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Diagnostic Study on Pillar 2 of the CAREC Energy Strategy: Regional Dispatch and Regulatory Development

Executive Summary

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DIAGNOSTIC STUDY ON PILLAR 2 OF THE CAREC ENERGY STRATEGY: REGIONAL DISPATCH AND REGULATORY DEVELOPMENT

EXECUTIVE SUMMARY[1]

1. The ESCC Central Asia Energy Action Plan, approved by the CAREC SOM on October 2009, explores opportunities for regional integration through power development, with only indirect assessments for bulk management of oil, gas and coal resources. The second Pillar of the Energy Action Plan, Regional Dispatch and Regulatory Development, calls for maximizing the benefits of the united Central Asian Power System. This entails moving towards the integrated planning of the transmission system on a regional basis, developing institutional capacity, and enhancing the role of the Central Dispatch Centre (CDC) and national dispatch centers.

2. This executive summary describes the rapid diagnostic carried out, as proposed under the Pillar 2 in the Action Plan.

A. Study objectives

3. One of the actions set out under the ESCC Central Asia Energy Action plan is to conduct a diagnostic study to identify key issues related to regional dispatch. The objective of the short-term diagnostic study was to provide a preliminary assessment of the opportunities and challenges in strengthening electricity dispatch and system operations across Central Asia. The key tasks include:

(i) Provide with the diagnostic of the Central Asia Power System (in terms of participants, flows, protocols, charges and settlements, intra-regional trade), describing critical events and implications over the last 8 months.

(ii) Assess the economic impact of isolated operation compared to joint operation for the CAPS region.

(iii) Prepare a preliminary SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis, with particular attention to immediate opportunities for easing constraints or improving combined grid operation, without any major investments ("low hanging fruits"). Describe next possible steps that could be performed in medium and long term.

4. *Approach:* This study is based on secondary information review and discussion with key participating countries. Its intent is to highlight key issues and opportunities for further study or, where possible, immediate action.

B. Current Status of the Central Asia Power System

5. Power networks of Uzbekistan, southern part of Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan constitute the Central Asian Power System (CAPS). It was designed in 1970s applying least-cost planning criteria to the single system, with an objective to provide a reasonable level of security of supply to consumers under the joint operation of the whole regional network. The present national borders did not exist at that time. It may be important to

[1] This executive summary condenses the findings of a World Bank-funded study undertaken between April and September 2010 by Mercados Energy Markets International.

note that some of the large hydro plants were designed not only to produce energy, but to regulate the river flow and allow for increased levels in areas under irrigation. The thermal based power source in other parts of the region was designed to meet base load demand. At that time, the location of plants and irrigation areas was irrelevant; however, now, with the disintegration of the Soviet Union, the hydro resources are located in different countries than the main irrigation areas. The countries with the large dams depend mainly on the generation of those hydroelectric plants for meeting their internal demand, as they have very limited thermal power sources. Therefore the coordinated use of water and energy is an important issue.

6. After the dissolution of the Soviet Union, CAPS countries continued joint operation of the power systems through a legal agreement, the "Parallel operation agreement", signed by the member countries in 1998. The operational coordination and control was provided by the Coordinated Dispatch Centre of Central Asia, called "CDC Energy". The dual use of water for irrigation was addressed with varying degrees of success through (short term) agreements.

7. For various reasons[2] CAPS is not currently operating as an integrated grid among all the five countries, as it was previously planned. The power exchange in the region has significantly decreased from about 15 to 2 percent. In the case of Turkmenistan and Tajikistan, the 500 kV interconnection lines are even switched off; only Kyrgyzstan and Kazakhstan are trading energy and regulation services, while the rest of the countries mostly engage only in technical exchanges[3].

8. The heterogeneous generation mix in the region, and the potential balance between inter-country supply & demand in alternating seasons and the time of the day, is a clear incentive for a joint operation of CAPS: strong water potential HPPs in Tajikistan and Kyrgyzstan and well developed thermal generation in rest of the CAPS[4].

9. However, when countries operate their power systems independently:

(i) Security of supply decreases significantly;

(ii) As a consequence, the amount of non-served energy becomes higher;

(iii) Non-optimal dispatch leads to the increase in operational expenses,

(iv) Additional investments become strongly required to ensure the internal supply (in some countries more than in others) such as additional reserve capacity,

(v) Operation of multipurpose dams becomes more contentious between conflicting country priorities.

10. Countries are now strengthening their own generation and transmission potential, aiming at the improvement of national energy security and increasing exports to countries outside of CAPS. Nevertheless, at the current stage countries are still not ready to provide reliable

[2] Some reasons include: large volume of unscheduled and unauthorized power drawls, lack of a transit compensation mechanism, different levels of security, quality of primary and secondary regulation, etc.

[3] I.e. parallel flows to support in special conditions in the event that part of a country's power system that needs to be supplied from another country, etc.

[4] More than 95% of demand in each of the countries is met by either hydro (Tajikistan and Kyrgyz Republic) or by thermal energy resources in other three countries.

operation of their national power systems, which would require significant more investments. Some evidence of this weak capacity includes the following examples:

(i) Tajikistan cannot supply remote areas and the winter peak consumption is impossible to cover by the power system as it is.

(ii) Kyrgyzstan needs involvement of the Uzbek side to supply consumers in the Northern part and two regions in the Southern part of the country.

