**Session 6: Enhancing Regional Power Trade in Central Asia:
Role of Regional Integration and Cooperation**

# Renewable Energy in Central Asia:
# Current Role and Possibilities for Regional Cooperation

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**ADB & CAREC Institute Workshop:
Achieving Energy Security in Central Asia: Role of Renewable Energy**

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## Outline

CA Economies Energy Profiles

Role of RE in Electricity Generation in Central Asia

International Cooperation for Strengthening Energy Security in CA

# CA Economies' Energy Profiles

# CA Economies' Energy Profiles

- Hydrocarbon resources are significant in Kazakhstan (oil; main importer - EU) and Turkmenistan (natural gas; main importer – China). Both are actively pursuing the options for export diversification.
- Very poor in fossil fuels, Kyrgyzstan and especially Tajikistan are enormously endowed by hydro resources.
- However, both Kyrgyzstan and, especially, Tajikistan suffer from shortage of electricity in winter and surplus of it in summer. Obstacles to intra-regional cooperation originate in water disputes with energy-rich downstream Turkmenistan, Uzbekistan and Kazakhstan, which need irrigation water in summer for their agriculture.
- Unsettles cross-border relations between Uzbekistan and Kyrgyzstan and Uzbekistan and Tajikistan also affect energy security. Owing to Uzbekistan's changed attitude towards bilateral border issues, the prospects for regional cooperation have been improving since 2017.
- Energy-water-food and border tensions facilitated disintegration of CA United Power System (CAPS) following the withdrawal of Turkmenistan (2003) and de facto departure from it by Uzbekistan (2009). This resulted in Tajikistan being cut off the CAPS (2009).

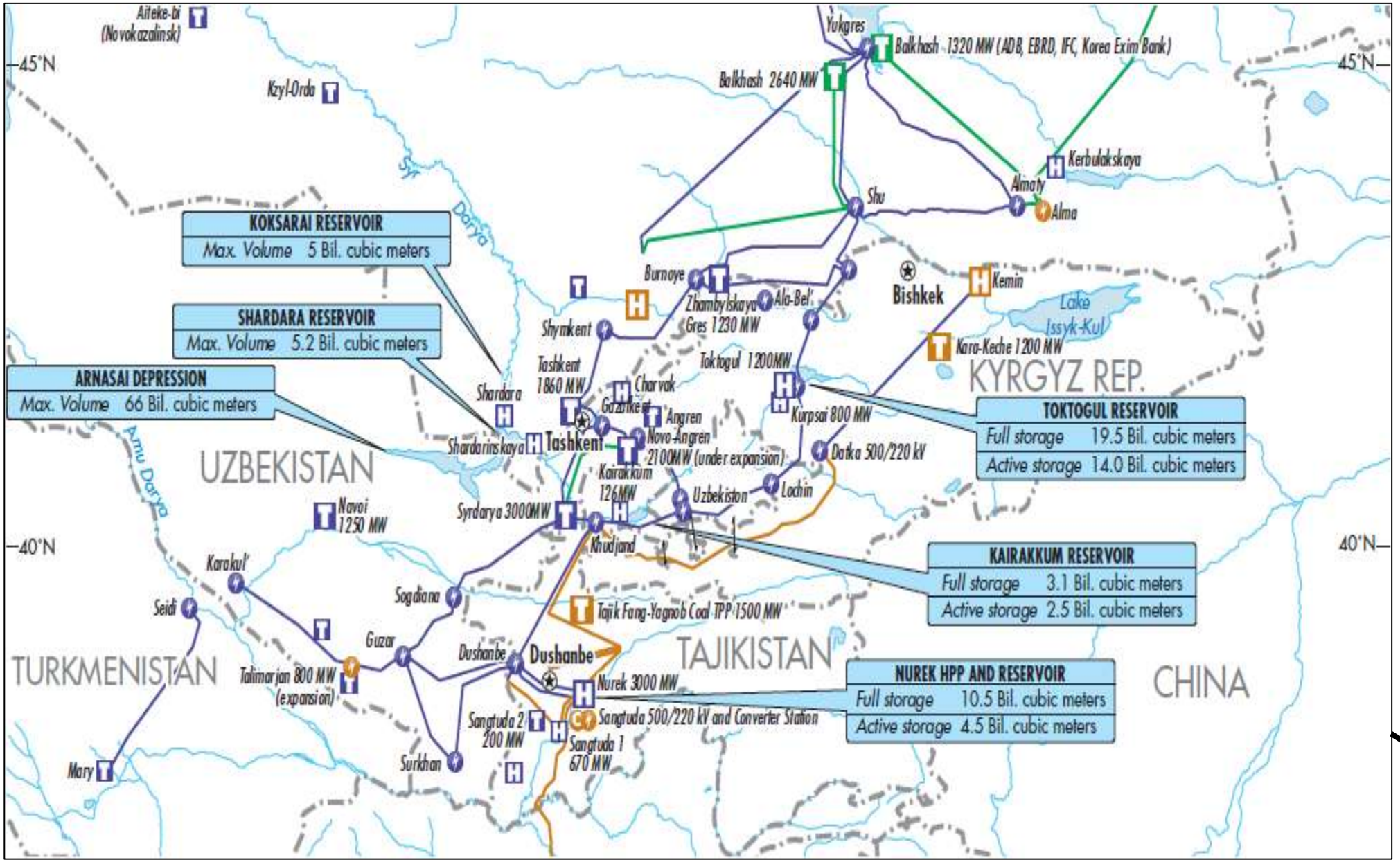

Source: http://www.casa-1000.org/MainPages/CASAAbout.php#objective and CIA.

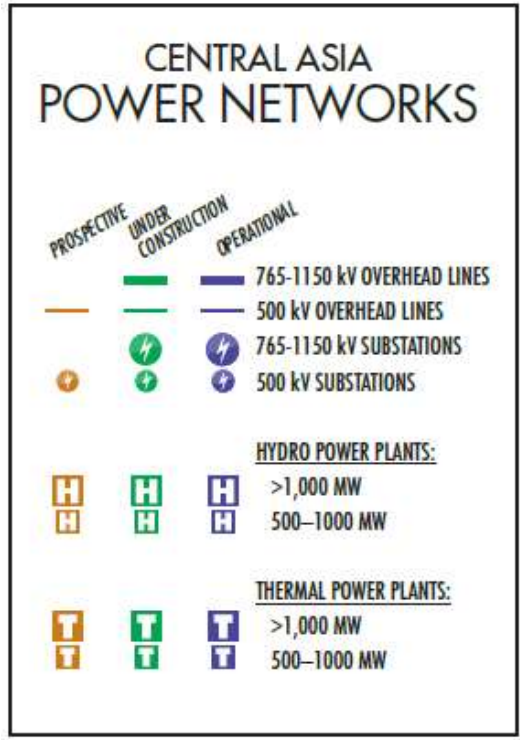

The Naryn and the Amu Darya rivers have potential to satisfy abundant hydropower to Kyrgyz R. and Tajikistan.

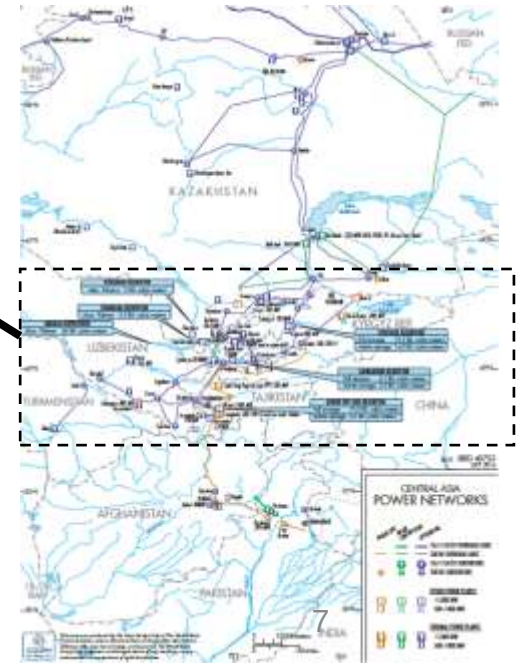
Moreover, these hydro resources feed the water systems of other Central Asian nations.

Dependency on transboundary water is the highest in Turkmenistan – 94%. Uzbekistan's dependency is 77% and Kazakhstan's is 42%.

Source: http://pubdocs.worldbank.org/en/830314526786336662/aral-sea-basin-large.pdf



