ELECTRICITY IN CENTRAL ASIA

MARKET AND INVESTMENT OPPORTUNITY REPORT

JULY 2007

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This report is a summary and overview only. It is a compilation of data from secondary sources and does not contain primary research. Its information can only be verified insofar as the sources it is based upon can be deemed credible.

This report will summarize and analyze these issues using data and research studies published by major development banks and international research organizations over the past seven years in order to present a concrete overview of the current state of the sector. It will use this to determine where opportunities for investment and development exist, and where Central Asia is going in the coming years.

1.0 INTRODUCTION AND OVERVIEW

The vast interdependent electricity systems of the Central Asian states stretch from Kazakhstan and Turkmenistan on the Caspian Sea to Kyrgyzstan and Tajikistan on the Chinese border, and from the Russian border in the north down to the Arabian borders in the south.

Until 1990, the five countries, Kazakhstan, Kyrgyzstan (Kyrgyz Republic), Tajikistan, Turkmenistan, and Uzbekistan, have functioned together as part of the USSR. The dissolution of the Soviet Union into fifteen constituent republics directly caused a severe decline in economic activity in all of them, from which some are only now beginning to recover.

The current level of interconnection of electricity systems is largely a remnant of Soviet planning, whereby the five states were treated as one region, and the divisions that have now become national borders were not a factor. Evidence for this can be seen in the way generating and transmission facilities are organized. For nearly ten years after independence, the countries experienced economic decline, political instability, a severe drop in electricity consumption, and in some cases, civil war.

For the most part, the re-emergence of the power sector has only been underway for seven or eight years, and in that time a remarkable amount of necessary market reform has been achieved. But that was only the first step, and the current state of the power sector is characterized by a large degree of instability and resistance to reform. But it is also characterized by a large degree of economic opportunity. The aim of this report is to analyze both trends.

Recent trends in the five republics suggest that the following are and will continue to be the major issues facing the electricity sector in the coming decade:

- Continuing reform of the emerging market systems for electricity towards the establishment of fully privatized competition;
- Reconciliation of various degrees of market emergence towards the establishment of a common power market between all five countries;
- Integration of the irregular and inefficient power transmission system to facilitate creation of intraregional power market;
- Urgently needed repair, refurbishment, and replacement of ageing and obsolete power transmission and distribution equipment;
- Feasibility of new interconnections and refurbishment of existing ones to other power systems, such as the EU, East and South Asia, towards establishing a successful power export market;
- Construction of new power generating facilities and upgrading existing capacity towards guaranteeing year-round power surpluses, both to meet growing demand within the region and to expedite export market development;
- Reform of electricity sector regulation to decrease direct government involvement and to allow more market-driven tariff policies to guide energy pricing;

- Reducing market and geopolitical risk to attract much-needed private sector investment in generation, transmission, and refurbishment projects;
- Reducing dependence on fossil fuel generation and investing in renewable energy, both to decrease environmental impact and to alleviate risk from fluctuating hydrocarbon prices;
- Diversifying sources of international development assistance and investment in order to prevent unnecessary tension over energy competition between large countries like the United States, Russia, and China.

N.B. The term "Central Asia" often has varying definitions in terms of country membership, and its use in research studies is often ambiguous. When specific data is used, for the purposes of this report, it will refer to only the five countries in question: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. When generalizations are cited from source reports, they may include references to other countries in the region such as Iran, Pakistan, Afghanistan, Russia, Turkey, Armenia, Azerbaijan, and Georgia.

<u>Figure 1.0</u>: Central Asia Geography

2.0 COUNTRY PROFILES

2.1 Republic of KAZAKHSTAN

2.1.1 Macroeconomic Profile

Table 2.0: Kazakhstan Profile

Category	2005 Data
Population	15.1 million
GDP (USD PPP)	$57.12 billion
GNI per capita (USD)	$2,940
GDP Growth	9.7 %
Inflation	7.6 %
Foreign Direct Investment (% of GDP)	3.5 %
Unemployment (% of labour force)	8.4 %
Source: World Bank Country Brief	

Of the five countries under consideration here, Kazakhstan was the most vigorous reformer of Soviet economic mechanisms. Privatization of enterprises, market liberalization, and the end of state economic planning occurred fairly rapidly through the early 1990s. Though corruption in various aspects has remained a problem, the government has been successful in opening up the country to foreign direct investment, most of which is targeted at the crucial oil and mineral industries.

In recent years, an economic boom has been seen, with GDP growth steady at over 9 percent for the past three years This has been driven largely by flows of oil revenue, and also to a significant degree, new growth in the recovering agriculture sectors. The government still owns several large enterprises, but privatization has not been hindered by government as it has in other CIS countries.

However, Kazakhstan's success in exploiting tremendous fossil wealth has generally discouraged commodity diversification, and led the economy to become high dependant on a few lucrative products. Despite agricultural development and mineral resource exploration, the main focus of economic growth has been and continues to be in fossil fuels.

16.6 percent of GDP comes from oil and gas-related activities, such as extraction, processing, refinery, and transportation, and of total Kazakh exports, resultant products account for nearly 70 percent. And the forecasts are more ambitious, oil production should reach 3 Mb/day, by 2015. Mineral wealth, including ferrous metals, has recently become a more substantial component of the export picture, as the extent of Kazakhstan's mineral deposits becomes better known.

2.1.2 Power Sector Profile

The partial privatization and unbundling of the Kazakh electricity industry was one of the chief major reforms made in the mid 1990s, and was designed to create a fairly competitive industry in order to address efficiency and energy infrastructure problems of the Soviet system.

As the largest and most geographically diverse and remote of the former Soviet states, Kazakhstan was more prone to such problems than its geographically smaller neighbours. The bulk of Kazakh power comes from thermoelectric plants, running on coal, oil, or natural gas, while a significant minority comes from hydroelectric facilities.

The furthest north of the five republics, it is integrated in some parts with the Russian electricity grid left over from the Soviet era. In fact, the northern parts of the country are better connected to the foreign Russian grid than they are to the domestic southern grid. This is reflected in the electricity production statistics. The main coal-fired plants are situated in the north, and generate nearly enough electricity to meet Kazakh demand. However, due to severe infrastructure problems left over from inefficient grid maintenance and Soviet planning, there is insufficient transmission capability between the north and south. In fact, the Russian Energy System (the northern grid) and the Central Asian Power System (the southern grid) are connected by only one 500 kV line.

As a result, Kazakhstan is forced to import power for consumers in the south from neighbouring countries, particularly Kyrgyzstan and Uzbekistan, while the excess capacity generated by thermoelectric plants on the northern grid is exported to Russia.

Poor layout and management is not the only problem, maintenance and renovation problems have meant that the lines incur a great deal of transmission loss, which significantly detracts from the efficiency of the overall system.

2.1.3 Elecltricity Production and Consumption

Table 2.1: Electricity supply by source of energy, in 2004

Type	Percentage	GWh
Coal	69.9 %	46,803
Oil	7.4 %	4,979
Gas	10.6 %	7,103
Biomass	0 %	0
Waste	0 %	0
Nuclear	0 %	0
Hydro	12.0 %	8,057
Geothermal	0 %	0
Solar	0 %	0
Total production		**66,942**
Power Imported		+5,234
Power Exported		-7,403
Total Domestic Supply		**64,773**
Source: IEA		

Table 2.2: Electricity consumptionby sector, in 2004

Sector	GWh
Industry	13,350
Transport	2,012

Residential	5883
Commercial and Public Services	0
Agriculture / Forestry	11,322
Fishing	0
Other	14,265
Total Final Consumption	**46,832**
Source: IEA	

2.1.4 Future Production and Consumption

Table 2.3: Kazakhstan Supply Scenario to 2020

Category	2005	2010	2020
Total electricity generation, GWh	67,100	88,080	99,260
Installed power plant capacity, MW	18,331	20,405	22,525
Source: CIS EPC and Eurelectric			

Table 2.4: Kazakhstan Demand Scenario to 2025

Category	Demand Forecast				Growth from 2004 Levels			
Year/Period	2010	2015	2020	2025	2004-2010	2004-2015	2004-2020	2004-2025
GWh/ growth rate	72,056	84,034	98,367	115,146	53.8%	79.4%	110%	146%
Source: IEA, Asian Development Bank								

2.2 Republic of KYRGYZSTAN

2.2.1 Macroeconomic Profile

Category	2005 Data
Population	5.3 million
GDP (USD PPP)	$2.44 billion
GNI per capita (USD)	$440
GDP Growth	-0.6 %
Inflation	4.4 %
Foreign Direct Investment (% of GDP)	3.5 %
Unemployment (% of labour force)	9.9 %
Source: World Bank Country Brief	

Table 2.5: Kyrgyzstan Profile

Like other former Soviet Socialist Republics, Kyrgyzstan faced a period of severe economic decline in the early 1990s, followed by a subsequent recovery leading up to the current period. Its macroeconomic profile is very consistent with its neighbouring countries, both in terms of sector profile and power industries.

Traditional sectors such as mining and agriculture still contribute the vast majority of the country's GDP and sustain the growth of wealth. The contraction of 0.6 percent in 2005 is slightly misleading, since GDP grew by a healthy 7.1 percent the previous year. However, the cause of the contraction – political turmoil – aptly reflects the primary risk associated with energy investment in the region: geopolitical instability. The overall economy has grown at roughly 5 percent per year since 1996, yet at tremendous cost of financing. Kyrgyzstan's external debt is the highest of any of the CIS countries, including the four others in Central Asia.

However, stabilizing factors have been seen as well. Severe inflation upwards of 700 percent in the mid-1990s has been curtailed to below 5 percent, and the economy continues to diversify beyond traditional sectors: construction, transportation, trading, catering, and – most importantly – power.

2.2.2 Power Sector Profile

State-sponsored electricity development grew at a fairly steady rate after the economic recovery, but due to low levels of foreign investment and only modest industrial-consumer growth beyond the gold-mining sector, the power sector has seen little expansion in recent years.

However, rapid increase in residential-consumer demand for power, driven by a fully connected residential population, has been seen, yet has not been met with a corresponding increase in supply. Generating capability is not necessarily the most salient problem; an estimated 45 percent of all generated electricity is lost due to grid problems such as distribution inefficiency, illegal diversion or leakages.

The principal reason growth has stagnated is that government funding has been diverted to repairing these problems in the system, rather than investing in new projects and new technologies. The government will be forced to spend $250 million between 2004 and 2010 just to address power leakages and grid distribution inefficiency.

Kyrgyzstan's power industry very much resembles its neighbour Tajikistan, with a fuel source mix that overwhelmingly favours hydroelectric power. Coal and fossil fuels are used to a limited extent, but the vast majority of power is produced by hydroelectric plants (see table below). Even with this proportion, it was estimated in 2004 that Kyrgyzstan was only exploiting 10 percent of its hydroelectric potential.

Despite the grid problems and underachievement of potential, Kyrgyzstan remains a net exporter of power. More than 20 percent of its total annual electricity production is exported, and of what remains for domestic supply, only 60 percent is used by Kyrgyzstan's 5.3 million people.

2.2.3 Electricity Production and Consumption

Table 2.6: Electricity supply by source of energy, in 2004

Type	Percentage	GWh Produced
Coal	3.5 %	524
Oil	0 %	0
Gas	3.5 %	523

Biomass	0 %	0
Waste	0 %	0
Nuclear	0 %	0
Hydro	93 %	14,094
Geothermal	0 %	0
Solar	0 %	0
Total production		**15,141**
Power Imported		+54
Power Exported		-3,382
Total Domestic Supply		**11,813**
Source: IEA		

Table 2.7: Electricity consumption by sector, in 2004

Sector	**GWh Consumed**
Industry	1,385
Transport	91
Residential	2,490
Commercial and Public Services	0
Agriculture / Forestry	2,149
Fishing	0
Other	982
Total Final Consumption	**7,097**
Source: IEA	

2.2.4 Future Production and Consumption of Electricity

Table 2.8: Kyrgyzstan Supply Scenario to 2020

Category	**2004**	**2010**	**2020**
Total electricity generation, GWh	11,813	16,030	17,370
Installed power plant capacity, MW	3,713	3,768	4,243
Source: CIS EPC and EURELECTRIC			

Table 2.9: Kyrgyzstan Demand Scenario to 2025

Category	**Demand Forecast**				**Growth from 2004 Levels**			
Year/Period	2010	2015	2020	2025	2004-2010	2004-2015	2004-2020	2004-2025
GWh/ growth rate	9,222	10,033	11,296	12,719	29.9%	41.0%	59.1%	79.2%
Source: IEA, Asian Development Bank								

2.3 Republic of TAJIKISTAN

2.3.1 Macroeconomic profile

Table 2.10: Tajikistan Profile

Category	**2006 Data**
Population	6.5 million

GDP (USD)	$2.31 billion
GNI per capita (USD)	$330
GDP Growth	7.5 %
Inflation	7.1 %
Foreign Direct Investment	13.1 %
Unemployment (% of labour force, estimated)	40.0 %
Source: EBRD Country Fact File	

Faced with the loss of Soviet subsidies, which accounted for half the state's revenue before 1991, Tajikistan plunged into a civil war lasting until 1997. Their period of economic growth and reform, therefore, has only been effectively underway for ten years. In that time, it has made remarkable strides towards ameliorating a destitute economy and impoverished population, yet the situation remains fairly dire to this day.

Among the members of the CIS listed on page two, Tajikistan is the poorest and least developed in terms of social or industrial infrastructure, and also in terms of electrical power infrastructure. Its main economic staples – aluminium and cotton – are prone to severe price fluctuations on the international market, giving the Tajik economy a high degree of instability year over year. There remains healthy economic growth, at nearly 10 percent per year on average, but it comes mostly in the tertiary service sector, which contributes roughly half of Tajikistan's meagre GDP. Privatization and market reorganization did occur in the 1990s, like in other former USSRs, but the political and social disruption from the civil war meant that it has taken a long time to re-engage the primary sectors and bring production up to full capacity. Indeed, as of 2006, all of the country' industrial operations were functioning at well below 50 percent capacity, with nearly a third completely idle.

A lack of market and demand and a lack of international investment appear to be the primary reasons for this low production. Yet, growth potential remains strong due to the underexploited natural resource wealth that Tajikistan possesses. Aluminium, gold, silver, uranium are all present in large quantities, as is the potential for even higher degrees of hydro electricity development.

2.3.2 Power Sector Profile

The lack of infrastructure to support market development mechanisms has meant that the state-owned electrical companies still control all phases of Tajik energy production. These companies have not been able to develop electrical capacity much beyond levels before the 1990s civil war.

As with its northern Kyrgyz neighbour, Tajikistan obtains an overwhelming majority of its electricity supply from hydropower plants, 90 percent in 2003, and 97 percent in 2004.

Due to the inefficient grid usage Tajikistan actually is *forced* to export electricity to Afghanistan and Uzbekistan. In order to get power from the primary production areas on the southern grid to the main usage areas on the separate northern grid, a large amount of domestic Tajik power must go through other countries. The large amount of electricity exported, as shown in Table 2.11, currently must be countered with a comparable amount of power imported in order to meet the demand. As can be seen, the amount of power imported in 2004 exceeds the reserve capacity of Tajikistan's generators. Without these imports, the country could not meet its demands.

Investment into Tajik hydroelectricity has only recently begun to focus on larger more ambitious plants. The existing hydro generators are relatively small, and thus when water flow is lower during periods of low winter temperature, production is substantially reduced, and winter blackouts are common.

Yet, strategic investment in large hydroelectric projects on the horizon, coupled with low projected population and energy demand growth means that Tajikistan is poised to become a net exporter of electricity by 2009. Though exporter status may be some years away, the government is already making agreements to supply power to neighbours when the capability is reached. Before that happens, current production levels will require substantial growth.

2.3.3 Electricity Production and Consumption

Table 2.11: Electricity supply by source of energy, in 2004

Type	Percentage	GWh Produced
Coal	0 %	0
Oil	0 %	0
Gas	2.3 %	405
Biomass	0 %	0
Waste	0 %	0
Nuclear	0 %	0
Hydro	97.7 %	16,872
Geothermal	0 %	0
Solar	0 %	0
Total production		**17,277**
Imports		+4,400
Exports		-4,714
Total domestic supply		**16,963**
Source: IEA		

Table 2.12: Electricity consumption by sector, in 2004

Sector	GWh Consumed
Industry	6,440
Transport	24
Residential	3,094
Commercial and Public Services	303
Agriculture / Forestry	4,372
Fishing	0
Total Final Consumption	**14,233**
Source: IEA	

2.3.4 Future Production and Consumption of Electricity

Table 2.13: Tajikistan Supply Scenario to 2020

Category	2002	2010	2020
Electricity generation (GWh)	15,300	19,500	33,000
Installed power plant capacity (MW)	4,422	5,097	9,517
Source: CIS EPC and EURELECTRIC			

Table 2.14: Tajikistan Demand Scenario to 2025

Category	Demand Forecast				Growth from 2004 Levels			
Year/ Period	2010	2015	2020	2025	2004-2010	2004-2015	2004-2020	2004-2025
GWh/ growth	11,267	12,410	13,972	15,731	-20.8%	-12.8%	-1.8%	10.5%
Source: Asian Development Bank								

2.4 Republic of TURKMENISTAN

2.4.1 Macroeconomic Profile

Table 2.15: Turkmenistan Profile

Category	2006 Data
Population	5.0 million
GDP (USD PPP)	$16.16 billion
GNI per capita	$1,700
GDP Growth	9.0 %
Inflation	10.5 %
Foreign Direct Investment (USD)	$ 220 million
Source: World Bank Country Brief	

The reorganization of the Turkmen economy following the Soviet collapse aimed to exploit the country's fossil fuel wealth, particularly in natural gas. State-led trade mechanisms were developed, but they were premature and poorly organized relative to other CIS members. For example, though access and refinery technologies were available to develop the resources, transportation infrastructure to export it, and credit relationships with buyers were inadequate. This culminated at the depth of Turkmen economic decline when, in 1997, crucial natural gas production was forced to shut down completely.

Oil and gas is the primary economic staple of Turkmenistan, though in recent years state-driven investments have been made to diversify the economy into textiles, food processing, fossil fuel refinery, transportation, and construction.

