Kyrgyzstan

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1. Overview of Electricity Supply

Kyrgyzstan has approximately 3.72 gigawatts (GWe) of generating capacity, about 80 percent of which is hydroelectric. Due to recent low reservoir levels, many of the hydroelectric power stations have been unable to meet the electricity demand of Kyrgyzstan for a significant part of 2008. The low reservoir levels are attributed to recent summer droughts, but also to widespread political corruption and mismanagement. On top of those issues, the current transmission system suffers great losses (Jefferson Institute, 2009). The total losses amount to 55.2 percent of the total amount of electricity entering the transmission system.

The losses in the electricity system can be divided into two types, technical and non-technical. Technical losses occur in all transmission and distribution networks and cannot be entirely eliminated. They can however be kept to a minimum through good network design and maintenance. Non-technical losses occur as a result of the difference between the amount of electricity distributed to customers and the amount that is actually paid for. These losses therefore occur because of the following:

- Theft
- Faulty meters - resulting in the amount of electricity used being under-recorded.
- Incorrect records - distribution company customer records not being correctly maintained resulting in some customers not being billed.
- Non - payment

The numerous disruptions of electricity to homes and businesses caused thousands of businesses to suffer large losses and to close. Many other businesses have decided to move

to Russia or Kazakhstan. Some residents were left without electricity and water due to the widespread electricity outages (Jefferson Institute, 2009).

The outdated Soviet-era electrical grid, designed to avoid the rough Tien Shan Mountains that run through the central part of the Kyrgyz Republic, is a major constraint for new energy infrastructure in the country. Plans to build a 240-mile 500 kV transmission line as well as a new 220 kV decongestion line connecting the northern and southern parts of the country should alleviate most of that concern. Since Uzbekistan controls some of the energy delivery systems in the southern region of Kyrgyzstan, plans to build and replace several 220 kV transmission lines are also being considered (Jefferson Institute, 2009).

The Kyrgyz Republic has had a slow move toward privatization of the energy sector. After independence, a vertically integrated, state owned utility was formed to generate, transmit, distribute and supply electricity throughout the country. This utility was also responsible for the operation on the district heating networks in Bishkek, Osh and some other towns. This utility company was eventually transformed into JSC Kyrgyzenergo, with most shares owned either directly or indirectly by the State. The remaining shares (about 7 percent) were issued to employees and sold via a mass privatization program. Kyrgyzenergo has recently been unbundled into separate generation, transmission and distribution companies.

The Government of the Kyrgyz Republic has now agreed to the principle of pursuing private sector participation in the largest distribution company, Severelectro, by means of a concession. In addition consideration is being given to attracting private sector participation in the remaining three distribution companies through the award of management contracts.

Demographical Information	
Population, millions (2009)	5.43
Land area, thousand sq km (2009)	198.5
Macroeconomic Information (2008)	
GDP, billion US$	11.41
Real GDP growth rate, percent	6.0
Foreign direct investment (net), million US$ (2007)	208
Electricity disposition, billion kWh (2006)	
Generation	15.62
Consumption	9.00
Exports	2.52
Imports	0.00
Generation capacity, GW (2005)	
Nuclear	0.00
Thermal	0.81
Hydro	2.91
Other renewables	0.00
Total	3.72

Sources: CIA World Factbook, U.S. Energy Information Administration, United Nations Conference on Trade and Development.

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2. Energy Policy, Barriers and Incentives

The Kyrgyztan government took steps in 1998 and 1999 to set the legal foundation for the development of Kyrgyzstan's energy market, with the intention of leading to the commercialization and privatization of Kyrgyzstan's energy sector. Laws were adopted related to electric power, oil & gas, energy conservation, and licensing, and private ownership of land. There was also a law enacted concerning foreign investment. The Kyrgyz State Energy Agency

worked out guidelines for rate policies, and set up rules for users of electricity and district heat.

The Government of Kyrgyzstan has established the state project “Kun” to coordinate the development of renewable energy sources.

The National Energy Program of Kyrgyzstan (though 2010) and the Strategy for the Fuel and Energy Complex Development (though 2025) call for the rapid expansion of renewables by building around 100 small hydroelectric plants with a total capacity of approximately 180 MW.