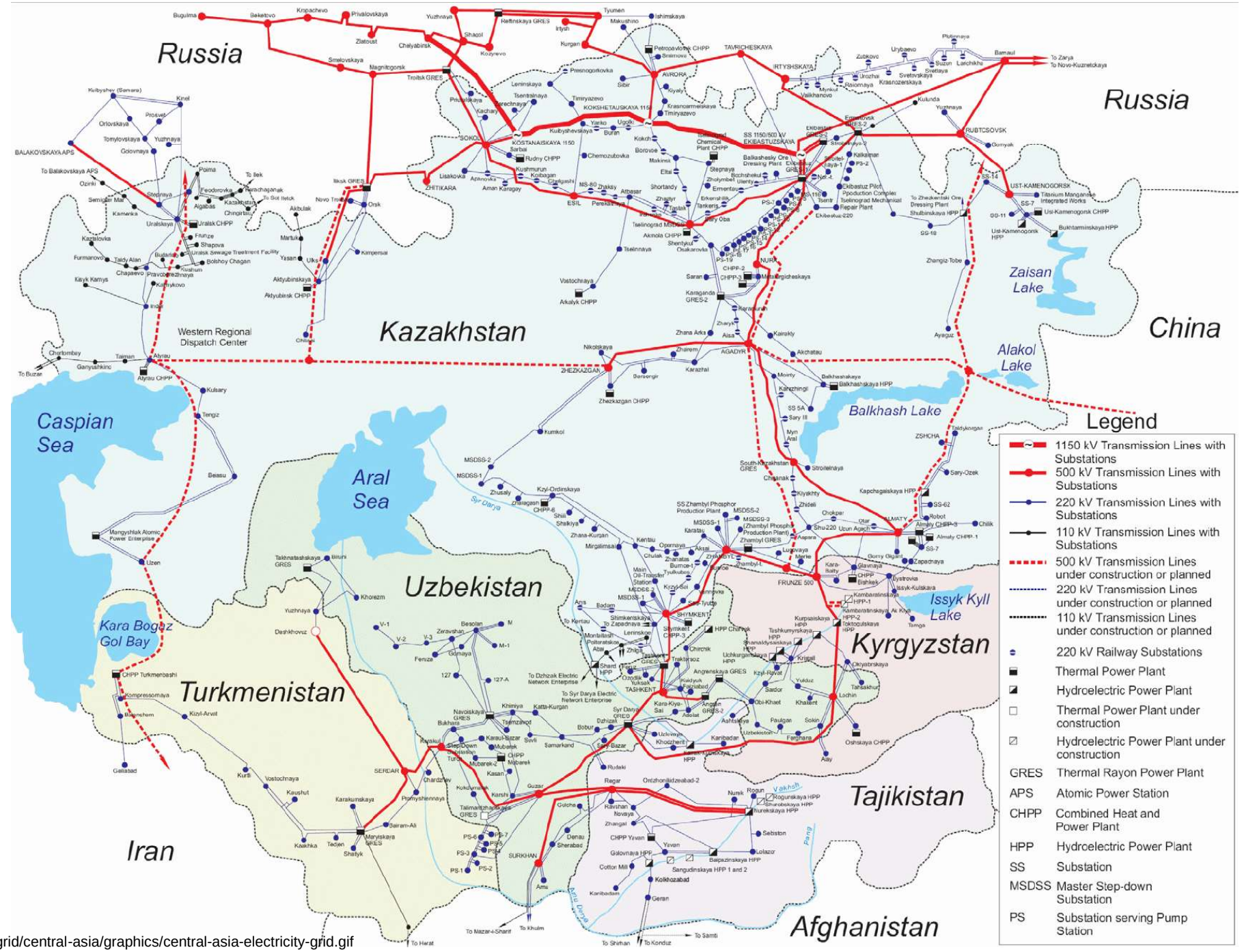
Hydropower potential in the upstream countries of Tajikistan and Kyrgyz R. is significant. Abundant hydropower can help meet all countries' electricity needs on a seasonal basis.

Source: http://www.worldbank.org/content/dam/Worldbank/Brief/Europe%20and%20Central%20Asia/central-asia/CAS407531.pdf

## Central Asian Power System

Three CA remain connected through CAPS: Kazakhstan, Uzbekistan and Kyrgyz R.

After Turkmenistan broke away from CAPS in 2003 and Uzbekistan refused either transit electricity or continue electricity-in-summer for gas-in-winter format (2009, 2012), Tajikistan found itself disconnected.



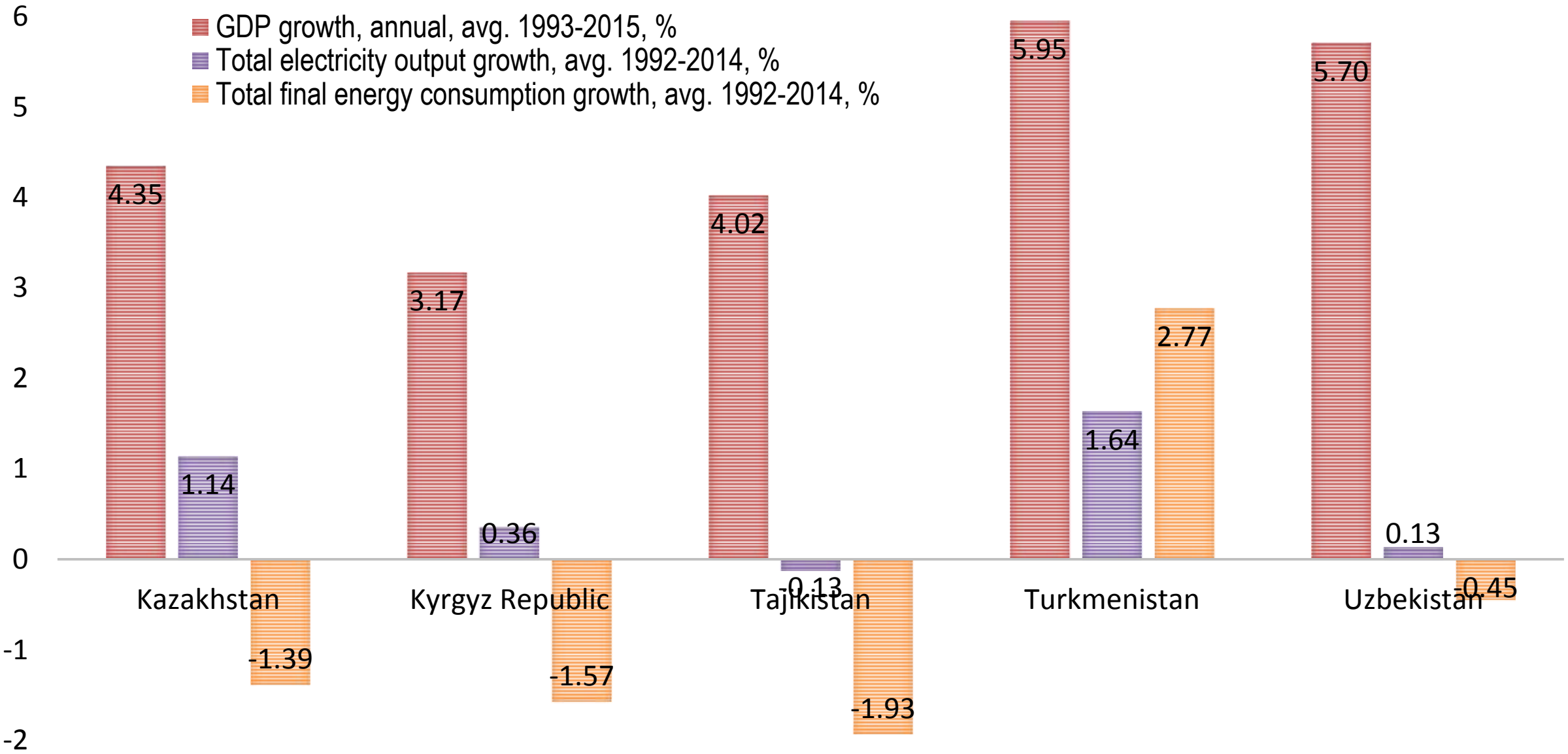

Source: http://www.geni.org/globalenergy/library/national_energy_grid/central-asia/graphics/central-asia-electricity-grid.gif

# Central Asian Economies' Profiles, 2016 (2014)

| | Kazakhstan | Kyrgyz Republic | Tajikistan | Turkmenistan | Uzbekistan |
|---|---|---|---|---|---|
| **Population, mn** | 17.8 | 6.08 | 8.73 | 5.57 | 31.85 |
| **Population growth, %** | 1.43 | **2.09** | **2.16** | 1.73 | 1.74 |
| **GDP growth, %** | 1.10 | 3.88 | 4.62 | **6.20** | **7.80** |
| **GDP per capita growth, %** | -0.32 | 1.73 | **6.90** | 4.38 | **5.94** |
| **Fossil fuel energy consumption, % of total** | **99.17** | 69.30 | 54.90 | n/a | **97.74** |
| **Renewable energy consumption, % of total final energy consumption** | 1.36 | **28.25** | **40.71** | 0.04 | 2.87 |
| **Alternative and nuclear energy, % of total energy use** | 0.93 | **30.13** | **49.06** | 0 | 2.32 |
| **Combustible renewables and waste, % of total energy** | 0.03 | 0.08 | 0 | 0 | 0.01 |
| **Energy use, kg of OE pc** | **4,434.40** | 650.40 | 335.39 | **4,893.49** | 1,419.48 |
| **Energy use , kg of OE per $1,000 GDP (constant 2011 PPP)** | 188.01 | 204.42 | 131.70 | **341.43** | **280.12** |
| **GDP per unit of energy use, PPP $ per kg of OE** | 5.32 | 5.14 | **7.98** | **14.29** | 3.69 |
| **GDP per unit of energy use, constant 2011 PPP $ per kg of OE** | **5.39** | 4.89 | **7.59** | 2.93 | 3.57 |
| **Energy intensity level of primary energy, MJ/$2011 PPP GDP** | 7.60 | 8.60 | 5.51 | **14.29** | **11.18** |
| **Energy imports, net (% of energy use)** | **-116.89** | 49.54 | 36.25 | **-191.51** | -26.16 |

Source: WB Database.

# Central Asian Economies' Growth – Energy, average growth 1992(3)-2014(5), %




Source: computed based on WB Database.

# Trends in CAs' Energy Profiles in 1990-2014

- Kazakhstan is the largest economy in terms of electricity output and total final energy consumption (TFEC), followed by Uzbekistan and Turkmenistan. The latter demonstrated the most notable increase.
- Central Asian economies exhibit dissimilar shifts in the patterns of electricity output and TFEC.

**Electricity output**

- Kazakhstan recovered to its 1990 level in 2010 and in 2014 had a growth of around 20% against 1990.
- Kyrgyzstan's electricity output had been fluctuating and in 2014 was still under its 1990 level.
- Tajikistan's output did not experience much volatility, but yet remains under its 1990 level.
- Turkmenistan overcame its 1990 level in 2007 and by 2014 increased electricity output by 40% against its 1990 level.
- Uzbekistan experienced lowest electricity output in 1999, which was nearly 20% less than in 1990, but since then gradually recovered and as of 2014 had output comparable to its 1990 level.