Despite diversification, recent profitability from high market price of oil has encouraged fossil fuel and industrial development far more than any other sector. Indeed, the high foreign capital and wealth accumulation from oil resources has discouraged the government from investing in less-lucrative areas.

There is a lack of foreign or private investment in developing secondary sectors as well, largely due to the pervasive state-presence in the economy. Foreign Direct Investment in Turkmenistan is actually below that of Kyrgyzstan and Tajikistan, countries with less than one-quarter of its GDP. Soviet-era economic planning is still performed by the government, and a push to privatize large industrial enterprises has not been seen. Private enterprise and corporate projects in which to invest are not a part of the economic landscape. Yet, the decline of Turkmenistan's foreign debt thanks to oil revenues, gives the appearance of fiscal strength and good macroeconomic organization. Beyond this projection of economic prudence, there is little transparency in state finance.

Performance and social indicators are rarely reliable, given that the Turkmen government and international observers have different standards for each. For example, since the government guarantees work for every citizen, the Turkmen unemployment standard is zero. Yet, international standards point to increasing joblessness amongst youth. The Turkmen government declares the economic growth rate to exceed 21 percent, whereas more reliable IFIs peg the rate at a much lower 13 percent.

Though projections for development indicate that public and economic reform could increase the economic growth rate by as much as 8 percent, the outlook for such reform is not promising, and decidedly uncertain. The only certainty international bodies agree on is that it is highly likely the Turkmen economy will become even more dependant on natural gas exports, as the expense of a stagnating agrarian sector, in the near future.

2.4.2 Power Sector Profile

Abundant natural gas reserves has steered the Turkmen electricity sector towards using it as the primary generating fuel. Save for minute quantity of hydroelectric generation, natural gas turbine plants produce all of the country's electricity. Its ease of acquisition has driven large-scale increases in overall generating capacity. As a result, Turkmenistan is a large net exporter of electricity.

Due to the potential for power export, international assistance funding in the early 2000s was offered from several sources to improve the efficiency of the power distribution grid in order to reduce the transmission costs of the exported power. The primary beneficiaries of the power exports, Iran and Turkey, were at the forefront of the refurbishment funding.

Despite efforts at refurbishment, Turkmenistan's distribution system still incurs tremendous power loss, over 1,500 GWh in 2004, due to ageing and inadequate maintenance. Further, the energy industry itself consumes a very large amount of electricity relative to the total supply, over 1,900 GWh in 2004.

Several foreign investors are taking advantage of Turkmenistan's export potential and locally abundant fuel to increase electricity capacity even further. A number of new gas turbine plants are under construction with the goal of increasing installed capacity to 4,300 MW and total production to 25,500 GWh by 2010, a substantial increase over current capabilities.

While these investment projects aim to substantially increase production capacity, domestic consumption is not projected to increase at anywhere near the same rate. As a result, when these projects are completed by 2010 and 2011, 40 percent of energy production will be exported for external consumption.

2.4.3 Electricity Production and Consumption

Table 2.16: Electricity supply by source of energy, in 2004

Type	Percentage	GWh Produced
Coal	0 %	0
Oil	0 %	0
Gas	99.9 %	11,467
Biomass	0 %	0
Waste	0 %	0
Nuclear	0 %	0
Hydro	0.1 %	3
Geothermal	0 %	0
Solar	0 %	0
Total production		**11,470**
Imports		0
Exports		-1,654
Total domestic supply		**9,816**
Source: IEA		

Table 2.17: Electricity consumption by sector, in 2004

Sector	GWh Consumed
Industry	2,280
Transport	162
Residential	1,329
Commercial / Public Services	0
Agriculture / Forestry	2,012
Fishing	0
Other	549
Total consumption	**6,332**
Source: IEA	

2.4.4 Future Production and Consumption

Table 2.18: Turkmenistan Production and Consumption Scenario to 2010

Category	2004	2010
Projected capacity (MW)	3,101	4,193
Demand Forecast (GWh)	6,332	14,513
Electricity Generation (GWh)	11,470	25,500
Source: IEA, Turkmenistan Ministry of Nature Preservation		

2.5 Republic of UZBEKISTAN

2.5.1 Macroeconomic Profile

Table 2.19: Uzbekistan Profile

Category	2005 Data
Population	26.2 million
GDP (USD PPP)	$13.95 billion
GNI per capita	$520
GDP Growth	7.0 %
Foreign Direct Investment (% of GDP)	0.3 %
Source: World Bank Country Brief	

The Uzbek economy was one of the most heavily reliant on agriculture during the Soviet period, and remains so today. Though it possesses similar natural resource potential to its neighbours – such as natural gas, oil, and minerals – agriculture still dominates the economic landscape, making up 28 percent of the country's GDP in 2005, the highest of any sector. Cotton is the chief staple crop, and the agriculture industry employs more labour than any other.

Rather than heavily liberalizing markets and opening the country to high levels of trade and investment, the government has pursued a more protectionist approach. Import-substitution industrialization, a strategy whereby the government attempts to develop domestic industries by restricting consumer access to imports from similar industries elsewhere, had been the key tool for economic development since independence. Developing this strategy necessitates a very slow scale back of state involvement in the economy, however, which is the chief reason the Uzbek transition has been called a "gradual" transition. Like other fossil rich countries – particularly its northern Kazakh neighbour – lucrative staple revenue is discouraging development in any other industries. Wealth and capital accumulation relies heavily on favourable oil or cotton or gold prices and continued state-driven investment in fossil fuel or mineral extraction. Indeed, as the Asian Development Bank puts it, Uzbekistan enjoys "continued strong – but narrowly-based – growth."[1]

Because of the requirements for long-term planning and organization under ISI, the government still plays a very active role in shaping the economic direction of Uzbekistan. Large-scale public investments, state import controls, economic planning, and foreign exchange restrictions are all part of the economic landscape. Compared to the Soviet era, the government's role in the economic sphere has not actually changed very much.

Perhaps for this reason, Uzbekistan recorded the least significant economic decline after the collapse of the Soviet Union. Whereas neighbours like Tajikistan erupted into civil war, and Kyrgyzstan suffered a severe recession, Uzbekistan recovered quickly, and has seen moderate and accelerating growth since the mid-1990s. Favourable international markets for the key Uzbek exports – cotton, gold, natural gas, and some manufacturing exports – have brought a large degree of capital to the country. A balance of payments surplus of between 9 and 11 percent of GDP has been recorded in the last 4 years. Yet, indicators suggest that this money is not being invested in the social sphere; poverty and unemployment continue to be relatively

[1] Asian Development Bank, "Asian Development Outlook 2007," 2007, pg. 128.

high. Instead, it is being used to replace revenue previously acquired from international borrowing; the government has put a moratorium on this practice since 2001, which has caused their debt to stabilize, and public deficit to decline.
Yet, the scaling back of state involvement remains limited, and government control over the economy remains high. There has been fairly little privatization of major corporations compared to other Central Asian countries, and government actions hinder greatly the ability of markets to operate efficiently. According to the World Bank, "state interventions into business operations through para-state industrial associations, a variety of state plans, and other administrative tools are widespread … governance is undermined by significant corruption."[2]

2.5.2 Power Sector Profile

Uzbekistan has serious information problems relating to government transparency and accountability. No projections have been made for future power scenarios, and economic performance indicators may not necessarily be reliable. International financial institutions, which in other transition countries have made significant investments into electricity development projects, have avoided the same in Uzbekistan. Government accountability is suspect, and the electricity industry remains so inextricably tied to it, that banks are reluctant to offer project funding or loans. Instead, they direct assistance towards whatever private institutions have been able to develop.

From international data that has been gathered, it becomes fairly clear that Uzbekistan plays a keystone role in the Central Asian power industry. Of all the generating facilities connected to the integrated Central Asian grid (encompassing Tajikistan, Kyrgyzstan, Turkmenistan, and southern Kazakhstan), half are located in Uzbekistan. There are 37 thermoelectric and hydroelectric plants with a combined installed capacity of 11,580 MW as of 2006. In 2004, upwards of 50,000 GWh were produced by these facilities, nearly as high as its Kazakh neighbour, with less than half the area.

Like its CIS neighbours, the power transmission and distribution system in Uzbekistan is a remnant of the Soviet era, and is in need of significant repair and renovation. According to the government, such overhauls are indeed planned for the near future; with the help of the state energy corporation, Uzbekenergo, the government is implementing its 'Program for development and reconstruction of power generating facilities in energy sector of the Republic of Uzbekistan for the period before 2010.' Though the development of this program suggests forward thinking, there is a lack of data projections for future production and consumption levels, which indicates that the opposite may be the case.

Despite reserves of oil and natural gas, Uzbekistan also appears to be making a push to diversify fuel sources and take advantage of hydroelectric potential even further. Hydropower contributed 12 percent of the 2004 supply, and the government seeks to improve that through large-scale development of small 440 MW plants.

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[2] World Bank, "Uzbekistan: Country Brief: Economy," 2006, par. 8.
<http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/UZBEKISTANEXTN/0,,menuPK:294197~pagePK:141132~piPK:141107~theSitePK:294188,00.html>

The percentage of thermoelectric power is likely to decline for two reasons. First, if the hydroelectricity project meets with success, it will likely increase the incentives to build additional facilities. Second, as other countries on the Unified grid increase their own capacities, the larger Uzbek thermoelectric plants will no longer need to produce such a large percentage of Central Asian power. For now, however, thermoelectric power remains comfortably entrenched as the primacy fuel source of both Uzbekistan and the rest of the region.

2.5.3 Electricity Production and Consumption

Table 2.20: Electricity supply by source of energy, in 2004

Type	Percentage	GWh Produced
Coal	3.9 %	2,009
Oil	9.2 %	4,707
Gas	74.0 %	37,763
Biomass	0 %	0
Waste	0 %	0
Nuclear	0 %	0
Hydro	12.8 %	6,554
Geothermal	0 %	0
Solar	0 %	0
Total production		**51,030**
Imports		+11,843
Exports		-11,929
Total domestic supply		**50,944**
Source: IEA		

Table 2.21: Electricity consumption by sector, in 2004

Sector	GWh Consumed
Industry	16,124
Transport	1,385
Residential	7,640
Commercial / Public Services	3,262
Agriculture / Forestry	13,673
Fishing	0
Other	0
Total consumption	**42,084**
Source: IEA	

2.5.4 Future Consumption (No production forecasts available)

Table 2.22: Uzbekistan Demand Scenario to 2025

Demand Forecast (GWh)	2003	2010	2015	2020	2025
	48,691	46,597	51,255	56,589	62,479
Source: World Bank					

SECTION 2.0 SOURCES: World Bank, International Energy Agency, European Bank for Reconstruction and Development, Commonwealth of Independent States' Electric Power Council, Eurelectric, Government of Kazakhstan, Government of Turkmenistan

3.0 POWER INDUSTRY STRUCTURE

3.1 Fuel Mix, Expected Changes, and Trends in Consumption

The fuel mix is, essentially, the breakdown of the relative use of various energy sources in generating facilities.

The current scenario of the Central Asian fuel mix, as aggregated from 2004 data, is shown in Table 3.0.

Table 3.0: Central Asian Electricity Fuel Mix, in 2004

Fuel Source	GWh Produced in all five countries, 2004	Percentage of Total GWh Produced
Coal (thermo)	49,336	30.4%
Oil (thermo)	9,686	5.9%
Natural Gas (thermo)	57,261	35.3%
Water (hydro)	45,580	28.1%
Wind (renewable)	0	0.0%
Biomass (renewable)	0	0.0%
Solar (renewable)	0	0.0%
Geothermal (renewable)	0	0.0%
Nuclear	0	0.0%
Source: IEA		

As can be seen, it is fairly clear that fossil fuels dominate the energy landscape, and produce more than 71 percent of all electricity. Hydropower has become a significant player in this mix, but is still dwarfed by the combination of the other three. No commercial renewable generation is available in any of the five countries.

All of the five countries have taken steps and pledged to increase their power generating capacities over the course of the next decade. Though this is part of the market integration and consolidation concept that will be discussed in sections 5.0 and 6.0, it is worth noting that projected domestic demand is not the major driving force behind plans to significantly increase generated power.

The outlook figures for generated electricity and power capacity demonstrate this. The growth of these numbers over the next several years shows that in all cases except one, **the growth of expected generation will exceed the growth of expected consumption by a comfortable margin**. In short, production is expected to grow much faster than consumption. These figures are presented in Table 3.2.

__Table 3.1__: Growth in Production vs. Growth in Consumption

Country	**Period** **(for which data is available)**	**Expected Generation Growth Rate**	**Expected Consumption Growth Rate**
Kazakhstan	2005-2010	31.1 %	> 18.9 %
Kyrgyzstan	2004-2010	35.7 %	> 29.9 %
Tajikistan	2010-2020	69.2 %	> 24.0 %
Turkmenistan	2004-2010	122.3 %	129.2%
Uzbekistan	2010-2020	21.4 %	N/A
Source: IEA, CIS EPC, Government of Turkmenistan			

The reason for the large discrepancies is that the Central Asian governments are in fact planning substantial increases in generation in order to meet **external demand**, and to become even greater **net exporters of electricity** than many of them are now.

Geopolitical and natural resource factors give these governments a highly favourable position when it comes to exporting energy. While Kazakhstan, Turkmenistan and Uzbekistan are endowed with considerable fossil fuel reserves, particularly in the Caspian region, the other two, namely Kyrgyzstan and Tajikistan possess tremendous hydroelectric potential that they have barely begun to exploit: Tajikistan takes the 8th world position in hydro potential while currently uses, like Kyrgyzstan only ten percent of it.

The geopolitical situation has created tremendous demand for energy in the neighbouring countries. To the east, the ever-growing demand of China and India is being increasingly met through the import of foreign power. Much of Central Asian power exports already go to China. To the south and southwest, the demand for power imports is being fuelled by the decimation of domestic infrastructure from violence, war, and governmental instability. Afghanistan and Iraq are tremendously dependant on foreign electricity, as domestic violence constantly threatens the security of the limited domestic supply. The electricity demand in Pakistan is growing constantly but the country needs adequate infrastructure: only some 5-7 percent of population like in Afghanistan is connected to the electric grid.

Thus, the appeal of increasing power export abilities becomes very great to the Central Asian countries. To take advantage of it, the countries are making some dramatic changes to their fuel mix. Amongst new generating facilities in the planning or development phases, the vast majority are hydroelectric plants. This demonstrates that the five republics are aiming to move their power generating capabilities away from the instability of fossil fuel prices towards a less expensive, more secure option. Given that none of them are exploiting very much of their hydropower capabilities, this move is very strategic.

3.2 Power Generation

Unlike integrated and densely populated areas such as the European Union or the United States, the Central Asian Republics are sparsely populated and spread throughout vast areas of inhospitable and intraversable terrain. The cost of transport of fuel supply, particularly to more remote regions, would be extremely high. As a result, power generation in this area tends to necessarily follow fuel costs.

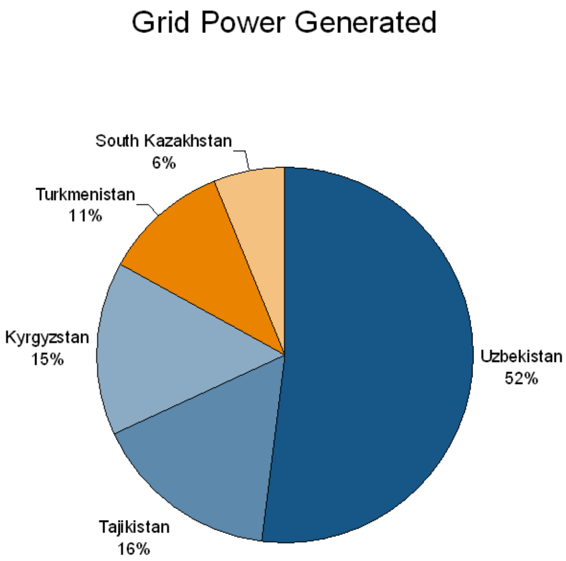
Where fuels are abundant locally, power generation facilities generally arise. In the hydropower countries, Kyrgyzstan and Tajikistan, the generating plants are built on waterways with a high level of flow. In the hydrocarbon generating countries, facilities are built next to or as part of coal basins or oil and natural gas refineries. . Such a structure allows costs of transporting generating fuel from where it is harvested to the generating facilities to be minimized. For example, several of the largest generating facilities in Kazakhstan, e.g. Ekibastuz, Karaganda, and Shulba, are also rich coal basins.

The effect of this is twofold. First, it means that power-generating facilities are integrally tied to the supply side rather than demand. The highest capacity hydro or natural gas plants are not located near major load centres and consumer areas where demand is greatest, but rather in remote or isolated areas where supply is greatest. Fuel transport costs may be low, but transmission costs to bring generated electricity to load centres are high.

Second, it means that generation capacity is broken down by fuel abundant area, not jurisdictional area. Since most of the plants in operation were conceived when the five republics were all within the Soviet sphere, there was no accounting for how much capacity ended up in each. Power was generated and distributed on a regional basis, not national basis. Today, more than fifteen years after the borders have been reasserted, the skewed result of this regional planning is fairly plain.

Table 3.0 shows the percentage of grid power generated by each country. Though these figures are not as skewed as they appear – Uzbekistan contains the largest number of consumers by a considerable margin – the concentration of capacity so heavily in one country combined with its central location makes the Uzbek power industry the unintentional lynchpin of the entire region.

Figure 3.0: Relative Power Contributions (CAPS Grid Only)



The north of Kazakhstan, though technically part of the region, is on a separate power grid that is integrated northward throughout South Russia and into areas of Siberia and Eastern Europe. The two grids were designed regionally, during the Soviet era, rather than on a country basis, and they are connected to each other by only one 500 kV line. This line is insufficient to transmit significant amounts of power from the north to the south, and so due to technical transmission restriction, Kazakhstan cannot sustain itself, despite sufficient generating capacity. Power generation in the north, which constitutes 73 percent of all power generated in Kazakhstan, is exported instead to the Russian connected areas such as Siberia. The remaining 27 percent is generated in South Kazakhstan, and is transmitted regionally to parts of Central Asia. It makes up only 6 percent of the **C**entral **A**sian **P**ower **S**ystem total.

