Energiya Coordinating Dispatch Center

Current status and development prospects of the Central Asian Unified Energy System

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Brief description of the CA region

- Central Asia consists of Uzbekistan, Tajikistan, Kyrgyzstan, Turkmenistan and Kazakhstan.
- Only Kazakhstan and Turkmenistan have access to sea - the Caspian in the west.
- Total population of the region is 65 million people.
- Total area of the region is 3,994,300 km^2

Energy resource potential of the CA countries

- The share of the CA republics in the discovered global coal reserves is approximately 2%, for natural gas - 4.5%.
- The discovered coal reserves are sufficient to last for more than 600 years, oil - 65 years, natural gas - 75 years.
- The region has been designated as the potential supplier of hydrocarbons in different directions and markets.

Energy resource potential of the CA countries

- The rich fuel and energy reserves are unevenly distributed across the territory of CA. 88,6% of discovered coal and 86% of discovered oil reserves are located in Kazakhstan.
- Gas reserves are split between Turkmenistan (43%), Uzbekistan (30%) and Kazakhstan (27%).
- More than half of energy consumed in the Central Asian republics comes from natural gas, 3/4 of which is consumed in Uzbekistan.
- Coal comes second, and 93% of it is used in Kazakhstan.
- Uzbekistan uses 38% of oil consumed in the region with 34% of it coming from Kazakhstan.

Water resource potential of the CA countries

- Central Asia countries possess significant water and energy resources that are distributed very unevenly across the territories of the countries.
- The region has 5.5% of the world's economically effective hydro power potential.
- Total hydro power potential of the region is 937 billion kWh of power per year.
- A significant portion of this capacity (56.2%) is concentrated in Tajikistan, but its utilization is low - 4.6%.
- Kyrgyzstan and Tajikistan differ significantly from the point of view of annual hydro power capacity (0,8 mln. kWh and 3,7 mln. kWh respectively).
- The coordinated actions underway now are an important factor of regional security and a prerequisite for the development of the production capacity of the fuel and energy complex of the region's countries, increasing their energy self-sufficiency and saving the investment resources.

Water potential of the CA countries

- 25% of the total drainage of the Aral sea basin is formed in Kyrgyzstan, 43% - in Tajikistan, 10% - in Uzbekistan, 2% - in Kazakhstan and 1% - in Turkmenistan.
- Water consumption has an opposite trend. For instance, in the last 10 years in Kyrgyzstan it amounted to 1%, in Tajikistan - 13%, in Kazakhstan - 11%, in Turkmenistan - 23% and in Uzbekistan - 39% of the total water intake from the Syrdarya and Amudarya rivers.
- Transboundary dependence on the water resources as a share of the river runoff originating outside of the country reaches 42% in Kazakhstan, 94% in Turkmenistan and 77% in Uzbekistan.

Water resource potential of the CA countries

- Hydro power is the base source in the energy mix in Kyrgyzstan and Tajikistan.

  - Share of HPPs in the installed capacity in Kyrgyzstan is 79%, in Tajikistan - 93%.

  - In the structure of production of fuel and energy resources their share is 77% and 96%, and in consumption - 43% and 40% respectively.

- However the share of hydro power in the structure of the regional fuel and energy balance is insignificant - about 3%, although the share of HPPs in the installed capacity in CA UES reached 35%.
- Overall the use of the economically efficient part of the hydro power potential in the region does not exceed 10%.

Use of RE in the CA countries

- Studies show that the share of renewable energy in the energy mix by 2050 should reach 18% or higher, if the greenhouse content in the atmosphere is to be stabilized.
- The concepts of the region's countries in the development of their energy sectors lead to the need to diversify the energy mix, including the expansion of RE.
- The Central Asia region has vast renewable energy resources and their addition to the energy mix may become a significant contribution to sustainable economic development, stable energy market and environmental safety.
- The renewable energy (RE) utilization pattern in the republics is at the stage of developing national programs and pilot projects.

Use of RE in the CA countries

- Of all RE types, wind and solar power plants offer the greatest potential in the CA UES.
- The main global practical problem, associated with the uptake of these stations, is their intermittent capacity that leads to fluctuations.
- In the Western countries the problem of fluctuation is addressed by improving the RE capacity forecasting mechanisms and ensuring the necessary reserve capacity at traditional stations (so called primary and secondary reserves (fast reserve types).
- It is believed that capacity fluctuations associated with the intermittent nature of solar power plants in the evening and at night are not a pressing problem because the systems have sufficient slow tertiary reserve, which is switched on manually.