**TFEC**

- Based on WB data, in 2014 Kazakhstan's TFEC was at around its 1996 level.
- Kyrgyzstan and Tajikistan had TFEC close to their levels back in 1993.
- Turkmenistan increased TFEC by over 40 % compared to 1990 level.
- Unlike other CA economies, Uzbekistan did not see significant fluctuations throughout 1990-2014.

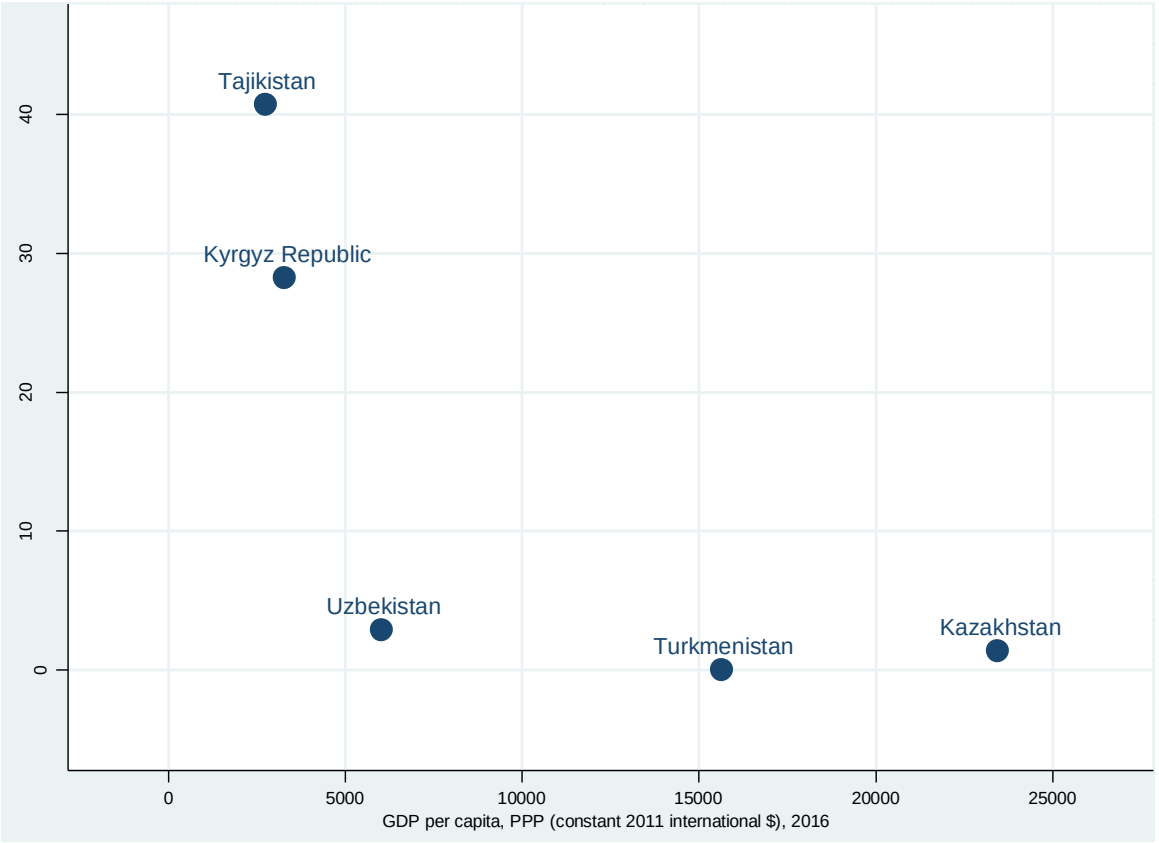
# Role of RE in Electricity Generation in Central Asia

# RE in Central Asian Economies, 2014

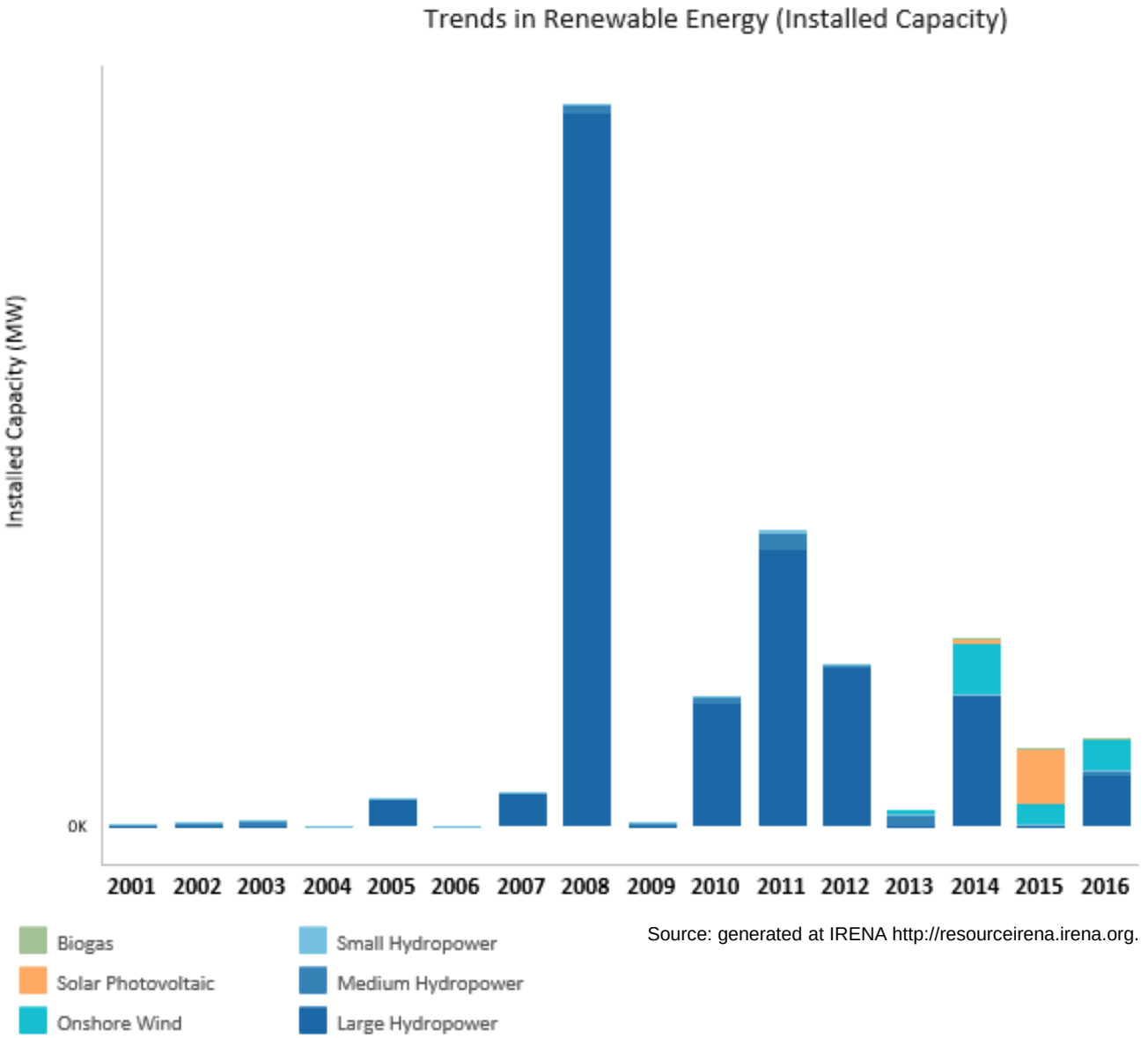
| | Kazakhstan | Kyrgyz Republic | Tajikistan | Turkmenistan | Uzbekistan |
|---|---|---|---|---|---|
| **Total electricity output, GWh** | 105,068 | 14,572 | 16,472 | 20,400 | 55,400 |
| **Renewable electricity output, GWh** | 8,277 | 13,298 | 16,000 | 0 | 11,830 |
| **Renewable electricity share of total electricity output, %** | 7.88 | 91.26 | 97.13 | 0 | 21.35 |
| **Total final energy consumption, TFEC** | 1,501,787.16 | 128,184.79 | 105,404.45 | 746,403.24 | 1,223,015.11 |
| **Renewable energy consumption, TJ** | 20,463.34 | 36,212.74 | 42,913.99 | 307.98 | 35,428.10 |
| **Renewable energy share of TFEC, %** | **1.36** | **28.25** | **40.71** | **0.04** | **2.90** |

Source: WB Data, database Sustainable Energy for All.

# RE vs Income




Lower income CA economies have higher share of RE (hydro); this is in line with the inverse Kuznets Curve: renewable share falls with increasing income before reaching a turning point where it begins to rise again.




Source: generated at IRENA http://resourceirena.irena.org.

In CA, larger new installations were in large hydropower segment, although, according to IRENA 2018, costs of solar and wind energy are decreasing most rapidly. While hydro power is still cheaper, time between financing and commissioning small hydro project is 2.3 years, while for solar it is 0.5 year and for onshore wind 0.8 years.

