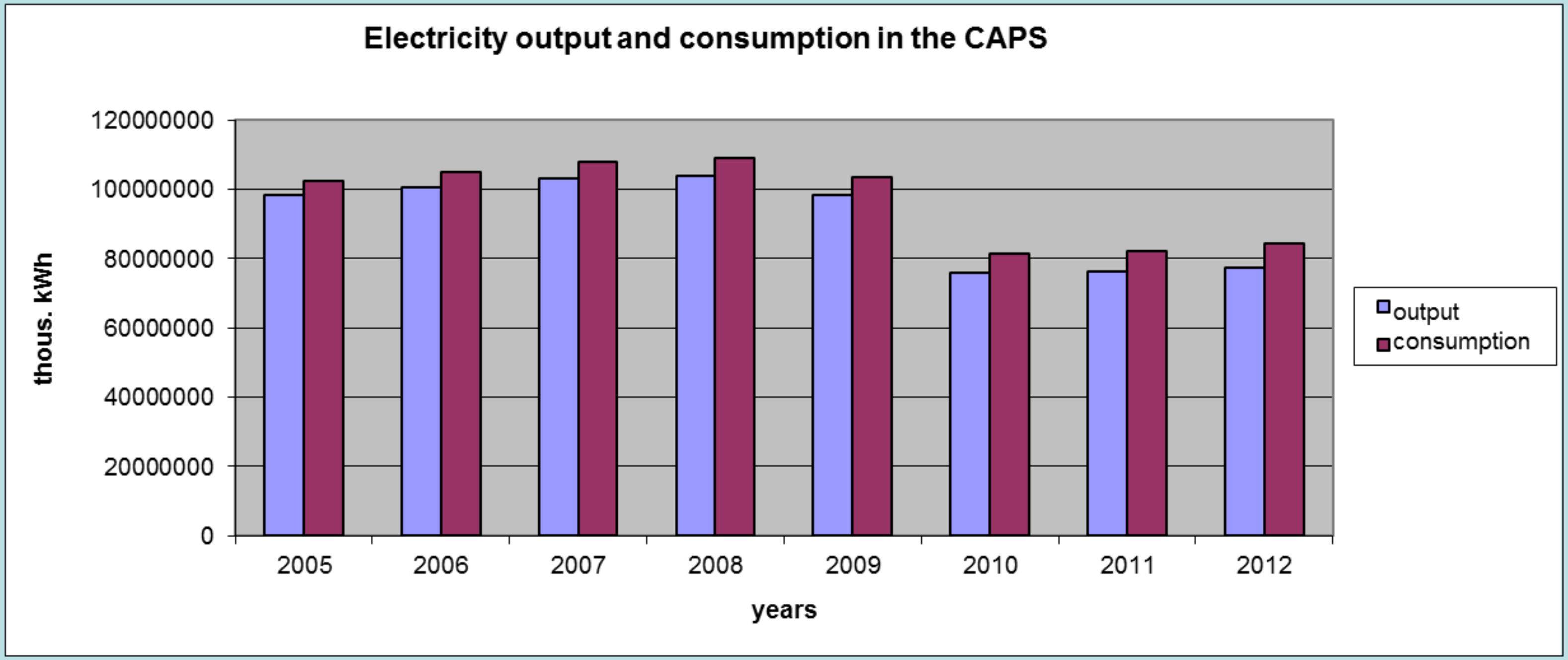
Energia Coordinating Dispatch Center

DISPATCHING IN THE CENTRAL ASIAN INTERCONNECTED POWER SYSTEM (as of May 2013)

Outline map of the main power grids (200-500 kV) in the Central Asian interconnected power system (CAPS) in the long term (until 2020)

• At present, power systems of Uzbekistan, Kyrgyzstan and the Southern Kazakhstan operate in parallel in CAPS. CAPS is synchronized with the Unified Energy System (UES) of the CIS through the UES of Kazakhstan.

