ENERGIA Coordination and Dispatch Center

THE INTERCONNECTED POWER GRID OF CENTRAL ASIA:
regional trade outlooks

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- With the acquisition of independence in 1991, the countries of the Central Asian region started pursuing the policy of “self-sufficiency”.
- The rise in energy prices resulted in a situation where it became more profitable for countries with reserves of fuel energy resources to export organic fuels outside the region.
- This disrupted the existing energy exchange patterns and reduced the interstate electricity trade.
- You may see the dynamics in the tables below.

mln-kWh

	1995	Energy systems of Central Asian countries					
		Imports					
		Republic of Kazakhstan	Kyrgyz Republic	Republic of Tajikistan	Republic of Uzbekistan	Turkmenistan	**Total:**
Exports	Kyrgyz Republic	786.6		69.1	928.7		**1,784.4**
	Republic of Tajikistan	309.4			296.1	31.8	**637.3**
	Turkmenistan	1,682.3		101.3			**1,783.6**
	Republic of Uzbekistan	432.2	412.5	1,128.6		315.7	**2,289.0**
	Northern Kazakhstan	1,100.7					**1,100.7**
	Kazakhstan (Atyrauenergo)				7.2		**7.2**
	Total:	**4,311.2**	**412.5**	**1,299**	**1,232**	**347.5**	**7,602.2**

mln kWh

	2000	Energy systems of Central Asian countries					
		Imports					
		Republic of Kazakhstan	Kyrgyz Republic	Republic of Tajikistan	Republic of Uzbekistan	Turkmenistan	**Total:**
Exports	Kyrgyz Republic	1,252.9		154.4	1,925.6		**3,332.9**
	Republic of Tajikistan		125.7		243.9		**369.6**
	Turkmenistan	34.8		818.7	67.8		**921.3**
	Republic of Uzbekistan		194.6	728.8		32.5	**955.9**
	Total:	**1,287.7**	**320.3**	**1,701.9**	**2,237.3**	**32.5**	**5,579.7**

mln kWh

	2005	Energy systems of Central Asian countries					
		Imports					
		Republic of Kazakhstan	Kyrgyz Republic	Republic of Tajikistan	Republic of Uzbekistan	Turkmenistan	**Total:**
Exports	Kyrgyz Republic	2,668.1		230.1			**2,898.2**
	Republic of Tajikistan	68.5	3.5		683.5		**755.5**
	Turkmenistan						**0.0**
	Republic of Uzbekistan			814.9		0.4	**815.3**
	Total:	**2,736.6**	**3.5**	**1045**	**683.5**	**0.4**	**4,469**

mln kWh

	2010	Energy systems of Central Asian countries					
		Imports					
		Republic of Kazakhstan	Kyrgyz Republic	Republic of Tajikistan	Republic of Uzbekistan	Turkmenistan	**Total:**
Exports	Kyrgyz Republic	1,799.7		17.5	8.6		**1,825.8**
	Republic of Tajikistan		96.6				**96.6**
	Turkmenistan						**0.0**
	Republic of Uzbekistan		13.3	320.8			**334.1**
	Total:	**1,799.7**	**109.9**	**338.3**	**8.6**		**2,256.5**

mln kWh

	2013	Energy systems of Central Asian countries						
		Imports						
		Kazakhstan	Kyrgyzstan	Tajikistan	Uzbekistan	Turkmenistan	Afghanistan	**Total:**
Exports	Kazakhstan				405.5			**405.5**
	Kyrgyzstan	593.9		21.1	20.7			**635.7**
	Tajikistan		28.1					**28.1**
	Turkmenistan							**0.0**
	Uzbekistan		15.2				1,293.3	**1,308.5**
	Total:	**593.9**	**43.3**	**21.1**	**426.2**	**0**	**1,293.3**	**2,377.8**

