Central Asia Power System Study. Update.

July 2010

Index of Contents

Project description

- World Bank study
- 3 international experts from MERCADOS EMI
- Collaboration with USAID experts involved in REMAP I

- Missions:
  - June: data gathering, discussion with stakeholders
  - September: presentation of results

- Deliverables:
  - July: CAPS current status overview
  - August: assessment of potential losses for each country and the whole region in the case of isolated operation
  - September: recommendations of possible low cost and rapid actions for CAPS improvement

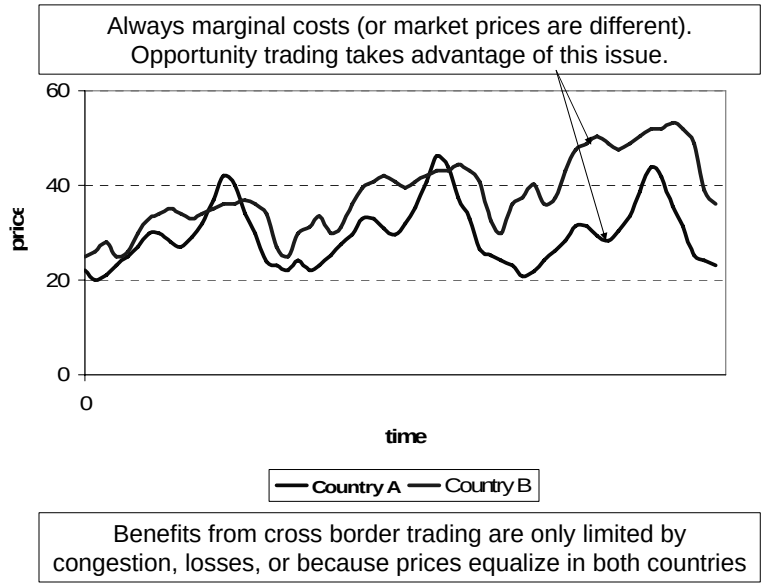
Main objectives

- Opportunities and challenges in improvement of electricity dispatch and system operations across CA
- Current status of the Central Asia Power System (CAPS)
- Economic impact of parallel (isolated) operation
- SWOT analysis
- Immediate opportunities for system improvement, without any major investments.

Benefits of integrated grid operation

- Security of supply
  - Increase of system security (mutual support during emergencies, shared reserve)
  - Less regulating facilities needed (regulation may be shared among systems)
- Balanced generation mix and optimal dispatch
  - Optimal use of primary resources
  - Optimized operation of generating facilities taking advantage of marginal cost differentials
  - Well developed grid allows better RES penetration and low-cost dispatch of the generation side (as far RES are always dispatched first) leading to the low carbon economy
  - Optimized operation of intermittent RES, allowing exports of generation that exceeds local demand
- Opportunities for RES development in the region
  - Countries with high RES potential can develop it, relying on the energy mix of neighbors
- Demand curve flattening caused by peak time differences
- Possibility to develop regional scale projects (too big for only one country)

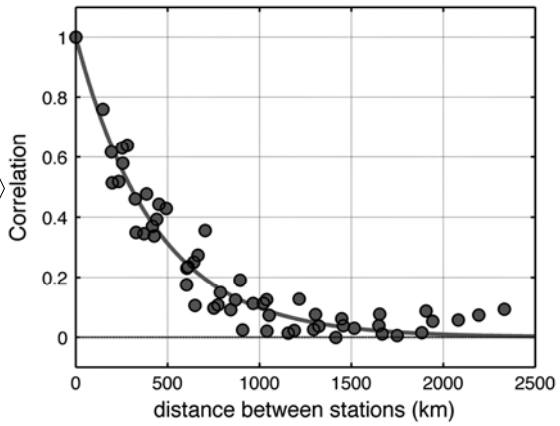
Dispatch Optimization



Good transmission system for intermittent RES

Correlation between pairs of wind generators

The more the distance between two wind generators, the less the probability that both of them are without wind



Geografical distribution increase the security of supply.
But needs the transmission system that would allow replacement of one generation by the other one.

