On the issue of power exchange and development of regional power trade in Central Asia

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In Soviet times, the power systems of the Central Asian Republics (CARs) were designed with the need to take advantage of available energy resources and seasonal energy interchanges between the countries. In the regional integrated power system built on 220-500 kV power grids, the thermal power stations in Kazakhstan, Turkmenistan and Uzbekistan have been combined with hydropower plants in Tajikistan and Kyrgyzstan. It allowed Tajikistan and Kyrgyzstan to export electricity in summer, when their hydro energy systems work at maximum capacity, and import electricity in winter, when there is a shortage of energy. Water discharge from hydropower stations in Tajikistan and Kyrgyzstan were coordinated in accordance with the primary objective to meet the irrigation needs of the downstream countries.

Electrical power systems modes were built on the basis of the need for the above-mentioned relationship of energy and irrigation. Thus, everything was pre-planned. In the energy sector the above was expressed in the plans of every energy unit with regards to generating and consuming of power (for every grid, for regional power centers, power plants, power companies, etc.). These plans were controlled and should have been strictly observed. Power trade was carried out not only between the Republican power systems in general, but also between individual power centers, provided that tariffs were various, they were not contractual and were established "at the top level".

In accordance with the plans of the Republican power system, the dispatcher plans were made not only for power plants, but also for inter-system overflows, provided that planning should have been carried out with a view of optimization of the power systems in general. Trade volumes were determined on the basis of technical flows between power grids.

The above is illustrated in the following table, which shows that in addition to the basic Republican power system there are some separate power centers available, which, without any direct connection to the main power grid, had nothing to do but to buy power from the neighboring power systems.

In-country overflows of power for 1990 in CAPS ml.Kwt/hour														
	1990	Central Asia energy systems												
		Republic that obtains power												
		Tadjik SSR		Uzbek SSR		Kazakh SSR			Turkmen SSR				Kirg SSR		Total
		North Tad	DVES	UzSSR	Sur han	KazSSR	Chu Kurdai	Jam bul	Tash auz	Cha rjou	Gaur dak	Ma ry	Talas Kiahty	Suluk ty	
	Uzbek SSR	3814.2	112.7			8139.8			658.2	288.1	166.1	0.7			13179.8
	Tadjik SSR				2344.2									324.1	2668.3
	Kirg SSR			2383.6			210.4								2594.0
	Kirg SSR (Frunze)							487.1							487.1
	Turkmen SSR			6066.1											6066.1
	Kaz SSR												227.4		227.4
	Kaz (Charjou)			309.9											309.9
	Total	3814.2	112.7	8759.6	2344.2	8139.8	210.4	487.1	658.2	288.1	166.1	0.7	227.4	324.1	**25532.6**

Since independence in 1991, the countries of CAR initiated the policy of energy "self-sufficiency". Growth of power tariffs led to the fact that for the countries that have reserves of energy resources it has become more profitable to export fossil fuels outside of the CAR. This led to violation of the existing schemes of energy exchange. Destruction of the unified banking system and introduction of national currencies led to the need, at the initial stage of reforming economies, of using barter energy exchange.

The consequence was that, instead of technical intersystem flows, the concept of commercial flows had to be introduced, as a result of balancing the technical flows. Function of calculating the volumes of commercial flows was assigned to the TAC Central Asia (now the CDC "Energy"). As a result, the volume of electricity trade declined from 25 GWh in 1990 to 2.3 GWh in 2010. It should be clearly understood that this reduction occurred in the first place with the transition to a new system of calculation of the volume of energy exchange (from technical flows to commercial flows). In parallel with the fact that due to the mentioned above reasons of "self balancing" the process of reducing the cross-border power trade was going on, dynamics of which can be seen from the following tables.

Energy systems of CA countries ml.Kwt/hour

EXPORT	1995	Import					
		Rep. Kazakhstan	Rep. Kyrgyzstan	Rep. Tajikistan .	Rep. Uzbekistan	Turkmenistan	**Total**
	Rep. Kyrgyzstan	786.6		69.1	928.7		1784.4
	Rep. Tajikistan	309.4			296.1	31.8	637.3
	Turkmenistan	1682.3		101.3			1783.6
	Rep. Uzbekistan	432.2	412.5	1128.6		315.7	2289.0
	From North Kazakhstan	1100.7					1100.7
	From Kazakhstan (AtyrauEnergo)				7.2		7.2
	Total	**4311.2**	**412.5**	**1299**	**1232**	**347.5**	**760.2**

Energy systems of CA countries ml.Kwt/hour

EXPORT	2000	Import					
		Rep. Kazakhstan	Rep. Kyrgyzstan	Rep. Tajikistan .	Rep. Uzbekistan	Turkmenistan	**Total**
	Rep. Kyrgyzstan	12252.9		154.4	1925.6		3332.9
	Rep. Tajikistan		125.7		243.9		369.6
	Turkmenistan	34.8		818.7	67.8		921.3
	Rep. Uzbekistan		194.6	728.8		32.5	955.9
	Total	**1287.7**	**320.3**	**1701.9**	**32.5**	**32.5**	**5579.7**