Legislation on renewable energy and specifically small hydropower stations has been fairly successful in Kyrgyzstan. To promote public awareness of renewable energy, booklets describing the benefits of small hydropower stations as well as how to install a small hydropower plant were distributed to rural communities. Also, a revolving credit facility was established in Karakol by the “Issyk-Kul Activist” NGO in order to help farmers finance small hydropower plants for their operations or residences. As a result of this legislation, two pilot projects (5 kW each) have been launched by local companies (Bogombayev, 2009).

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3. Wind

Although there has been minimal wind development activity, Kyrgyzstan has a fair potential for wind energy development.

The “Master Plan of Wind Power Development of the USSR till 2010”, was released in 1989. According to this wind atlas Kyrgyzstan's wind power resources are limited to 4-5 m/s at 30 m height. However, some of these areas are adjacent to the Kazakhstan border, where wind speeds as high as 6 m/s are indicated, for example to the north of the capital city of Bishkek.

The 90 billion kWh/y technical potential, corresponding to 2500 MW installed capacity, estimated in this study seems to be derived from the vast areas available for wind energy development. A more reasonable estimate may be closer to 1500 MW.

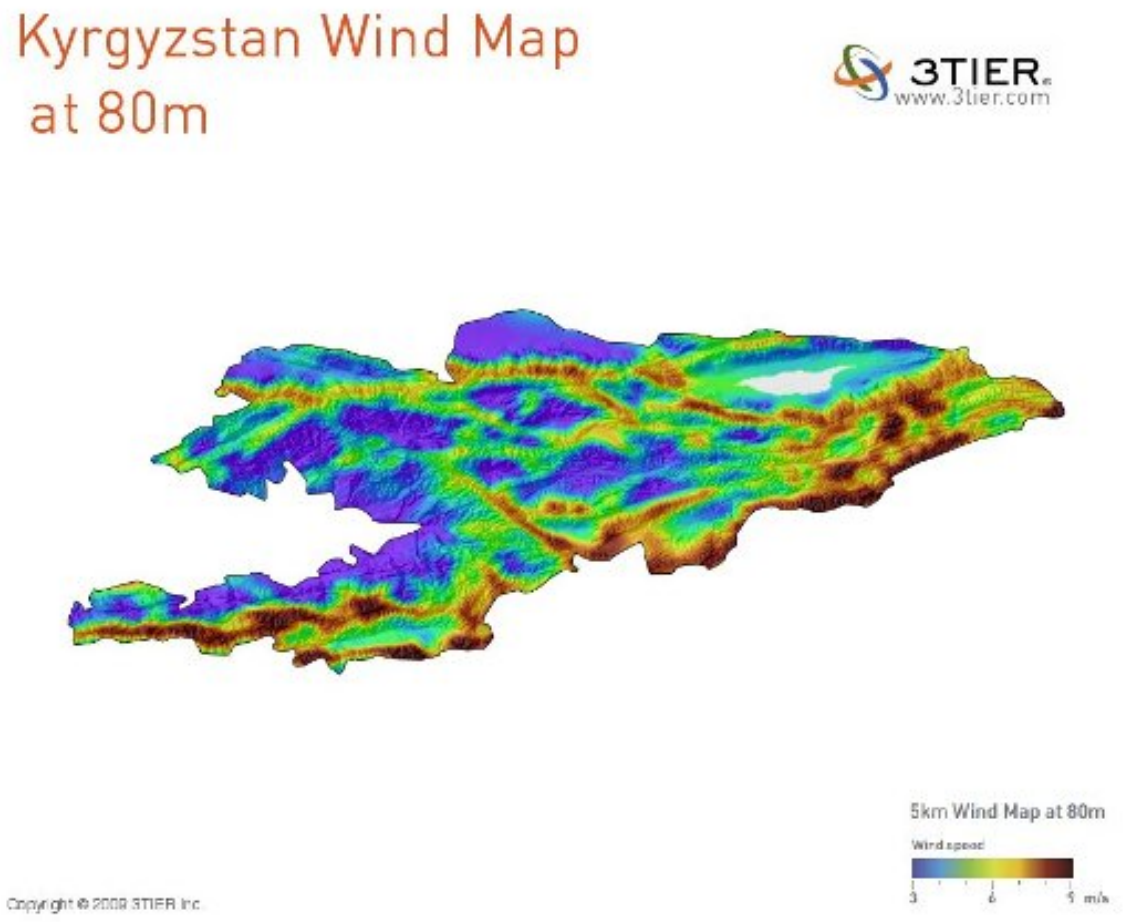
More recently, wind data was collected from 81 stations around Kyrgyzstan. The reported annual average wind speed ranges from 0.5 m/s to 3.6 m/s. The total wind potential is estimated at 1,500 MW, which is similar to the above estimate. Further studies need to be completed to identify specific sites and quantify the wind resource in certain areas on the country (Jefferson Institute, 2009).