mln kWh

	2014	Energy systems of Central Asian countries						
		Imports						
		Kazakhstan	Kyrgyzstan	Tajikistan	Uzbekistan	Turkmenistan	Afghanistan	**Total:**
Exports	Kazakhstan		188.8		652			**840.8**
	Kyrgyzstan	300.2		12.6	8.6			**321.4**
	Tajikistan	226.7						**226.7**
	Turkmenistan							**0.0**
	Uzbekistan		**14.7**				1,425.2	**1,439.9**
	Total:	**526.9**	**203.5**	**12.6**	**660.6**	**0**	**1,425.2**	**2,828.8**

mln kWh

	2015	Energy systems of Central Asian countries						
		Imports						
		Kazakhstan	Kyrgyzstan	Tajikistan	Uzbekistan	Turkmenistan	Afghanistan	**Total:**
Exports	Kazakhstan		602.8					602.8
	Kyrgyzstan	337.5		7.1	9.3			353.9
	Tajikistan		159.1					159.1
	Turkmenistan							0.0
	Uzbekistan		9.9				1,288.5	1,298.4
	Total:	**337.5**	**771.8**	**7.1**	**9.3**	**0**	**1,288.5**	**2,414.2**

mln kWh

	2016	Energy systems of Central Asian countries						
		Imports						
		Kazakhstan	Kyrgyzstan	Tajikistan	Uzbekistan	Turkmenistan	Afghanistan	**Total:**
Exports	Kazakhstan		335.3					**335.3**
	Kyrgyzstan	210.6		13.5	5.8			**229.9**
	Tajikistan		**14.1**					**14.1**
	Turkmenistan							**0.0**
	Uzbekistan		3.3				1,497.8	**1,501.1**
	Total:	**210.6**	**352.7**	**13.5**	**5.8**	0	**1,497.8**	**2,080.4**

•This resulted in a situation where individual countries generate power from fossil fuels, rather than import, on a mutually beneficial basis, surplus electricity generated from renewable hydro resources in neighboring countries.

•The only exception is year 2017, when the volume of regional trade somewhat increased because of the export of electricity from Kyrgyzstan to Uzbekistan.

mln kWh

	2017	Energy systems of Central Asian countries						
		Imports						
		Kazakhstan	Kyrgyzstan	Tajikistan	Uzbekistan	Turkmenistan	Afghanistan	**Total:**
Exports	Kazakhstan		7.7					7.7
	Kyrgyzstan	8.9		12.8	1,218.0			**1,239.7**
	Tajikistan		7.5					7.5
	Turkmenistan							**0.0**
	Uzbekistan		3.7				1,850.8	**1,854.5**
	Total:	**8.9**	**18.9**	**12.8**	**1,218.0**	**0**	**1,850.8**	**3,109.4**

Central Asian power grids: Long-term development plan

•At present, the power grids of the Southern part of Kazakhstan, Kyrgyzstan and Uzbekistan operate within the Central Asian Interconnected Power Grid (CA IPG). Through the power grid of Kazakhstan, they operate in parallel with the Unified Power Grids of Russia and the CIS.

•The frequency in the CIS Unified Power Grid is regulated by the Unified Power Grid of Russia. Therefore, all imbalances in CA IPG are absorbed by the North-South transit line of Kazakhstan, which is a bottleneck in CA IPG.