(iii) The Kyrgyz transmission network has to be used in order to supply Fergana valley in Uzbekistan.

(iv) Uzbekistan and Kazakhstan are unable to cover the daily peak without regulation services provided by Kyrgyzstan and Tajikistan.

C. Benefits of Cross-border Power Trading – Lessons from other jurisdictions

11. To a certain extent, all countries of the region have new construction of power networks and generating facilities under way as they seek energy security and independence. The role of the electricity integration and CAPS is evolving and will be shaped by choices made in the near term. Operational experience of power systems in other regions confirms that integration of power systems delivers more advantages in terms of both power supply reliability and market development. Globally more countries are joining part of larger grids and Turkey joining the European grid is the most recent example of harnessing mutual benefits[5] to all. The benefits of integrated operation would include:

(i) **Reduced costs.** Operating cost savings would be realized via more efficient dispatch, economies of scale for generation and maintenance. For example, it would enable thermal plants to operate continuously to meet the base load, avoiding expensive shut-down and re-starts where more flexible hydropower units are available to manage peak loads. Investment cost savings may arise from lower capacity reserve requirements. For example, providing access to thermal power can lower the required storage of a hydro-based system in the dry season. Different time of occurrence of peak loads in each country coupled with the large variability in minimum and maximum demand supplied on most of the days provide strong incentives to optimize operating costs in the system as well as for each of the countries.

(ii) **Increased revenue**. Cross-border power trade opens up opportunities for the sale of surplus energy.

(iii) **Improved reliability and quality of service.** Regional cooperation provides emergency support in case of major breakdowns; increased load and fuel diversity smoothes demand profiles, improves the stability of system operation and mitigates fuel risks. As an example, sufficient thermal and hydro storage can complement intermittent wind resources.

[5] Turkey is the most recent example of joining the European grid to form the World's largest grid. Synchronization with Europe would be a win-win for Turkey (increased stability of grid), Europe (more access to hydro power in Turkey) and the World (by reduced environmental impacts from the expanded grid).

(iv) **Reduced emissions**. Emissions reduction can be achieved through more efficient generation and dispatch.

12. Numerous studies have demonstrated potential savings from regional power integration. For instance, a Generation Investment Study conducted by the European Union on the Balkan Region shows that implementing common expansion planning and operating practices could save the region up to Euro 6.7 billion (constant 2005 Euros) over the period 2005-2020. A study on Southern African power pool indicates that optimizing generation and transmission investments on a regional basis would result in savings of US$2 – 4 billion over 20 years, or 5% of total system costs.

D. Estimated benefits of cross-border trading

13. During the diagnostic study a model to identify optimal generation/transmission expansion in a multi-country system was used (ORDENA Plus®)[6] to see impacts of integrated and isolated operation.

14. Analyzing the modeling results, the great reduction in the system operation costs can be seen with the joint operation of the system and optimization of generation resources. **About 1500 MUSD of fuel costs can be saved in just 3 years of joint operation (**table below. The outputs of the model do not intend to represent the exact operational practices, in absence of enough information for that analysis, but do show the order of expected benefits of a joint operation of the CAPS to minimize costs and maximize security.

Year	Interconnected System, MUSD	No Interconnection, MUSD	Savings, MUSD
2010	11,490.30	12,000.80	510.50
2011	16,446.27	16,910.15	463.88
2012	18,036.30	18,520.19	463.88

E. Recommendations

15. The main issue is to re-create confidence of CAPS members on the benefits of joint operation. It requires mitigation of any negative effects of joint operation, whether actual or perceived by the CAPS members, mainly related to unscheduled flows, security of supply, and negative impact of transits.

16. A range of measures that could help establish a collaborative climate in the CAPS can be organized in three stages:

(i) **Short-term and low cost measures**. These measures would partially solve the existing problems by proposing methodologies for assessment of deviations and transit service compensation, approaches for regional coordination in the case of power system failures, review of primary frequency control coordination, organizing seminars and

[6] The model optimizes the joint operation/expansion of 5 countries and the result is compared in cases of the isolated and joint operation/expansion country-by-country. Hydro component was represented stochastically in the model.

discussions of all involved stakeholders, etc. These activities will provide the necessary legal and regulatory basis for regional collaboration, addressing the problems that encourage the CAPS members to leave the joint operation. This stage would be highly profitable, as sizable benefits arising from integrated operation can be achieved with very little investment. At the same time, this stage is critical for re-creating countries' confidence in the CAPS joint operation, so a failure to achieve this target may produce irreversible negative effects.

(ii) **Medium-term targets and intermediate cost measures**. This stage would aim to improve the supervision and control hardware, install commercial metering, implement software for daily dispatch, real time re-dispatch, post operation calculations and settlement of deviations and transit compensations. At this stage it is suggested to identify the requisite expansion of regional transmission system that would optimize the joint operation of CAPS members, including transactions with neighboring countries.

(iii) **Long-term targets requiring higher investments.** Reinforcement of the transmission and generation system, which involves long maturation times and significant investments. With growing demand, it may be worth evaluating a large regional peaking facility, hydro or gas based plant, to be owned by all the countries for frequency regulation.

17. Short-term actions are suggested to be considered a primary priority and in the case of successful implementation, the majority of the existing drawbacks in the region would be corrected. Thus, after a successful implementation of stage 1, stages 2 and 3 would aim to further increase benefits of joint operation.