The most promising areas for wind power potential are:

- Chuisk district (North Kyrgyzstan)
- Osh district (South Kyrgyzstan)
- Issyk-Koul district (East Kyrgyzstan)
- Djelal-Abad district (West Kyrgyzstan)

The following figure displays the wind velocities throughout Kyrgyzstan at a height of 80 meters. As shown, many different locations throughout the country have significant wind potential.

Kyrgyzstan Wind Resource Map (Source: 3Tier)



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4. Biomass

Kyrgyzstan occupies about 200,000 $km^{2,}$ located in the center of Eurasian continent, on the high mountain range of Tien Shan and the Pamirs. The total area of agricultural lands in the Republic is about 10 million hectares including 1.2 million hectares of lands under cultivation. Among the latter there are 800 thousand hectares of irrigated lands, growing 90 percent of plant products. More than 50 percent of agricultural lands are occupied by pastures that determined the main branch of agriculture – livestock breeding. The livestock waste, which could be used after processing in biogas plants, constitutes approximately 2500 thousand tons per year.

A majority of rural population (that constitutes about 65 percent of a total population of the country, i.e. more than 3.5 million people) has no opportunities to acquire a fuel for preparing food and heating. Therefore the majority of forest stands are cut out. Practically all lands under cultivation obtained by individuals from the collective farms have been cleared without re-fertilization or harvesting for more than 10 years. The methane emissions from cattle

waste, which is decomposed in the open air, annually constitutes more than one million cubic meters.

It is estimated that biogas plants could produce some 5 million tons of fertilizer and some 200 million cubic meters of gas in Kyrgyzstan annually. Currently, biogas facilities produce around 2 million cubic meters of biogas annually, which is used in the residential and commercial sector. They also produce 70,000 tons of fertilizer each year (Bogombayev, 2008).

Biomass resource type	Total production	Production density
Total land area covered by	(avg. 2006-2007, km^2)	(avg. 2006-2007, %)
Arable Land	19,019	10
Permanent Crops	3,962	2
Permanent Meadows and Pastures	93,754	47
Forest Area	8,726	4
Other Land	75,776	38
Inland Water	8,150	4
Primary crop production	(avg. 2006-2007, tonne)	(tonne /100 km^2)
Total primary crops (rank among COO)	4,307,145 (12)	2,170 (6)
Top 10 primary crops		
Potatoes	1,314,350	662
Wheat	774,600	390
Maize	449,350	226
Barley	215,600	109
Sugar beet	190,700	96
Tomatoes	180,000	91
Carrots and turnips	152,500	77
Vegetables fresh nes	135,850	68
Apples	127,850	64
Onions, dry	115,750	58
Animal units, number	(avg. 2006-2007, number)	(number / 100 km^2)
Cattle	1,095,550	552
Poultry	4,700,000	2368
Pigs	78,250	39
Equivalent animal units	1,173,850	591
Annual roundwood production	(2006-2007, m^3)	(m^3 / 100 km^2)
Total	27,300	14
Fuel	18,000	9.1
Industrial	9,300	4.7
Wood-based panels	NA	NA
	(2006-2007, tonne)	(tonne / 100 km^2)
Paper and paperboard	2,400	1.2
Recovered paper	NA	NA

Source: Food and Agriculture Organization of the United Nations

Kyrgyzstan Biomass Resource Data

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5. Solar

Kyrgyzstan is rich in solar resource. The average annual output of solar energy is about 1,500 - 2,500 kWh per square meter; also, approximately 2,600 sunshine hours are recorded annually (Jefferson Institute, 2009). Small scale solar technologies are spreading rapidly throughout the country - especially in tourist attraction areas such as Lake Issyk-Kul. The purchasing of solar collectors for heating water as well as solar water tanks are increasingly common. However, these technologies are still relatively expensive. Higher electricity tariffs in the future could make these systems more economical. The growing demand for these systems has created new opportunities for local business as most collectors are produced domestically (Bogombayev, 2008).