Use of RE in the CA countries

- In the UES of CA and Kazakhstan that have a weak interface with the UES of Russia, this simplified option is not acceptable. As a rule, the main shortages of power deliveries to consumers are observed in peak hours, when the actual capacity of the power stations is not fully utilized due to the lack of fuel (gas) or its high prices (furnace oil) - in other words because of the lack of disposable tertiary reserve.
- The most difficult are the load pickup hours, when one must keep up with the sharp increase of consumption with a simultaneous loss of capacity of SPPs, which is a challenge.
- Without taking special measures, large-scale application of solar power plants will be a threat to sustainability and energy security of the CA UES:

  - it is necessary to combine SPP construction with the introduction of energy accumulators;

  - it is necessary to strengthen the emphasis on the creation of hydroaccumulating stations in the development of the hydro potential;

  - take measures to stimulate backup capacity, including tertiary (mobile GTUs, capacity market etc.)
- It is necessary to assess the maximum level of RE integration potential in all countries across the region.

Power sector in the CA countries

- The working mode of the CA energy systems throughout the year is determined by executing the tasks under contractual interconnections taking into account fuel supplies and hydrological situation on the main CA rivers.

- The installed capacity of CA UES as of 01.01.2019 is 21,656.1 MW, which 54.4 MW higher that the installed capacity as of 01.01.2018.

- Power generation across the CA UES and ES of South Kazakhstan in 2018 reached 89.3 bln. kW/h, which is 1.9 bln. kW/h or 2.2% higher than generation in 2017.

Power sector in the CA countries

- The installed capacity of the power plants in the energy systems of the Republic of Uzbekistan is 14,200.5 MW, which is 45 MW higher that the installed capacity as of 01.01.2018. – 14155,5 MW.
- The changes were due:

- commissioning of the Tashkent CHP SGU with installed capacity of 370 MW;
- modernization of the Charvak HPP generators 1, 2, 3 and 4 (aggregate increase by 16 MW). Installed capacity of the station reached 666 MW;
- decommissioning of TG-3, TG-4, TG-7 and TG-8 at the Angren CHP with a total capacity of 241 MW;
- decommissioning of TG-2 at the Takhiatash CHP with 100 MW capacity.

Power sector in the CA countries

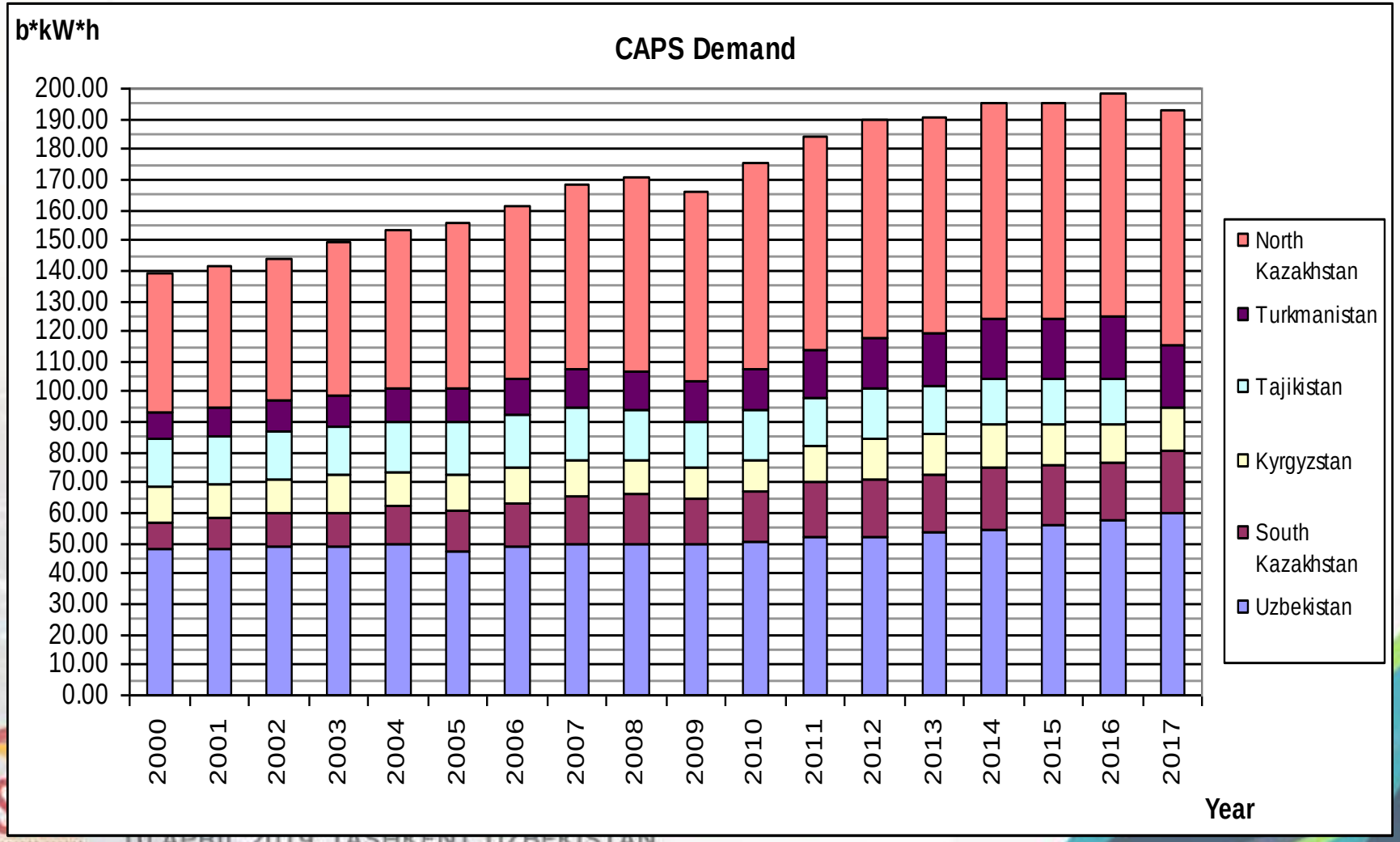
- The installed capacity of the energy systems of South Kazakhstan is 3,523.4 MW, which is 9.4 MW higher that the installed capacity as of 01.01.2018. Changes were due to the commissioning of:
- - WPP Sarybulak-1 with a capacity of 4.5 MW;
- - WPP Sarybulak-2 with a capacity of 4.5 MW;
- - SPP Burnoye-2 with a capacity of 50 MW;
- - small HPP Energo Almaty with a capacity of 0.4 MW,

