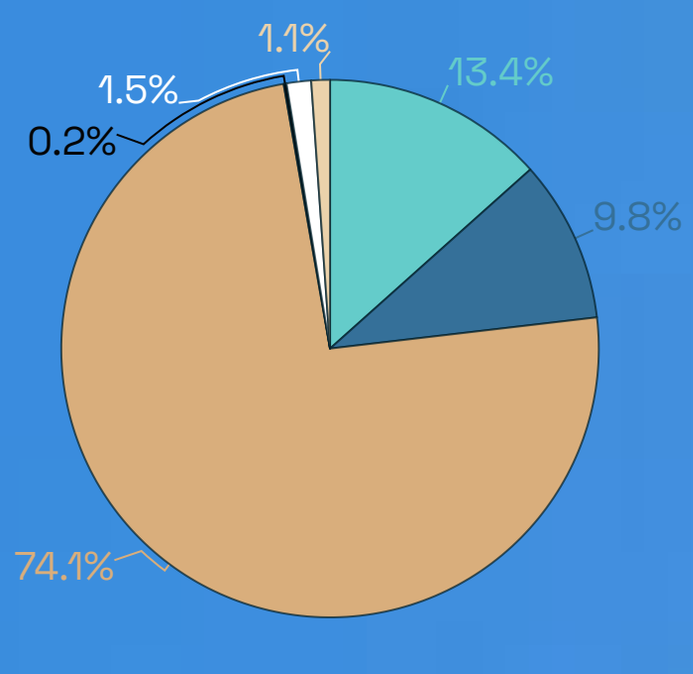
  Domestics Annual Consumption: 340 mcm in 2020
- **Net Gas imports:** 93.8% of supply, 318 mcm, in 2020
- **Importing Countries:** Russia (75.3%), Kazakhstan (14.4%),Uzbekistan (10.2%)
- **Emissions Contribution:** 9.1% in 2021

  Consumption by Sector: Residential (71.5%), Industry (23.5%), Commercial & Public Services (5.0).
- **Gas Network:** In 2013, Kyrgyzstan sold its gas network to Gazprom for 1$, as it couldn't finance necessary rehabilitation.
- **Gas Developments:** Decreasing production due to gas field depletion and infrastructure deterioration.

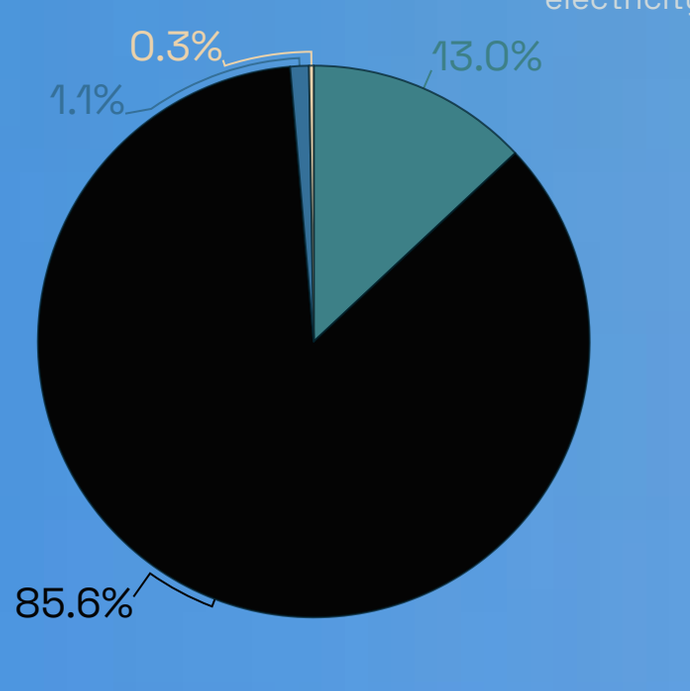
Electricity

- **Installed Capacity:** 3.9 GW: Hydropower 3.03 GW, Thermal 0.86 GW.
- **Electricity Production:** 15.1 TWh in 2021.
- **Price:** Industry: $0.06/kWh;
- **Households:** $0.01/kWh or: $0.03/kWh if consumption exceeds 700 kWh.
- **Net Imports:** 8.8% of electricity supply, 1.1TWh, in 2021.
- **Importing Countries:** Turkmenistan (88.6%), Tajikistan (10.6%), Kazakhstan (0.8%).
- **Supply & Demand Trends:** Wintertime shortages and summertime surpluses due to hydropower generation dependence on seasonal river flow.
- **Transmission & Distribution loses:** 18.0% in 2020.
- **Electricity Developments:** New generating capacity and modernization of networks is needed to address electricity supply shortages. No clearly defined long-term policy for electricity development.