The two grids will be referred to as the **Russian Grid** and the **CAPS Grid.**

Before 2000, South Kazakhstan made an attempt to disconnect from the CAPS grid and operate on a unified domestic market. Though sufficient supply was available from the northern thermal plants, the one existing transmission line (500 kV) could not bring the required power to south, and massive power outages throughout the region forced it to reconnect to CAPS.

3.3 Power Transmission

Though power generation does face issues of over-reliance and isolated facilities, the bottom line is that generation is not the problem. Each of the countries in question generates sufficient power to meet its domestic demand in most years, and as a unified region, Central Asia generates an annual surplus. Most of the country units are already net exporters of electricity. While others experience only seasonal shortages of power, they are projected to generate surpluses year round within the next decade. The countries in question, Tajikistan and Kyrgyzstan, do experience annual winter shortages from low water flow. Therefore they need, during winter seasons, to import electricity mainly from Kazakhstan and Uzbekistan. Their total power generated is dependant on annual rainfall, and they may be forced to import power in dry years, but for the most part, they can generate sufficient power as water flow comes out from glaciers higher than 4,000 m.

Since supply is not a major problem, the blame for the region's electricity vulnerability must be placed squarely on the power transmission system.

As often as generating facilities are found close to major urban centres, they are found in remote areas far from consumers. As a result, the CAPS grid is characterized, according to the Asian Development Bank, by "low load density and long distances between the generation plants and the load centres."[3]

The grid is made up of a series of long transmission lines that carry electricity across large distances between plants and high load centres. The length and isolation of these lines present a **low security of supply**, even if generating capacity is nominal, because investment from development banks or private sources has not been sufficient to create loop connections.

Table 3.1: Central Asia Power Loss 2002 and 2004

Country	Power system loss in 2002 (GWh)	Power system loss in 2004 (GWh)	Power system loss in % (2004)
Kazakhstan	17,995	10,408	15,5
Kyrgyzstan	4,271	4,575	30,2
Tajikistan	3,028	2,561	14,8
Turkmenistan	N/A	1,521	13,3
Uzbekistan	11,162	4,500	8,8
Source: ADB, IEA			

Further, the design and layout of the grid's many connections is inefficient and not adaptable to changes in regional demand. One of the most salient problems in the southern region is that the two major 500 kV lines that service the Tajikistan grid both run from Uzbekistan, but do not connect to each other. Despite sufficient domestic supply, power transmitted from one part of the country to the other must go through Uzbekistan first. This is only one example.

The long distances combined with inefficient design results in a tremendous amount of power loss through transmission. Indeed, where large discrepancies occur between the total power produced and the total amount consumed, the difference is often mostly attributable to transmission or distribution loss. Table 3.1 outlines the level of power distribution loss in 2002 and 2004. The statistics related to Kazakhstan and Uzbekistan show a drastic reduction of losses between 2002 and 2004 that shed some doubts about reliability of the data concerned. Or perhaps the losses in 2002 included thefts which have been substantially reduced meantime.

Poor design is not the only transmission problem. Further complications arise from the regional breakdown of consumer type. Sectors requiring large amounts of power, such as heavy industrial, mining, or agricultural production, are not necessarily close to urban residential areas. Farming must be done where ambient conditions are most conducive and mining must be done where mineral deposits are most profitable, and this has not necessarily corresponded to the layout of the grid. This presents tremendous difficulties of routing power to isolated areas. Often, the cost of this has

[3] Asian Development Bank, "Regional Economic Cooperation in Central Asia: Final Report: Electric Energy," December 2000, pg 9.

forced constructors to settle for long, low voltage transmission lines to reach some areas, which increases the vulnerability of the system and puts the system at risk of overload.

Further still, the system suffers from poor maintenance, obsolescence, and inferior technology. Repair is badly needed in several key areas, and these requirements often outweigh the desire to invest funds in new technologies or redesign.

"Due to these reasons, the regional transmission grid in Central Asia geographically forms an irregular structure extending over many countries, partly as an interconnected grid, partly as an isolated power system or subsystem of the Russian grid," according to the Asian Development Bank.[4]

For a complete analysis of the Central Asian power transmission systems, including schematic diagrams of both of the regional grids, refer to section 5.0.

3.4 System Regulation Issues

According to CIS- EPC, the role of a system regulator is "the establishment of tariffs in the regulated fields of activities and provision of non-discriminatory competition and efficient electric market competition."[5]

The best way to facilitate this is to have independently functioning regulators to monitor the system and ensure that it securely provides electricity, and that the buying and selling of that electricity is conducted properly. Using tools such as price caps, licences, and monopoly authorization, they provide a link between the generating companies, the consumers, and the government.

However, the EPC concedes that only some CIS countries have established independent regulators, and none of them are in the Central Asian area. In lieu of this, certain government bodies act as regulators, but remain state organizations. While the EPC is optimistic that its member countries will all eventually establish independent regulators, thus far this has not been seen yet. In the case of Kyrgyzstan, the regulator is the State Inspectorate for Energy and Gas, belonging to the newly created Ministry of Energy & Industry (2007).

(to be deleted, it is not exactly that).

According to the EBRD, "The state controls the power sector through the Energy Agency, which balances the interests of energy producers and consumers. This balance is sustained through control over the prices and operations of the power companies in terms of their reliability, safety and undisturbed operation, power supply and consumption. The Energy Agency is authorised to issue licences, approve tariffs, regulate the rights and duties of the power distribution companies and consumers, regulate technical regulations and standards, facilitate competition and resolve other

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[4] Asian Development Bank, "Regional Economic Cooperation in Central Asia: Final Report: Electric Energy," December 2000, pg 9.

[5] CIS Electric Power Council and Eurelectric, "Comparison of the EU and CIS Electricity Markets," November 2005, pg 11.

sector related matters. The Energy Agency operates independently from the power companies and does not interfere with their activities."[6]

Generating capacities and transmission are regrouped into a major national company (Uzbekenergo-Uzbekistan;- KEGOC-Kazakhstan; Electric Power Plants-Kyrgyzstan; Kuvvat-Turkmenistan; and Barki Tochik-Tajikistan) owned by their respective state governments. Only a very small number of companies operate fully independently. Such a managerial structure is at risk of inefficiency and irresponsiveness to market mechanisms. . This is the most prominent issue facing system regulation.

Further, the question of who is being regulated arises. Though there are some small independent generating and transmission companies, the United Dispatch Centre and its national and local subsidiaries are also state organizations. All five governments own the UDC, known as Energia, on an equal basis. When regulatory issues concern system operation, the scenario arises that one state organization is monitoring and regulating another state organization, which is highly inefficient.

Other issues include setting fair energy prices. In countries where oil and natural gas are the primary power generating fuels – Uzbekistan and Turkmenistan, mainly – the power industry is subject to tremendous fluctuations in the world prices for these fuels. The low average income of consumers, in all categories, is difficult to reconcile with high cost of fossil fuels, and therefore the task of setting fair prices is extremely difficult. State subsidies are allocated but even though non-payments by consumers cause substantial losses to the power companies.

Yet, some of the countries have taken steps to improve the functioning of their various regulatory bodies through international cooperation. In a 2005 meeting of CAREC, the Central Asian Republics Economic Community, all members except Turkmenistan joined to form CMERF, the **C**AREC **M**embers **E**lectricity **R**egulators **F**orum, in association with the Asian Development Bank. By capitalizing on mutual information collaboration and experience sharing, they hope to develop their state regulators into more effective bodies. (For a full analysis of these organizations, see section 3.7).

3.5 Power Pricing Overview

Power pricing in the region is an irregular, non-uniform process given that regional economics splintered at the end of Soviet rule. Since that time, each of the countries has had to contend with different issues in setting the price for generation, transmission, and distribution of electricity.

Generation pricing is the most contentious issue, since there is a very large discrepancy across the five countries as to the cost of generation. Whereas the hydroelectric concentration of Tajikistan and Kyrgyzstan do not have to contend with fluctuating fuel prices, the fossil fuel driven power in the other three often do. Further, when setting prices, issues such as system loss, improper metering, and consumer income must be considered. A more complete analysis of electricity tariffs can be

[6] EBRD, "Power Sector Reforms in Early Transition Companies," *Law and Transition Online,* Autumn 2004.

found in section 4.3, however the bottom line is that the government-owned companies set prices, and they are set well-below cost. The government subsidizes the transmission and distribution companies for the difference.

Market mechanisms like pricing signals do not factor into tariff setting, since most of the countries do not have functioning competitive markets. In ones that have the most developed market, such as Kazakhstan, prices tend to be much higher and much closer to cost recovery levels. In general however, there is little consultation among stakeholders when tariff policies are set. Beyond coordination through the government that controls the generation, transmission, and distribution companies, there is little transparency of operation. Budgeting, auditing, and other pricing related procedures are kept private, and do not meet international standards. As a result, and as the discrepancy shows, the pricing policies result in very little, if any, correlation between the cost of the electricity chain, and the prices levied.

However, whatever policy does determine pricing is driving them up in the medium term. Kazakhstan and Uzbekistan have implemented multi-year tariff reform programs aimed at closing the gap between cost and price at both ends (i.e. raising tariffs and lowering costs simultaneously). The others are likely to follow a similar pattern in the same time frame.

3.6 Key Market Players and Market Growth Potential

Kazakhstan

Since 1996:

- **large power generation** plants (excluding CHPs of less than 100 MW) were set apart in independent companies. They were stock hold, and most of them were privatised ((see Table 4.1). CHPs of middle capacities (less than 100 MW) were transferred into communal property with local management structure;
- regional joint stock distribution network companies were formed on the basis of the voltage scale, e.g. with 110-35 kV and local networks with 6-10 and 0,4 kV. Their functions include the purchase, distribution and commercialisation of electricity.

Kazakhstan Electricity Grid Operating Company **(KEGOC)** is a state-owned, national transmission and distribution system operator for transmission lines of 220 kV and above it; responsible for national and regional dispatch centres and coordination with new emerging market power companies, such as:

- **Almaty Power Consolidated –** The largest energy company in South Kazakhstan, it is a vertically organized corporation controlling all levels of electricity operations, production, transmission, and distribution, in the area of Almaty, a market it monopolizes to a large degree. *Closed Joint Stock Corporation*
- **AES/Suntree –** Foreign power company with assets in the UK, Italy, Poland, and Kazakhstan. In particular, they own 100 percent of the Ekibastuz power generating facility, the largest plant in Central Asia. 70 percent of the company is owned by the British AES Electric Ltd., while

the remaining 30 percent is owned by Suntree, a company operating in the CIS. AES, the parent company, is a *Publicly Traded Company.*

- **State Property & Privatization Committee –** Branch of the Ministry of Finance responsible for regulating the emerging markets with special emphasis on monitoring of the functioning of the government's property in that market. It is designed to coordinate and implement government policy in regards to the privatization of its assets over time, including in the energy industry. *State Institution.*
- **Eurasian Energy Corporation –** Has assets in both fuel production and electricity generation. Owns coal facilities including the Aksu power generating facility, as well as repairs and maintenance subsidiaries. The government holds a minority stake in the company. *Publicly Traded Company.*
- **Energoproekt –** Kazakh subsidiary of Russian energy logistics and engineering company. *Limited Liability Partnership.*
- **KazZinc –** Primarily a well-known metallurgic corporation specializing in lead, copper, zinc, and other precious metals. Specialized energy production subdivision manages generation, transmission, and distribution along grid sections it owns, and trading electricity. It also owns and operates the Bukhtarma Hydroelectric facility. *Joint Stock Corporation.*
- **Ispat Karmet/Mittal Steel –** Kazakh subsidiary of Western-Europe-based LNM Group, the world's largest steel manufacturer. Provides complete, low-cost electricity services in the Temirtau region. *Publicly Traded Company.*
- **Whitesman Limited –** Owns Pavlodar- I power generating facility. *Publicly Traded Company.*
- **CCL Energo –** Owns Pavlodarskyaya power generating facility.
- **Roskazenergo –** Owns Petropavlovsk power generating facility. *Publicly Traded Company.*
- **For a full list of known companies operating in the Kazakh power market, see section 4.1.**

Kyrgyz Republic

*The electric power sector is unbundled, the companies are state-owned. The control share holding on electricity generation and transmission is reserved to the State for undetermined term, while t*he sale of large share holdings (up to 70%) is foreseen in electricity distribution sector.

Electric Power Plants Joint Stock Company

A joint stock company, majority state-owned. It is the main producer of electricity in Kyrgyzstan comprising 6 HPPs (in operation and under construction) and 2 TPPs and repair subsidiaries. It reports to the Ministry of Energy & Industry.

National Grid of Kyrgyzstan Joint Stock Company

A joint stock company, fully state owned; responsible for transmission and dispatching of electricity. It also reports to the Ministry of Energy & Industry.

Regional Distribution joint stock companies

Four regional joint stock distribution companies were created.

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Tajikistan

Barki Tochik State Holding Company
A state-owned company,major operator for generation, transmission, and distribution of electricity in Tajikistan. Vertical structure, responsible for the above three levels, including metering, billing, and payment collection. It reports to the Ministry of Energy & Industry.

Uzbekistan

Uzbekenergo Joint Stock Company
The major operating company for generation, transmission, and distribution in Uzbekistan; a verical structure company, responsible for all above three levels, including metering, billing, and payment collection. State-owned joint stock company, attempts to fully privatize met with resistance; coordinates between government and supply companies, though generation and transmission infrastructure is still predominantly state-owned; the other mainly manufacturing companies are:

- **Azia Elektro Group –** Manufacturer and Distributor of wide spectrum of small-scale technical power generation equipment. Represents similar Russian companies in Uzbekistan. *Limited Public Corporation.*
- **Chirchik Transformer Works –** Manufacturer of power transformers and power substations at a regional scale, including designs of 10 kV, 35 kV, and 110 kV transmission lines. The largest manufacturer of its kind in Central Asia. *Open Joint Stock Corporation.*
- **Dek Elektro –** Uzbek Subsidiary of Russian company DZNVA, manufactures low-voltage automatic switch equipment. *Open Joint Stock Corporation.*
- **Elus –** Manufacturer and distributor of high voltage equipment for distribution lines and power substations. Switches, switchboards, and transistor equipment are major products.
- **NP-Esan** – Manufacturer of full spectrum of electricity transmission and distribution products, particularly relay equipment for thermoelectric power stations and communications equipment. *Limited Public Corporation.*
- **NVA –** Manufacturer of complete power substations and low-tension products with a special emphasis on research and development of new techniques and production methods for improving power processes. *Russian-Uzbek Joint Venture.*
- **Tashelektroshitkomplekt –** Largest regional producer of transmission equipment up to 110 kW. *Joint Venture.*

Turkmenistan

Kuvvat Energotechnological Corporation
State-owned operating corporation That includes 5 regional production associations, electric power stations, as well as repairing and some other enterprises. It belongs to the Ministry of Energy and Industry. Minimal data available.

As can be seen from this overview, there are varying degrees of market development in different parts of the region. Kazakhstan, which has seen the most market development of any of the CIS countries, has the most privatized market of any of the five, with several foreign and domestic corporations with complete ownership of power generation and transmission products. Uzbekistan is the next, with a fairly privatized market for electricity supply products, even if much of the generation and transmission equipment is still state-owned. The other three have seen minimal market development, particularly in Turkmenistan when very little data is available regarding the state electric power corporation's internal structure and operations. Tajikistan and Kyrgyzstan have a much smaller market infrastructure to begin with, and whether market competition will develop there remains to be seen.

The potential for internal market development has taken large strides forward in recent months. The differing stages of national development has thus far impeded the establishment of a unified market for power, however agreements are now in place to integrate some of those markets as a first step towards establishing a full common pool. In May of 2007, six CIS members signed an agreement to establish a common electricity market between them. Of the six, three were in the Central Asian region: Kazakhstan, Kyrgyzstan, and Tajikistan. They have entered into the common market agreement with Russia, Armenia, and Belarus to form what will essentially become an electricity free trade zone.

Experts have indicated that this is a good step for most parties involved. Russia benefits the most, since it will be able to obtain cheap electricity from the other members to meet its large demand, however it will benefit the supplying countries as well, since it will develop their power infrastructure towards sustainable export capability. Further, the success of the agreement may prompt other countries, particularly Uzbekistan and Turkmenistan in this case, to join the common market and create a unified Central Asian electricity pool. With the market-driven development and a unified group, the potential benefit for market growth both within and outside the zone will be tremendously profitable. The success of the initial agreement will provide a good barometer of the potential for the growth of this market.

3.7 International Development Business Plans and Regional Cooperation: Who is Who?

Electric Power Council of the Commonwealth of Independent States

The EPC CIS is taking an active role in market development in Central Asian power in order to facilitate integration with the EU electricity market. Under this long-term project, it is the view of both the EPC and of the European power concern Eurelectric that the two market systems must be made compatible before full integration could be possible. In Central Asia, this means further market reform, privatization, and domestic consolidation. In effect, the countries must look inwards before they can look outwards.

Amongst the governments of the CIS, integration is at a very early stage. The wide geographic membership and varying grid connections, including Russia, Central Asia, and Eastern Europe, give this organization a very wide scope for electricity reform. Though the existing interconnection of the electricity grids - particularly the shared grid between the four southern countries and southern parts of Kazakhstan – suggests that governments are taking an active role to integrate towards the goal of a common market, this is not the case. Integration at a state level is lagging far behind integration at a corporate or technical level, and the interconnection of the power lines on the common grid is a circumstance as much attributable to common Soviet past than to contemporary government efforts.

However, some Central Asian governments have been taking individual initiatives to make their domestic electricity markets more liberal, and subsequently more compatible for future integration with the Eurelectric grid. The government of Kazakhstan, for example, has attempted to build on the success of the 1996 establishment of market electricity by establishing a retail market for power in 2006. Kyrgyzstan has already had some degree of success in such a project; in 2001, industrial consumers of power had a choice of electricity supplier for the first time. Yet, whether these systems are fully competitive markets, or simply new incarnations of divested state control, remains to be seen.