• Tajikistan's energy system has been isolated since 2009.

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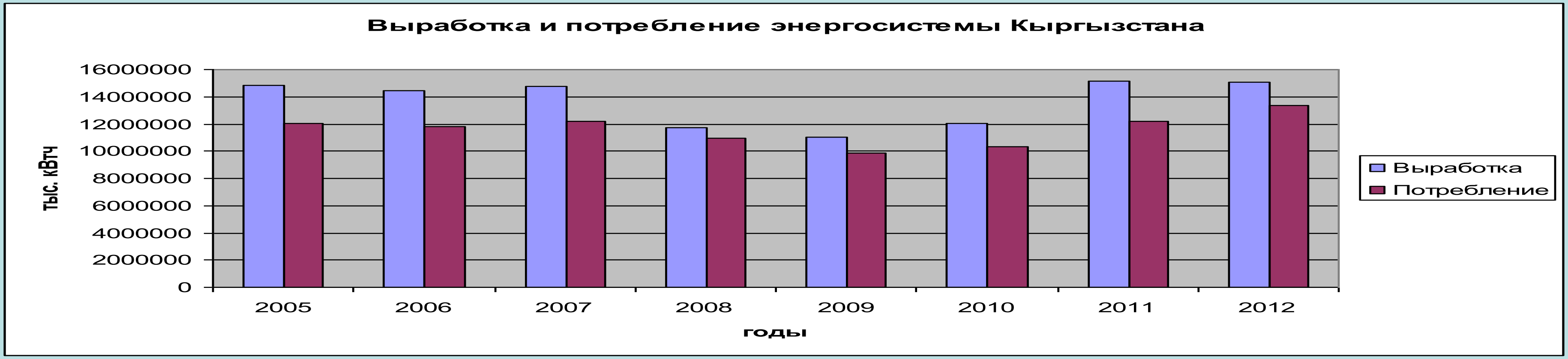
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Energy balance in the AWP 2013

- In the AWP (autumn and winter period) for 2012-2013 (from October 2012 to February 2013), CAPS within the power system of Kyrgyzstan, Uzbekistan and the Southern Kazakhstan was working in parallel with the power systems of the Northern Kazakhstan and the Unified Energy System of Russia.
- From October 2012 through February 2013, **the balance of power in CAPS** was covered with power generation by own power grids of Uzbekistan, Kyrgyzstan, the Southern Kazakhstan, as well as with the power received from the Northern Kazakhstan.
- Like the year before, this year the AWP allowed deviations in the scheduled power flows and, as a consequence, the unintended power flows between power grids.

Reasons:

- lack of capacity and energy reserves in CAPS because of the shortage of energy in the winter season;
- absence or late conclusion of contracts.

- From October 2012 through February 2013, the power system **of the Southern Kazakhstan** covered its deficit, mainly by receiving power:
  - from the Northern Kazakhstan – ca. 4 bln. kWh;
  - under contracts with Kyrgyzstan (nearly 123 mln. kWh actually supplied, of which 113 mln. kWh are a compensation for losses in the networks of JSC KEGOC by OJSC National Power Grid of Kyrgyzstan).
- From November through February, there were unintended takeoffs of electricity by the power grid of Uzbekistan: nearly 186 mln. kWh from the power grid of the Southern Kazakhstan, and 4 mln. kWh from the power grid of Kyrgyzstan.

Power balance

- Actual power balance in CAPS in the past months of the autumn-winter period of 2012-2013 was maintained in the context of a lack of capacity reserves due to an acute shortage of fuel resources.
- The power balance was closed with of the output of own power plants and getting power from the Northern Kazakhstan; power flow to Afghanistan reached 280 MWh.
- Actual maximum power demand in the power grids of CAPS under the current AWP was registered at 6.00 pm on **December 31, 2012,** and reached **14,132 MWh,** which is 60 MWh higher than the total maximum power value committed by power grids.