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



Electricity Generation by Source (% Total Electricity Generation)



Key Takeaways:

1. Kyrgyzstan's 2018-2040 National Development Strategy outlines plans to increase renewable energy production, excluding large-scale hydropower, to constitute 10% of the total energy supply by 2040.
2. Subsidized energy tariffs, however, act as a barrier to investments in renewable energy as well as transmission and distribution infrastructure refurbishments.

Low-carbon Energy

Energy Tariffs

Except for industry, where tariffs have significantly increased since 2015, electricity and heating tariffs in Kyrgyzstan fall short of cost recovery and generation. Consequently, exacerbated by decreasing energy export revenue, the power and heating sectors suffer from insufficient cash flow to fund necessary maintenance and refurbishment or to finance necessary investments in alternative energy sources and district heating in a timely and efficient manner. Additionally, due to low prices, consumers are disincentivized to invest in end-use energy efficiency improvements.

Although large residential and industrial consumers pay higher tariffs to cross-subsidize residential consumption, cross-subsidies remain insufficient for full cost recovery. Indeed, residential consumption accounts for nearly 65% of total final energy consumption, and driven by low tariffs, has increased by a multiple of 11.6 since 2000 and is expected to keep on growing.

Modern Tarriff Methodology & Just Transition

Consequently, a new tariff methodology is required to incentivize investment into the energy sector whilst simultaneously not burdening the livelihoods of the population of Kyrgyzstan. Thus, subsidies should be gradually phased off for all consumers to enable cost recovery and stimulate necessary investment into the energy sector. Yet these must also be accompanied with support mechanisms for Kyrgyszstan's most vulnerable groups.

Technologies Potential

Hydrogen

Hydrogen Production Potential (Thousand Tons per Annum): Minimum Scenario: 5, Maximum Scenario: 145

Potential Hydrogen Costs

Green Hydrogen: $6 per kg of Hydrogen at an electricity price of $0.1 per kWh. $2.5-3 per kg of Hydrogen with current electricity tariffs of $0.03/kWh.

Potential Consumption

Transport: Accounts for 15.5% of total final energy consumption and is hard to abate.

Seasonal low-carbon energy storage systems based on hydrogen: Dampens intermittent hydropower and renewable electricity generation.

Solar

Average Theoretical Solar Potential: 4.1 kWh/m2

Average Annual Duration of Sunshine: 2,600/8,760 hours PV Coverage Needed to Supply Current Electricity

Demand: 0.055% % of the country's toerritory.

LCOE Costs: Estimated at $0.1/kWh.

Current Projects: Small local producers, NEW-TEK LLC, operate with a total annual production capacity of 50 MW.

Bioenergy

Bioenergy Potential: 2.7 TWh annually.

Barriers: High costs and low conversion efficiency relative to fossil fuels as well as a nonexistent bioenergy supply chain.

Current Use: 70 biogas plants operate at small farms and in rural homes.

Wind

Wind Potential: 2 TWh annually.

Total Technical Feasibility: 140 GWh/2TWh

Average Wind Speed: In residential areas average wind speeds do not exceed 2.5 m/s, Steady speeds of 4 m/s are observed on watershed far from centralized energy grids.

Barriers: Remoteness of ideal locations to the central grid.

Areas for Development: Deploying small wind farms close to local electricity consumers.

Current Developments: Sporadic projects involving low-power turbines (5-6 kW) for autonomous consumption have been introduced.

Large Hydropower

Technical Hydropower Potential: 18.5 GW of capacity or 142 TWh annually

Current Consumption: 10% of the country's technical potential is exploited.

Total Energy Supply: 13.0 TWh in 2021

Total Installed Capacity: 3.03 GW

Generation Constraints: Regional river flow regulation and water use for irrigation.