As of 2005, the joint ad-hoc group between the EPC CIS and Eurelectric had concluded that there were still substantial reforms to be made, and both committed to taking an active role in promoting the convergence of the two markets for mutual benefit in the future. As recently as May 2007, the project was making significant progress, as commitments were made by both government regulatory bodies and private-sector heads of energy and operating companies that the unification of power systems was in their mutual best interest. An agreement that a **common energy market will** be formed amongst all members of the CIS has already been signed by Kazakhstan, Kyrgyzstan, and Tajikistan, along with several others. With more widespread agreement, the prospects for this project are positive.

Should approval for a unified power system spread to the rest of the CIS and even beyond that, the EPC may also be able to fulfil the same role in Eurasia as the Union for the Coordination and Transmission of Electricity, UCTE, does in Europe. EPC CIS has been working with UCTE for several years on a new approach to market reform, and as a result, is well-placed to become the organization responsible for creating with several studies refer to as the Trans-Asian Synchronised United System (TASUS). This is a project aimed at restoring the unified operation, not just technically but legally and politically, of the power dispatch system, as it existed in Soviet times. While no organization has taken full responsibility for this long-term project, EPC CIS's close work with UCTE, it's strong presence in Central Asia, wide former Soviet membership, and its established reputation, makes it a strong candidate to fulfil this role.

Economic Cooperation Organization

The Economic Cooperation Organization has a large degree of overlapping membership with the CIS. All the five Central Asian Republics are members, along with the Arabian states (Iran, Pakistan, and Afghanistan) and the Caucasus states (Turkey and Azerbaijan).

Energy and power are one of the three primary concerns of the ECO, and they have consistently included studies on power and electricity interconnection as a major part of their work programme. Their scope is significantly narrower than the EPC CIS however, given that several of their members have pressing economic needs that long- term projects cannot satisfy.

Since 2000, the ECO energy ministry has attempted to ensure that South Asia will not be isolated from the rich energy sources in Central Asia should the market there become more integrated. In a November 2000 meeting of the Ministry of Energy/Petroleum, the ECO adopted a plan of action for the development of Central Asia's power systems over the next four years. The plan was multi-faceted, took on a very broad scope, and aimed to address both market and technical development. It included the following objectives:

- **Interconnection of the ECO's Power Systems**
- **Power Trading**
- **Energy Efficiency and Conservation**
- **Oil and Gas Pipelines**
- **Renewable Sources of Energy**

The main technical aspect of this project was devised in 2001, when the ECO's Strategic Experts Task Group (SETG) drafted Terms of Reference for a feasibility study on the interconnection of power systems. The aim was to increase the efficiency of the trading relationship between the energy abundant north and the power scarce south.

Together with the ECO Secretariat, they obtained a loan of 400,000 USD from the **Islamic Development Bank** to finance this study. The goal was to assess the potential for creating new north-south connections to facilitate the export of power from CAS countries to Afghanistan, Iran, and Pakistan.

In 2002, a workshop on the Regional Power Trading Strategy was held in Tehran, where it was determined that developing a legal scheme for trading power within the ECO was a crucial step to fostering development of transmission mechanisms.

In 2006, a partnership between NESPAK, a Pakistani engineering service firm and the Kyrgyz Institute of Energy and Communication were contracted as consultants to perform the study. Under consideration by the study are five specific transmission projects designed to enhance the north-south power flow and, under a new power trading strategy, provide a more secure supply of electricity to rapidly growing populations in Pakistan, Iran, and Afghanistan.

The study is currently underway, and according to the terms of reference, NESPAK is examining the feasibility of the following transmission projects:

- Expansion of existing 150KV Kizyl Arvat (Turkmenistan) – Alliabad (Iran) line;
- New 154KV Zahedan (Iran) – Kalat (Pakistan) transmission line.
- The second transmission line between Imishly (Azerbaijan) and Parsabad (Iran).
- Construction of 132 kV line between Sarakhs (Iran) – Maru (Turkmenistan).
- Construction of 132 kV line between Mirjaveh (Iran) – Mand (Pakistan).

It is significant to note that these projects, even if deemed feasible, focus primarily on integration in the Caspian-Arabian corridor, rather than in the more energy-abundant regions of the CAS. The obstacle to this appears to be the *legal incompatibility of the two market regions,* and the ECO has made it one of the primary goals of the project to overcome these obstacles, and make power trading between the five republics and their southern neighbours more achievable. As such, as part of the feasibility study, they aim to devise the following:

- **A power trade strategy, including Draft Legal Agreements and analysis of price structure to facilitate the necessary trade between CIS and other ECO countries**

Until legal issues are addressed, it appears that further development, transmission integration, and proliferation of power trading between CIS states and their ECO neighbours to the south, may be forestalled. This project is still ongoing.

United States Agency for International Development (USAID)

In early 2006, the United States Agency for International Development launched their own initiative to develop power markets in Central Asia. Dubbed the Regional Energy Market Assistance Program, or REMAP, the program was instituted in its Central Asian form to modernize the electricity markets and ensure a more secure supply of energy. Like the EPC CIS project, it is aimed at market reform rather than investment in technical projects.

The program singles out Kazakhstan, Afghanistan, and Pakistan as the countries that will require the most need for a secure electricity supply in the near future, and makes provisions to ensure a more stable market system to facilitate this.

REMAP performs an assessment of each country's capability and need and sets up a producer-consumer framework to determine the wisest trade relationships to promote. For example, it aims to make it easier for the future net producing nations of Tajikistan and Kyrgyzstan to trade and supply their net consuming neighbours like China and Pakistan.

USAID is mostly interested in market compatibility, and like the EPC CIS-Eurelectric project, bases their programme on the premise that the interconnecting markets must be made compatible before a profitable common market can be established. Market systems have developed at different rates since their inception, to the point where Kazakhstan has the most open market in Central Asia. Indeed, the American AES Corporation owns five power plants there, and consumers have more choice in power sources than anywhere else in the region. On the other hand, Tajikistan and Kyrgyzstan, the primary targets of REMAP, are much less open to foreign investment due to legal hurdles and restrictive legislation. USAID seeks to change this. By promoting investment in countries with large potential for excess supply, USAID is attempting to foster power security in a region with ever-increasing demand.

There is also a geopolitical factor involved in this program. By fostering investment and links in energy-rich Kazakhstan, Tajikistan, and Kyrgyzstan, USAID is attempting to balance the investment influence of Russia and China, who also have considerable interest in the region's energy. Russian companies in particular have significant foreign direct investment in the region, and USAID aims to create a more stable environment to promote similar FDI from western companies, like the American AES.

Further, by focussing on those three, USAID is attempting to "marginalize" more politically unpalatable countries like Uzbekistan and Turkmenistan, where democratic concerns tend to deter western investors. This practice amounts essentially to energy development sanctions.

Shanghai Cooperation Organization (SCO)

The youngest of the development organizations listed here, the SCO was formed in 2001 out of the members of the "Shanghai Five." Its mandate is vague since it claims to exist to foster 'trade and cooperation' between the member states, yet it has attracted much attention in the west precisely for this reason. Should the organization ever exhibit any deeper internal cooperative consolidation or take on a proactive geo-strategic character, the combination of Russia and China in one multilateral organization would represent a comparable counterbalance to NATO.

No such character is evident, and what has instead been the case is that prominent members like China and Pakistan are taking advantage of the bilateral collaboration to build cooperative power relationships with countries like Kazakhstan and Kyrgyzstan. They have used the SCO as a forum for negotiating specific projects, rather than overarching development projects like other organizations are pursuing. Pakistan signed an agreement on power exports from Kyrgyzstan and Tajikistan to meet energy shortages, and China signed an agreement with Kazakhstan to become China's largest foreign provider of electricity within five years.

The first major power collaboration between China and Kazakhstan has been a feasibility study to examine the construction of additional generating units at the large Ekibastuz generating facility near the Chinese border, bringing it's capacity to 7,200 MW, and the subsequent construction of an 800 kV transmission to bring the power to China. China is currently seeking sources of investment in the project. These specific projects are encouraged by the SCO, which provides, if nothing else, motivation for future collaboration and solidarity between members.

Central Asian Regional Economic Cooperation (CAREC)

At the same time, the SCO has been cooperating with an older organization known as CAREC, the Central Asian Regional Economic Cooperation. With a more limited membership, which excludes Turkmenistan, CAREC's mandate is to alleviate the indigence of the Central Asian region through economic development, and as such actively participates in the energy industry as a facilitator of this goal.

With primary funding from the Asian Development Bank, CAREC has taken an active role in making Central Asian electricity markets more compatible with each other. In order to facilitate this, they launched a project in 2005 known as CMERF, the CAREC Members Electricity Regulators Forum. The goal of the project was to increase collaboration between the system operators across borders, share experiences, and establish a constructive mutually beneficial relationship, whereby all the markets can improve at the expense of none.

Table 3.3: Membership in Regional Development Organizations

CIS (EPC)	ECO	SCO	CAREC
Kazakhstan	**Kazakhstan**	**Kazakhstan**	**Kazakhstan**
Kyrgyzstan	**Kyrgyzstan**	**Kyrgyzstan**	**Kyrgyzstan**
Tajikistan	**Tajikistan**	**Tajikistan**	**Tajikistan**
Turkmenistan (observer)	**Turkmenistan**	**Uzbekistan**	**Uzbekistan**
Uzbekistan	**Uzbekistan**	People's Republic of China	People's Republic of China
Armenia	Afghanistan	Russia	Afghanistan
Azerbaijan	Azerbaijan	India	Azerbaijan
Belarus	Iran	Iran	Mongolia
Moldova	Pakistan	Mongolia	
Russia	Turkey	Pakistan	
Ukraine			
Georgia (withdrawn)			

Of all the ongoing energy projects in the region, CAREC and CMERF are the most productive. Since CMERF was formed in 2005, already a large report has been issued, financed by the ADB, on all the energy related projects and feasibility studies aimed at improving the overall system. It has also produced a comprehensive report on tangible measures for improving the system now, and avoiding technical problems later, when export markets to the east and south would be more dependant on the functioning CAPS systems. A list of these projects can be found in section 5 following an overview of the Central Asian power grid.

SECTION 3.0 SOURCES: ADB, EBRD, World Bank, IDB, CIS EPC, ECO, SCO, USAID, CAREC, IEA, Government of Kazakhstan, Government of Turkmenistan, Kazakhstan Business Magazine, The Journal of Turkish Weekly.

4.0 POWER GENERATING FACILITIES

4.1 Existing Plant Data: Fuel and Performance

Table 4.1: Kazakh Power Generating Facilities

Kazakhstan (Current Total: approx. 18,000 MW)			
Plant Name	**Fuel Type**	**Installed Capacity**	**Owner (if known)**
Ekibastuz I	Thermoelectric-Coal	4,000 MW	AES Suntree
Aksu (Yermakov)	Thermoelectric-Coal	2,400 MW	Japan Chrome
Zhambyl	Thermoelectric-Gas	1,230 MW	Energoproekt
Ekibastuz II	Thermoelectric-Coal	1,000 MW	RAO-UES/KEGOC
Bukhtarma	Hydroelectric	747 MW	KazZinc
Shulba	Hydroelectric	702 MW	AES Suntree
Karaganda II	Thermoelectric-Coal	608 MW	Samsung Deutchland
Pavlodar	Thermoelectric-Coal	550 MW	CCL JIL Refineri
Karaganda III	Thermoelectric-Coal	440 MW	Ispat Karmel/Accelor Mittal
Petropavlovsk II	Thermoelectric-Coal	380 MW	Roskazenergo
Kapchagai	Hydroelectric	364 MW	Tractebel CA
Pavlodar I	Thermoelectric-Coal	350 MW	Whitesman Ltd.
Ust-Kamenogorsk	Hydroelectric	331 MW	AES Suntree
Almatin III	Thermoelectric-Coal	290 MW	Tractebel CA
Ust-Kamenogorsk	Thermoelectric-Coal	242 MW	AES Suntree
Tselinograd II	Thermoelectric-Coal	240 MW	
Atyrau	Thermoelectric-Oil	215 MW	Energoproekt
Djeskazakan	Thermoelectric-Coal	177 MW	
Almatin I	Thermoelectric-Oil	173 MW	Tractebel CA
Tchimkent III	Thermoelectric-Oil	160 MW	Government of Kazakhstan
Zhanazoi	Thermoelectric-Gas	158 MW	
Karaganda I	Thermoelectric-Coal	151 MW	Karbid
Kyzl-Orda VI	Thermoelectric-Coal	146 MW	
Almatin II	Thermoelectric-Oil	145 MW	Tractebel CA
Rudnen	Thermoelectric-Oil	123 MW	Myl Ltd.
Balkhash	Thermoelectric-Oil	120 MW	Samsung Deutchland
Chardarinsk	Hydroelectric	100 MW	Government of Kazakhstan
Almaty Cascade	Hydroelectric	61 MW	Tractebel CA
Ulba	Hydroelectric	28.5 MW	
Leninogorsk Cascade	Hydroelectric	14 MW	AES SUntree
Karatalsk	Hydroelectric	10.1 MW	Government of Kazakhstan
Tishinskaya	Hydroelectric	6.25 MW	
Kariusov	Hydroelectric	6 MW	
Koksu	Hydroelectric	5 MW	
Talgar	Hydroelectric	3.2 MW	
Zaisan	Hydroelectric	2.0 MW	GESEnergo
Sergeevsk	Hydroelectric	2.0 MW	
Uspensk	Hydroelectric	1.92 MW	
Antonovsk	Hydroelectric	1.6 MW	
Georgievka	Hydroelectric	1.4 MW	

Aksu	Hydroelectric	0.92 MW	
Urdzhar	Hydroelectric	0.2 MW	
Sources: UNEP, Power Kazakhstan			

Table 4.2: Kyrgyz Power Generating Facilities

Kyrgyzstan (Current Total: approx. 3,565 MW)			
Plant Name	**Fuel Type**	**Installed Capacity**	**Owner (if known)**
Toktogul	Hydroelectric	1200 MW	
Kurp-Say	Hydroelectric	800 MW	
Bishkek	Thermoelectric	588 MW	
Tash Kumyr	Hydroelectric	450 MW	
Shamaldysai	Hydroelectric	240 MW	
Uch-Kurgan	Hydroelectric	180 MW	
Osh	Thermoelectric	50 MW	
At-Bashi	Hydroelectric	40 MW	
Alamedin 1-7	Hydroelectric	20 MW	
Kalinin	Hydroelectric	9 MW	
Lebedinov	Hydroelectric	8 MW	
Bystrov	Hydroelectric	1 MW	
Sources: U.S. Department of Energy, Kyrgyz Ministry of the Environment			

Table 4.3: Tajik Power Generating Facilities

Tajikistan (Current Total: approx. 4,564 MW)			
Plant Name	**Fuel Type**	**Installed Capacity**	**Owner (if known)**
Nurek Dam	Hydroelectric	3000 MW	
Baipaza	Hydroelectric	600 MW	
Golovnaya	Hydroelectric	210 MW	
Yavan	Thermoelectric-Gas	200 MW	
Dushanbe	Thermoelectric-Oil	200 MW	
Kayrak-Kumskaya	Hydroelectric	134 MW	
Kairakkum	Hydroelectric	126 MW	
Varvarinskaya	Hydroelectric	28 MW	
Perepadnaya	Hydroelectric	24 MW	
Tsentralnaya Tajik	Hydroelectric	18 MW	
Pamir I	Hydroelectric	14 MW	
Khorog	Hydroelectric	10 MW	
Sources: U.S. Department of Energy			

Table 4.4: Turkmen Power Generating Facilities

Turkmenistan (Current Total: approx. 3000 MW)			
Plant Name	**Fuel Type**	**Installed Capacity**	**Owner (if known)**
Mary	Thermoelectric-Gas	1685 MW	
Turkmenbashi TPS	Thermoelectric-Gas	590 MW	
Abadan/Buzmeyin	Thermoelectric-Gas	248 MW	GE

Balkanabat/Nebitdag	Thermoelectric-Gas	126.4 MW	
Seydi SRPS	Thermoelectric-Gas	80 MW	
Gingukush/Hindigus	Hydroelectric	-	
Source: Alexander's Gas and Oil Connections			

Table 4.5: Uzbek Power Generating Facilities

Uzbekistan (Current Total: approx. 12,000 MW)			
Plant Name	**Fuel Type**	**Installed Capacity (MW)**	**Owner (if known)**
Syrdarya	Thermoelectric-Gas	3,000.0	
Talimardjan II	Thermoelectric-Gas	2,400.0	RAO-UES
Novo-Angren	Thermoelectric-Coal	2,100.0	
Tashkent	Thermoelectric-Gas	1,860.0	
Navoi	Thermoelectric-Gas	1,250.0	
Talimardjan	Thermoelectric-Gas	800.0	
Charvak	Hydroelectric	620.0	
Khodzhikent	Hydroelectric	165.0	
Gazalkent	Hydroelectric	120.0	
Farkhad	Hydroelectric	120.0	
Chirchik-2	Hydroelectric	80.0	
Tavak	Hydroelectric	74.0	
Chirchik-1	Hydroelectric	42.0	
Akkavak-1	Hydroelectric	30.0	
Khisraus	Hydroelectric	20.0	
Aktepin	Hydroelectric	20.0	
Nizhne-Bozsuyskiy-23	Hydroelectric	18.0	
Kadyryin	Hydroelectric	10.0	
Kibrai	Hydroelectric	10.0	
Shakhrikhan-5	Hydroelectric	10.0	
Salar	Hydroelectric	10.0	
Nizhne-Bozsuyskiy-14	Hydroelectric	10.0	
Burdzhar	Hydroelectric	10.0	
Nizhne-Bozsuyskiy-19	Hydroelectric	10.0	
Nizhne-Bozsuyskiy-18	Hydroelectric	7.5	
Nizhne-Bozsuyskiy-22	Hydroelectric	5.0	
Source: U.S. Department of Energy			

4.2 Future Plants

Table 4.6: List of Planned, Proposed or Incomplete Power Generating Facilities

Kazakhstan	Mainak	Hydroelectric	300 MW		Planned
	Semipalatinsk	Hydroelectric	78 MW		Planned
	Uralskaya	Thermoelectric	150 MW		Planned
	Atayubinskaya	Thermoelectric	450 MW		Planned
	Yuzhno-Kazakhstanskaya	Thermoelectric	1,280 MW		Planned
	Zapadno-Kazakhstanskaya	Thermoelectric	500 MW		Planned
	Kerbulak	Hydroelectric	50 MW		Planned
	Tolebi	Hydroelectric	2 MW		
	Lake Balkash	Nuclear	640 MW		Operational by 2012