Products and Services in Regional Systems

- Products
  - Energy traded through
    - Bilateral contracts
    - Day-ahead markets(*)
    - Balancing markets(*)
  - Ancillary services
  - Long term reserves

- Supported by:
  - Transmission
  - Congestion management
  - Operation coordination
  - Control of scheduled cross border flows

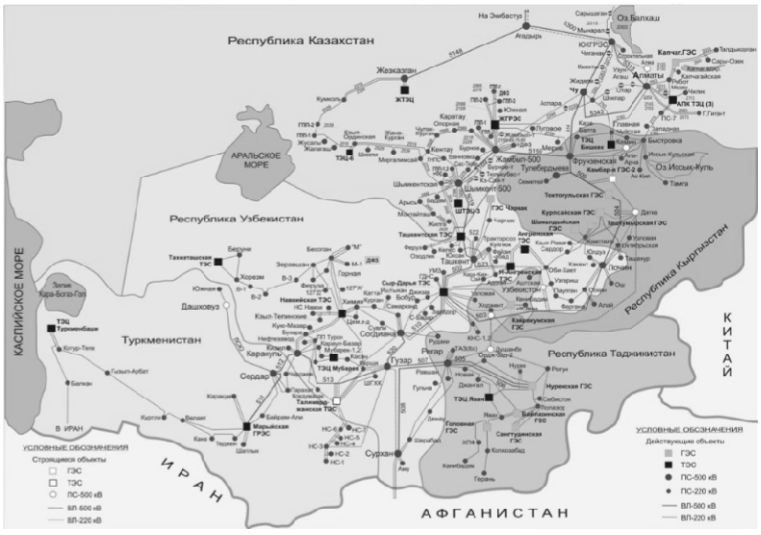
Support during emergencies

(*) Classical opportunity trading, typical between SO, today tends to day-ahead and balancing markets

Products in Cross Border Markets

• Physical Bilateral contracts	• UCTE, USA, NordPool, SAPP, Central America, South America
• Day ahead markets	• Participants of one market offer-bid in each other: UCTE, USA • Regional market: Nord Pool, Central America • Between SO: Colombia-Ecuador
• Balancing market	• NordPool (partial)
• Financial contracts – Power Exchange	• NordPool, several in UCTE, NYMEX
• Ancillary services market	• Only through bilateral contracts
• Long term reserves	• Implemented through bilateral contracts (Reserve provider and TSO or between TSO).

CAPS design.

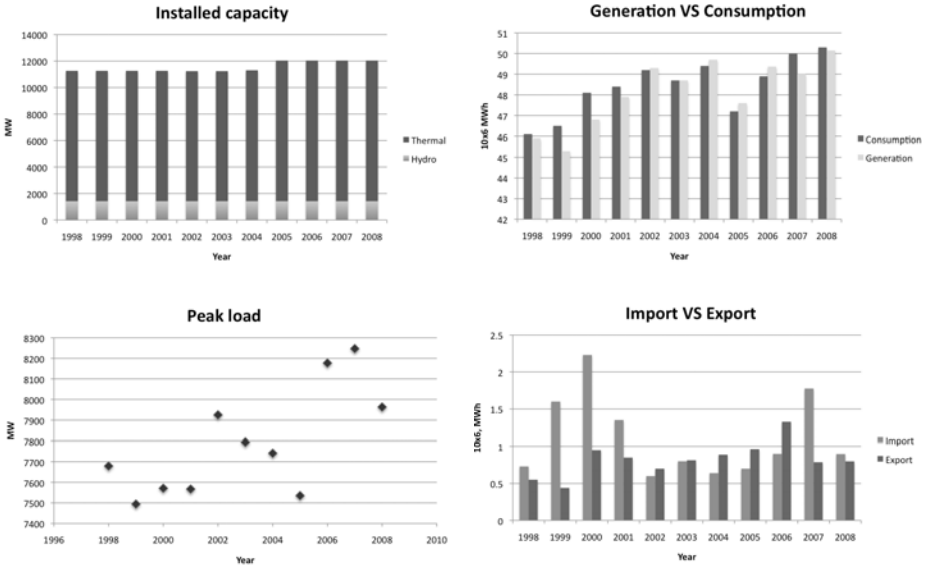


Source: CDC Energy presentation (September, 2009, Almaty)

CAPS design. Benefits of combined grid operation.