  and decommissioning of GG-1 and GG-2 at the Shardari HPP with a total capacity of 50 MW for reconstruction

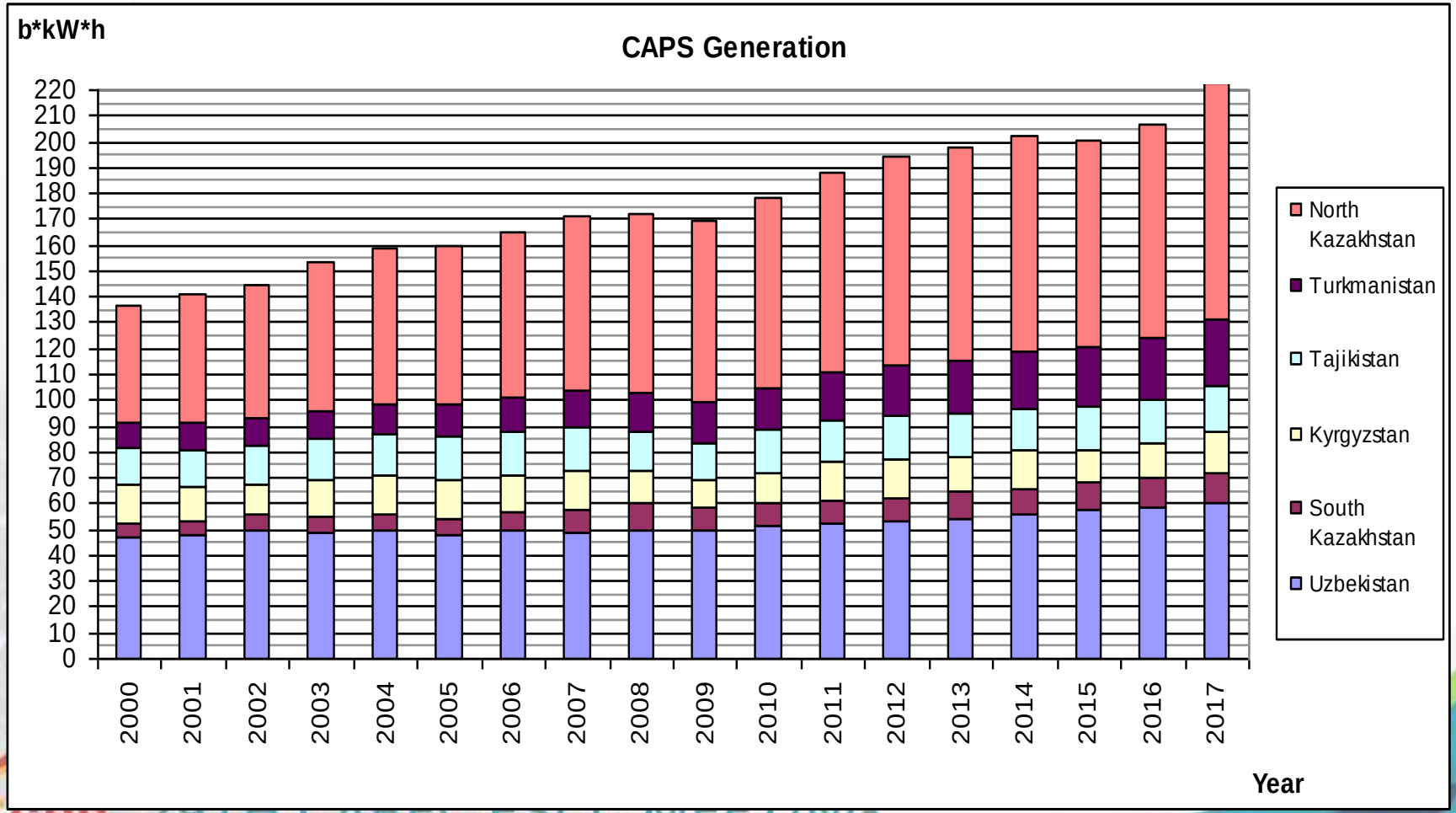
- The installed capacity of the power plants in the energy systems of the Kyrgyz Republic reached 3,932.2 MW.