(for reference: previous winter's aggregate maximum was also registered on **December 31, 2011,** and reached **13,820** MWh vs. 13330 MWh of the total maximum power value committed by power grids).

- Winter peak demand increased in all power grids of CAPS.

- Actual maximum power demand in the **power grid of the Southern Kazakhstan** amounted to **3,480 MWh,** which is 250 MWh higher than the maximum power load in the previous AWP.

It was proposed to close the power shortage in the **power grid of the Southern Kazakhstan** during peak-load hours in the AWP 2012-2013 mostly by receiving up to 1,350 MWh from the Northern Kazakhstan, as well as up to 300 MWh from CAPS power grids.

- In December, actual maximum power demand in the **Kyrgyz power grid** reached 2,994 MWh, which is 60 MWh higher than the previous AWP level.

In the presence of excess capacity during peak-load hours, the power grid met deficits in the Kazakh and Uzbek power grids.

In December and January, the power control range of the Naryn chain of hydropower plants decreased significantly due to maintenance shutdowns of hydraulic turbine generators.

- Actual maximum power demand in the **power grid of Uzbekistan** was registered in December and reached **8,260 MWh,** which is 200 MWh higher than the previous AWP's maximum level and 360 MWh higher than planned.

Load of generating units of thermal power plants over much of the winter period was limited due to a fuel shortage and forced shutdown of the power generating equipment.

The situation has somewhat improved with the launch of a combined cycle gas turbine plant (478 MWh) at Navoi TPP (during the start-and-adjustment period from October through February the CCGT-1 was running for nearly 2,200 hours or 90 days).

- With the committed consumption level and adequate fuel supply, the Uzbek power grid expected to have up to 600 MWh of excess power during evening peak hours.

- Actual balance of power during AWP was in a deficit of more than 600 MWh.

- The deficit was covered mostly by unauthorized takeoff of **up to 600 MWh** from the Northern Kazakhstan, often with front-loaded transit from the North to the South of Kazakhstan in excess of allowable limits, which could result in an emergency situation.
- The situation was quite the opposite during off-peak hours: actual power output from the power grid of Uzbekistan during the minimum demand night hours reached **of 1,000** MWh and created an emergency situation at the border of the Russia and Kazakh power grids.

What is the cause of imbalance in the Uzbek power grid?

1. Power is generated by thermal power plants with low adjustment range and low maneuverability.
2. Dependence of gas (primary fuel) supplies on differential ambient temperature.
3. Decreased accumulation of reserve fuels (black oil fuel and coal), as compared to the previous years.
4. Separation of the Tajik power grid from CAPS, which resulted in the power grid losing up to 600-700 MWh of peak power.
5. Operation of new cost-efficient base-load generating units (without unloading even at night, when energy is in excess).

Actions to improve the power balance situation in CAPS:

1. it is advisable to renew the parallel operation of the Tajik power grid with CAPS, which requires meaningful dialogue at the government level;
2. draw attention to the increase in the adjustment range of power plants, especially in the newly commissioned CCGT (specify the range of loads with an acceptable efficiency coefficient);
3. build average-capacity power plants with **daily** or **monthly** storage reservoirs (small hydropower plants are built on water courses and have no adjustment range, while high-capacity hydropower plants with large long-term storage reservoirs are a separate issue that is not covered by this presentation);
4. build PSPPs – reversible pumping generating units operating in the generating or pumping mode; these produce double effect in terms of power control without leading to a drawdown of reservoir, which is very important for the region with the lack of water resources;
5. more efficient consumption (demand) management.

Commissioning of equipment in 2012 that affects operation of CAPS:

• **in the power grid of Uzbekistan:** commissioning of a modern, mobile and cost-effective combined cycle gas turbine (CCGT) with a capacity of 478 MWh at Navoi TPP. This has had a significant positive impact on the balance of power in the Samarkand-Bukhara generation system with very short power supply.