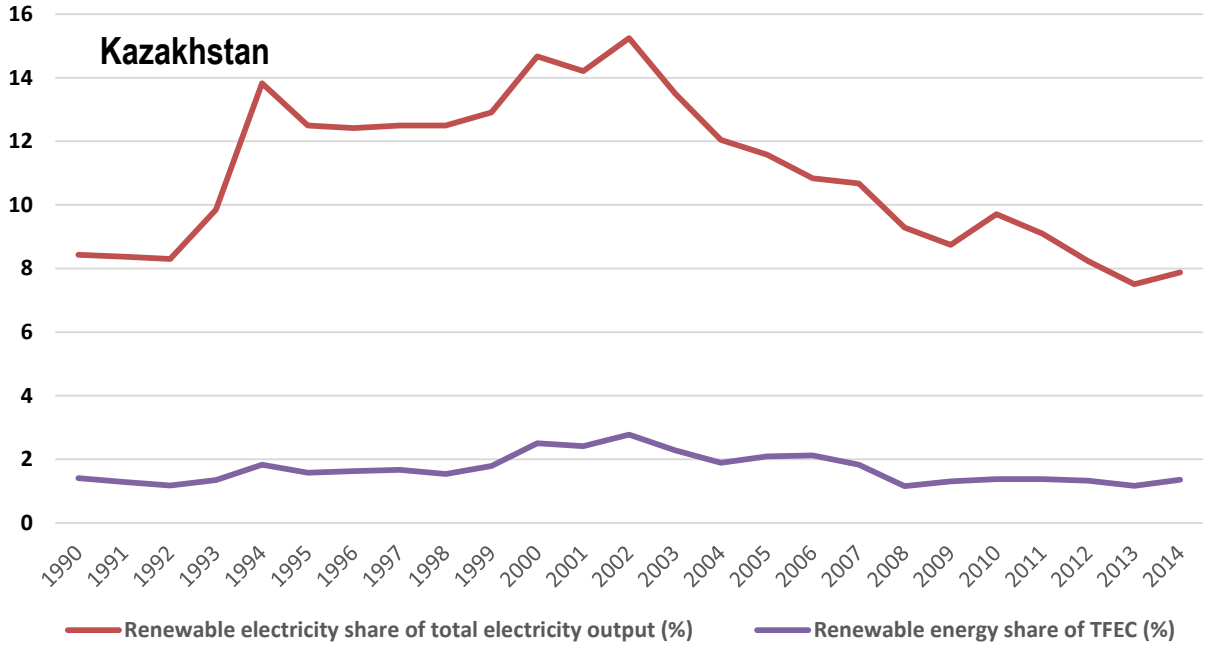
## Renewable Energy in CAs' Energy Profiles in 1990-2014

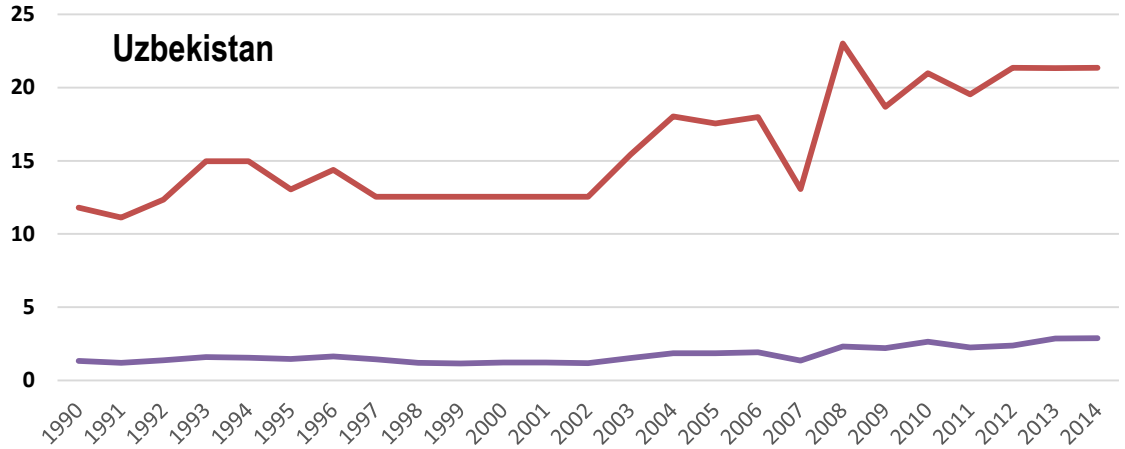
- Renewable energy, hydropower, plays by far the decisive role in power generation and TFEC in Tajikistan and Kyrgyzstan and contributed slightly over 20% to electricity production in Uzbekistan.

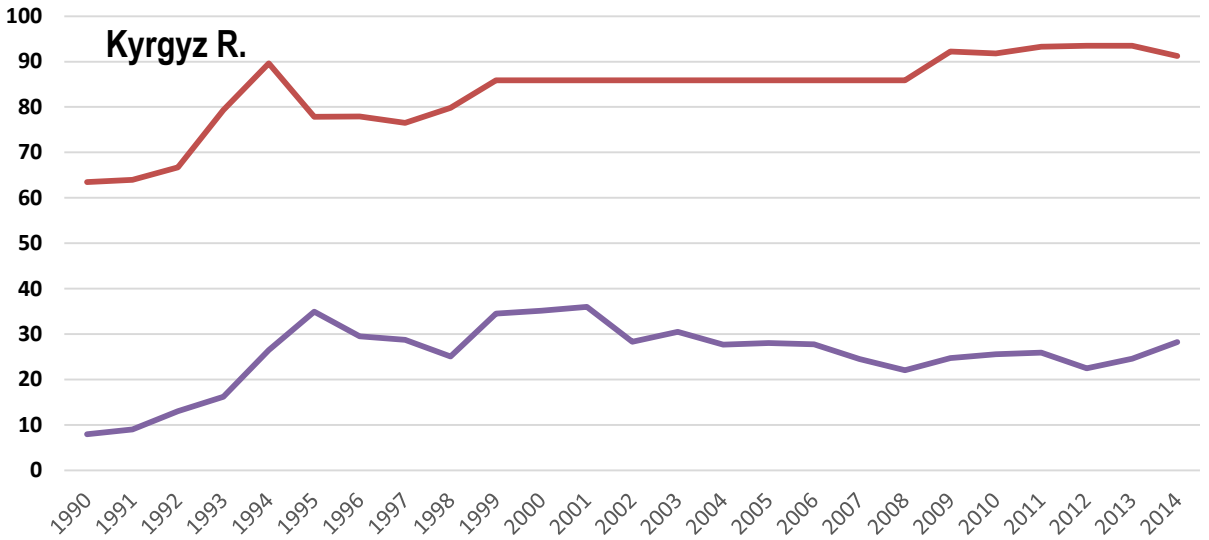
- Throughout 1990-2014, the role of renewable sources in electricity output in Kazakhstan peaked in 2002 (to 15%) and then steadily declined to remain at around 1990 level of 8%. To the contrary, Uzbekistan increased the employment of RE by some 10% against the 1990 level. Reliance on hydro resources for electricity generation increased for Kyrgyzstan and Tajikistan by some 28% and nearly 10%, respectively.

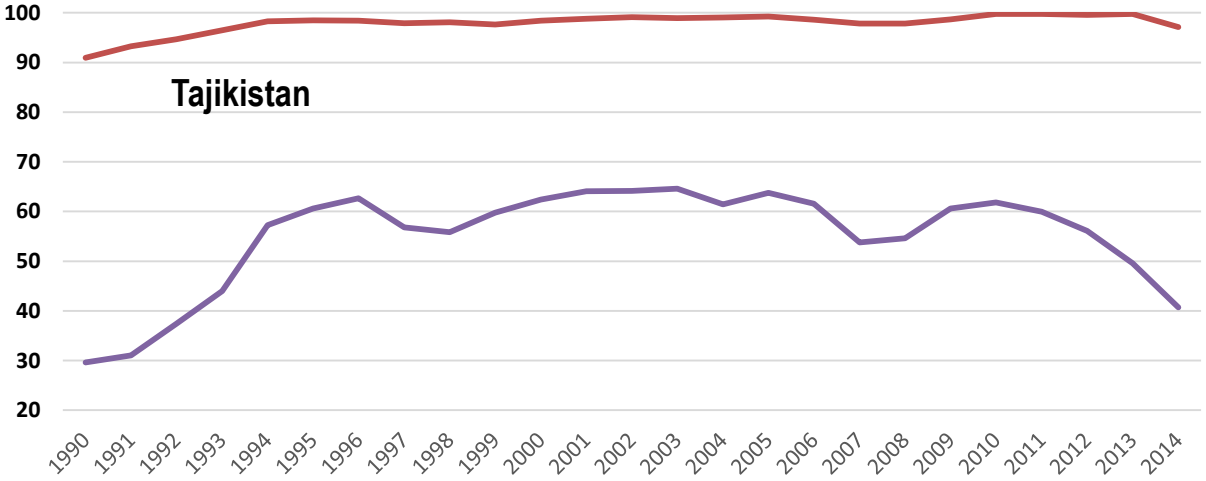
- With hydro power included, Kazakhstan is much less relying on RE, while Turkmenistan ascribes no role to RE. Without large HPP generation, Kazakhstan is most advanced for both diversity of RE sources and scale of generation.

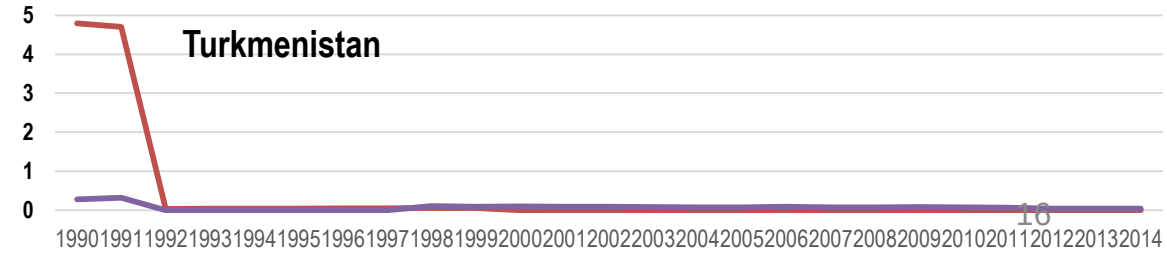
# Share of RE in Electricity Output and Consumption, %




Source: WB Data from database Sustainable Energy for All.