Current Developments: The government plans to increase hydropower capacity by 1.9 GW with the addition of the Kambarata hydropower plant. It is expected that the plant will have an electricity output of roughly 6 TWh/year.

Small Hydropower

Technical Potential: 1.6 GW

Annual Generation Potential: 5-8 TWh

Current Production: 245.9 GWh.

Current Installed Capacity: 53.8 MW

Sites for Development: River basins adjacent to the rivers of Chu, Talas, Naryn, Sary-Jaz, Karadarya, Syrdarya the Lake Issyk-Kul

CCUS

No current data on Kyrgysztan's CCUS potential is available.

Key Takeaways:

1. Investments in developing integrated energy systems and regional electricity interconnectivity can help Kyrgyzstan overcome seasonal electricity shortages and efficiently exploit summer surpluses in electricity production.
2. Interconnectivity would enhance the resilience of the regional energy systems by enabling parallel operations, while allowing for an increased integration of renewable energy.

Energy Interconnectivity

Security of Supply

Kyrgyzstan's energy security is threatened by hydropower's susceptibility to seasonal water fluctuations and the regional water-energy nexus as well as by aging and inefficient transmission infrastructure. Consequently, the government has focused on diversifying energy production and rehabilitating thermal and hydropower stations as well as transmission networks. Yet, energy security can be further addressed by investing in the Central Asian power system and energy interconnectivity.

Integrated Energy Systems

As illustrated in the figure below , Kyrgyzstan's power system, constructed during the Soviet era, is integrated with the Central Asian Power System (CAPS) via neighbouring Kazakhstan, Uzbekistan, and Tajikistan consequently enabling the flow of electricity between member states during surpluses and shortages in electricity supply.

In 2021, Kyrgyzstan exported 300 GWh of electricity to Kazakhstan and 246 GWh to Uzbekistan. In turn, Kyrgyzstan imported 681 GWh from Kazakhstan, 504 GWh from Uzbekistan and 498 GWh from Turkmenistan.

Map of regional electricity interconnection

Source: USAID (2015), Central Asia Electric Grid.

Benefits of Interconnectivity

1) Increase efficiency of electricity markets by optimizing the use of primary energy resources.

2) Increase reliability and efficiency of the respective power systems by sharing reserves and emergency support.

3) Improve conditions for integrating ever-increasing volumes of unstable RES-based generation.

Harmonizing Water Supply

Furthermore, regional integration is imperative because river flow regulation and agricultural water use in Kyrgyzstan, Tajikistan, Uzbekistan, and Kazakhstan have implications on Tajikistan's and Kyrgyzstan's hydropower output. Thus, cementing the importance of the CAPS within the region would increase the level of mutual trust and cooperation between member states and consequently realign national interests towards maximizing hydropower efficiency, output and trade.

CASA - 1000

The Central Asia Electricity Transmission and Trade Project (CASA-1000) aims to help Tajikistan and Kyrgyzstan export surpluses of electricity in the long run during the summer to neighbouring Kazakhstan, Uzbekistan, Afghanistan and Pakistan (funded by the World Bank).

Under this project, 500 kV DC facilities are being constructed in Tajikistan, Afghanistan and Pakistan, and the 500 kV AC energy systems of Kyrgyzstan and Tajikistan are being interconnected with the construction of the 500 kV Datka-Khujandt overhead line.

When operational, the transmission network will integrate the power systems of Central and South Asia via the creation of a regional electricity market and enable parallel operations, mutually increasing energy system resilience.

Transmission Challenges

Transmission losses have been a longstanding issue in Kyrgyzstan. In 2010, transmission losses amounted to 28%, and despite commendable progress of almost thaving losses in 10 years, due to significant investment in retrofitting transmissions lines, transmission losses in 2020 amounted to 18%. Hence, grid refurbishment is urgent and significantly important for interconnectivity with neighbouring countries to mitigate the risks of interregional power blackouts, such as those which affected the Kazakhstan, Kyrgyzstan and Uzbekistan systems in 2022.

UNFCCC 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 energy system resilience.