	Aktau	Nuclear	-	-	Permanent Shutdown 1999
Kyrgyzstan	Kambarata I	Hydroelectric	1,900 MW	RAO-UES	Planned
	Kambarata II	Hydroelectric	360 MW	RAO-UES	Planned
	Kambarata III	Hydroelectric	170 MW		Under Construction
	Karabulun	Hydroelectric	163 MW		Planned
	Dzhamykel	Hydroelectric	130 MW		Planned
	Dzhilanaryk	Hydroelectric	80 MW		Planned
	Dzhilanaryk II	Hydroelectric	98 MW		Planned
	Janykel	Hydroelectric	130 MW		Planned
	Kirov Kyrghyz	Hydroelectric	163 MW		Planned
	Kokemeren I	Hydroelectric	360 MW		Planned
	Kokemeren II	Hydroelectric	912 MW		Planned
	Naryn	Hydroelectric	182 MW		Planned
	Orto-Tokoy	Hydroelectric	21 MW		Planned
	Oruktan I	Hydroelectric	60 MW		Planned
	Oruktan II	Hydroelectric	48 MW		Planned
	Oy-Tal	Hydroelectric	12.2 MW		Planned
	Sandalai	Hydroelectric	24.2 MW		Planned
	Toguztorouz	Hydroelectric	248 MW		Planned
	Uchkun	Hydroelectric	88 MW		Planned
	Akbulin	Hydroelectric	100 MW		Planned
	Aktalin	Hydroelectric	38 MW		Planned
	Alabukin	Hydroelectric	600 MW		Planned
	Bashin Discharge	Hydroelectric	135 MW		Planned
	Chon Kemin	Hydroelectric	15 MW		Planned
	Daraut-Kurgan	Hydroelectric	10 MW		Planned
Tajikistan	Rogun I	Hydroelectric	1,200 MW	RusA1	Under Construction
	Rogun II	Hydroelectric	2,800 MW	RusA1	Under Construction
	Sangtuda I	Hydroelectric	670 MW	RAO-UES	Operational by 2009
	Sangtuda II	Hydroelectric	220 MW	Government of Iran	Operational by 2010
	Dashtijum	Hydroelectric	4,000 MW		Planned
	Pamir II	Hydroelectric	14 MW		Under Construction
	Shurob	Hydroelectric	750 MW		Planned
	Kaphtarguzar	Hydroelectric	650 MW		Planned
	Andarbak	Hydroelectric	250 MW		Planned
	Yamchun	Hydroelectric	150 MW		Planned
	Yemts	Hydroelectric	100 MW		Planned
	Shkev	Hydroelectric	74 MW		Planned
	Langar	Hydroelectric	60 MW		Planned
	Dashoguz	Thermoelectric-Gas	254 MW		Operational June 2007

Turkmenistan	Mary	Hydroelectric	1 MW		Under Construction
Uzbekistan	Yufk II	Hydroelectric	8 MW		Planned
	Andijan Mawm	Hydroelectric	12 MW		Under Construction
	Sokh	Hydroelectric	14 MW		Under Construction
	Akhangaran Hydro	Hydroelectric	21 MW	China National Electric Equipment Corporation	Planned
	Andizhan Hydro	Hydroelectric	50 MW	China National Electric Equipment Corporation	Planned
	Pskem	Hydroelectric	459 MW		Planned
	Pioneer Uzbek	Hydroelectric	8 MW		Planned
	Shakhrikahn	Hydroelectric	15 MW		Planned
	Shakhrikahn I	Hydroelectric	30 MW		Planned
	Uycha I	Hydroelectric	20 MW		Planned
	Uycha II	Hydroelectric	39 MW		Planned
	Gulba Hydro	Hydroelectric	6 MW	Uzyodenergo	Under Construction
	Shakhimrdan Hydro	Hydroelectric	2 MW	Uzyodenergo	Under Construction
	Bachishamal II	Hydroelectric	18 MW		Planned
	Ghavasay	Hydroelectric	10 MW		Planned
	Karkidon	Hydroelectric	10 MW		Planned
	Tupolang	Hydroelectric	175 MW	China National Electric Equipment Corporation	Under Construction
	Ghissarak	Hydroelectric	45 MW		Under Construction

4.3 Heat Consumption Rates

Table 4.7: 2004 Heat Production and Consumption Data

Kazakhstan	Fuel Source	Heat Generated 2004	Heat Consumed 2004
	Coal	362 TJ	362 TJ
Kyrgyzstan	Coal	2,149 TJ	
	Gas	10,273 TJ	12,422 TJ
Tajikistan	Gas	3,838 TJ	3,838 TJ
Turkmenistan	Gas	5,536 TJ	5,536 TJ
Uzbekistan	Coal	3,847 TJ	
	Oil	7,888 TJ	
	Gas	96,454 TJ	108,189 TJ
Source: IEA			

4.4 Current Tariffs and Payments

Table 4.8: List of 2003 Electricity Tariff Rates by Country

Country	(¢/KWh) in 2003
Kazakhstan	2.64
Kyrgyzstan	1.40
Tajikistan	0.50
Uzbekistan	2.15
Turkmenistan	N/A
Source: World Bank	

These tariffs are misleadingly low, because electricity consumers in the five republics are vastly undercharged for power. The World Bank study which compiled these figures in 2003 found that the tariff rate that would bring the power companies cost recovery was substantially higher than the rates seen above, by as much as 60 percent in some countries. This is reflective of the social and technical situation, whereby the final effective tariff must account for both the cost of production, expected system losses, and the consumers' ability or propensity to pay. Were the tariffs set at profitable levels over the past fifteen years, non-payments and non-collections would have been even more disastrous than they are now.

Non-payments are not the only problem in determining effective pricing policies. Power losses include not only electricity that is unbilled in cash payment, but also electricity that is never delivered due to technical system issues like grid maintenance, defective metering, normative charging, power diversion and large amounts of theft.

These practices are difficult to monitor, their prevalence relative to each other difficult to gauge, and their impact on revenue nearly impossible to project. Ineffective metering also makes it difficult to determine non-payment and collection trends by individual consumer group.

Estimates are best made on an aggregate level, and according to the World Bank, "the unbilled consumption is estimated to range from 5% to 18% in these countries. Non-payment problems are pervasive and on average only about 70% to 85% of the bills are collected."

Table 4.9 lists bill and payment collection by country for 2002. Data is not available for Turkmenistan.

Table 4.9: 2002 Electricity Tariff Payment Data

Country	Billings (% of sales)	Collections (% of billings)
Kazakhstan	N/A	85 %
Kyrgyzstan	80 %	80 %
Tajikistan	70 %	70 %
Uzbekistan	85 %	75 %
Turkmenistan	N/A	N/A

Source: World Bank

4.5 Future Heat and Electricity Tariffs

The current low tariffs for both electricity and heat in the region are partially a result of the steep decline in demand for both during the 1990s. The economic turbulence from the Soviet collapse cause many industries to shut down due to lack of funding, and many industrial power and heat consumers disappeared completely.

Power generation and distribution companies could charge low tariffs because the government could more easily provide production subsidies when production levels were so low.

Since 2000 however there has been a modest recovery in power demand in all five countries such that the low tariffs and government subsidies are strained to cover the generating and distribution costs. Population growth is only a moderate contributor to the demand increase, the industrial recovery and new export opportunities are the main driving forced behind a demand expected to require between 6,000 and 12,000 MW of new generating capacity by 2025.

The current tariff and subsidy program covering heat and electricity costs will not be adequate to cover this demand. Tariffs are already increasing towards cost recovery level in the relatively wealthier countries like Kazakhstan and Uzbekistan, and can be expected to increase in the other countries over the next few years.

As long as they remain below, then the governments in the five republics are essentially, fully supporting the heat and electricity industries. For many companies, the low tariffs they charge mean that operational subsidies from the government account for more than *half* their annual revenue. As low as the tariffs already are, they are not even fully effective, since poor or defective metering and collection inefficiencies mean that the power companies aren't even collecting the full amount their meagre prices amount to. As a result, government subsidies will become more essential to their operation. This is a situation the government does not wish to remain in, and scaling back subsidy payments is a primary goal of various governments.

To cover the difference, tariffs can be expected to increase across the board over the next several years.

This is not simply because of the jeopardization of the government subsidies. Increasing tariffs is the most effective way to temper the growth of demand. Higher prices will force residential and industrial consumers to be more responsible and frugal with power use.

One World Bank study finds that if tariffs were increased to cost recovery level, then demand growth would be reduced to 2 percent per year until 2025. Such low growth would give the electricity sector the time required to find new investments, inject funding into infrastructure and development, and ultimately increase their market cash flow when an integrated market becomes a reality.

However the main driving factor behind tariff increases is and will continue to be the unwillingness of government to continue subsidizing power companies the majority of their income.

4.6 Overview of Power Management System

The CAPS grid is managed by a state-owned organization called the United Dispatch Centre, or Energia, based in Tashkent, Uzbekistan. The UDC manages subsidiary National Load Dispatch Centres in each of the countries. The NDCs, in turn, co-ordinate between the UDC and the local monitoring stations in various load centres of each country.

It is the responsibility of all three levels to ensure system security and that adequate power is made available to various targeted consumers based on prearranged agreements. It balances supply and demand indicators in real time and ensures that system reserves to manage shortages, regulation of frequency and voltage to manage power flow, and reactive power compensation when irregularities occur. The NDCs also monitor the local 110 kV power lines, since they are regional lines, do not typically cross any borders, and are the most important to ensuring power can be brought regionally to customers.

Yet, shortages and excess capacities are not a random occurrence in the CAPS system, they are mostly predictable and, could be managed more effectively. For example, South Kazakhstan, Kyrgyzstan and Tajikistan face and will continue to face annual winter shortages due to decreased hydro capacity from low water flow. The hydroelectric facilities can be made to run in an operational mode in winter that will allow them to function more effectively, though at the potential expense of the ecosystem down river. It does not seem likely that such measures will occur. Instead, the new facilities under construction are being designed to minimize the impact of cold weather on the ability of hydro facilities to generate power. They are some years away from operational status.

For now, shortages due to annual hydroelectric slumps are dealt with through trade with countries that have excess thermoelectricity. Uzbekistan and North Kazakhstan in particular, which generate year round power surpluses due to more consistent fossil-driven electricity, trade with the others when shortages occur.

The UDC, NDCs, and Local Dispatch Centres do monitor the operation of the power system, though the extent to which they *manage* it hinges on their ability to remedy potential problems. Designing more efficient facilities and diverting power from other areas do provide alleviation, but they are bypass measures designed to fix problems rather than prevent them in the first place. Infrastructure reform, and a unified power market as it was designed by the Soviets would be a more lasting solution.

Throughout the 1990s and early 2000s, periodic lack of power to consumers was often accepted as a fact of life in Central Asian winters, and neither the grid nor the dispatch centre have the infrastructure available to “manage” predictable annual long-term shortages. Only recently have business plans begun to address the infrastructure deficiencies that cause the shortages.

SECTION 4.0 SOURCES: EBRD, IEA, World Bank, United States Department of Energy, Alexander’s Oil and Gas Connections, Kyrgyz Ministry of the Environment, Power Kazakhstan, UNEP

5.0 CENTRAL ASIAN POWER TRANSMISSION SYSTEM

There are two separate grids that make up the Central Asian transmission system. Since both were devised during the Soviet era, how they were constructed in relation to current national borders was given secondary consideration. As a result, the grid separates along an east-west axis through Kazakhstan, and as mentioned, only one 500 kV transmission line connects the northern grid, upon which Russia and North Kazakhstan are connected, and the CAPS grid, upon which South Kazakhstan, and the other four are connected. Figure 5.0 displays a schematic diagram of the northern grid.

5.1 Schematics

<u>Figure 5.0</u>: RAO UES Russian Electricity Grid
(Source: Oxford Society for Caspian and Central Asia).

As can be seen, it is already well integrated throughout western and southwestern Russia, through Siberia to the Korean peninsula. Though it connects to the European grid through multiple points, including power stations in Finland, Belarus, and the Ukraine, the most concentrated area of international connection is through Kazakhstan.

Figure 5.1 shows a close up of the North Kazakhstan part of the grid. It demonstrates the extent to which north Kazakhstan is connected to the Russian grid. There are multiple connection points, including the famous 1150 kV transmission line between Ekibastuz in Kazakhstan, and Chelyabinsk in southern Russia. It is the highest voltage capability of any power transmission line anywhere in the world, and the only one of its kind.

It should be noted that this figure only shows the points where the grid crosses the border. The part of the grid found on the Kazakh side is much more integrated, and can be seen in Figure 5.2.

Figure 5.1: **Russia-North Kazakhstan Power Grid Connections**
(Source: Global Energy Network Institute)

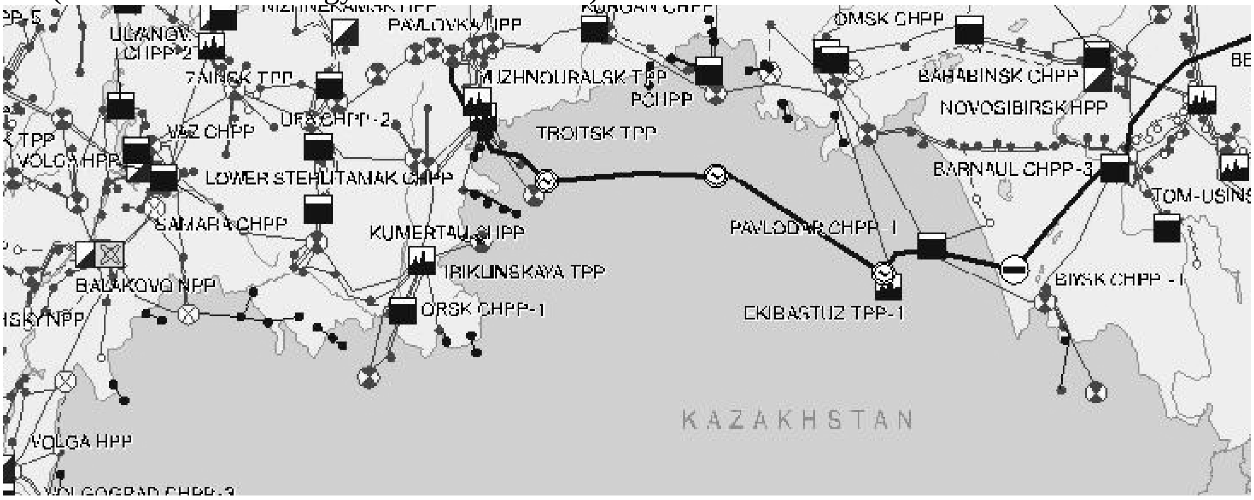
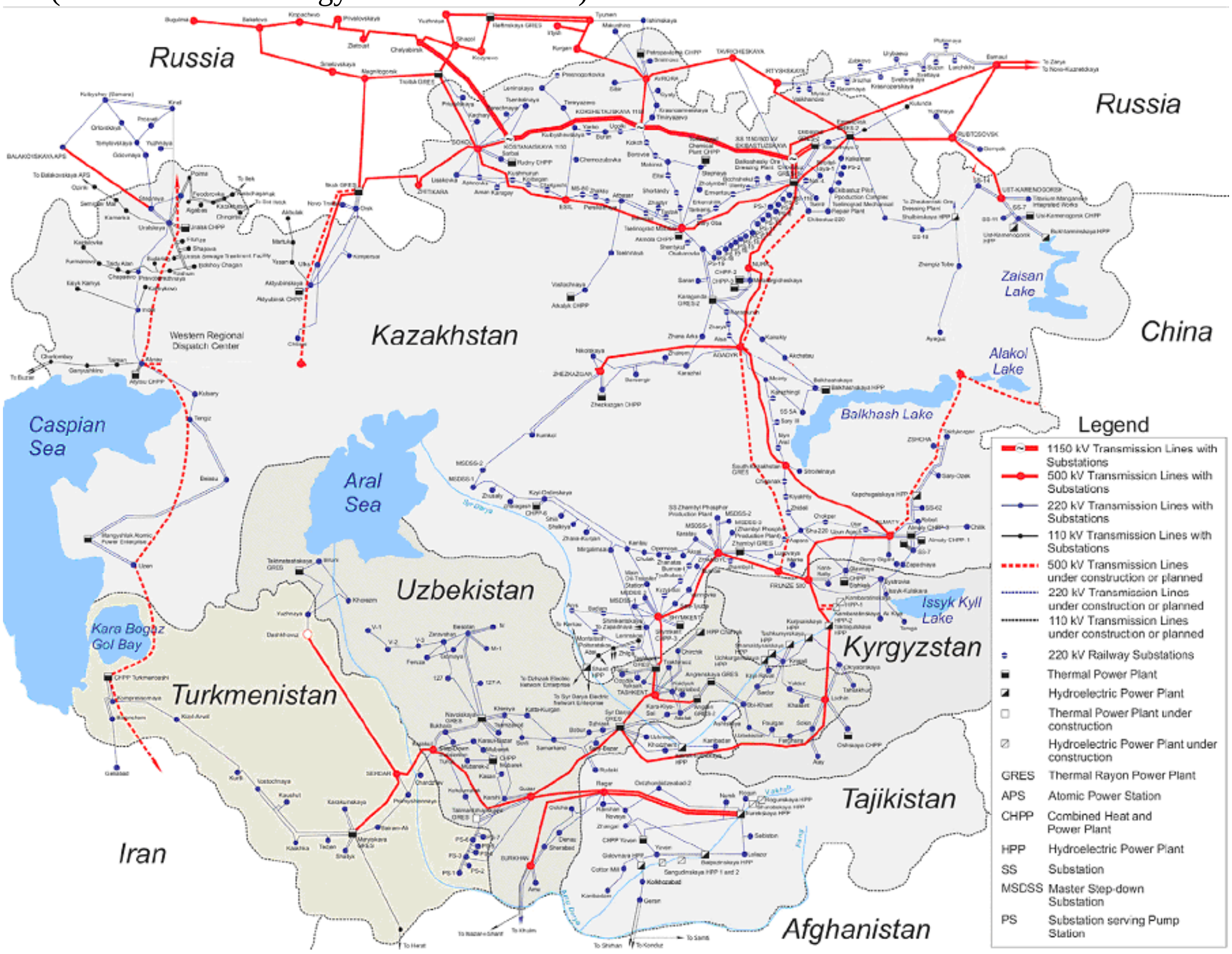


Figure 5.2 displays a schematic diagram of CAPS, or the southern grid, upon which Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, and the south and southeastern parts of Kazakhstan are connected. It also shows the northern grid as it is integrated into Kazakhstan.