For evaluation of solar energy resource potential in Kyrgyzstan two areas have been evaluated: Bishek, the capital and Tien Shan. The first is located in a part of the plains, while the second is in a mountainous area at a station 3,614 m above sea level.

	Bishkek	Tien Shan
Jan	223	328
Feb	273	407
Mar	379	632
Apr	516	739
May	667	774
Jun	740	734
Jul	786	706
Aug	697	673
Sep	532	570
Oct	352	472
Nov	212	335
Dec	170	290
Yearly	5547	6660

Monthly and annual total solar radiation incident on horizontal surface, MJ/m^2

	Bishkek	Tien Shan
Jan	305	518
Feb	272	469
Mar	303	523
Apr	428	586
May	574	590
Jun	711	591
Jul	754	611
Aug	730	650
Sep	585	634
Oct	431	623
Nov	314	539
Dec	246	495
Yearly	5633	6829

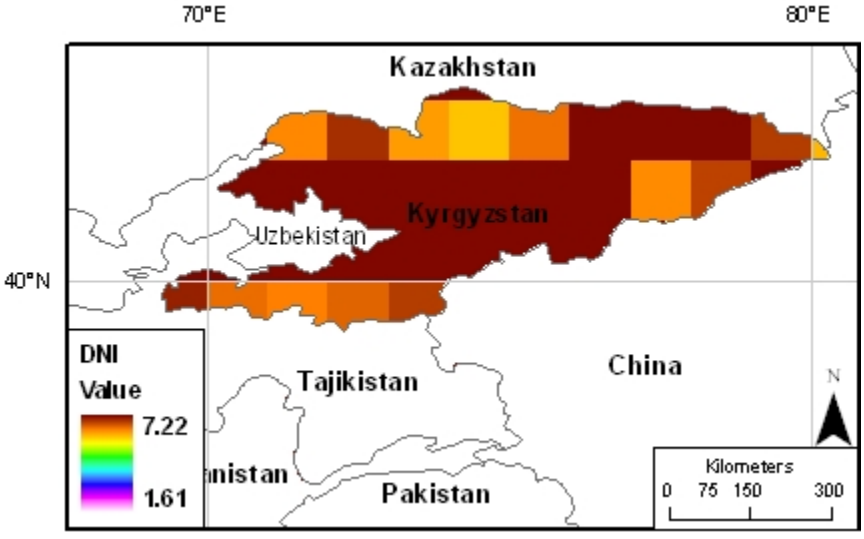
Monthly and annual direct solar radiation incident on surface normal to sunlight beams, MJ/m^2

The annual course of solar radiation has a considerable summer maximum which is typical of continental climate conditions.

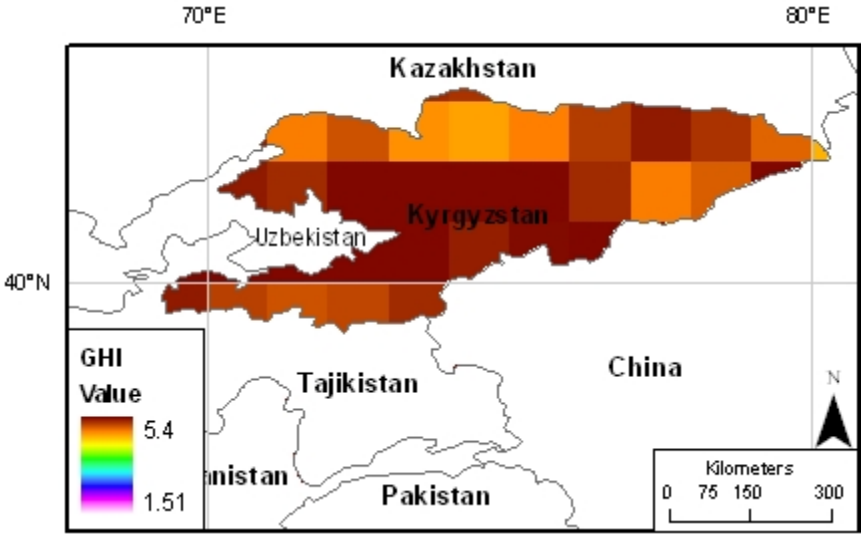
Kyrgyzstan also has necessary raw materials to support monocystalline and polycrystalline wafer production for solar panels. Astra KCMP is a monocrystalline wafer producer located in the Chui region of Kyrgyzstan; their company was started in 2004 (Astra-kcmp, 2008).