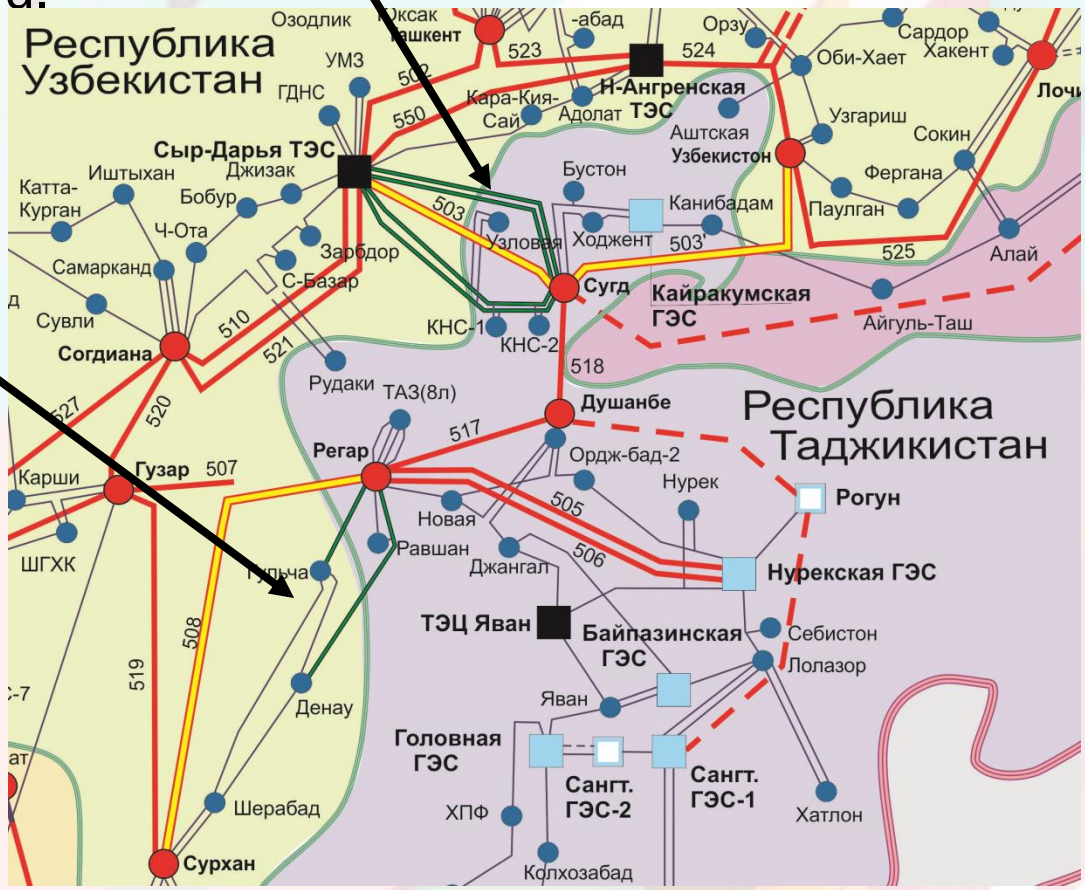
•In 2018, the 500 kV North-East-South Kazakhstan transit line is expected to come into operation (Phase I [Ekibastuz-Semey-Ust Kamenegorsk] has already been put into operation; Phase II [Semey-Aktogay-Taldykurgan-Alma] will be put into operation this year) and improve the reliability of the connection between CA IPG and the UPGs of Kazakhstan and Russia.

•At the end of 2009, because of the power and capacity balance issues, the deficit-generating Tajik power grid was separated from the CA IPG and has been operating in isolation ever since.

•At present, the power grids of Uzbekistan and Tajikistan have focused on the restoration of their parallel operation.

•The counterparts have agreed upon the interconnection scheme for Regar-Surkhan transit line in the South and the 500 kV cut-in section in the overhead transmission line between SDTES thermal power plant (Uzbekistan) to Sughd switchyard.

• In case of implementing this scheme, another 500 kV ring appears through the Tajik power grid, which will increase significantly the reliability of both the Tajik power grid and the adjacent energy nodes of the power grid of Uzbekistan.



•Separate passive (i.e. without generation) parts of the power grid of Afghanistan connected, respectively, to the power grids of Uzbekistan, Tajikistan and Turkmenistan, cooperate with the power grids of CA IPG in so-called island mode.

•At present, winter power for the North-Eastern Energy System of Afghanistan (NEPS) is supplied via 220 kV lines from the Uzbek Power Grid (Surkhan substation), and summer power is supplied from the Tajik Power Grid (Sangtuda HPP-1); parallel operation of these two power grids through the Afghan substation at Pul-e Khomri is forbidden by the stability condition.

•The South-Eastern Energy System of Afghanistan (SEPS) operates in an autonomous mode.