Power sector in the CA countries

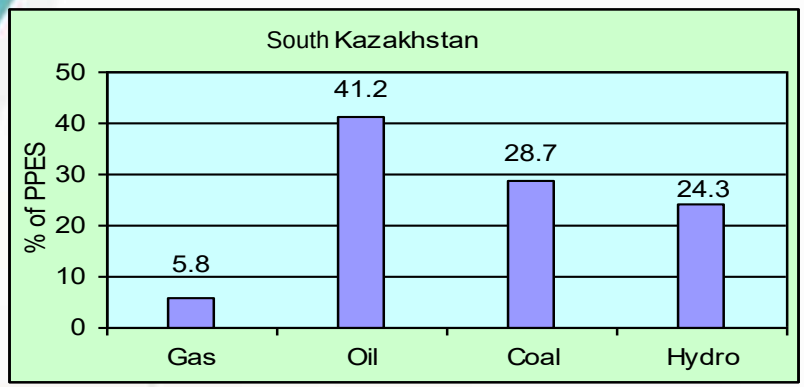
Power consumption in the CA UES and the energy systems of South Kazakhstan in 2018 reached 99.5 bln. kW/h, which is 5.2% higher than in 2017.

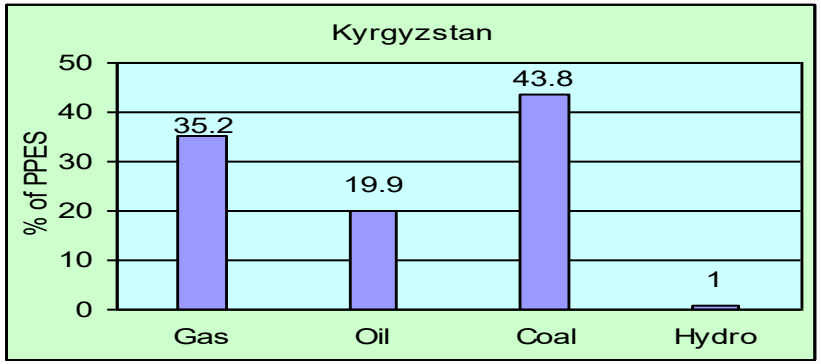


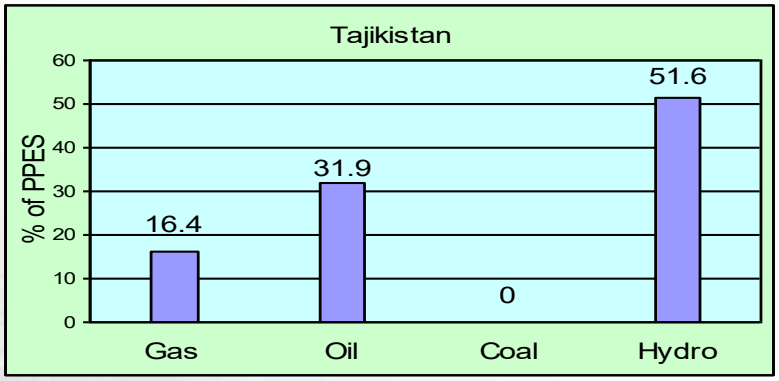
Power generation in the ES of CA and South Kazakhstan in 2018. - 89.3 bln. kW/h, which is 2.2 higher than in 2017. The share of CHPs in the CA UES is 70.4%, HPPs - 29.3%, WPP and SPP - 0.3% of the total generation.