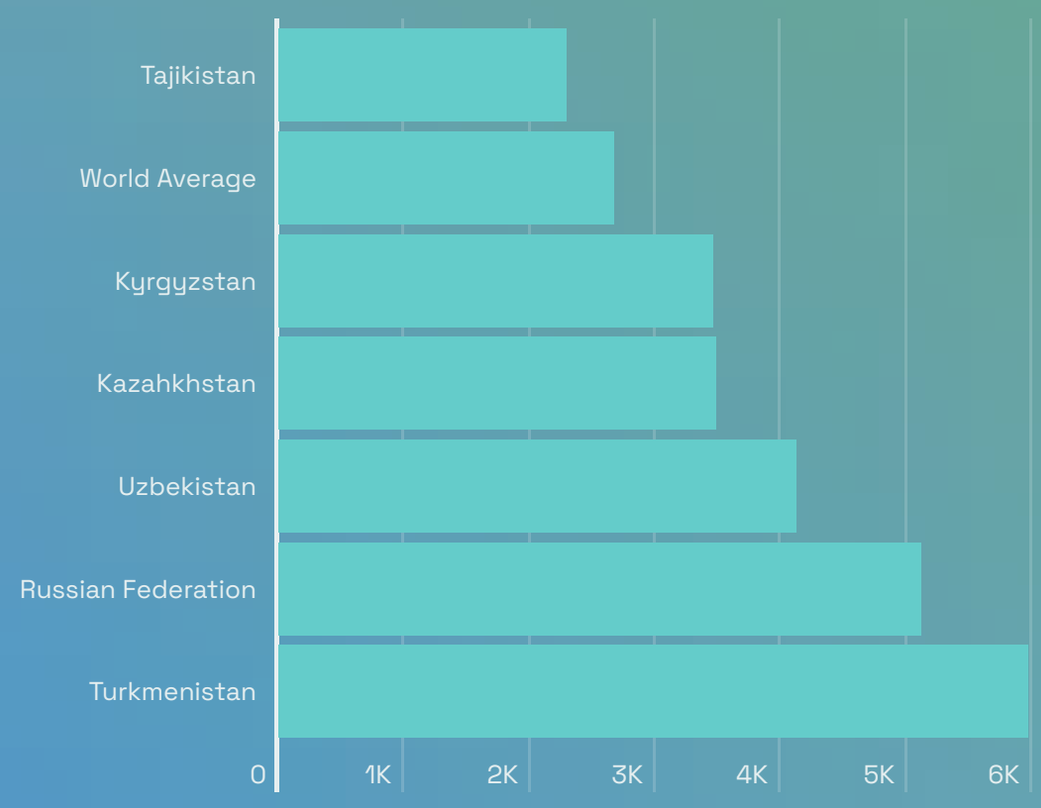
Energy Efficiency

Key Takeaways:

1. Kyrgyzstan's final energy consumption has roughly doubled in the last decade, growing by 104% between 2010-2021, especially in the residential sector which accounts for 64.5% of energy consumption.
2. Whilst electricity consumption per capita is low, around 40% below the global average, Kyrgyzstan's energy consumption per unit of GDP is roughly 30% greater than the world average.
3. Improvements in energy efficiency are essential. The technical energy savings potential of residential buildings is estimated at 90%. Additionally, transitioning to more efficient space heating would reduce energy and carbon intensity.

Kyrgyzstan's Energy Intensity of GDP, 2021

Energy Intensity (MJ/thousand 2015 USD)



Transport

Kyrgyzstan's transportation sector accounts for 15.5% of total final energy consumption and 17.6% of the nation's GHG emissions, with rising vehicle ownership over the past decade. The sector holds an estimated annual energy savings potential exceeding 40%. However, apart from imposing higher duties on the imports of older vehicles, there are currently no policies aiming to enhance energy efficiency within Kyrgyzstan's transport sector. Such policies could include import bans on inefficient vehicles, fuel economy standards, or strategies related to public transport. Additionally, developing a national electric vehicle and hydrogen strategy could enable pathways to decarbonizing transport.