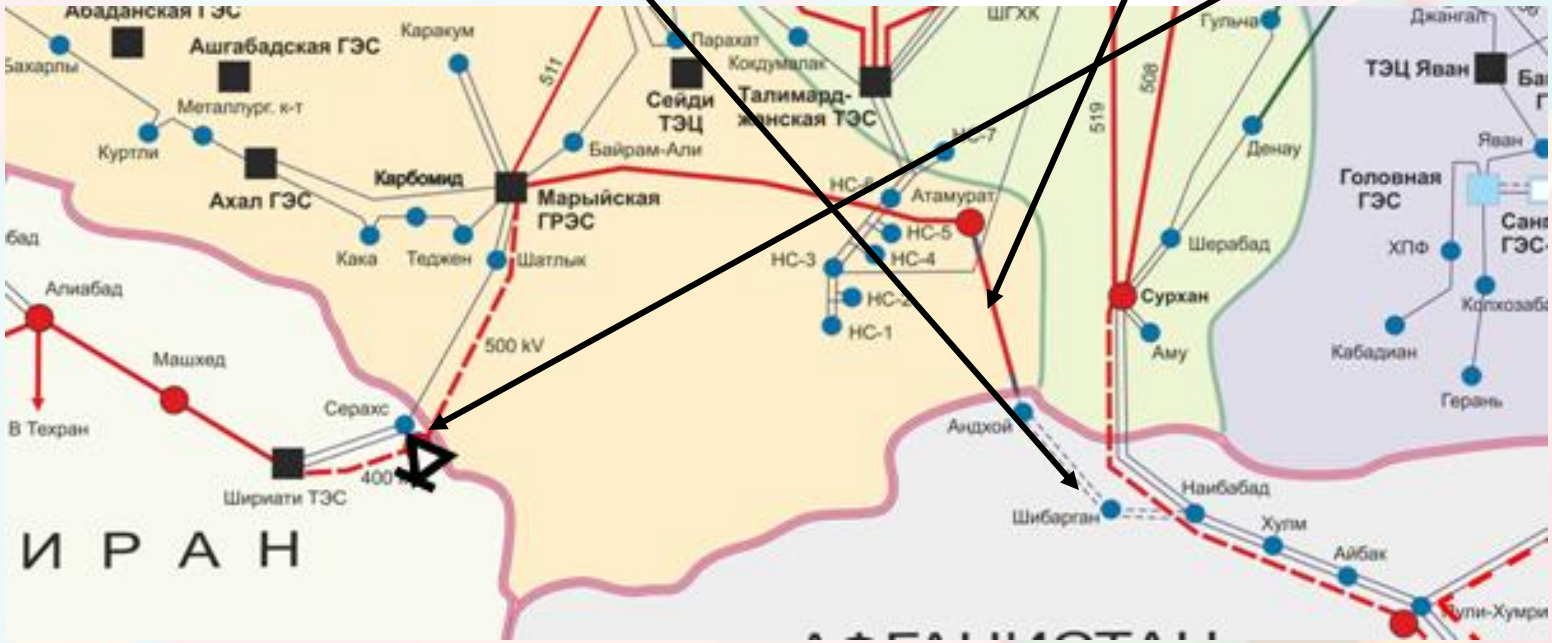
•The transmission capacity of the NEPS with the existing 220 kV lines (more than 460 km) has been exhausted completely and does not exceed 420 MW.

•220 kV lines alone are not enough to create the Unified Power Grid of Afghanistan.