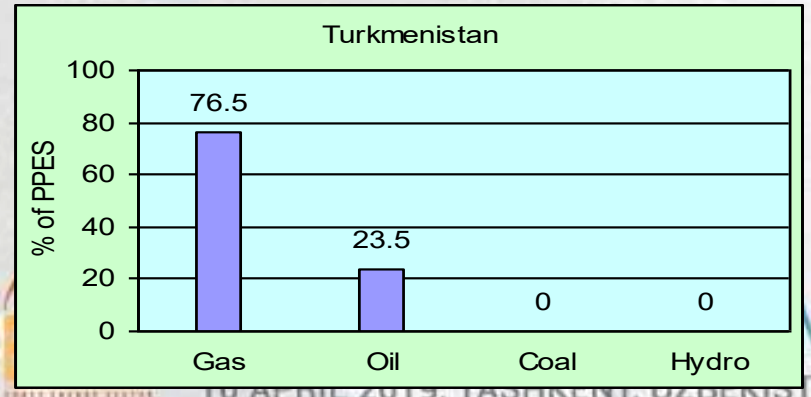


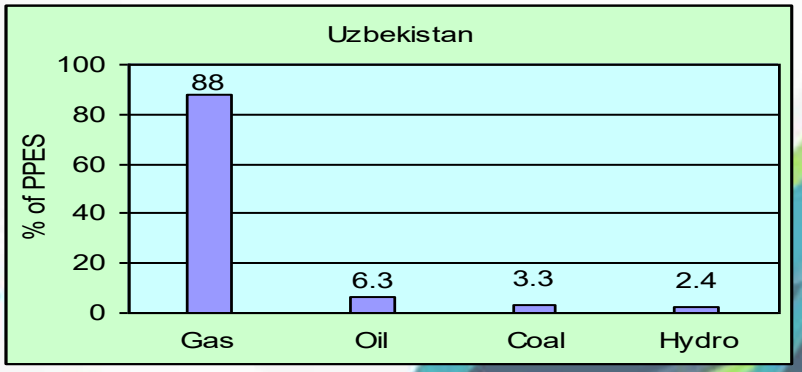
UES energy systems generation by types of fuel











Regional trade in 2018 grew due to increased deliveries from Uzbekistan to Afghanistan and the emergence of deliveries from Tajikistan to a designated region of Uzbekistan.

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	Year 2017	Central Asia Power Systems						
		Import						
		Kazakhstan	Kyrgyzstan	Tajikistan	Turkmanistan	Uzbekistan	Afghanistan	**Sum:**
Export	**Kazakhstan**		7,7					**7,7**
	Kyrgyzstan	8,9		12,8		1218,0		**1239,7**
	Tajikistan		7,5					**7,5**
	Turkmanistan							**0,0**
	Uzbekistan		3,7				1850,8	**1854,5**
	Sum:	**8,9**	**18,9**	**12,8**	**0,0**	**1218**	**1850,8**	**3109,4**