- Energy security increase in the CA countries
  - Shared reserves
  - Mutual support in emergencies
  - Improved frequency control
- Optimized operation of thermal, RES and hydro plants
  - Reduction of water spillage
  - Reduction of intermittent RES “spillage”
  - GHG reduction benefits
- Complementary mix of the generation resources
- Optimal mix in terms of frequency and capacity adjustment
- Balancing surplus/deficit between countries within and outside the CAPS region
- Better investment environment caused by:
  - Creation of a market for regional scale projects
  - Big hydro potential of small countries
  - Large energy deficit in neighbor countries
- Demand curve flattening

Uzbekistan. National power system.



Uzbekistan. National power system.

- Excess of power generation and capacity
- Strong dependence on fuel supply
- Strong connections with Tajikistan and Kyrgyzstan power systems in terms of transit services and power trade
- No supply contracts with Kyrgyzstan during the last two years
- No supply contracts with Tajikistan since the end of October, 2009

Uzbekistan. Undergoing and future projects.

Transmission projects Uzbekistan-Afghanistan:

- 220 kV line to supply Kabul - in operation
- 500kV line to connect the Surkhan and Guzar substations in Uzbekistan – in operation

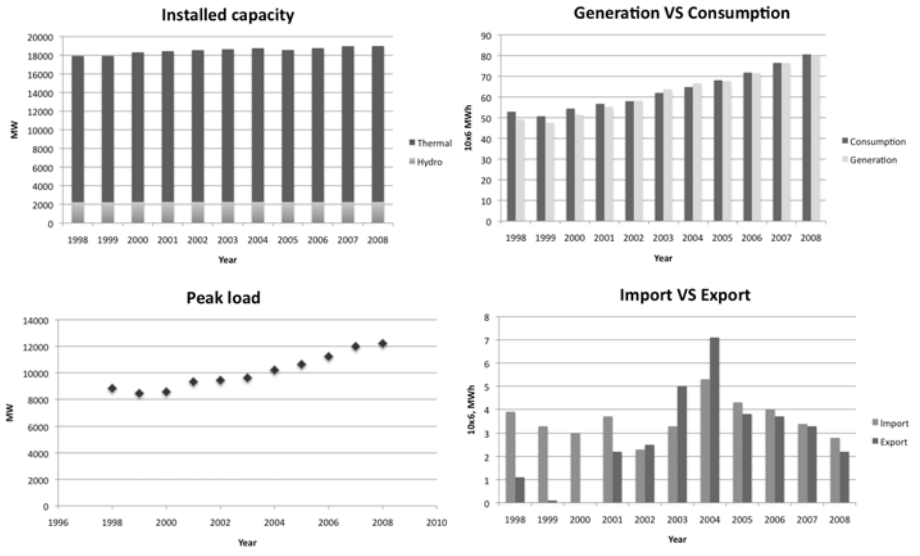
Generation projects:

- Two 400 MW blocks at Talimarjan – to be completed in 2013
- Rehabilitation of the Andijan district heating system – planned
- Renewable energy projects in remote areas – planned

Uzbekistan. Problems of isolated operation.

- Problems associated with adequate frequency (capacity) regulation
- Security of supply problems (fuel supply) caused by sharp climatic fluctuations
- The absence of power interchanges with Tajikistan is problematic from the technical prospective and costly for the system. It leads to power shortages

Kazakhstan. National power system.



Kazakhstan. Undergoing and future projects.

Transmission projects.