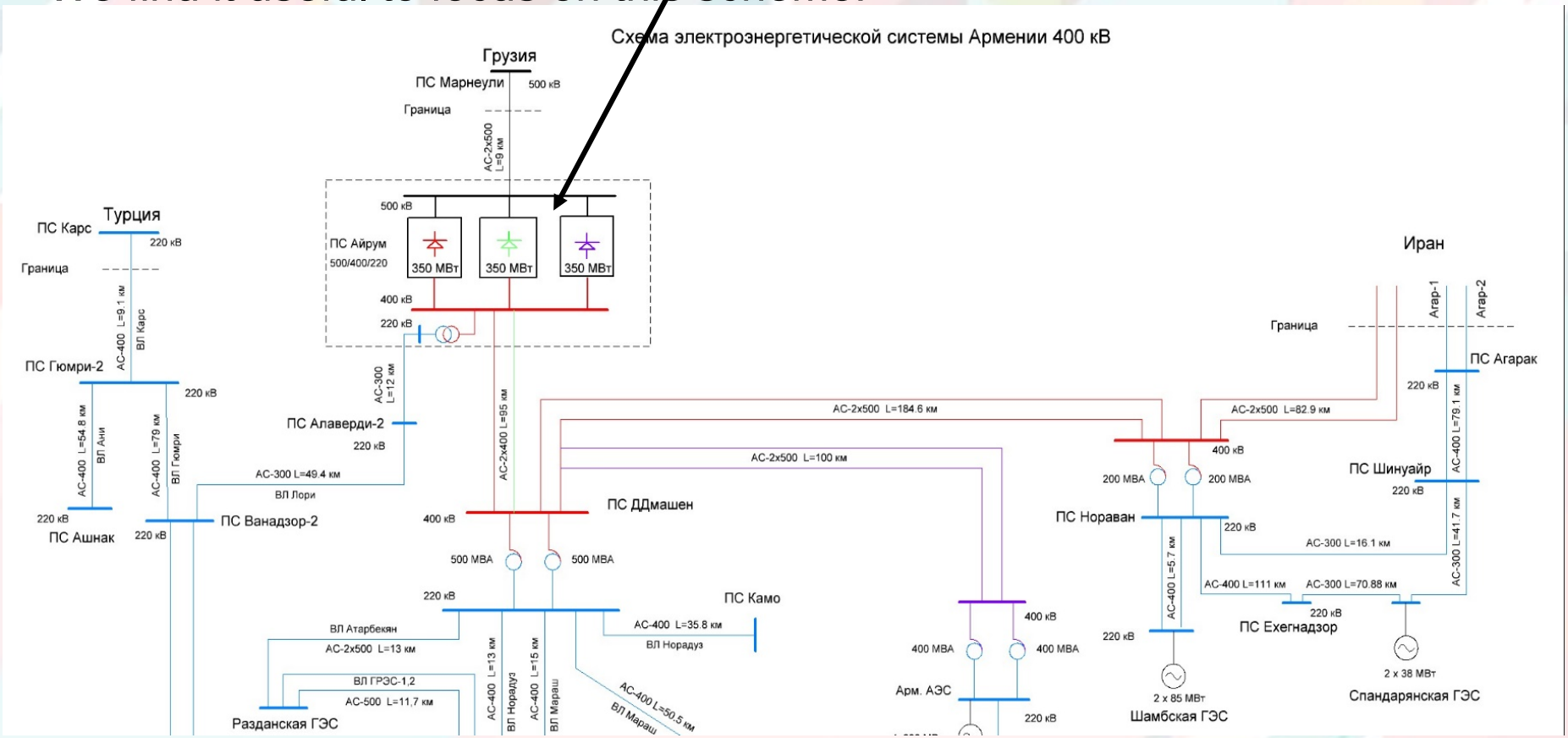
• At present, a 500 kV overhead transmission line Pul-e Khomri – Kabul is under construction to combine NEPS and SEPS.

• The Uzbek and Afghan power grids have reached an agreement on the construction of a 500 kV Surhan – Pul-e Khomri overhead transmission line to ensure full-fledged connection of the Afghan power grid for operation in parallel with the CA IPG.