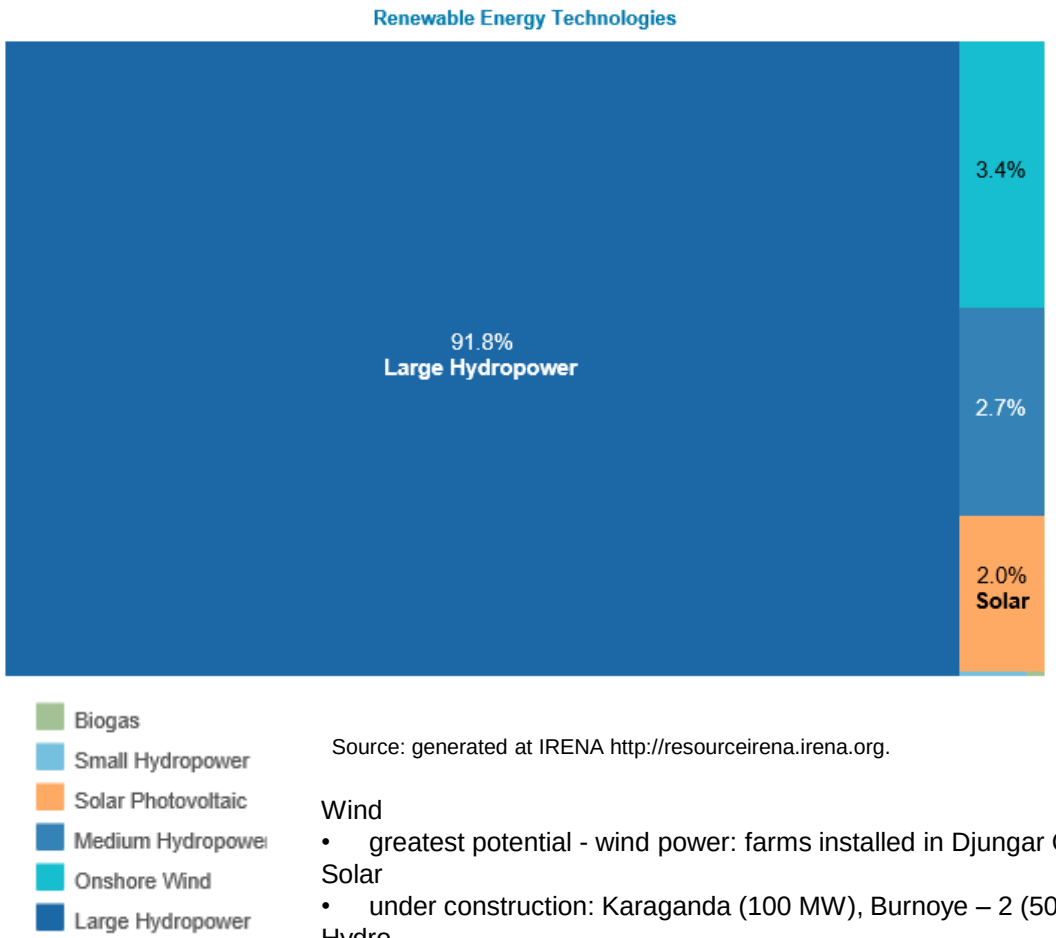
## Production of RE in Central Asian Economies, 2013-2015, TJ

| | | Hydro | Solar PV | Wind |
|---|---|---|---|---|
| **Kazakhstan** | 2013 | 27,832 | 4 | 18 |
| | 2014 | 29,746 | 5 | 48 |
| | 2015 | 33,369 | 166 | 474 |
| | 2015/2013 | 20% | 42 times | 26 times |
| **Kyrgyz Republic** | 2013 | 47,178 | | |
| | 2014 | 47,871 | | |
| | 2015 | 39,934 | | |
| | 2015/2013 | **-15.4%** | | |
| **Tajikistan** | 2013 | 61,456 | | |
| | 2014 | 58,723 | | |
| | 2015 | 60,840 | | |
| | 2015/2013 | -1.1% | | |
| **Uzbekistan** | 2013 | 41,616 | | |
| | 2014 | 46,656 | 6 | |
| | 2015 | 52,679 | 6 | |
| | 2015/2013 | 26.6% | | |

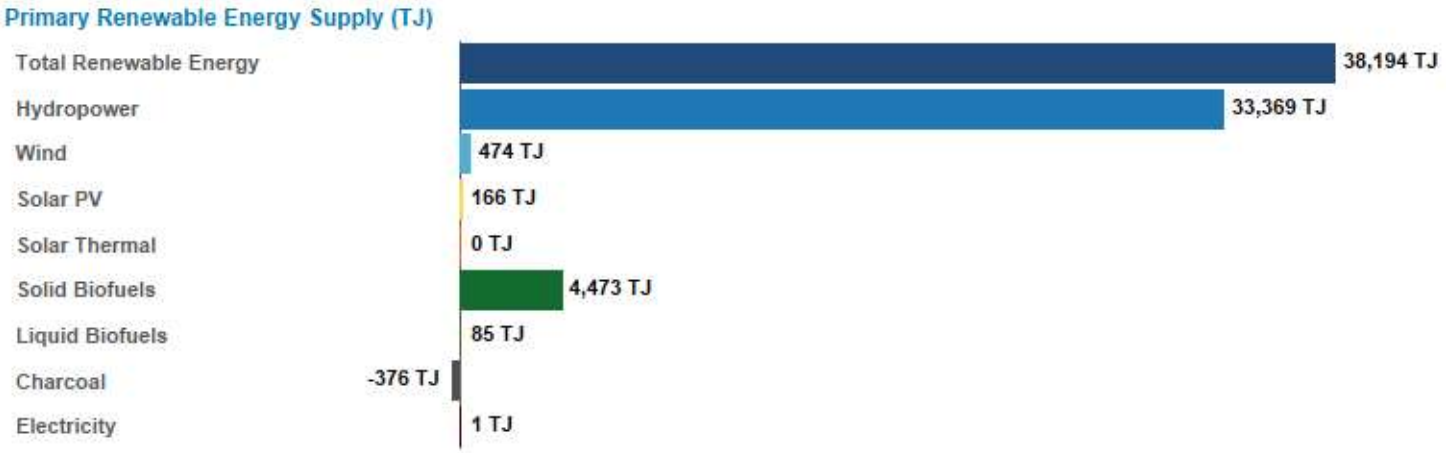
Note: no data available on Turkmenistan.
Source: IRENA database.

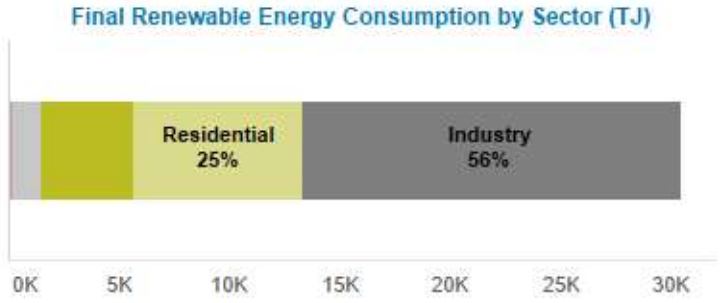
# Kazakhstan

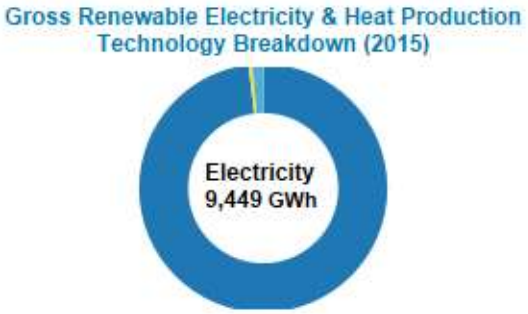
## Installed Capacity RE, 2016




## RE Balance, 2015




Source: generated at IRENA http://resourceirena.irena.org.

Wind

- greatest potential - wind power: farms installed in Djungar Gates, Mangystau, Peak Karatau and Chu Ili Mts., projected installed capacity of 780 MW;

Solar

- under construction: Karaganda (100 MW), Burnoye – 2 (50 MW) (Burnoye – 1, 50 MW, completed in 2014);

Hydro

- the main hydropower resources are located in the eastern and southeastern regions: on the Irtysh river – Bukhtarma (675 MW), Ust-Kamenogorsk (332 MW) and Shulbinsk (702 MW); on the Ili river – Kapchagay (364 MW); on the Syrdarya river – Shardara (100 MW);
- the Moinak HPP (300 MW) is presently under construction. By 2020 it is planned to commission Kerbulak (50 MW), Bulak (68 MW) and number of smaller HPPs with a total installed capacity of 56 MW (small-scale - with a capacity of up to 35 MW);