• **In the Southern area of the integrated power grid of Kazakhstan:**

– commissioning of ПС-500 kV Alma with VL-500 Almaty Alma (L-535) with the adjacent 220 kV network;

– attainment of the projected capacity of 300 MWh (2x150 MWh) at Moinak hydropower plant in Almaty load center.

– upgrade of the 1control automatic equipment SS Almaty-500 by the commissioning of the above assets.

• **CAPS** introduced new and improved emergency control system (ECS) units (emergency control);

– AEMD (automatic exposure metering devices) reconstructed at Syrdarya TPP;

– ECS commissioned at SS Lochin;

– the existing ECS structure in the Western part of CAPS to be supplemented with necessary actions by including CCGT-478 to the Navoi TPP;

– improved AEMD of the Toktogul hydropower plant;

– restructured load shedding in CAPS.

– under-frequency load shedding restructured in CAPS.

Commissioning of equipment expected in CAPS in 2013:

- ***In the power grid of Kyrgyzstan*** (June-July)

• Commissioning of the SS 500-220 kV Datkah with:

– OHTL Lochin 500 kV SS - SS Datkah;
– OHTL 500 kV SS Datkah - Toktogul hydroelectric power station;
– OHTL 220 kV SS Crystal - SS Datkah (2 circuits)
Kurpsayskaya HPS - SS Datkah,
SS Datkah - SS Torobayev (2 circuits)
SS Datkah - SS Uzlovaya (2 circuits)

with a set of emergency control system.

Project emergency control system is based on modern technology; therefore efforts to commission the ECS will include, *inter alia,* adjustment to the ECS system existing in CAPS.

- ***in the power grid of Uzbekistan*** (November-December):

• commissioning of the OHTL 500 kV SS Sogdiana - Talimardjan TPP;

• launching the OHTL Guzar 500 kV SS - SS Karakul at ODC 500 Talimardjan TPP.

Commissioning of these OHTL will have substantial impact on emergency management principles in the Western part of CAPS.

Bottlenecks in the electrical circuit

In 2012, parallel efforts were made strenuously under conditions that did not always allow ensuring:

- regulatory stability of the transit network,
- necessary reliability of the UES in general, as well as the power supply for consumers in certain regions.

Reasons:

- failure to meet net power flows planned by power grids in a number of modes.
- restriction and, at some sections, exhaustion of network transmission capacity of a number of transits due to:
  - the lag in development of backbone networks;
  - inferiority of the means of emergency control and telemetry.

- Main transit OHTLs were run with the load close to the maximum allowed load according to the condition of stability or current-carrying capacity.

- Comparison of the values of planned, actual and permissible flows is provided in the following table.

- According to the data on actual network load, a number of sections worked with the minimum stability margin.

- The situation was aggravated by emergency repairs of the VL-500 kV: L-501, L-504, L-514, L-515, L-516, L-522, L-530 and a generating unit of Talimardjan thermal power plant.

Controlled cross-sections	Proposed flow for the autumn and winter period of 2012-2013 (according to the CDC's schedule) MWh	Actual flow for the autumn and winter period of 2012-2013 MWh	Maximum allowed flow, MWh
L-501, L-509, L-2-Ch, L-2-D	**1500**	**2250**	**2300**
L-509, L-516, L-237	**1050**	**1860**	**1800**
L-509, L-515, L-D-F, L-224	**880**	**1600**	**1600**
L-530, L-532	**1200**	**1550**	**1200**
L-514, L-A-G, L-B-3, L-228, AT-3 Shu	**800**	**1080**	
L-509, L-515, L-D-F, L-224, L-530, L-532	**1980**	**2300**	**2200**
L-520, L-H-К, L-H-C	**770**	**1550**	**1000**
L-510, L-521, L-20-D, L-Zarbdor	**1580**	**2400**	**1900**
L-513, L-К-G, L-Sh-G, L-Nasos, L-C-C, L-К-C	**400**	**1060**	**1100**
L-503, L-502, L-20-Кs (from the buses of GЭC-20)	**850**	**1675**	**2000**
L-522, L-2-T, L-2-U	**450**	**1025**	**800**
L-503, L-504, L-524, L-25-O-1,2	**870**	**1510**	**1500**
L-Kr-К, L-Kr-C, L-Kr-U, L-Kurpsayskaya-Torobayev	**1200**	**1300**	**1200**

The most stressful sections of the network were:

1. The northern part of the UES

The main challenge was to ensure reliable operation of the North-South Kazakhstan 500kV transmission line (L-5300 and L-5320).