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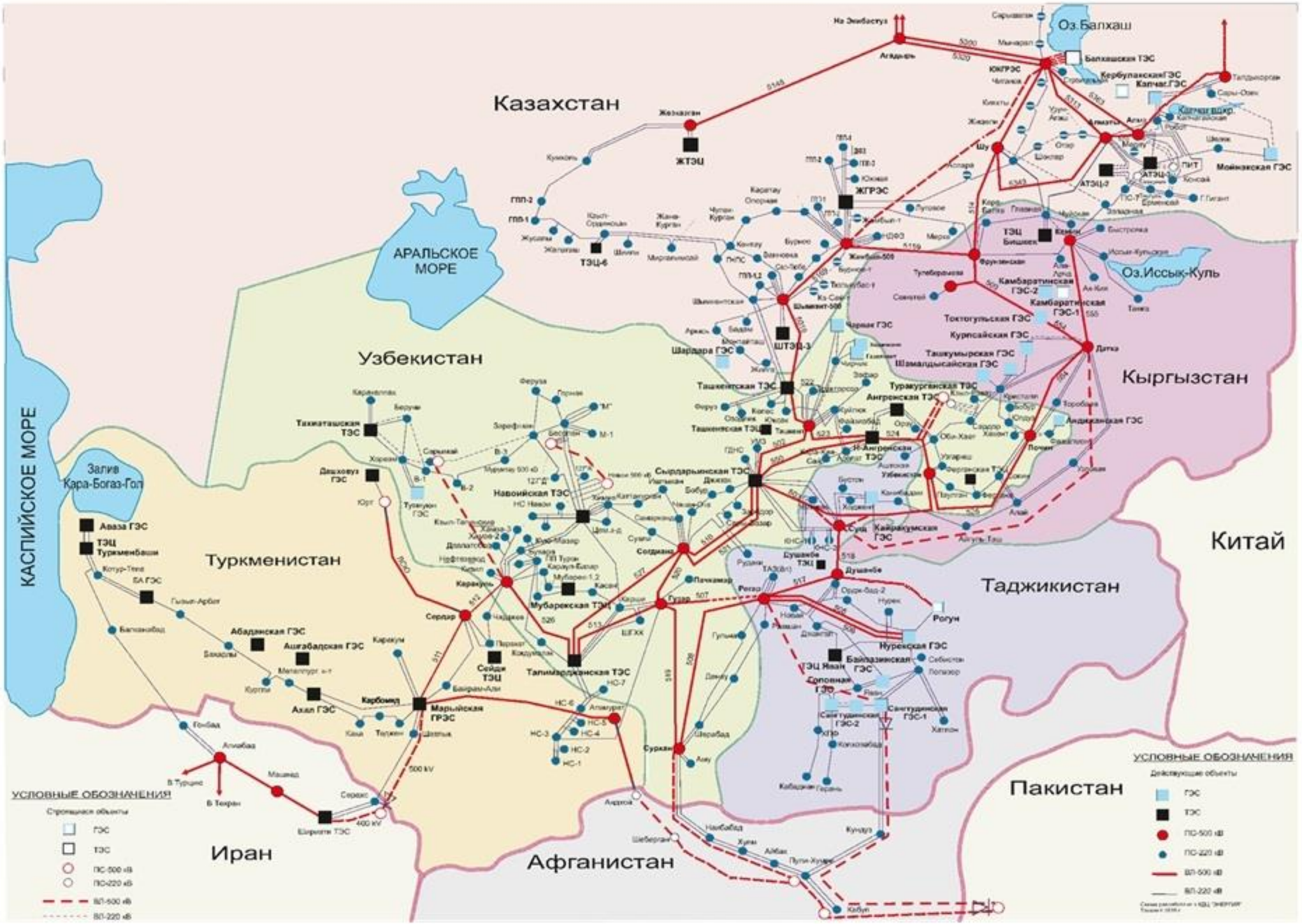
	Year 2018	Central Asia Power Systems						
		Import						
		Kazakhstan	**Kyrgyzstan**	**Tajikistan**	**Turkmanistan**	**Uzbekistan**	**Afghanistan**	**Sum:**
Export	**Kazakhstan**		6,1	12,1				**18,2**
	Kyrgyzstan	3,3		24,8		754,9		**783,0**
	Tajikistan	12,1	2,8			1480,9		**1495,8**
	Turkmanistan					356		**356,0**
	Uzbekistan		6				2591,7	**2597,7**
	Sum:	**15,4**	**14,9**	**36,9**	**0,0**	**2591,8**	**2591,7**	**5250,7**

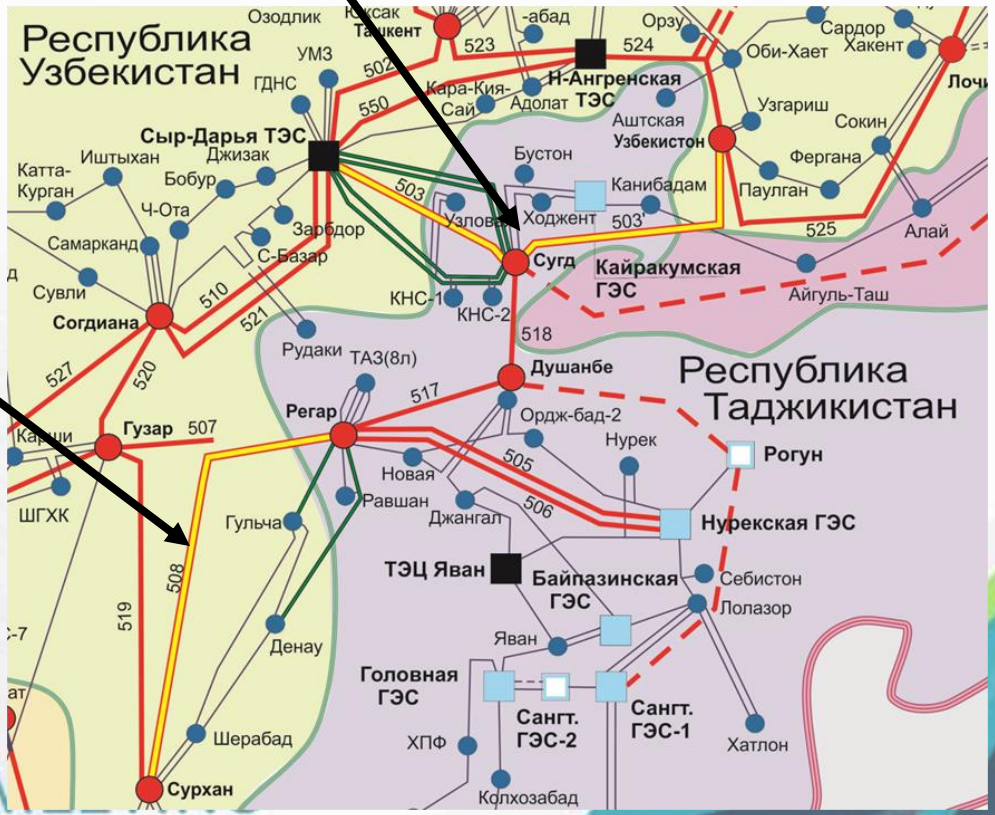
Перспективный план развития электрических сетей Центральной Азии