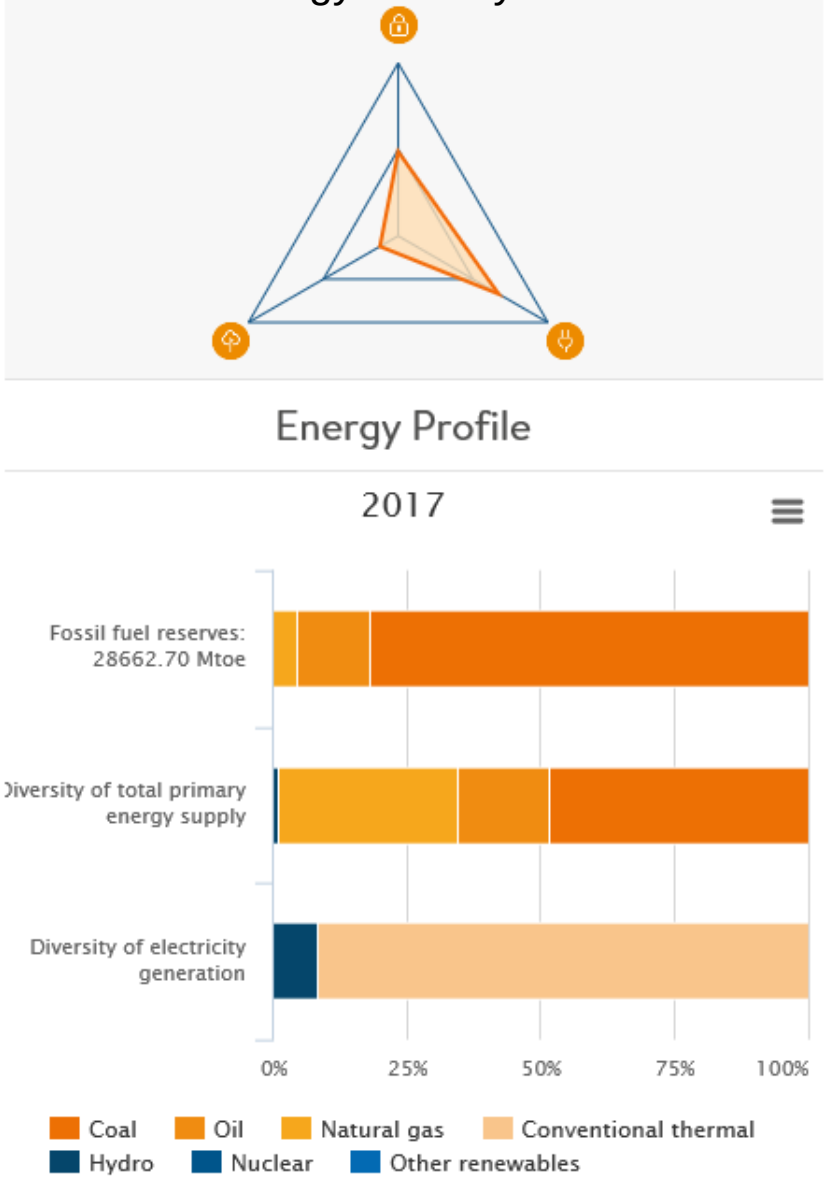
Biomass

- almost unused biomass waste; only one large-scale facility operates - Vostok Biogas (in Kostanai region), generation 3 GWh/y.

# Kazakhstan

Renewable Energy Country Attractiveness Index (by EY), RECAI

| | 2015 | 2016 | 2017 | 2017 Trend | 2017 Score |
|---|---|---|---|---|---|
| Index Rank | 84 | 82 | 78 | ▶ | CBD |
| Energy Security | 72 | 65 | 65 | ▶ | C |
| Energy Equity | 52 | 54 | 59 | ▶ | B |
| Environmental Sustainability | 122 | 122 | 120 | ▶ | D |




Source: generated at World Energy Council.

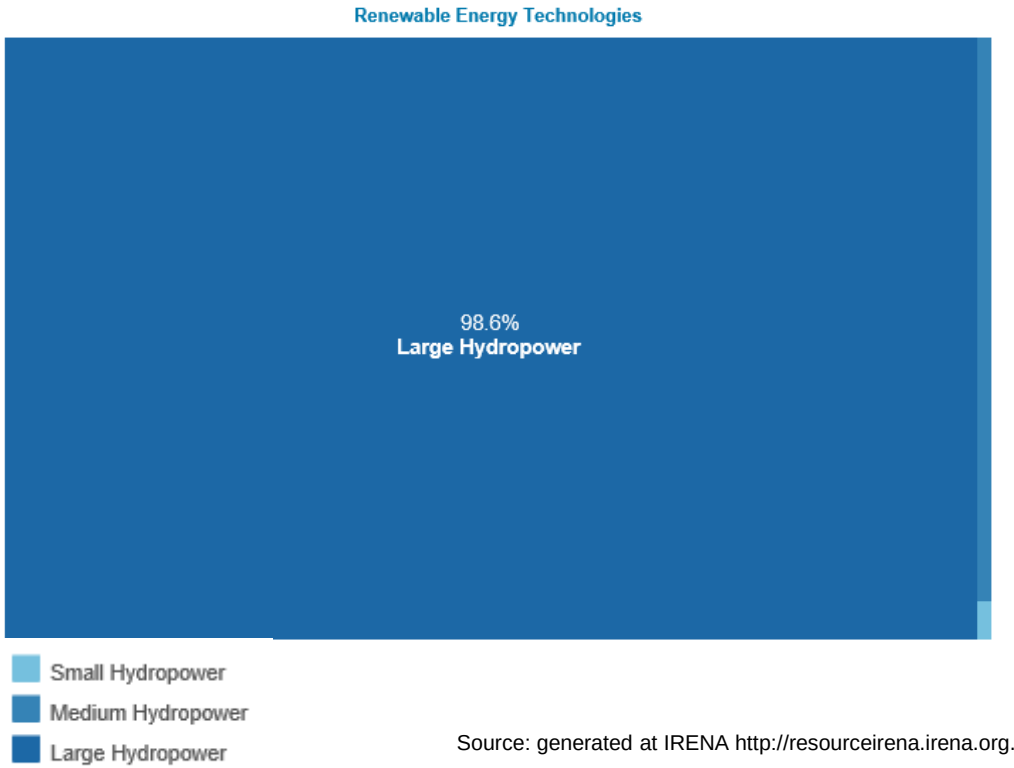
**Recent RE policy developments:**

strengthening state institutions responsible for energy efficiency in production, extraction and consumption of energy:

- National Concept for Transition to a Green Economy up to 2050 (2012): RE by 2020 – 3% of the country's electricity; 2030 - 30%; 2050 – 50%;
- Transition to a Green Economy, approved by the Order of the President of Kazakhstan in 2013;
- Law On Supporting the Use of Renewable Energy Sources (2013). FIT for 15 years (2013-2028) for biomass, solar, wind, geothermal and hydropower up to 35 MW;
- energy saving programmes to reduce energy intensity of industry by 25% by 2020 vs. 2008;
- policies to support development RE: law on investment – up to 30% of the costs related to building, land and equipment can be subsidised;
- modernisation of existing power generation, power grids and oil refining installations.

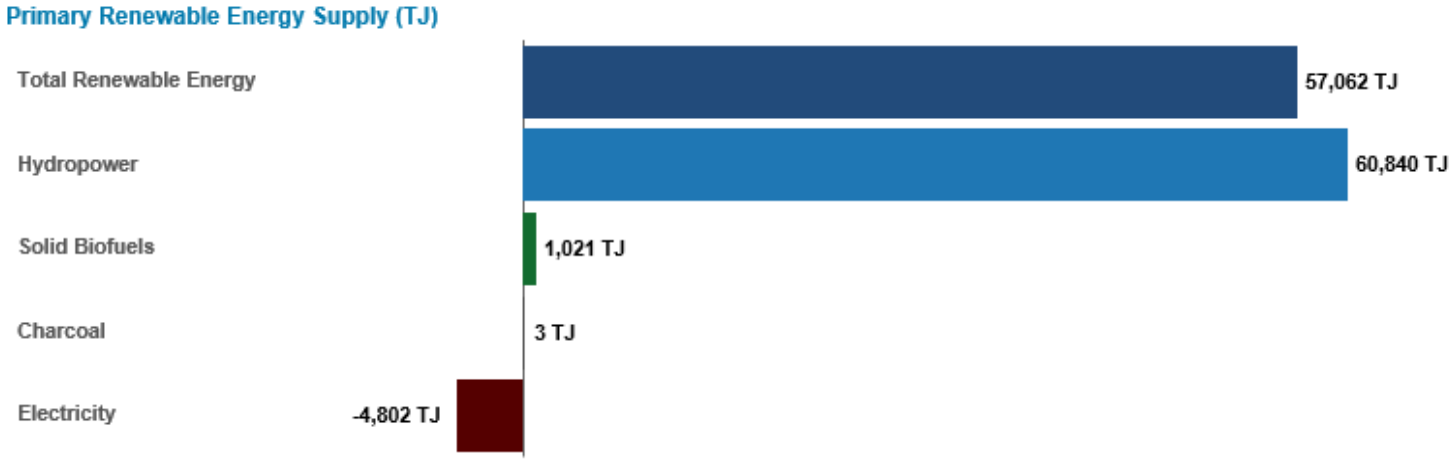
# Tajikistan

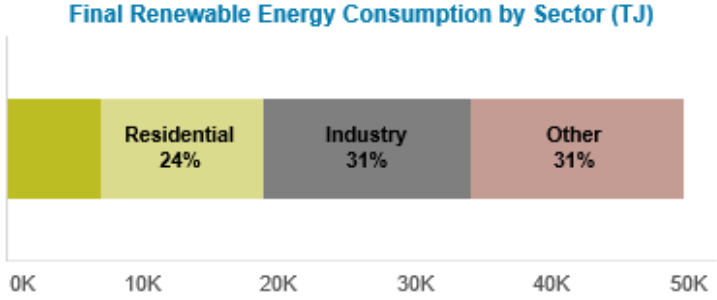
## Installed Capacity RE, 2016

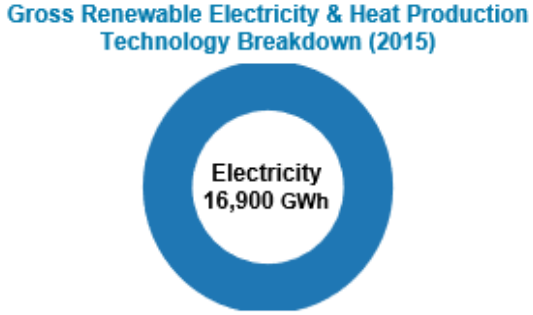



Source: generated at IRENA http://resourceirena.irena.org.