The maps below show the direct normal insolation and global horizontal irradiation for Kyrgyzstan. As shown, the country has significant solar potential throughout a majority of its region.

Kyrgyzstan Solar Direct Normal Insolation (Source: NASA)



Kyrgyzstan Global Horizontal Irradiation (Source: NASA)



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6. Geothermal

Geothermal resources of Kyrgyz Republic include many thermal springs and high heat producing granites. It is believed that the low to medium heat geothermal resources could be used for district heating. The widespread occurrence of granites enriched in radioactive elements (U, Th, K) could make Kyrgyzstan a good candidate for hot fractured rock geothermal resource. The Kyrgyz Republic also has low ambient temperatures and large amounts of waters available for cooling purposes - two conditions that could further Kyrgyz Republic's potential for geothermal power generation.

Currently, the application of thermal water consists mainly of therapeutic baths in the Djalal-Abad Region and Fergana Basin. Plans exist to use the thermal water in the area of city Bishkek and in the valley of lake, Issyk-Kul. Despite the ambient air reaching temperatures of - 40 °C, lake Issyk-Kul never freezes; this is likely an indicator of high heat flows in that region. Also, recently in the Inylchek area, rock temperatures of 75 °C were reported, which indicate a geothermal gradient greater than 100 °C/km (Panax Geothermal, 2008).

Geothermal resources are concentrated in the reservoirs formed in sediments of depressions and in the convective fissured hydrothermal systems of foothills. The evaluation of resources for two hot water fields was carried out. It included the following fields:

- Issyk-Ata (nearby Bishkek city); temperature 55 °C, TDS 0.5 g/l; total flow rate 690 l/s
- Ak-Su (Issyk-Kul Basin); temperature 60 °C, TDS 0.5 g/l; total flow rate 415 l/s.

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7. Hydroelectric

Hydropower contributes the greatest amount of all resources to the power sector of Kyrgyzstan, approximately 80 percent of the total generating capacity. The installed capacity of Kyrgyzstan totals 2.9 million kWh (EIA, 2005).

The country's hydropower infrastructure is the second largest source of Kyrgyz exports. To underscore the importance of this industry, it should be noted that the cumulative hydro-energetic reserves of the Kyrgyz rivers exceed those of the famous Russian Volga river by several hundred percent. Kyrgyzstan exports electricity to Russia (over 2.7 billion kWh annually) as well as neighboring Kazakhstan, Uzbekistan, Tajikistan and China.

By absolute indices of potential hydro resources and by concentration of potential hydro resources on the territory Kyrgyzstan has one of the highest potentials amongst CIS countries. The major part of hydropower resources (30 percent) is concentrated in the basin of the Naryn River, the main river of the Republic. It is estimated that the Naryn River can support 33 additional hydroelectric stations with an estimated capacity of 6,450 MW. The largest small hydropower potential is concentrated in northern, southern and eastern districts of the Republic. It is estimated that Kygyzstan uses only 3 percent of their small stream potential (Jefferson Institute, 2009).

In January 2005 Kazakhstan approved a new strategy for developing the country's hydroelectric energy resources. Kyrgyzstan has 360 MW of capacity under construction and another 5,500 MW planned (UDI, 2009). Most of the stations will be located in southern Kazakhstan, an area largely dependent on imported electricity from Kyrgyzstan and Tajikistan.

Most of the mentioned planned hydropower plants are larger facilities; however, recent legislation is also extremely supportive of small hydropower plant stations for residential and farming use. The National Energy Program of Kyrgyzstan (though 2010) and the Strategy for the Fuel and Energy Complex Development (though 2025) call for the rapid expansion of renewables by building around 100 small hydroelectric plants with a total capacity of approximately 180 MW.

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8. Relevant Links

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9. References

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10. Country Contacts

Contacts made in the preparation of this assessment are gratefully thanked for their contribution to this report. Please see webpage for contacts listing.

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