Figure 5.2: Central Asian Power System (CAPS) Grid
(Source: Global Energy Network Institute)



There are several important things to note about the layout of this grid.

First, as is clearly shown, the north of Kazakhstan is more integrated with Russia than it is with the south. The single 500 kV line that connects the vast distance between the regions is shown, as well as several proposed or planned new lines (dashed lines) to better link the two grids. Some of these lines, and several others that are not shown, are projects already planned or underway particularly the line that is shown following nearly the same path as the existing line, which is under construction. The current line has a transmission capacity of only 600 MW, well short of the demand in South Kazakhstan. For more information about the projects, refer to section 5.3 below.

Second, there are two 500 kV lines running from the Rogun power station in central Tajikistan into Uzbekistan that service the south, and one running from Syrdarya that services the north. But no connections run between them. Because of this layout, even though the lines are separated by only a few hundred kilometres, power must be exchanged with Uzbekistan to arrange transfer.

5.2 Transmission System Assessment

Even though the schematics do showcase one major problem with the grid – its irregular design and layout – the fact is that system operation remains synchronized. Though inefficient, is adequate to transmit power based on the prearranged exchange agreements made through the Central Asian Power Council. The same can be said for Energia, the dispatch centre, which adequately regulates the system and monitors the transmission of power.

Reforming the grid completely and reorganizing the bureaucracy that manages and regulates it would indeed be beneficial to the transmission system, however it is not a realizable goal. The cost associated with such a massive undertaking is more than any of the governments or IFIs can afford. Instead, they have invested in smaller projects aimed at moderate but effective improvement in transmission efficiency. A list of technical projects targeting this goal can be found in section 5.4.

The more pressing problem is the operational condition of the system already in existence. Most of the equipment is a relic of the Soviet era, is outdated and is a major contributor to the massive amounts of system loss experienced every year. (See Table 3.1). Many transmission lines and power substations are on the verge of collapse and most are in need of replacement.

Yet transmission and distribution system operators are not taking the required steps to maintain the grid. The projected production capacity of the region’s power generating facilities is sufficient to meet domestic demand for many years, and has the potential to become a large export source. Due to large losses from distribution, however, system capacity must be *well* ahead of demand to account for the losses the current system brings. Increasing overall capacity by one thousand MW only brings about an increase of several hundred MW of capacity actually available to consumers.

In short, unless the transmission system is modernized, domestic demand will catch up and overtake supply must faster than anticipated, within several years according to some researchers.
Yet the power and transmission companies have little or no incentive to take such measures. As long as electricity tariffs remain deliberately below the cost recovery levels, all companies are operating at a significant loss. (See Table 5.0). Even in Kazakhstan and Uzbekistan, where tariffs are significantly higher than elsewhere, and prices are considered high, they are still below levels needed to cover cost of generation and distribution.

Table 5.0 compares actual tariffs to cost tariffs in 2003.

Table 5.0: Cost-Operating Efficiency in 2003

Country	Electricity Tariff 2003 (¢/KWh)	Cost Recovery Level (¢/KWh)	Percent Coverage
Kazakhstan	2.64	2.80	94 %
Kyrgyzstan	1.40	2.30	61 %
Tajikistan	0.50	2.10	24 %
Uzbekistan	2.15	3.50	61 %
Turkmenistan	N/A	N/A	N/A
Source: World Bank			

Companies are subsidized for this loss by the government and by loans from development banks, but tariffs in general will be rising in the coming years to deal with these discrepancies. This is a mixed blessing.

Though it will bring companies closer to recovering costs on their current production, the increasing tariffs will also act as a mechanism to check growth of demand. For a full discussion of tariff policies, see section 4.4.

Either way, without profits to reinvest in infrastructure, motivation for maintenance is minimal. As indicated, increasing tariffs will do little, since many domestic consumers cannot and do not pay at *current* levels. It is an unfortunate Catch-22 of the system, but without profits, there is minimal investment. Yet without investment to improve efficiency and lower costs, there will be minimal profits.

Referring specifically to Kazakhstan, one researcher argues that “today, just a few new owners modernize and reconstruct their facilities … the wear and tear of electrical plants (estimated at 60-80%) has resulted in the growing gap between their designed (18,500 MW) and factual (14,400 MW) capacity.

“The electric grid is not an exception and the situation is even more dangerous because using worn-out grids increases losses. Electric power transmission services, which are included in the sector of natural monopolies, account for approximately 20 percent of the final cost of electric power; however the owners of electric power transmitting companies refuse to invest in the reconstruction of the grids.”[7]

[7] Sergei Smirnov, “Kazakhstan’s Electric Power: Facing Crisis in Two Years?” Kazakhstan Business Magazine No. 2, 2007.

In Kazakhstan alone, in *addition* to the new 500 kV north-south connection, it is estimated that more than 100,000 km of 110 kV lines and an additional 614 power substations are needed to restore power security to rural areas currently in danger of losing electrification.

In summary, though plans are already well underway to construct new and refurbish old cross-border links into Iran, Pakistan, and Afghanistan, as well as to link the Russian/Kazakh grid to China in order to develop the lucrative export market, the reconstruction, refurbishment, and modernization of the grid *within* the Central Asian region is a much more pressing issue. It must precede any development abroad, lest its failure or damage render any international projects useless.

There is some evidence that governments and their generating and distribution companies are taking such steps. A list of current and proposed technical projects is found in section 5.4.

5.3 Import and Export Opportunities

Currently, there are several ongoing and overlapping plans to expand the trade of electricity in the Central Asian region. For a list of such initiatives, see section 3.7. While there is a good deal of importing and exporting of electricity already taking place, it is not done on a coherent business plan basis, but rather through bilateral agreements based on need.

Within the CAPS area, there is also a good deal of power exchange, though it is more often a necessary function of Soviet design, which placed generating and distribution systems on a regional basis, such that the Central Asian system was designed to be integrated and function together.

Yet with the reassertion of national borders, inter-Soviet power exchanges have now become international power exchanges. Instead of the existence of a proper market mechanism preceding the trade of a good, the trade of the good preceded the market, and now an intensive drive to develop that market to cope with the necessary power trading is underway.

At the same time, the CAPS is being developed for export relationships abroad. The power systems on the CAPS grid are already generating surplus power at most times of the year in most areas, and the push to maximize generating capacity using locally abundant fuels is primarily designed to exploit the high-demand markets adjacent to the CAPS region. Iran, Afghanistan, Pakistan, and China have tremendously active power international exchanges, due either to low domestic generating capacity, rapidly increasing population, or the same seasonal production problems that hinder Central Asia.

As a result, several organizations have offered funds to improve the infrastructure linking the CAPS grid to other neighbouring grids, even before the market *within* the five republics is developed. It is an irregular process, since the fuel mix of each domestic generating system is different, and while some of the CAPS countries face seasonal shortages that would prevent export, others have regular surpluses.

There are also legal issues that inhibit the integration of markets. According to a report done by the United Nations in 2006, overcoming legal barriers, resolving legislative disputes, and establishing rules, procedures, and other processes to manage international exchange is one of the primary hurdles to international electric power grid interconnections. Aside from technical and financial problems, these issues pose the biggest threat to the establishment of an international exchange.

The report cites institutional compatibility, operational responsibility, bilateral transparency, shared infrastructure, and liability protocols as just some of the chief issues that must be resolved through legal arrangements before international power interconnections can be operated effectively. Since market integration and reform has proved difficult, countries with large fossil fuel reserves and reliable power surpluses have branched out successfully into the world market already, while the smaller countries with seasonal fluctuations have not been as successful.

Market reform will continue to be a lengthy process in Central Asia, and the emergence of demand voracity outside the region threatens to relegate domestic market development to secondary status. For a full summary of the organizations investing in CAPS export and market development, see section 4.7.

5.4 Technical Project Overview

The following is a brief summary of the major technical projects underway to improve the Central Asian Power System. Not included is the construction of new generating facilities, a list of which can be found in section 3. Table 5.1 summarizes the projects and their relative costs, followed by a description of each.

Table 5.1: Current Technical Project Summary

Project	Location	Type	Cost (million USD)
New Major Power Transmission Lines	Kazakhstan,	Construction - Transmission Infrastructure	247.07
	Tajikistan	Construction – Transmission Infrastructure	115.00 to 200.00
New Power Generation Capacity	Kazakhstan	Upgrade – Generating Facilities	1,080.00
	Kyrgyzstan	Upgrade – Generating Facilities	200.00
	Uzbekistan	Refurbishment – Generating Facilities	1,150.00
	Kazakhstan	Refurbishment – Generating Facilities	1,070.00
New Transmission Reactor Mechanisms	All	Upgrade – Transmission Infrastructure	Variable
Emergency Mechanisms	All	Upgrade – Computing Equipment	Variable

Transmission Loss Reduction	All	Refurbishment – Transmission Infrastructure	3,000.00

5.4.1 New Major Power Transmission Lines

The first project is the north-south Kazakhstan line linking the Russian grid to the CAPS grid. This project is one of the most salient and obvious ways that Central Asian power infrastructure can be improved. Not only will it better connect two grids that are currently essentially separated, but it will enable more widespread power trading as access to Russia is increased.

Though it is classified as a Kazakh project, it concerns all five countries. It consists of reinforcement of the existing line, which faces severe stability problems due to fluctuating use over the past fifteen years. Industrial collapse and demand recession in South Kazakhstan meant that high-voltage industrial power transfers were only occasionally needed, whereas residential transfers on lower voltage lines grew relatively more intense. As a result the reactors and substations were not properly maintained, and today do not function satisfactorily. The installation of additional reactors is needed.

Further, construction of a second line, shown in Figure 5.2, is underway and will follow roughly the same path as the existing line. It is a 500 kV line, and construction has been underway since before the Soviet collapse.

The section between Ekibastuz and Agadyr is nearly complete. When work stopped in 1994, foundations were complete and nearly half of the towers and one fifth of conductors were already installed. KEGOC has currently classified the project as ‘Phase II,’ indicating that plans for resuming have been approved and bids for construction are being entertained.

Needed now are 400 km of line connecting Agadyr to Ukgres, and 800 km of line connecting Ukgres to Zhambyl. The former is underway, in ‘Phase I’ with consulting services contracted and funds procured through a 2005 EBRD loan. The latter has not yet been planned.

KEGOC obtained separate loans for various parts of the project in 2005. The EBRD provided 87.8 million USD, while World Bank provided 161.09 million.

Total project cost: 247.07 million USD

A second major project is planned in Tajikistan, where a line linking the south and north load centres is needed to avoid having to arrange power exchanges with Uzbekistan to transmit from one to the other.

The major load centres and industrial areas are in the north, while the main hydroelectric generating facilities are found in the south. 85 percent of northern demand is satisfied with southern power.

A new transmission line of 500 kV is planned to link the two centres. Its route has been planned, and since it must cross through difficult mountain terrain, access to the construction route is difficult and is taking time. Not only will the line link Tajikistan internally, but it will provide a secondary looped corridor to transmit power to Uzbekistan and Kyrgyzstan, which would provide additional system stability.

Total project cost: 115 million-200 million USD**.**Most recently (December 2006) the ADB provided loans to Afghanistan and Tajikistan for the construction of new 220 kV double circuit transmission line that will link the hydropower stations on Tajikistan`s Vakhsh River to Kabul.

Thus, Tajikistan could export up to 300 MW of its current power generation surplus, during the spring-summer period and cover partially shortfalls in neighboring Afghanistan. The project also includes new investments and upgrading of electrical infrastructure on Tajikistan territory, that will help reduce the winter power deficit by boosting the available level of generation and decreasing technical loses in the south of the country.

Total project cost: 56.5 million USD.

5.4.2 New Power Generation Capacity

As infrastructure projects like the north-south line aim to better integrate the power systems, there are ongoing projects to increase baseline capacity as well. Kazakhstan announced in June 2007 that it would be increasing its production capacity rapidly to meet an expected 58 percent rise in demand. Demand forecasts have increased and are now expected to rise to between 115,000 and 120,000 GWh by 2015, instead of the roughly 90,000 the government had previous projected. As a result, Kazakhstan will be injecting more funding into the completion of new generating facilities and the upgrading of capacity at existing facilities.

Though new generating facilities do present large new potential capacity, equally productive is the refurbishment and upgrading of capacity at already existing facilities. Thus, though the number of new facilities planned or under construction (as seen in section 4.2) might seem low, much of the new capacity will come from existing plants. For example, the **Ekibastuz** plant in Kazakhstan is currently designed for 4,000 MW, but it can accommodate much more, and installation of two new 500 MW units to increase the capacity to 5,000 MW is currently underway.

Total project cost: 1.08 billion USD

The **Bishkek** thermoelectric power plant, Kyrgyzstan's only thermoelectric facility, is currently being upgraded through a new 400 MW combined cycle plant. This is aimed at meeting the country's winter hydroelectric shortages.

Total project cost: 200 million USD

In Uzbekistan, the **Syrdarya, Tashkent, Angren, and Navoi Angren** facilities are set to undergo an extensive long-term overhaul over the next fifteen years to restore their original operational capacities. Loans from various organizations like the EBRD and Japan Bank for International Cooperation have been obtained as preliminary sources of finance to begin the first phases, in the area of 281 million USD.

Total project cost: 1.15 billion USD

The original **Ekibastuz** plant units in Kazakhstan are also set for refurbishment to extend their life, as well as the **Karaganda**, and **Aksu** generating facilities. These are some of the oldest in the region, and the refurbishment is aimed at preventing their eventual decommissioning due to decay.

Total project cost: 1.07 billion USD

5.4.3 Transmission Line Reactors and Frequency Control Mechanisms

Due to the turbulent fluctuations in load over the past fifteen years, particularly at crucial power corridor parts of the grid, several of the larger 500 kV have been shut down, since residential consumption has been the major driver of demand growth during the post-Soviet industrial slump. This leaves smaller 220 kV lines managing extra high voltages over long distances.

To remedy this, shunt reactors of varying capacities are needed to prevent overload. The needs of the various substations are separate and ongoing.

Further, there is a need to equip smaller or older power generating facilities with power frequency control mechanisms to better control the output of power onto the grid. Currently, only the newest and largest plants, and often only hydroelectric facilities have this available. Examples of such mechanisms include gates to slow or stop the flow of water into hydroelectric turbines, or valves to slow or stop the flow of fossil fuels into thermoelectric turbines. Controlling power in this way is known as primary frequency regulation, and it maintains a balance between the amount of power generated within the facility and consumption. Frequency control is an essential component of system security.

Currently, Kyrgyzstan is the most active in installing frequency governors, which will benefit neighbouring countries, who in turn pay for the power regulating services. The total cost of this project will depend on how many facilities are selected, and whether other countries follow suit.

Total project cost: variable.

5.4.4 Emergency Equipment and Power Management System

This project is aimed at improving the ability of the various operating companies and monitoring regulators under the UDC to observe and manage system safety.

This includes constructing new reliability mechanisms, such as microprocessor relays and shunt reactors as well as an upgraded monitoring operations program known as

SCADA. **S**upervisory **C**ontrol and **D**ata **A**cquisition is used by each of the Regional Dispatch Centres in all five countries to monitor power transmission and distribution, and a variant, SCADA/EMS, **E**mergency **M**anagement **S**ystem is used at each of the five National Dispatch Centres. These programs are obsolete, out of date, and ineffective monitoring mechanisms, and as a result there is a push to modernize the technology in preparation for increased international trade.

Kazakhstan has taken the first step to modernize systems at both levels. Financed by the World Bank and EBRD, it is implementing software upgrades and rehabilitated telecommunications systems to communicate between the various centres. This will allow better and more rapid communication of information between regional dispatch centres and the National and United centres, particularly in the event of an emergency. In Tajikistan, the replacement of SCADA with a new modern system is part of a larger project to construct a new National Dispatch Centre, since the existing one does not conform to standards.

How to manage power emergencies also requires equipment reinvestment, particularly at the communications level. Power crisis mechanisms are nearly always automatic, and when errors or anomalies are detected, measures are often taken at a system level with no human input. These include mechanisms for avoiding disturbances to stable operation, maintaining synchronous operation, reducing load on equipment, when possible, and limiting voltage drops in substations. The problem is communicating information about these automatic protocols from where the emergency occurs to the monitoring and transmission stations. This would help eliminate spurious emergencies and quicker recovery in the event of a problem. As a result, a push is being made to introduce modern computers and telecommunications equipment into the existing automatic emergency system.

The cost of this project will depend on how many of the other countries follow the lead of Kazakhstan in completely replacing the antiquated SCADA system. It is currently being co-financed by EBRD and World Bank.

Further, there has been an explicit acknowledgement that sufficient generating capacity will not prove a viable substitute for distribution infrastructure in the event of a power emergency, and an ongoing project to devise new schedules for power diversion should one of the major lines fail have been devised. They seek to reduce load at crucial points on the system should a transmission line or power station fall off the grid such that even though transmission may be severely lessened, the entire system does not collapse as it did very frequently in the late 1990s and early 2000s. Given the fragile cost-covering mechanism employed by power companies, electricity losses of even a few minutes cause revenue losses of thousands of dollars.

5.4.5 Environmentally Friendly Technologies

A brief examination of the list of existing power generating facilities immediately provides a solid indication of the salience of the environmental aspects of energy and electricity: fairly low.

Beyond the moderate use of hydroelectricity, none of the region's energy comes from renewable fuels. No wind, biofuel, solar, geothermal, or any other renewable electricity is generated anywhere in the region. The use of hydroelectricity, while commendable from an environmental standpoint, is more likely a pragmatic response to the vast unexploited water flow potential of the region than a conscious decision to use cleaner fuels. Indeed, insufficient environmental precautions have been taken in many cases, and the ecosystem downriver from facilities and the flow of water to and from crucial reservoirs has been threatened in several cases.