## RE Balance, 2015



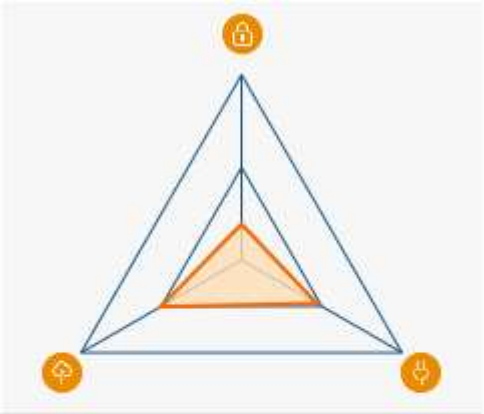



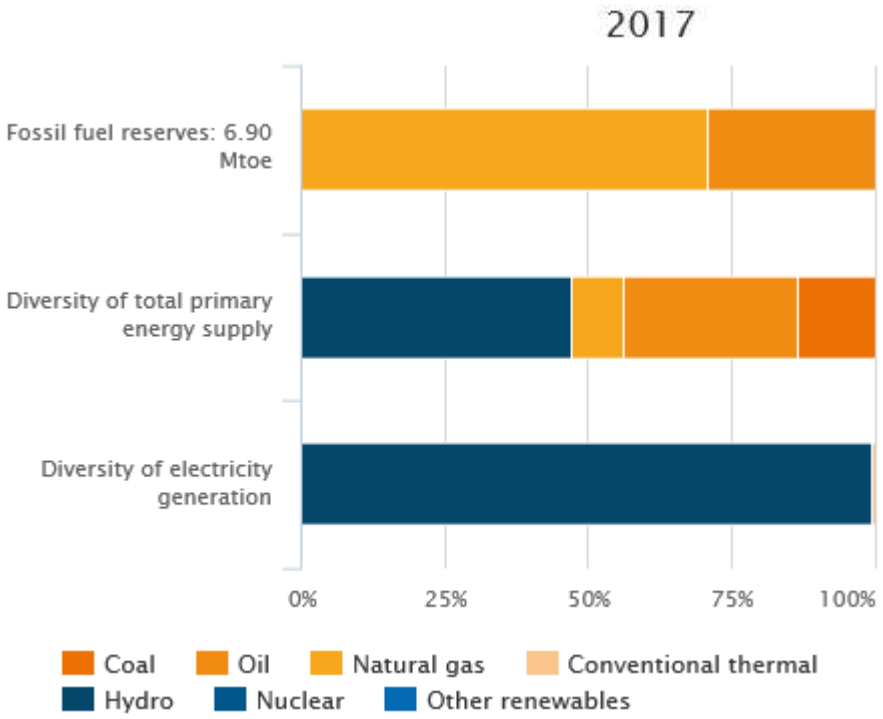

- The terrain and climate are highly favourable to the development of hydropower. Tajikistan's economically feasible potential for hydro power is estimated to be 263.5 TWh/yr, of which only about 6% has been harnessed so far.
- Installed hydro capacity amounts to about 5,500 MW. The principal HPP is Nurek (3,000 MW), which produces approximately 11.2 bn kWh/y. The fourth and last unit at the Sangtuda 1 plant on the river Vakhsh came into operation in 2009; together, the four units added 670 MW of capacity.
- An enormous hydro potential exists on the river Pyanj (the principal tributary of the Amu-Darya): 14 HPPs with an aggregate capacity of 18,720 MW can be built.

# Tajikistan

RECAI



Energy Profile




| | 2015 | 2016 | 2017 | 2017 Trend | 2017 Score |
|---|---|---|---|---|---|
| Index Rank | 88 | 83 | 91 | ▶ | DCB |
| Energy Security | 99 | 86 | 112 | ▶ | D |
| Energy Equity | 88 | 87 | 86 | ▶ | C |
| Environmental Sustainability | 31 | 39 | 69 | ▼ | B |

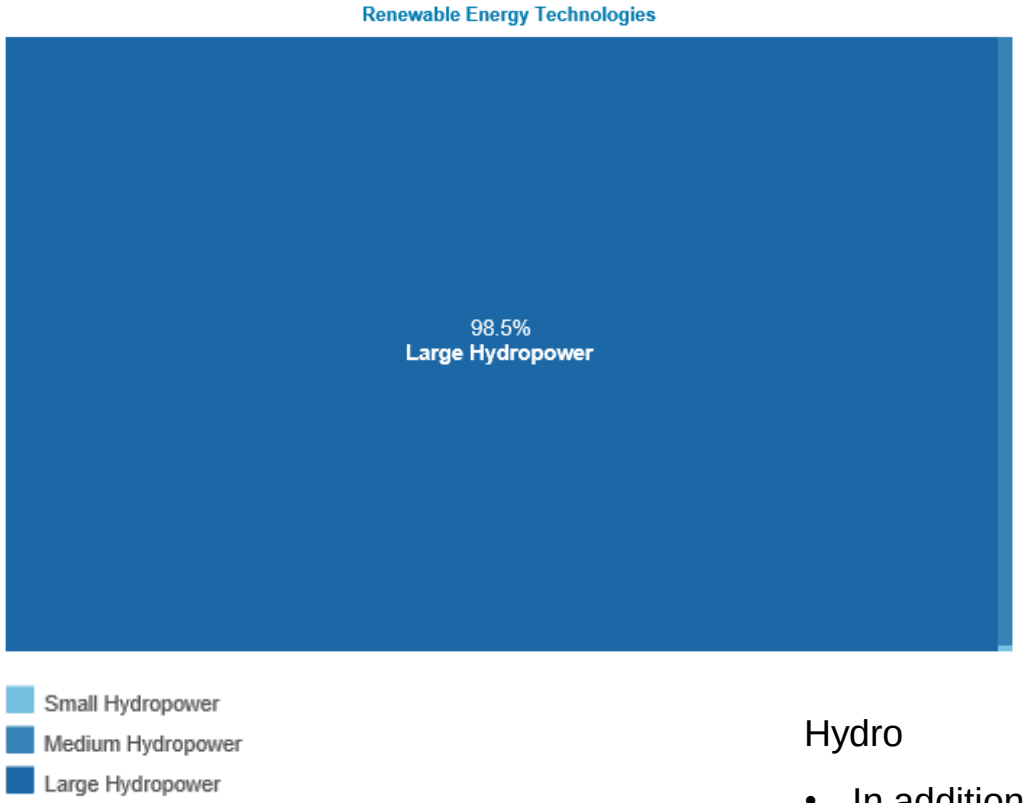
**Recent RE policy developments:**

- Several mini and small plants, with a total capacity of 47 MW, were commissioned in 2010 and 2011.
- FIT based on the project's costs, guaranteed for 15 years. Electricity produced from wind, solar, geothermal, biomass and hydropower (up to 30 MW) plants are eligible when plant operators receive approval from the government's Antimonopoly Service.
- The Long-term Programme for Building Small Hydropower Plants 2009 – 2020 (construction of some 190 small HPP of total capacity 100 MW), the Target Programme for the Widespread Use of Renewable Energy Sources and the Law on the Use of Renewable Energy Sources (2010).
- State owned electricity company, Bargi Tajik, owns most electricity generation capacity. Bargi Tajik will be restructured to become an independent regulator in the electricity sector. Energy sector liberalization in combination with tariff policy reforms will attract and increase private investment.

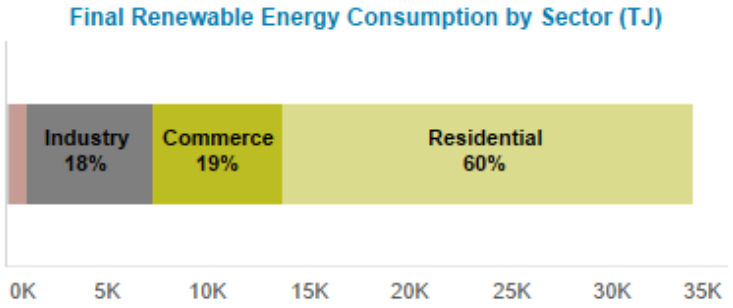
Source: generated at World Energy Council.

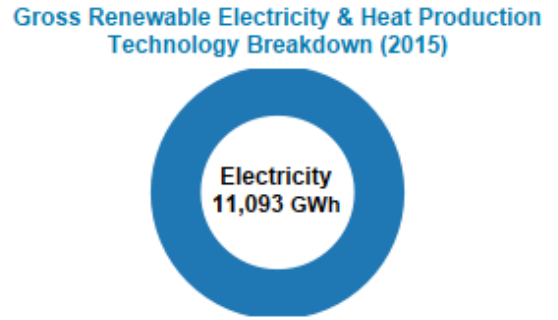
# Kyrgyzstan

## Installed Capacity RE, 2016




## RE Balance, 2015


Hydro

- In addition to Toktogul HPP (1,200 MW), Kambarata HPP 1 (1,860 MW);
- by 2020, Kambarata HPP 2 (120 MW);
- By 2025, Higher-Naryn cascade of HPPs (237.7 MW);
- by 2025-30, Kazarman cascade of HPPs (1,050 MW) and Susamyr-Kokemerens cascade of HPPs (1,305 MW);

Source: generated at IRENA http://resourceirena.irena.org.