- Ekibastuz – Yukgres 500 kV line – in operation.
- Moinak Project – 2 lines of 220 kV – under development.
- Alma Project – enforcement of Almaty region network – in operation
- Batys Transit Project
  - Line North Kazakhstan - Aktobe (500kV)
  - Expansion of two existing substations by 500 kV each
  - Construction of a new 500 kV power transmission line

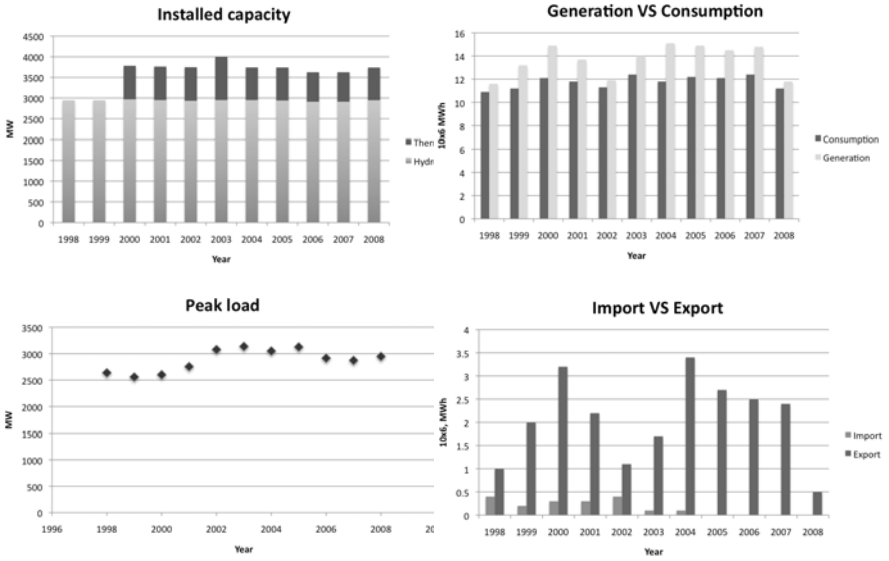
Generation projects.

- Central-Asian Electric Power Corporation (CAEPCO) - generation and transmission assets upgrade
- Ekibastuz GRES-2 Power Plant - Technical Conditions improvement
- Wind generation – development of wind atlas, pre-feasibility study of 10 sites, pilot projects

Kazakhstan. Problems of isolated operation.

- Possible problems with voltage control
- Need for frequency and capacity regulation
- Non-optimal dispatch regime

Kyrgyzstan. National power system.



Kyrgyzstan. National power system.

- Excess of capacity in the power system
- Multiyear water management
- Connection with all the CAPS
- Power trade and ancillary services

Kyrgyzstan. Undergoing and future projects.

Transmission projects:

- Datka – Kemin 500kV line - feasibility study

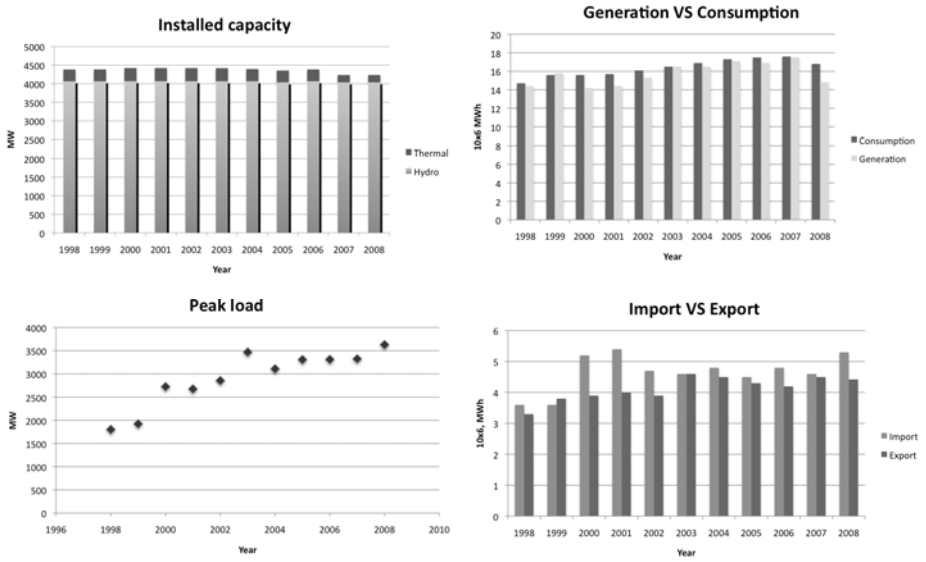
Generation projects

- Kambarata 1 (1900MW) and 2 (240 MW) HPPs – under construction
- Energy Emergency Assistance Project (EEAP) to increase thermal generation and heat at the Bishkek CHP – 2009/2010
- Small and medium-sized hydropower projects (up to 30 MW) – under development

Kyrgyzstan. Problems of isolated operation.