Transmission during AWP was exposed to the maximum load.

Energy shortages, lack of capacity reserves in the UES, takeoff of excessive volumes of energy by the power grid of Uzbekistan during the peak-load hours resulted in the line being loaded by up to **1,550 MWh (as compared to the maximum allowed 1,200 MWh)** and the automatic power surge system being activated up to 17 times a day (see the APS operation statistics below).

In addition, it stands to mention difficulties in power supply to consumers of the Northern part of Kyrgyzstan and the Almaty load center.

The total flow to the load center in the cross section of L-509, L-515, L-224, L-D-F, L-5300, L-5320 exceeded the maximum permissible value by 100 MWh; in this case, the upsetting was controlled manually because of imperfections in the ECS.

APS-1 operation statistics in CAPS during AWP 2011/12 and 2012/13

	AWP 2011-2012		AWP 2012-2013		
	Total	Of which, w/o disconnection of consumers		Total	Of which, w/o disconnection of consumers
November 2011	384	62	November 2012	53	2
December 2011	639	208	December 2012	93	16
January 2012	301	79	January 2013	46	11
February 2012	174	62	February 2013	66	5
Total:	**1498**	**411**		**258**	**34 (13%)**

The main reason for automatic activation of the APS-1 was a significant deviation of the Uzbek power grid from the planning schedule.

2. South-West (SW)

The SW section of the energy system of Uzbekistan is in very short supply of electricity. In case of involuntary emergency repair of a unit at TalTPP, the 500-220 kV connection of SW with CAPS (L-510, L-521, L-20-D, L-Zarbdor) worked without ensuring sustainability with a load of **up to 2,400 MWh (whereas the acceptable flow is 1,900 MWh).**

The following measures were taken to prevent harmful power surges for the transit of CAPS-Kazakh UES and dangerous reduction in the frequency of SW after activation of the ECS:

- cutoff of up to 4 units in CAPS (at SDTPP, NATPP, ToktHPP);
- OH to SW (up to 1000 MWh).

The input was made manually, with visual control based on special trained special promptly prepared materials.

3. Central part of the UES

Upon direction of the flow to buses of TashTPP, the load at the section of 500-220 kV L-522, L-2-T, L-2-U in the central part of the UES reached nearly **1,025 MWh (whereas permissible level is 800 MWh).** Additional measures of ECS' impact on disconnection of the second generator (NATPP) were required to unload the VL-220 kV L-2-T and L-2-U upon emergency disconnection of L-522.

4. Ferghana part of the UES and the power grid in the South of Kyrgyzstan:

Because of the backlog of network construction in the Southern part of Kyrgyzstan, which was under favorable auspices in terms of the power balance during AWP 2012/13, there were bottlenecks that reduced reliability of the UES in general, such as:

- presence of up to 300 MWh of pent-up capacity;
- excess of the permissible load in OHTL 220 kV, which was used to output power from the lower cascade of power plants in the Toktogul chain of hydropower plants. Summary load of these VL-220 kV reached **1,300 MWh (whereas permissible level is ca. 1200 MWh).** Moreover, in a number of modes there was significant current overload in the L-Kr-U. In actual modes, disconnection of the VL-220 kV in the South of Kyrgyzstan could have led to disconnection of two generators of the Kurpsai hydropower plant from the ECS (up to 400MW), which is unacceptable due to the lack of automated equipment for rejecting load in the South of Kyrgyzstan, thereby compensating for the lost power.
- introduction of the Southern Kyrgyzstan power grid modes was hampered by the lack of the necessary volume of telemetering data.