Further, hydroelectricity is only a major fuel source in Tajikistan and Kyrgyzstan, the two Central Asian states with the lowest population and which together produce only 31 percent of the electricity on the CAPS grid (which excludes the major facilities in North Kazakhstan). Elsewhere, where natural gas, oil, and coal-fired thermoelectric facilities generate most of the power, hydro has little role to play.

Since the total power output of the region is fairly low, so too are its emissions of environmentally damaging substances such as soot, ash, and greenhouse gases. Yet this does not mean that environmental issues have no salience in Central Asia.

For example, the major coal producing regions found in Kazakhstan come under much scrutiny for their environmental standards. Due mostly to the age of the facilities and equipment, the output of Sulphur Dioxide and mono nitrogen oxides from coal-fired generating facilities at Karaganda and Ekibastuz are very high. In 2000, a UNECE study found that to bring the emissions levels of these plants to German standards would have cost 1.5 billion USD.

Further, if the coal fields at Ekibastuz undergo planned further development to increase the capacity of the facility under a recently announced plan, both to meet domestic demand and to create excess for export to China, the ash waste that is currently polluting the air with smog around the plant will increase in volume by several million tonnes every year. In many of the thermoelectric plants in Uzbekistan, Turkmenistan, and Kazakhstan, waste gas accumulated through exploitation and refinery of oil is simply flared away. The amounts of residue and excess are not insignificant, they could very easily be used to generate more electricity if properly collected and stored. Projects and studies aimed at determining the amount of power that could be generated by this fuel are underway.

Environmental regulatory bodies have been commissioned in recent years to examine and manage the impact of the hydroelectric developments on the waterways of Central Asia. A Water and Energy Consortium was recently formed to address grievances and manage the exploitation of the region's reservoirs. This is an ongoing project and the structure of the so-called WEC is continually evolving to meet the new environmental concerns about the water usage.

A major problem associated with environmental initiatives in Central Asia is that statistical evidence gathered on the current conditions of such things as air pollution and water quality is very poor and generally less reliable than it was during Soviet times. The number of monitoring organizations and facilities declined sharply, sampling procedures are not standardized, and the compilation methods for aggregate data are out of date.

As a result, environmental initiatives are necessarily based on imperfect information, and as a result carry less weight than they normally would. Given the low level of capital available for investment in the first, the directing of that investment towards environmentally friendly technologies is nearly impossible.

From what data that has been gathered, it appears that the overall environmental situation is fairly grim. According the Asian Development Bank, poor air quality in urban centres is a major health concern, as is the condition of regional water, which is unsuitable for drinking or irrigation in most cases, and is receding in supply. As much as 40 percent of all groundwater is unsuitable for drinking. Air pollution exceeds acceptable maximums in larger cities, and industries are increasingly reverting to older technologies and fuels to cut costs at the expense of Sulphur, Carbon, and nitrogen oxide emissions.

Within the scope of what the power sector can accomplish, it is making positive changes in its approach to the environment. As it prepares to develop export markets and integrate with East Asia, South Asia, and Europe, financial assistance provided by IFIs is increasingly contingent on the completion of an acceptable environmental impact assessment such that new construction and generating capacity is more environmentally friendly than the ageing existing equipment.

For a more complete analysis of renewable energy potential in Central Asia, refer to section 6.3.

5.4.6 Reduction of Power Losses

Smaller individual projects to reduce losses, such as rehabilitation of ageing power lines, reinforcing weak transmission systems, increasing theft prevention security, and rehabilitating power substations, could provide an incremental 13,287 GWh of electricity between 2005 and 2010. The World Bank has calculated an aggregate total for these small loss-reduction programs.

Total project cost: 3 billion USD

SECTION 5.0 SOURCES: EBRD, ADB, CAREC, World Bank, International Association for Energy Economics

6.0 INVESTMENT OPPORTUNITIES AND NEW TRENDS

> "Supply options such as system loss reduction, rehabilitation of generating units, and completion of large projects presently languishing **for want of funds**, could produce enough electricity to meet the forecast demand and leave substantial surpluses for export."
>
> World Bank, 2006

6.1 Opportunity Overview

There is no shortage of investment opportunities in Central Asia's electricity market. Indeed, there are several areas that not only provide lucrative opportunities for large investments, but are actively searching for such investment to complete projects already underway. Lack of sustainable and consistent investment is one of the reasons that the timeline for the major construction, governmental, and research projects is so long. The ECO study on the interconnection of South Asian power systems, which took 5 years just to begin, or the construction of the Rogun hydroelectric power complex, stalled at various times over the past decade due to lack of investment, are prime examples.

According to a 2004 UN report on efficient resource use, there was a time that during which improving the tariff situation alone would have generated enough new revenue to implement much-needed investment projects. However as the equipment obsolescence became more pronounced over the past five years, and as demand has and will continue to grow, this is no longer the case. Fiscal self-sufficiency in the electric power industry is not a realizable goal, even with substantial oil and gas revenues. Colossal investment is needed.

Finding opportunities is not the problem in this region; any or all of the technical or organizational projects on the preceding list require substantial investment, not only from IFIs but from private sources as well. The problem in Central Asia has never been finding destination projects; the problem has been mitigating the unusually high strategic and geopolitical risks.

Demand is very hard to predict in the region, since consumption levels are not necessarily a reliable indicator. The problems with improper metering, theft, distribution loss, non-payment, and widespread rural non-connectivity skew demand figures so much that it is difficult for project proposals to offer much investment security. Normal factors such as past consumption, population growth, or current tariff levels are not as useful, since each fluctuates fairly rapidly over a short period of time. As a result, growth forecasts typically have a very large range of values. It is difficult to reconcile the security of large investments with such imprecise and potentially unreliable indicators.

There is also a large political risk. Aside from foreign direct investment, whereby foreign companies directly own power generating facilities or parts of the grid, and of which there is a growing amount, one of the only ways to invest is through ownership of supply or distribution companies. As indicated, though most are "private," many of these companies are wholly or majority-owned by their respective governments. In most cases, the government will have retained ownership of higher than 75 percent of the company, in order to maintain full operational control, while divesting the remaining shares to give the appearance of a competitive market.

Further, attracting investments from North America and Europe is difficult since there are often human rights and democratic legitimacy concerns in these countries. Questions about the authority of government and its efficacy in managing public goods like electricity are often called into question.

The result of this is that the most high-profile and risky projects are often financed by development loans from the **ADB, World Bank, EBRD,** and **IDB,** instead of private companies, investors, or financiers. But as indicated earlier, these organizations tend to direct their funds towards infrastructure projects, like grid modernization or feasibility studies, since these projects are geared more easily towards development, than towards new generation capacity.

Investments have not been forthcoming, and the difficulty of attracting capital will likely remain acute over the next several years. In Kazakhstan alone, investment of 10 billion dollars is needed by 2015 to meet the infrastructure requirements for its development strategy.

6.2 Hydroelectricity

One glance at the list of new power generating facilities planned or under construction in the five republics seen in section 4.2 demonstrates the extent to which they have already begun to capitalize on this investment opportunity. A vast majority of new facilities and a small majority of new designed capacity will be hydroelectric.

The reason for this market direction is not difficult to discern. The vastness of the region makes for high fuel transportation costs, which are eliminated along with the cost of fuel itself with hydroelectric facilities. Though environmental questions remain regarding damage to the ecosystem during winter operations, the fact remains that hydro facilities are a much cleaner alternative to present to international investors as the face of Central Asian energy, particularly in light of the region's (deserved) reputation as an oil and gas driven economy. Table 6.0 outlines the levels of current hydro capacity compared to the potential capacity from the major water flow systems in each country.

Table 6.0: Hydroelectric Power Potential and Installed Capacity

Country	Installed Hydro Capacity (MW)	Potential Hydro Capacity (MW)	Percent Exploitation
Kazakhstan	2,000	20,000	10.0 %
Kyrgyzstan	3,000	26,000	11.5 %
Tajikistan	4,000	40,000	10.0 %
Uzbekistan	1,700	Modest	N/A
Turkmenistan	Negligible	Modest	N/A

Source: World Bank

While data is not available for Turkmenistan, there are few indications that hydropower potential in that country is very high. However figures for the other four countries tell a very simple story: current capacity is barely scratching the surface of the energy the region's waterways can provide.

Yet large-scale investment in developing generating facilities has not been forthcoming. According to the World Bank, "hydro-rich Kyrgyz Republic and Tajikistan, despite having the hydro potential and being able to export hydroelectricity, face their own problems in implanting growth strategies into the regional energy market, and in attracting new external investment sources."

6.3 Renewable Fuels: *The EBRD Renewable Energy Initiative*

As can be seen from the plant data and from the power generating facility projects currently planned or under construction, each of the five countries tends to obtain the majority of their supply from locally abundant fuel sources.

Uzbekistan and Turkmenistan, both privy to vast reserves of Caspian and Aral gas and oil, use it as the primary fuel source for the majority of their generating capacity. Kazakhstan, with locally abundant coal reserves, generates power primarily from coal-fired plants. The eastern countries, Tajikistan and Kyrgyzstan, are abundant in water flow, and therefore place hydroelectricity above other types. From this, it appears fairly clear that pragmatism, local practicality, and low cost are the primary concerns in determining the types of fuel sources used in the generation of regional electricity.

Since the costs associated with generating wind, solar, or bio fuel power are high, and the yields – particularly when connected to a poorly maintained grid – are low, it is not surprising that they have not been implemented in any significant way to the fuel mix.

Yet the prevalence of hydropower remains a moderate indicator that these countries are interested in decreasing their reliance on fossil fuels. The dependence the three eastern countries have on price-dynamic fossil fuels is a situation that the governments would like to improve.

In light of this, the **European Bank for Reconstruction and Development** began the EBRD Renewable Energy initiative, a widespread aggregation of renewable energy options in its member countries throughout Eastern Europe and Central Asia. It assesses the current energy situation in each of the countries, as well as progress and future potential for integrating renewables into the fuel mix.

The following is a summary and analysis the Initiative's review of the five Central Asian republics. An outline of each renewable scenario is followed by an assessment of the potential, Very Strong, Strong, Moderate, or Low, of each major renewable source:

6.3.1 Kazakhstan Renewable Potential

Clean Energy Scenario:

- Apart from modest investment into hydroelectric power, Kazakhstan has not initiated much development of renewable fuel resources.
- The low cost of fossil fuel due to locally abundant supply has discouraged the diversification of energy into renewable fields.
- Energy exchanges with Russia have accrued 250 million USD in debt since 1990.
- Extraction and use of coal, the fuel source for the vast majority of generating capacity, is not done in an environmentally efficient way
- Environmental policy is the most evolved in Kazakhstan, since it has ratified the Kyoto Protocol, and has attempted to build a legal environmental framework from Kyoto commitments, and attract foreign investment to assist in this process
- To alleviate dependence on fossil fuels, finance long-term debt by lowering fuel costs, reduce environmental impact from coal extraction and combustion, and to work within the legal framework of the Kyoto Protocol, Kazakhstan is exploring renewable energy potential, particularly in wind development, where a UNDP exploratory project is currently underway.

Wind Power

VERY STRONG

Kazakhstan has very strong wind potential, largely due to the pervasiveness of wind-intensive areas. The majority of the country's land mass has wind potential of at least 4-5 m/s, with a few coastal areas reaching 6 m/s.
The Caspian Sea coast, the mountainous Chinese border (Djungar Gates) the Chu-Iliysky mountains near Astana, and several other lower mountain ranges in Central Kazakhstan all demonstrate viable wind development opportunities.
Exploratory projects are underway and agreements for future export of wind power to China have been made, but as yet there are no commercially operational wind generators.
Potential: 1,300 TWh (Djungar Gates alone)

Biofuel Power

MODERATE

Kazakhstan has only moderate biofuel potential largely due to the large area of desert covering the country's landmass, which yields little biomass. Deforestation does produce timber waste, a potential fuel source, but the annual potential is only 200,000 toe. Livestock waste, is also a potential source, but with equally moderate potential at 52,000 toe from cattle methane waste extraction.
More significant biofuel prospects come from straw. Cereal straw is an important agricultural crop, and if 20 percent of the annual harvest could be commandeered for biofuel, it could produce 2.5 million toe. In 2006, Kazakhstan commissioned a bioethanol facility to begin producing the fuel.

Solar Power

STRONG

The sheer size of Kazakhstan compared to its Central Asian neighbours gives it a distinct advantage in the development of solar power, since more surface area yields more direct sunlight.
The country receives between 2200 and 3000 hours of sunlight per year on average, enough to generate 1300-1800 KW/m^2/year.
Several areas in particular, including that surrounding the Aral sea coast, receive the most sunlight in a year. However the expense of the technology has meant that virtually no exploration of integrating it into the fuel mix has been made.

Geothermal Power

STRONG

In the ongoing process of searching for new oil deposits and drilling for wells, the thermal water temperature is also analyzed for geothermal electric potential. The potential is fairly strong, and throughout the southeastern region, major geothermal sites have been identified as electricity potential. Chimkent, Zhambyl, Kyzyl-Orda, Almaty, and Ily River/Panvilov Field have all been identified as high-potential sites. All the geothermal reservoirs have temperatures in the 80-120 degree Celsius range, with some reaching even higher to 170 degrees. Together, they have the potential for 4300 thermal MW, roughly 1,400 electric MW.

6.3.2 Kyrgyzstan Renewable Potential

Clean Energy Scenario:

- The vast majority, over 80 percent, of Kyrgyzstan's power generating capacity already comes from a renewable fuel: hydro.
- The mountainous river systems and high water flow rate in summer give a total potential capacity of nearly 10 times the currently exploited capacity.
- Environmental concerns over water reservoir conditions, water conservation, and ecosystem damage have driven a moderate push to diversify fuel sources. Though there is some thermoelectric production near Bishkek, the capital, there are no plans to create more fossil fuel production.
- For the most part, the renewable scenario has been completely focussed on developing new hydro facilities, as the list of planned projects attests, but there have been some investigations into other renewable fuels as well.

Wind Power

STRONG

There are many areas of wind development potential, particularly in corridors in the northeast and southwest, however wind speed is the inhibiting factor. According to the wind atlas, the wind-intensive regions all are rated at 4-5 m/s only. As a result, the potential for wind generation throughout the country ranges from 1500 MW to 2500 MW. The Chuisk, Osh, Issyk-Koul, and Djlel-Abad regions are the most promising for wind development. However investment into hydropower yields greater returns for the time being, and no commercial exploratory work has been done.

Biofuel Power

MODERATE

Biofuel potential is not promising because it could produce very large amounts of electric power, but rather because it would not take very much investment to cultivate bio fuels. The country's residents are already primarily rural and agrarian, and anaerobic manure digestion to generate heat and cooking fuel would be an easy step. Further, several small biogas plants have been privately opened, with government assistance now being received. Large-scale commercial viability remains questionable, and private investment into the field has not been forthcoming.

Solar Power

STRONG

Despite its small size, Kyrgyzstan has a very mountainous terrain, meaning that especially at higher altitudes there is a large amount of sunlight. As one exploratory study showed, comparing sunlight at lower altitudes in the capital Bishkek with higher altitudes in the mountainous Tien Shan, the geography makes solar energy a natural alternative. Domestic water heating panels are in limited use, but no commercially viable solar projects have been conceived. As with elsewhere, the technical costs and lack of investment have relegated it to secondary status behind ferocious hydropower development.

Geothermal Power

LOW

Very little research has been conducted on the extent of Kyrgyzstan's geothermal potential, but of the few explorations that have been done, temperatures were not high enough to produce commercially viable geothermal energy.

6.3.3 Tajikistan Renewable Potential

Clean Energy Scenario:

- Nearly all of Tajikistan's electric power already comes from renewable fuel – hydro.
- Except for two small thermoelectric plants, which generate only 5 percent of the country's electricity, all power comes from water.
- Development of renewable energy has very high potential for success, but several prevalent factors hinder the investment climate.
- Electricity tariff prices are very low, which reduces incentives to develop higher-cost renewables. There is little public awareness or government support for development of new technologies. The political situation is unstable and not conducive to mitigating foreign investment risk.

Wind Power

STRONG

Tajikistan, since it encompasses a very mountainous region, has strong wind potential. Mountainous corridors and high altitudes create favourable, useable wind speeds on roughly 15 percent of the territory. The Fedchenko and Anzob regions feature wind speeds of 5-6 m/s, while other lowland areas have usable speeds of 4-5

Biofuel Power

MODERATE

Biofuel usage is viable only on a local scale. The agrarian communities have the potential to develop agricultural waste into fuels and several experimental biogas facilities are in operation as in Kyrgyzstan. The anaerobic fermentation of manure, and in particular the thermo chemical conversion of residue from cotton, Tajikistan's biggest

Solar Power

VERY STRONG

Of all 27 countries involved in the EBRD, Tajikistan has the highest solar values of any. The high altitudes combined with the unusually high number of sunlight days in a year – between 280 and 330 - make solar potential, particularly in isolated communities,

Geothermal Power

LOW

Tajikistan shares part of the Tien Shan foothills with Kyrgyzstan, and it is here that the only exploratory studies of geothermal potential have been conducted. Though temperatures here are in the range of viable geothermal energy, this is not a commercially viable location, and is not likely to spawn other

6.3.4 Turkmenistan Renewable Potential

Clean Energy Scenario:

- Turkmenistan has tremendous wind power potential and high solar potential as well, but these are overshadowed by the well-known wealth of oil and gas.
- The reserves of natural gas mean that the country can meet the domestic electricity demand with currently existing facilities and without the need for new development.
- State pervasion in the energy sector provides many subsidies to consumers such that electricity costs are either very low or non-existent.
- There are programs in place aimed at reducing the environmental impact of oil and gas extraction and refinery and energy saving/water conservation measures by the public. This, rather than renewable development, has been their primary response to greenhouse gas emissions.
- With no push from the government or consumers, there is virtually no movement to develop renewable energy in Turkmenistan.