Energy systems of CA countries ml.Kwt/hour

EXPORT	2005	Import					
		Rep. Kazakhstan	Rep. Kyrgyzstan	Rep. Tajikistan .	Rep. Uzbekistan	Turkmenistan	**Total**
	Rep. Kyrgyzstan	2668.1		230.1			2898.2
	Rep. Tajikistan	68.5	3.5		683.5		755.5
	Turkmenistan						0.0
	Rep. Uzbekistan			814.9		0.4	815.3
	Total	**2736.6**	**3.5**	**1045**	**683.5**	**0.4**	**4469**

Energy systems of CA countries ml.Kwt/hour

EXPORT	2010	Import					
		Rep. Kazakhstan	Rep. Kyrgyzstan	Rep. Tajikistan .	Rep. Uzbekistan	Turkmenistan	**Total**
	Rep. Kyrgyzstan	1799.7		17.5	8.6		1825.8
	Rep. Tajikistan		96.6				96.6
	Turkmenistan						0.0
	Rep.		13.3	320.8			334.1

	Uzbekistan						
	Total	1799.7	**109.9**	**338.3**	**8.6**		**2256.5**

In turn, this has led to the fact that in Tajikistan the cases of non-performing water discharges have become frequent in summer due to lack of power demand and due to limited capacity of water reservoirs, and in winter in Tajikistan and Kyrgyzstan there were shortages of electric power. Striking example of this situation were power shortages in the winter in dry years, especially in 2007 and 2008.

Reducing electricity interchanges combined with decline of mineral energy resources supply led to the fact that hydropower in Tajikistan and Kyrgyzstan made transition from irrigation mode to energy mode with prevailing power generation in winter. Since water is needed for irrigation in summer, this has led to the problems associated with performance of reservoirs. This resulted in the situation in which some countries produce electricity using fossil fuels, instead of implementing of mutually beneficial imports of excessive electricity from neighboring countries generated by renewable water resources.

Transition from technical flows to commercial flows has led to the need to introduce one more new concept, which was not in existence previously, which is "**transit of electricity"**. In the United Energy System of Central Asia (CAPS), which used to work in stand-alone mode, it was necessary to urgently develop the methodology to determine the volume of power transit. Developed in CAPS and currently effective methodology has played an important role in putting in order of the relationship between energy systems, but it is not perfect and has flaws, which, as experience has shown, have been creating difficulties for implementation of the power exchange through the network of third-countries.

In particular, the methodology involves obtaining of permits for transit of electricity and the matter is sometimes associated with other non-technical problems. As a result, there have been cases where contracts signed for supply of electricity did not work. Thus, transit difficulties have led to the situation that in 2003 the Turkmen power system without having markets for power export in CAPS, left it and began to work with the power system of Iran.

Is it possible to restore the power trade in the region at the same level and what is to be done for that?

At present, the power systems of South part of Kazakhstan, of Kyrgyzstan and Uzbekistan, operate within the CAPS in parallel with the Unified Energy System of Russia and CIS through the energy system of Kazakhstan (at the end of 2009, due to the problems with maintaining the balance of power, the energy deficient Tajik energy system was separated from the CAPS and currently works in isolation). Some separate, passive (without generation) parts of the power system in Afghanistan, which are

connected, respectively, to the grids of Uzbekistan, Tajikistan and Turkmenistan, operate within the CAPS grids based on the so-called island schemes.

Currently, with the support of international donors, the critical work is going on for creating the Unified Power System of Afghanistan. Naturally, the question arises as to which mode it should operate with neighboring power systems in the future.

Study conducted by Fichtner Company, showed that there is no clear decision yet, although one of the findings is clear: 220 kV lines are not enough for setting up of the Unified Power System of Afghanistan.

From the point of CDC "Energy" view, the most attractive for CAPS from both, technical point of view and recovery/development of regional trade, is an option for development of power system in Afghanistan proposed by Fichtner, which unfortunately has not been duly appreciated - development based on construction of 500 kV lines, which will not only be systemically important for Afghanistan itself, but at the same time will be the structural units of CAPS and will greatly enhance the existing scheme of power association. The emergence of powerful alternative power connections through Afghanistan will allow:

- restore one of the most powerful areas of power trade between Turkmenistan and Tajikistan, which will mitigate the problem of winter shortage in Tajikistan;
- provide the impetus for restoration of the currently disabled links between the power systems;
- reanimate also some other areas of power trade between the countries of Central Asia
- not only transmit electricity from Central Asia to South Asia (via the DC link), but at the same time use it to cover their own deficits in CAPS power systems;
- create a permanent source of revenue for the Afghan power system as a transit grid.

Afghan AC of 500 kV will be a structural element, an integral part of CAPS and will be used as a DC line not for six months, proposed by the CASA-1000 project, but all year-round. As to the latest, according to the CDC "Energy", with a view of inter-regional power trade within the CAPS, the investments for more expensive project could be returned in a shorter time compared to the DC line project. Provided that it can be implemented step by step, and begin to pay off after the completion of each stage. It is not difficult to see that the Fichtner option keeps all positive features of CASA-1000 project.

And, which has already become a tradition, at the end of its presentation, the CDC "Energy" again draws attention to the fact that no matter what development option for the regional power system would be adopted, the status of emergency control in CAPS would require a revision of its basic principles and its reconstruction.

Thanks for your attention