5. Problem with the setting up of systems for newly commissioned CCGT:

- Commissioning of CCGTs at the Surgut SDPP-2 (Russia) has led to the simultaneous swinging of the existing 800 MWh units.
- In March 2013, there was swinging at the 800 MWh unit of Talimardjan thermal power plant.
- In Russia, AEC (automatic excitation control) of all newly commissioned CCGTs are certified with the use of a physical electrodynamic model at St. Petersburg's Research and Development Institute.
- This issue has not been examined in the CAPS region.

Status of
emergency management in CAPS

- Currently, CAPS has no coordinated emergency control system.
- Emergency control is composed of individual local modules.
- Equipment is worn-out and obsolete.
- Principles of emergency control have not been revised for a long time.
- Abundance of manual (non-automatic) impacts increases the risk of improper operation of the emergency control system.
- Only local effects of emergency control are explored upon commissioning of new facilities.
- Parallel operation of CAPS with the Kazakh UES and Russian UES was organized without adjusting the operating principles of the existing automatic controls (the project was not commissioned due to the lack of funds);
- Upon commissioning of the second section of Agadyr – UKGRES (South Kazakhstan State Regional Power Plant), emergency control system was implemented only in a part of the Kazakh power grid.

- In May 2012, the CAPS Task Group has drafted a modernization program with a view to upgrade the emergency control system of the CAPS and the Southern Zone of Kazakh UES.
- The plan calls for a three-tier hierarchical structure of building emergency control system activities:
  - Tier one – emergency control actuators at power facilities of power grids;
  - Tier two – local, centralized systems in individual energy regions (3 in Uzbekistan, 2 in Kyrgyzstan, and 2 in Kazakhstan);
  - Tier three – centralized coordinating unit with the installation of a central emergency control system at *Energia* CDC.
- What needs to be developed:
  - Terms of reference for the technical and financial appraisal of the Plan (estimated cost (SredAzEnergosetproekt) of preparing the extended ToR is USD 100 thousand; the timeline is 6 months);
  - Feasibility study for the CAPS and Southern Zone of Kazakh UES: Emergency Control Modernization Project (estimated cost of the project (according to the HVDC Power Transmission Research Institute, UES Research and Development Center) is USD 2-3.5 million).
- Donors are needed to run this regional project.

Energy sector regional cooperation Master Plan implementation progress

• Chapter 3.6 of the Final Report on the Energy Sector Master Plan finalized and approved last year includes an appraisal of implementing a new SCADA/EMS system at *Energia* CDC.

• $ 10 million are allocated for this purpose in Annex 3.6 (8a, 8b, 8c), of which:

$ 7.73 million	- hardware and software
$ 0.5 million	- reconstruction of premises;
$ 0,386 million	- spare parts, tools and instruments;
$ 0,645 million	- personnel training.

• It would be good to learn about ongoing efforts to accomplish this objective.

- In particular, the CDC considers it an appropriate priority measure to allocate part of the funds for the establishment of a regional training center at *Energia* CDC before full-scale implementation of SCADA; this will allow strengthening capacity of CDC employees and CAPS power grids experts.
- It is proposed that 1-2 classrooms (15 students each) be created and equipped with appropriate hardware and software that allows to:
  – simulate power system modes;
  – deliver training courses for the operating personnel of power grids and CAPS as a whole;
  – build capacity of the engineering and technical personnel;
  – explore new technologies used in the energy sector;
  – provide training in modern planning techniques and other special topics by inviting relevant experts (or by online distance learning).
- Against the background of general decrease in the level of competence of specialists graduating from universities and given the lack of training institutes in Central Asian countries, refresher training at a regional training center will be a good mechanism for sustainable development of all energy systems in the region.

Thank you!