Wind Power

VERY STRONG

Some researchers have estimated that Turkmenistan's wind power potential may be equally to its fossil fuel potential. The country's long Caspian coastline and large central desert area provide strong, reliable winds, both in the 4-5 m/s category and in the 5-6 m/s category. Some areas near the coastal town of Turkmenbashi have reliable speeds even higher than 6 m/s. If fully developed, this could yield a theoretical capacity of 500,000 MW over the long term, with 10,000 MW in mid-stage development.

Biofuel Power

LOW

Waste from livestock is used exclusively as fertilizer, and no known infrastructure for utilizing waste fuels exists. Other biomass such as forest waste is also minimal, since forest covers less than 1 percent of the country, and the government forbids deforestation.

Solar Power

VERY STRONG

The south and southeastern part of Turkmenistan yields tremendous solar power opportunities. Three separate areas in three different parts of the region all receive comparably high amounts of sunlight: Gasan-Kuli, Ashkabat, and Chardzhou. These regions receive the most usable sunlight of any territory in the former USSR.

Geothermal Power

MODERATE

If not for the exploratory ventures for oil and gas reserves, the geothermal water temperature would have not been explored in any way. Nevertheless, they have uncovered a modest potential for geothermal power, particularly in the Darvaza Region, the Caspian Coast Region, and the Kopet-Dag Foothills. Temperatures ranging from 70 to 100 degrees Celsius have been located, and if developed, could yield approximately 6,600 thermal MW of heat.

6.3.5 Uzbekistan Renewable Potential

Clean Energy Scenario:

- Uzbekistan has tremendous natural gas reserves, which has discouraged the development of renewable energy fuel sources.
- Hydropower potential is driving the primary push to diversify into renewable energy, not potential from other sources.
- Hydropower development projects received government assistance projects while other renewable fuels do not.
- Tariff prices, like several other Central Asian states, are very low compared to cost of generating.
- Increasing demand may overtake production as early as 2010 if significant new generation is not established.
- The main funding and incentive provision for development of renewables is coming from the UNDP, who are financing feasibility studies, and helping to draft legal framework agreements for projects in biomass, solar, and geothermal electricity.

Wind Power	**Biofuel Power**	**Solar Power**	**Geothermal Power**
LOW	STRONG	STRONG	STRONG
There is very low potential for wind energy in Uzbekistan. The only area with usable winds is in the Aral sea region in the northwest of the country, fairly isolated from major communities and not very well placed to sustain major investment. It is currently projected that wind developments in that area, as well as in some windier areas of Central Uzbekistan, could yield a capacity of 100 MW.	Cotton is an essential staple crop un Uzbekistan just as in Tajikistan. It has the largest crop of any of the former Soviet Union countries, and the use of cotton harvest waste locally as domestic fuel for household equipment is already widespread. Further, there is useable forestland covering 3.2 percent of the territory. The primary source would remain cotton, however, of which there is 3 million tonnes of stalk produced every year. There is a good deal of interest in advancing technology for thermo-chemical conversion of cotton into energy.	The highest levels of solar radiation are found in the south of Uzbekistan, but there has been experimentation of using solar energy across the country to supplement local and isolated agrarian communities, when transfer of power through conventional means is difficult or impossible. In general, it is estimated the Uzbekistan is one of the best countries for integration of solar power, however insufficient aggregate studies have been done to measure the effects across the whole country. Three areas, Tashkent, Samarkand, and Termez have all shown equal potential, and this has encouraged several exploratory projects financed by the UNDP. These projects aim to make solar power a viable fuel for remote rural water heating by 2010.	Unlike several of the other republics, Uzbekistan has been the recipient of a fairly widespread examination of geothermal capabilities. Development of reservoirs is already in initial stages. The Amu Darya basin, Surkhan basin, Tashkent basin, and Fergana valley have all shown promise, with usable temperatures of between 65 and 120 degrees Celsius. For pumping operation, these reservoirs have a capacity of 1150 thermal MW.

6.4 Market Efficiency Opportunities

Creating market efficiency and a properly competitive electricity sector largely remains within the legislative prevue of the various governments. Indeed, it has more to do with creating rules, processes, and procedures at a government level than taking advantage of investment.

Yet, there remains a certain scope for sources of finance to invest in a competitive future in Central Asia.

Apart from large degrees of state ownership, one of the reasons markets have not been able to become more competitive is that they have limited room for growth while they remain confined to national borders. Market integration in Central Asia is not only a legislative goal, but a technological goal as well.

Customs legislation currently requires that all transfer of electricity across borders, of which there is a considerable amount due to the structure of the power grid, must be declared by the supplier just like any other good. Technology to register the cross-border transfer of power automatically would be conducive to legislative changes that exempt power from being declared each time. This would make cross-border exchanges easier, could introduce more power suppliers into the market pool, and bring the CAPS one step closer to market integration.

7.0 CONCLUSIONS AND RECOMMENDATIONS

While each of these potential areas of investment poses large amounts of differing risk, many of the major IFIs are optimistic about the future of ventures there. The region remains in a developmental state, but the opportunities this presents can be very promising.

According to the Asian Development Bank, “Many of the energy reforms and institutional capacity building that is taking place will result in more concessions becoming available for private investors.

“The ongoing privatization processes in the region also present extensive opportunities for equity stakes, joint ventures, and majority-owned foreign enterprises.”

Attracting investors to much-needed technological, equipment refurbishment, and infrastructure programs is simply a matter of reducing the political and market risk through positive development and effective use of funding. This is possible within a relatively short time frame.

What needs to be done is to identify the specific areas that hinder private investment attractiveness, and identify the development projects that are in the most need of new funding, and to find a way to close the gap.

The five major areas most in need of investment are, and will continue to be:

- Refurbishment of electricity transmission infrastructure;
- Construction of new generation capacity;
- Exploiting untapped hydroelectric potential in Tajikistan and Kyrgyzstan;
- Introduction of renewable energy generation beyond hydro;
- Technologies to facilitate essential market integration.

All sources agree that growth in these area is fundamentally necessary to facilitate the ultimate self-sufficiency, profitability, and success of the Central Asian power market.

As a result, following from this and from other assessments of this report, the following major recommendations are tendered:

Establish a medium-term plan for tariff reform

This is mentioned first because it is one of the only measures that has fairly immediate, realizable, and tangible results. The ultimate goal for the electricity industry is to develop a successful and sustainable domestic and external market for electricity, to profit from energy resources. This cannot be done without substantial investment. One of the quickest ways to generate funding for that investment is through tariff reform.

Tariff reform has been occurring already for more than five years, often with understandable immediacy due to the flagrant gap between cost-covering and the former tariff level. But it has been done on an individual basis by country, and sometimes even by region, and has often been so drastic that it has had a curbing, depressing effect on demand. As tariffs increase, ability to pay decreases, demand decreases, and non-payment increases.

A coherent, multinational plan to reform tariffs must be made in cooperation with all five countries. Only through such a concerted effort can the best balance be struck between increasing the tariffs towards cost levels, while keeping them at payable levels. This is not a short-term measure, since achieving this balance will require gradual, sustainable increases, but neither is it a long-term measure, since efforts made particularly in Kazakhstan to achieve cost recovery have met with some success.

If the industry is able to recover their operating costs, it will free up government subsidies for refurbishment and investment projects, and will also demonstrate a degree of sector maturity that will be positive for investments.

Direct funding towards infrastructure projects

Increasing generating capacity to meet future demand is essential, but it must be done concurrently with grid overhaul lest it be hindered by a lack of transmission ability.

The age and lack of maintenance of the transmission and distribution systems is the primary reason why theft and improper metering is so rampant. Without reliable metering, it is fairly difficult to detect and eventually curb illegal power use.

Not all loss comes from theft; a good deal is lost simply through the inability of the grid to properly transmit. Refurbishment must be a top priority because it can increase the efficacy of generating capacity **substantially.** It is the root problem of supply-demand incongruence, because between the two is an inefficient delivery mechanism that skews and will continue to skew the relationship. Demand is seen as increasing, and thus efforts are made to increase supply. However the proper functioning of the intermediary system would eliminate the immediacy of that need.

If the difference between installed capacity and actual capacity, or the level of transmission and distribution loss were brought to acceptable levels, then the pressure to create new supply would be drastically reduced, and would be dictated by proper signals.

Essentially, if the infrastructure were to function properly, the power saved for consumer use could make **more** of a difference to supply than any or all of the current new generating projects.

Strategically develop new generating capacity

New generating capacity must also play an important role in the process, but not at the expense of transmission infrastructure that is, in many ways, more vital.

Rather, the development of new generating capacity ought to be done strategically, particularly through capitalizing on the region's hydropower potential.

As indicated above, it is estimated that only 10 percent of the region's hydroelectric potential is currently being exploited, and this must change over the long term. Not only will increasing reliance on water decrease the financial and market impact of the volatile world market for organic fuels, but it would also unlock the vast resources of contemporary venture capitalists looking to invest in clean energies.

The popular public movement towards green sustainable energy can look to some of the Central Asian states as an example of what can be achieved through taking advantage of beneficial local conditions to produce clean energy. This will encourage investment in this potential, of which there is much. Fossil fuel generation will continue to play a significant part in the energy mix of the region, the reserves of coal and gas in the western areas is too great and lucrative to dissuade its development, but it must be done concurrently, through a regional strategy.

Maintain a vigilant outlook on costs

This does not refer to financial costs of electricity development, but rather to the derivative costs, particularly to the environment, of rapid development.

In many areas of the developing world, large amounts of energy potential in a particular product leads to rapid uninhibited development often with little regard to the environmental cost. This has begun to happen in areas of Central Asia, where the rapid development of hydropower has not taken water security and conservation into account.

If hydro is dominate new developments over the coming years, and given the sheer volume of new hydro projects, (though not necessarily capacity), it looks as if it will, then the "rational and efficient" use of this water must be made a top priority.

International organizations, particularly the U.N. and the self-commissioned Water and Energy Consortium, have been fairly adept at pointing out where problems with hydro development exist. Their efforts will need to expand and continue to be essential to the safe development of clean energy.

Allow further privatization of energy and electricity markets

This is an intermediary step that will be necessary to facilitate the eventual functioning of a common market in the region.

The underlying truth that cannot be ignored is that strategy for the development of energy and electricity was done on a regional basis for most of the 20th century. Central Asia was conceived and developed as a single power region, and the attempt to function nationally and divisively with the existing infrastructure is contradictory and has most likely retarded the growth of the market.

If each individual country takes steps to make their market development as synchronous as possible, particularly in privatizing the system, then the eventual consolidation into a common market will be much faster and easier. This has not been the case thus far, during which Kazakhstan has made remarkable and admirable strides towards efficient private domestic market functioning, while other places such as Turkmenistan have made little progress at all.

Make investment as attractive as possible

A colossal amount of investment in all areas from market integration, to transmission infrastructure to generating capacity, to new technologies is needed with a fairly large degree of immediacy.

The problems of attracting investment have been examined at length, but it is imperative that the governments and the industries themselves take whatever measures possible to minimize the risk associated with regional electricity investment. Lowering the political risk, demonstrating a degree of market stability and maturity, showing strong returns on investments already made, and showcasing the positive outcomes capital injection can have must all be primary goals.

Drawing investment to critical areas is likely to remain difficult unless specific measures are taken to mitigate risk. Recommendations from the ADB in this vein are particularly noteworthy. They believe the five countries should “aim for a few selected, fast-tracked, quality private sector investments to demonstrate to the international community that Central Asia is committed to attracting private sector investment in the energy sector. Intensified efforts at regional energy cooperation are required to reduce the costs of energy resources in the region.”

There is also substantial potential to attract investments into new technologies, some of which could possibly play a large role in the future energy mix. Particularly when from IFIs, foreign governments, and energy organizations, attracting investment is much easier and more publicly and politically palatable when it is for renewable technologies.

The wind and biofuel potential mentioned in section 5 should not be cast aside as merely interesting projects with future possibilities. They may in fact be the key to unlocking a large amount of foreign capital, and as such should be treated as viable legitimate power options, where the potential for their use exists.

Prioritize

There are two market development processes occurring simultaneously, the consolidation of the regional electricity market, and the integration of the power systems with the surrounding regions. This is a mixed blessing. It has unlocked a vast export market that is and will become increasingly lucrative in the near future, particularly as demand increases in China and Pakistan, but the Central Asian countries must be cautious in their development to ensure that individual action does not inhibit the development of the region as a whole.

In this vein, the international organizations such as CAREC and the SCO have been invaluable in facilitating regional action and bilateralism with a multilateral benefit. If Central Asia is to become one of the primary and fundamental sources of power on the Asian continent, these international bodies must remain vigilant and ensure that the external market development does not proceed at the expense of the internal market, lest the existing infrastructure, both physical and organizational, collapse from within.

Establish common legal frameworks for market operation

This is also a measure that is an intermediary to the eventual development of a functioning common market as well as to improve energy efficiency.

Much of the power in the region is already a share resource due to the structure of the grid and generating facilities, yet it is governed by individual government acts that vary in their regulatory treatment of power.

The way electricity is generated, transmitted, regulated, and distributed, must be treated the same way by all five governments as long as the establishment of a common market remains the goal. According to the UN, "maximum benefits from energy conservation may and must be achieved through stronger international cooperation."[8]

Improve statistical procedures

All regional projects, whether they are designed to increase generating capacity, improve sections of the transmission grid, develop a solar power facility, or build a gas pipeline all rely on statistics and information.

The procedures for provision of information about the electricity sector is notoriously poor in much of the region, and non-existent in others. This makes it extremely difficult for international financial institutions to allocate their funding, for governments to assess demand and supply options, and for researchers in sustainable energy to adequately develop new technologies.

As indicated by a UN report on energy conservation and efficiency, the improvement or establishment of proper monitoring of production and consumption of electricity, both by governments and their derivative companies, would go a long way to improving organizational infrastructure and attracting investment. Accurate, reliable information is the basis for all development decisions, and in many parts of the region

[8] United Nations Economic Commission for Europe, "Strengthening Cooperation for Rational and Efficient Use of Water and Energy Resources in Central Asia," 2004, pg. 94.

it is lacking. This is perhaps best seen in the lack of or conflicting projections of future demand, which is crucial information to regional development.

New national and international rules must be established, monitoring technologies must be implemented, and consolidation and collection of data and information must be done more accurately and attentively. A large-scale scenario approach, whereby multiple factors are considered to present a set of possible energy outcomes in the medium term, would prove highly useful, and has done so in many other electricity regions in the world.

Conclusions

Seventeen years on, the emergence of the Central Asian states as independent economies is, in reality, only now beginning. It has taken this long in most of them for demand and production to recover from the severe immediate decline of the 1990s. Some sectors have still not recovered. Some may never recover. Independently restoring what they had as a unit in 1990 has only been a preliminary step to their national economic development.

In the electricity sector, the true key to develop independently is, paradoxically, to attempt to restore some level of combined operation. The regional, rather than national, layout of the electricity grid, and the placement of power generating facilities were both conceived during a time when there were no national borders. To truly develop their respective power sectors, they must return to this mode of thinking. This means establishing common legal principles for shared use of the transmission system and forming a common, competitive electricity market rather than exclusive, often violated bilateral trade agreements.

The incentives and motivation for taking such measures are increasing constantly, as power-scarce regional neighbours continue to explore ways to assist Central Asian development. The demand growth in South and East Asia is far more likely to increase exponentially than to abate in the coming years, and this export-oriented approach may provide the precise stimuli needed to trigger Central Asian power and industrial development.

At the same time, partners in Europe seek to find alternative sources of power too, while maintaining a counterbalance to other influences in the region. The power resource potential will likely make Central Asia a much more contentious area in the coming years, yet this is not a negative outcome. The international attention and development potential brought by the energy-hungry world may be enough to induce the market reforms badly needed to further overall industrial development.

The magnitude of this reform will require time, IFI funding, an increase in private investment as indicated, and most importantly, a genuine commitment from the respective governments.

N.B. Due to the low level of political and economic transparency in Turkmenistan, and to a lesser degree Uzbekistan, concrete data about their respective electric power sectors is rare. Turkmenistan, in particular, is not a member or has withdrawn from several international organizations dealing with the power sector. Data figures relating to output, cost, pricing, or capacity often are produced by the government itself or are not available at all. In either case, any data cited may not be reliable. For a complete list of international organization memberships, see section 3.7.

APPENDIX A: TERMS OF REFERENCE

Electricity Market Opportunities in Central Asia*

Following a draft proposal received from RAO to study electricity market opportunities in Central Asia, WEC has developed these Terms of Reference for a market research project to identify the current trends and the outlook for electricity market opportunities in Central Asia. The study will rely on existing published material, fact funding missions by the WEC staff and other experts and any other relevant data and information collection methodologies. The study will evaluate the available information and develop an analytical report assessing on the opportunities for creating a regional electricity market in Central Asia, with potential alternatives for electricity export to third countries (Afghanistan, Pakistan, Iran, China).

The study will be conducted within the WEC's Regional Action Plan for the Middle East and Central Asia and provide within its scope:

1. A short macroeconomic overview of the region's economy in general and power industries in particular. Analysis of the current and future forecast of demand for electricity compared with generation capacities, taking into account energy intensity trends, energy efficiency improvements and potential for energy savings in a longer term, by 2015-2020. Current and long-term electricity balance, by 2015-2020.
2. An outlook for further development of the power generation capacities in the region, in particular hydro and thermal power generating plants. This will include the planned and actual decommissioning of the existing power generating plants and construction and commissioning of new capacities up to 2015-2020
3. Assessment of the existing power transmission systems, including internal and cross-border links, losespower flows within and between regions. Overview on management, loses and operational conditions of power transmission lines.
4. A review of key market players such as producers, traders, consumers, etc., including regulators and their legislative powers and functions. Power sector regulations, including environmental regulations and their enforcement (emissions standards, penalties, etc.)
5. Review of the refurbishment and upgrading programmes for the existing facilities, including costs, timetables and sources of finance.
6. Investment policies. Review of the major planned power generation and transmission projects, including general information about technologies, costs and commissioning terms. Sources and conditions of financing.

7. Opportunities for electricity trade exchange between countries and export to third countries (Afghanistan, Iran, China and Pakistan). Current management systems for power shortages and excess capacities in. A brief summary of business plans (if any) and other projects in the region.
8. General conclusions and recommendations

APPENDIX B: LIST OF SOURCES

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