Residential

The residential sector accounts for 64.5 % of energy consumption 74.1% of electricity consumption and 42.9% of greenhouse gas emissions. Most buildings have been constructed during the Soviet era and are energy inefficient. The technical energy savings potential of the country's residential buildings, including the installation of efficient appliances, has been estimated at nearly 90% of the sector's annual consumption. Yet, despite the presence of a legislative framework, few coordinated efforts to improve building efficiency, particularly regarding aging buildings, have been adopted and minimum efficiency performance standards are often not enforced during construction.

Additionally, transitioning to more efficient space heating could reduce residential energy and carbon intensity. Indeed, only 17% of residential buildings are connected to district heating, which, due to financial constraints associated with low tariffs, lacks investment in its maintenance and expansion and is consequently aging and inefficient. Average losses associated with district heating amounted to 25% in 2020. The remaining 83% of residential buildings predominantly rely on coal, followed by wood and dung and are consequently susceptible to the significant health risks associated with indoor air pollution derived from their combustion.

Industry

Industry contributed 9.3% of total final energy consumption and 5.5% of the nation's GHG emissions in 2021. Its estimated annual energy efficiency potential amounts to roughly 11% of annual energy consumption. Standards for new industrial-consuming equipment, such as pumps and motors, have been introduced. Yet, there are no measures to replace existing inefficient equipment or to incentivize industrial energy management systems. Tariff for industrial energy consumers have increased by 70% since 2015, nevertheless there is currently no data evaluating efficiency gains correlated to tariff increases.

Critical Raw Materials

Key Takeaways:

1. Although Kyrgyzstan's critical raw material resources are modest compared to other Central Asian countries, Kyrgyzstan's reserves of CRMs could possibly enable national economic development in line with the energy transition.

CRM Importance

Currently many countries are considering objectives to increase their self-sufficiency in 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 solar panels, wind turbines and electric vehicles/batteries."

Kyrgyzstan's Proven Reserves of Raw Materials Critical to the Manufacture of Renewable Energy Technolgoies

Critical Material	Metric Tons	Uses (as Components)
Aluminum/Bauxite	42,101,00	Solar Panels, Wind Turbines, EV's, Batteries/Storage
Copper	640,000	Solar Panels, Wind Turbines, EV's, Batteries/Storage
Iron Ore	549,000	Solar Panels, Wind Turbines, EV's, Batteries/Storage
Tin	186,761	Solar Panels
Lead	41,000	Solar Panels, Wind Turbines, EV's, Batteries/Storage
Zinc	24,000	Solar Panels & Wind Turbines
Lithium	13,923	Batteries/Storage
Molybdenum	2,523	Wind Turbines
Tellurium	1,524.5	Solar Panels
Silver	672	Solar Panels
Cobalt	373	Wind Turbines

CRM Resources in Kyrgyzstan

Currently, Kyrgyzstan focuses on the production of silver and copper, respectively producing 14.5 and 7,200 metric tons per annum. Although Kyrgyzstan's reserves of mineral resources are modest compared to other countries in Central Asia, it still has moderate to high geological potential for large-scale mining of critical materials for clean energy technologies. Indeed, as seen in the table below , Kyrgyzstan has reserves of manganese, chromium, lead, zinc, aluminum, copper, iron, tin, indium, lithium and graphite.

Coal Mine and Just Transition

Coal currently significantly contributes to Kyrgyzstan's energy mix. Nevertheless, future hydropower and renewable energy developments, notably the 1.9 GW Kambarata HPP, would limit Kyrgyzstan's coal requirements. Thus, to ensure a just transition in energy and safeguard the livelihoods of those involved in Kyrgyzstan's coal industry, alternative livelihood avenues must be established. Given that many coal mines in Kyrgyzstan also contain modest 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 UNECE Group of Experts on Coal Mine Methane and Just Transition stands ready to assist Kyrgyzstan in reducing and managing methane emissions from active, closed, and abandoned coal mines. They can also aid i repurposing existing coal mines to exploit their CRM resources while providing support for mine closures.

Frameworks for CRM Management

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. These frameworks should be adopted by Kyrgyzstan to harness their natural resources potential whilst diminishing negative externalities associated with mining.

Policy options for Securing Access to CRMs in Kazahstan

- Promoting Circular Economy
- Fostering Innovation and Cooperation
- Strengthening Governance and Transparency
- Increasing Investment
- Diversifying Primary Sources

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