**Kyrgyz R.**

**Recent RE policy developments**

- only 10% of hydroelectric potential is being exploited;
- RE remains undeveloped; if only small-scale HPPs are defined as RE sources, the installed RE is 1.1%;
- HPPs have high wearout; Kambrata 120 MW HPP is the newest addition (2010), while small HPP were constructed in 1940-60s;  main capacities were built in the 60s and 70s, including the largest Toktogul 1,200 MW HPP; total of 1,250 MW were constructed in the 1980s;
- The Law on Renewable Energy Sources (2009) introduces FIT, which are designed to ensure reimbursement and coverage of investment costs for up to 8 years. However, the law is yet to be fully implemented, and several bylaws on the definition of tariff calculation and determination, etc. are still under development;
- the laws on Energy and on Electrical Power envisages the restructuring of a state-owned OJSC Elektricheskie Stantsii, which produces 98 % electricity. Legally unbundled market, but SO distribution and supply services remain;
- National Energy Programme recognizes environmental protection in the energy sector and the promotion of a new tariff policy, but no specific targets are set;
- The Law on Renewable Energy Sources exempts imported and exported equipment and materials for the use of renewable energy power plants from custom duties;
- transmission companies are obliged to purchase renewable electricity;
- subsidised electricity tariffs make private investment in RE unattractive;

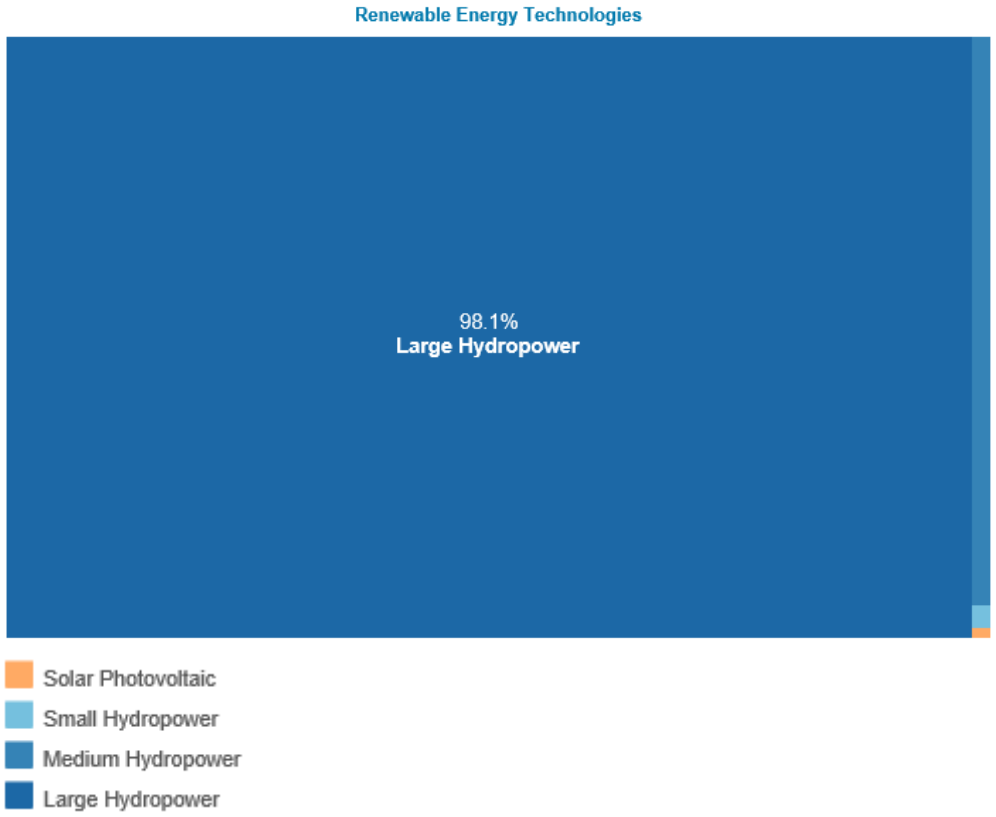
## Turkmenistan

## Recent RE policy developments

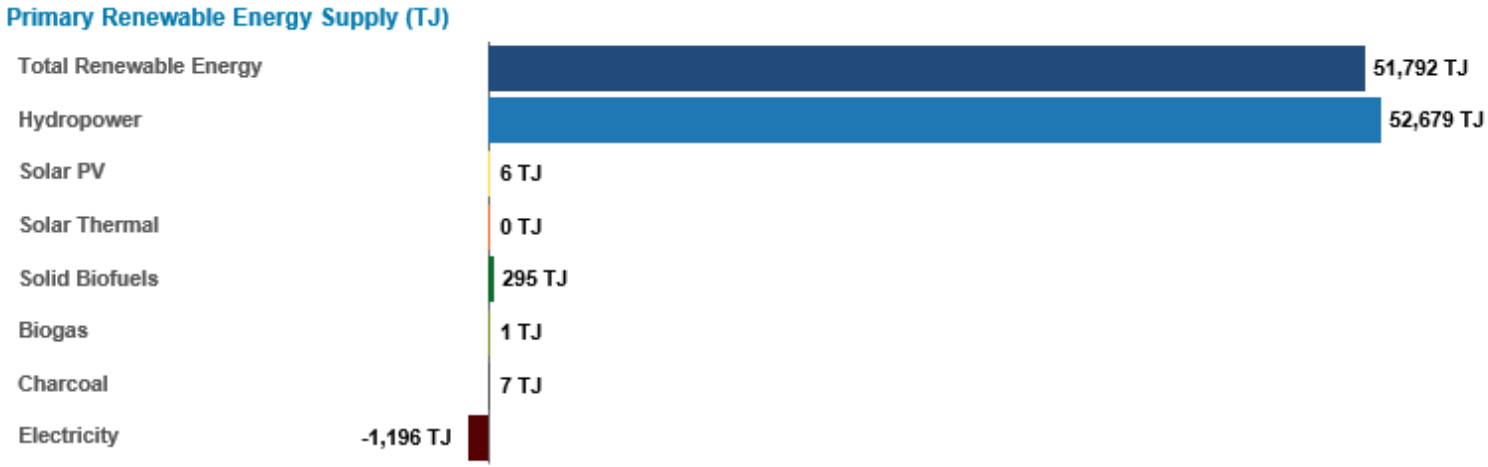
- tremendous potential for solar power plants, especially in the regions Kuli, Gasan and Ashgabat, remains unattended over Turkmenistan’s abundance of natural gas;
- the electricity market is managed by state owned Turkmenenergo, which owns and operates the grid, generates and distributes the electricity to the end consumers.
- there is no RE legislation; the National Strategy on Climate Change (2012) outlines the long-term vision for promoting RE and low-emission.
- the government decided to create a National Climate Change Fund to finance climate change mitigation and adaptation projects, including RE generation.

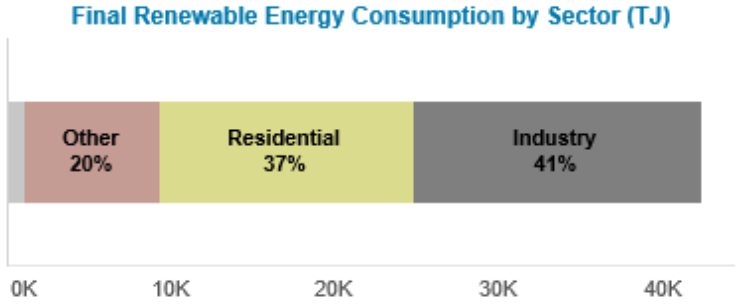
# Uzbekistan

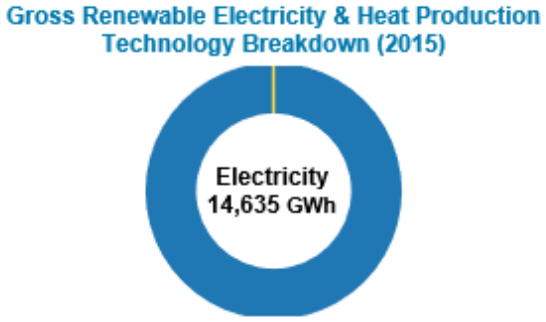
## Installed Capacity RE, 2016




## RE Balance, 2015




Source: generated at IRENA http://resourceirena.irena.org.

## Uzbekistan

## Recent RE policy developments

- The Law on Rational Energy Utilization (1997) - project-specific FIT by allowing a sufficient return on the capital invested, the future operation costs and other technical costs for renewable energy facilities.
- State-owned electricity company UzbekEnergo generates 97.5% of the country's electricity. The remaining 2.5% is the entire installed small hydropower capacity, of which 2.1 percent is operated by state owned Uzsuvenergo and 0.4 % is operated by small block-stations enterprises.
- To attract foreign investment, there are exemptions for newly established RE enterprises from profit tax, property tax, and unified tax payments for small and medium enterprises. RE producers are also exempt from payments to the country's road fund. Those tax privileges are granted for 3 years if the foreign investment is between $300,000 and $3 mn, or for 5 and 7 years respectively for investments up to and exceeding $10 mn respectively. The government also ensures legislation stability for 10 years. Although, the share of the foreign capital should not be less than 33% for the incentives to apply.

# Technical Potential for Installed Renewable Electricity Capacity in MW

| | Kazakhstan | Kyrgyz R. | Tajikistan | Turkmenistan | Uzbekistan |
|---|---|---|---|---|---|
| Small Hydro | 4,800 | 1,800 | 23,000 | 1,300 | 1,800 |
| Wind | 354,000 | 1,500 | 2,000 | 10,000 | 1,600 |
| Solar PV | 3,760,000 | 267,000 | 195,000 | 655,000 | 593,000 |
| Biomass | 300 | 200 | 300 | not significant | 800 |
| | | | | | |
| Hydropower, estimated generation capacity, Twh | 27 | 99 | 317 | 2 | 15 |

Source: UNDP, Renewable Energy Snapshot.

## Domestically Embedded Hurdles to RE Development

- exclusive role of SOE in electric power sector => private investment, foreign capital is highly problematic;
- high subsidisation of energy tariffs => disincentive to develop costly RE projects;
- lack of comprehensive RE legislation & policies with, perhaps, one exclusion being Kazakhstan;
- aged energy systems (Kyrgyzstan’s HPP);
- high losses in electricity transmission;
- billing and collection;

# International Cooperation for Strengthening Energy Security in CA

# International Cooperation for Strengthening Energy Security in CA

EU

- INOGATE for 11 nations in EE, Caucasus and CA
- Investment Facility for Central Asia, IFCA
- Sustainable Energy Programme for Central Asia, CASEP

WB

- Central Asia Energy Water Development Program, CAEWDP
- support to CASA-1000 (2014-2020) - power sector interregional cooperation initiatives between Kyrgyz R. and Tajikistan (CA) and Afghanistan and Pakistan (SA) under CASAREM (Central Asia South Asia Regional Electricity Market)

ADB

- Central Asia Regional Economic Cooperation, CAREC

EBRD

- renewable energy projects in CA, especially in Kazakhstan

Eurasian Development Bank

- renewable energy projects in CA, especially in Kazakhstan

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