- Uneven concentration of power generation sources and insufficient transmission capacity between north and south
- Absence of electric power export opportunity
- Absence of revenues from ancillary services provision

Tajikistan. National power system.



Tajikistan. National power system description.

- Almost 100% is hydro generation
- Excess in summer and deficit in autumn/winter.
- Seasonal water management
- Interconnections with Uzbekistan, Kyrgyzstan and Kazakhstan

Tajikistan. Undergoing and future projects.

Transmission

- North-South 500 kV line - in operation
- Tajikistan - Afghanistan 220kV line – under development
- CASA 1000 – under development

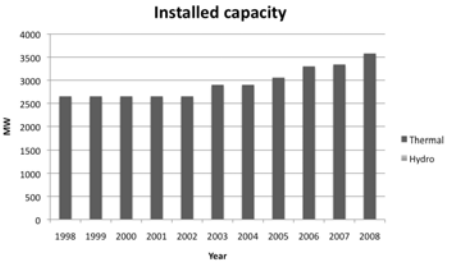
Generation

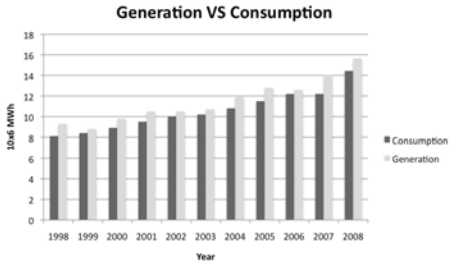
- Sangtuda I 670 MW HPP – in operation since 2009
- Sangtuda II 220MW HPP – to be commissioned in 2012
- Rogun 3600 MW HPP - Techno-Economic Assessment and an Environmental and Social Impact Assessment of the project
- Sarez HPP – feasibility study
- Small and medium-sized hydropower projects (up to 30 MW) – under development
- Two CHPs (in Dushanbe – 270 MW and in the northern region – 300 MW) – under construction

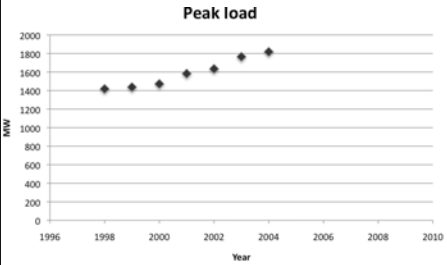
Tajikistan. Problems of isolated operation.

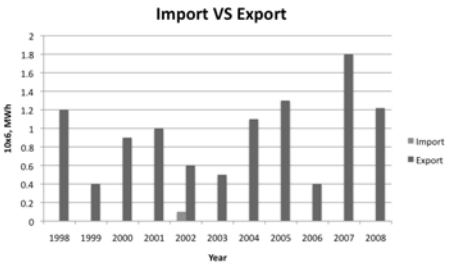
- Lack of fuel for existent thermal power stations (318 MW of installed capacity)
- 2.5-2.6 billion kWh of winter deficit
- Power excess in summer coupled with seasonal water management, leads to high power excess and water spillages
- $87 mln - losses caused by spillages from May 2010

Turkmenistan. National power system.









Turkmenistan. Undergoing and future projects.

Transmission projects

- Tajikistan - Afghanistan transmission lines – in operation

Generation projects

- New gas turbines in Ashgabat, Balkanabad, Avaza (Caspian Sea) – 254 MW – to be commissioned in 2010

Problems associated with isolated work for CA region

- Reduction of the systems reliability - noncompliance with (n-1) reliability principle
- Unnecessary power losses and over consumption of fuel and hydro-resources
- Loss of opportunity of reducing short term operating costs
- Loss of opportunity of sharing ancillary services
- Need for water agreements revision

Ingredients for successful regional cooperation