• At present the CA UES consists of the energy systems of South Kazakhstan, Kyrgyzstan and Uzbekistan, that work in parallel with the Unified energy system of Russia and the CIS through Kazakhstan's energy system.

• Russia's UES regulates the frequency in the Unified CIS energy system. This is why all imbalances in the CA UES are transited following the North-South Kazakhstan route, which after the commissioning of the 500 kV transit North-East-South of Kazakhstan improved the reliability of the connection between the CA UES and UES of Kazakhstan and UES of Russia.

- At the end of 2009 the problems of keeping the balances of capacity and energy led to a situation where the deficit-prone Tajik energy system was separated from the CA UES and up until today has been working in isolation.
- At present the energy systems of Uzbekistan and Tajikistan have embarked on restoring parallel operation.
- The parties have agreed the scheme for the connection to the Regar-Surhan transit in the south with a HV-500 back-to-back SDCHP - Uzbekistan at the PS Sudg; engineering of the adjacent grid and the PA is underway.
- The implementation of this scheme leads to the creation of yet another 500 kV ring through the Tajik energy system, which will significantly improve reliability of both the Tajik energy system and the adjacent power hubs of Uzbekistan's energy system.



• The separate, passive (without generation) parts of the energy system of Afghanistan work with the CA UES energy systems in the so-called island mode, connected to the energy systems if Uzbekistan, Tajikistan and Turkmenistan.

• At present power supplies to the North-Eastern part of the energy system of Afghanistan (NEPS) in the winter go through the 220 kV lines from the Uzbek energy system (SS Surhan) , and in the summer - from the Tajik energy system (Sangtuda HPP-1), whereas the parallel work of these energy systems through the Afghan substation Puli-Khumri is prohibited on sustainability grounds.

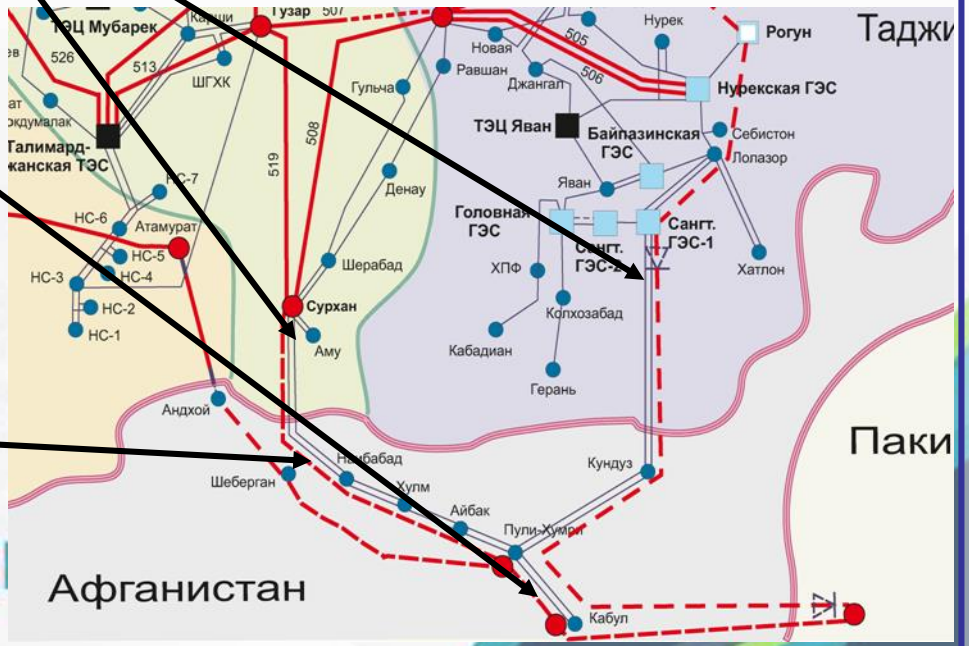
• The South-Eastern energy system of Afghanistan (SEPS) works autonomously.