- At the same time, Turkmen power grid, which works in parallel with Iran, has already built a transmission line within the limits of 500 kV from the Turkmen Atamurat substation to the Afghan border in Andkhoy region.
- In turn, Afghanistan is building a 220 kV overhead line within the limits of 500 kV from Andkhoy to Pul-e Khomri.
- Given that the Turkmen power grid works in parallel with Iran, inclusion of a line connecting Turkmenistan with the Afghan power grid operating with the Central Asian power grid is only possible through a back-to-back station.
- In the opinion of CDC, there is yet another option:
  - restoration of the parallel operation of the Turkmen power grid with the CA IPG; and
  - operation of the power grids of Turkmenistan and Iran through a back-to-back station that will link the 500 kV Mary-national border overhead transmission line (under construction) and the 400 kV Serakh-national border overhead transmission line (under construction).



- For example, such a link through a 500/400 kV back-to-back station exists between power grids of Georgia and Armenia (Georgia works in parallel with Russia, while Armenia works in parallel with Iran and Turkey)
- We find it useful to focus on this scheme:



- In implementation of the option with a back-to-back station between Iran and Turkmenistan, the latter will be a bridge between Turkey, the Caucasus, Iran and Central Asia.

- Creation of such an alternative route can diversify dramatically the regional trade in electric power and capacity.
- Let me remind you that there is no such concept as electricity transit through the Russian power grid in the so-called nodal model of the energy market existing in Russia.
- The Russian nodal model allows neither trading in electricity by transit through Russian networks, nor interchanging capacity reserves by power grids located in different time zones.
- In the proposed model, with a back-to-back station between Iran and Turkmenistan, the potential of the power grids (Iran, Armenia, Turkey and Georgia, on the one hand, and Central Asia and Turkmenistan, on the other) in terms of power exchange can be fully utilized, thereby reducing the total reserve; and the seasonal trade in electricity (unlike in Central Asian countries, the annual maximum in Iran is in the summer, and the annual minimum is in the winter) can be put in place.

• Let’s focus on yet another project, CASA-1000, which is supposed to build:

- 500 kV Datka-Sughd overhead transmission line, 477 km;
- 500 kV overhead transmission line, 750 km DC link between Sangtuda HPP - Peshawar with DC substations in Tajikistan and Pakistan.

• Without going into details of this project, it should be noted that the tie-in of 500 kV CDTES-Uzbekistan overhead transmission line at Sughd substation will allow using the generating capacities of Uzbekistan, as well as those of Kazakhstan and Turkmenistan, to use the shortest path for the winter supply of electricity to Pakistan.

• The idea of synergy between TUTAP and CASA projects proposed by CDC Energia has not been supported, although the above scheme shows that 500 kV Datka-Sughd overhead transmission line and a 1,300 MW DC substation in Sangtuda are clearly redundant if we switch to an alternating current transmission.

• There are (1) a 500 kV ring through the power grid of Afghanistan, and (2) parallel 500 kV Pul-e Khomri-Kabul-Peshawar overhead transmission lines that ensure the N-1 reliability principle for Uzbekistan, Tajikistan and Afghanistan schemes, as well as for the TUTAP and CASA projects.

Now a few words about the harmonization of technical issues related to the regional trade expansion:

- The volume of technical power exchange flows will grow in the years to come, and the requirements for coordination of joint operation of power grids will increase, as well.
- SCADA systems are the main tool used for this. They are installed already in most power grids, and in some power grids they are currently under installation or at an active development stage.
- CDC Energia appears to be the narrowest bottleneck in this area, as it still lacks a modern SCADA system and operates its own operational information complex (OIC) improved on an ongoing basis by the CDC staff.
- However, given that the main algorithms incorporated in the current software were developed in the 70-90's of the last century, fundamental reconstruction of the OIC system to bring it in line with the modern SCADA systems is impossible.
- It should be noted that CDC Energia does not own power lines, power plants or substations. Therefore, instead of the SCADA/EMS installed in power grids, CDC Energia needs to install the topmost equipment and software only, which is much cheaper than installing a complete SCADA/EMS.
- In its recent regional study, Fichtner estimated the needs for SCADA installation in CDC Energia at USD 10 million (see Annex 3.6 - 8b, Project: 4864R14 01.09.2011).
- We kindly ask you to consider a possibility of allocating grant funds under CAREC programs for the implementation of SCADA in CDC Energia.

Thank you