• The capacity for transmission to NEPS using the existing 220 kV lines (with a length of more than 460 km) are fully exhausted and do not exceed 420 MW.

• 220 kV lines alone are not sufficient to create a Unified energy system of Afghanistan.

• At present HV-500 kV Puli-Khumri - Kabul is under construction, which will unite NEPS and SEPS.

• The Uzbek energy system is building the HV-500 kV Surhan-Puli-Khumri line, which will enable full-fledged connection of the Afghan energy system to the parallel work with the CA UES.



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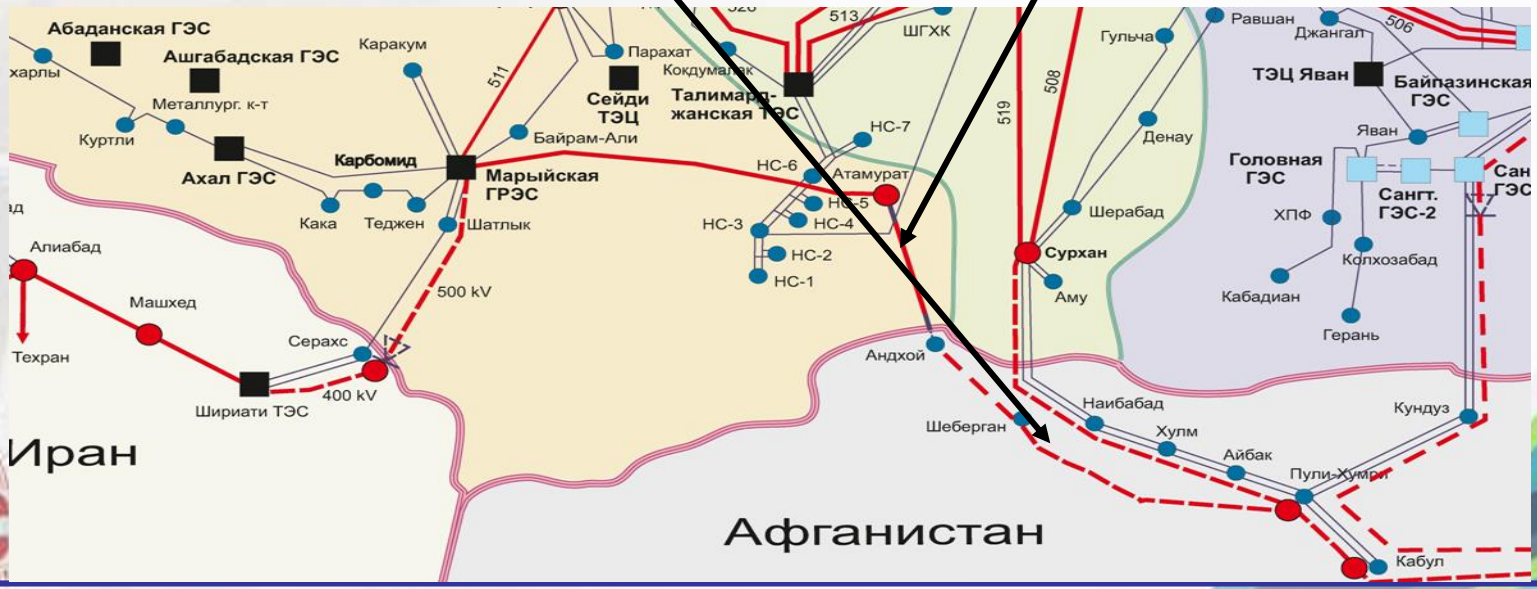
- At the same time, the Turkmen energy system has already constructed the 500 kV - size line from the Turkmen SS Atamurat to the Afghan border in the vicinity of Andkhoy.
- On its part, Afghanistan is building a 500 kv size HV-220 kV from Andkhoy to Puli-Khumri.
- It is noteworthy that the Turkmen energy system stopped working in parallel with Iran and requested to restore parallel work with the CA UES. CA UES energy systems have agreed this issue on their level, but Turkmenistan is required to join the Intergovernmental agreement of 1999 and implement a PA project.
- This is why the connection of the line connecting Turkmenistan with the Afghan energy system working with the CA UES will now be possible without a back-to-back station and will lead to the formation of another 500 kV ring
- On the contrary, as the CDC suggested some time ago, with the restoration of the parallel work of the Turkmen energy system with the CA UES, the work of the energy system of Turkmenistan and Iran will now be possible through the back-to-back station or using island schemes.



Thank you for your attention