



British Council

Preparation of Model Solutions for Energy Utilization of Biomass

Energy Sector Review

Kyrgyzstan



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(National Contact Point)**

and



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List of abbreviations

CEE	Central and Eastern European countries
SEE	South East Europe
CHP	Combined Heat and Power Plant
DH	District Heat
DHW	Domestic Hot Water
EE	Energy Efficiency
EI	Energy Intensity
EU	European Union
EBRD	European Bank of Reconstruction and Development
GDP	Gross Domestic Product
GHG	Greenhouse Gases
Inc	Incorporated
M	Million
NG	Natural Gas
RES	Renewable energy sources
SHPP	Small Hydropower Plant
VA	Value Added
VAT	Value Added Tax

Units

GJ	Giga Joule
GW	Giga Watt
GWh	Giga Watt hour
KV	Kilo Volt
kWh	Kilo Watt hour
MJ	Mega Joule
M m ³	Million cubic meter
MW	Mega Watt
MW _{el}	Mega Watt (installed electric capacity)
MW _t	Mega Watt (installed heat capacity)
MWh	Mega Watt hour
PJ	Peta Joule
TJ	Terra Joule
TWh	Terra Watt hour
W	Watt
ToE	Tons of Oil Equivalent

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Executive summary

Under the former Soviet system, energy supply and demand patterns were established on a regional basis for Central Asia. Kazakhstan was responsible for the coal industry, Uzbekistan for natural gas, and Turkmenistan for oil. Though the Kyrgyz Republic has small deposits of all of these resources, due to its remote location these deposits had never been developed to the same extent as in other republics. The collapse of the Soviet Union forced the Kyrgyz Republic to import all of its demand for natural gas as well as oil products at much higher cost than under the previously subsidised prices. The country depends on foreign suppliers of fossil fuels (Russia and other Central Asian countries) for about 60 % of its primary energy demand. On the other hand Kyrgyzstan has overproduction of electricity due to significant hydro power potential and existing production capacities. That allows country to exports electricity to neighbour countries (China, Uzbekistan, Kazakhstan) and to Russia.

The severe economic downturn that has followed the country's independence has brought about a dramatic change in the pattern of energy consumption by sector and by products in the Kyrgyz Republic. During 1991-1994, the share of industry in total consumption declined from 42 % to 31 %, that of agriculture remained at about 13 %, and that of household increased from 27 % to 40 %. If there is counted also final heat consumption of public buildings then the sector of buildings exceeds 50 % of the total country final energy consumption.

Kyrgyzstan as one of the NIS' transition economy countries presents the typical decline of economy and energy consumption connected with the transition process. The energy decline is not only due to the decline of economic activity but also to industrial restructuring. The economic revival shown in the recent few years since 1999 is partly connected with an increase of economic activity, and a shift from energy intensive industry, (connected with the production of basic materials, i.e. machinery, heavy chemistry, etc.) to less energy intensive branches, producing goods and commodities according to domestic and international market demand.

Energy intensity against national product in Kyrgyzstan is about four (3.8) times the World average and almost five and half time the OECD average.

Most of the exports are agricultural and energy intensive mining products (gold, lead). Exports, employment, industrial and agriculture outputs, social stability and moderate poverty level are maintained by subsidized energy prices.

There is massive consumption of energy for space heating and domestic hot water that facilitates considerable seasonal differences in energy demand. Winter peaks are met with the limited capacity of the domestic electricity distribution network.

Energy economy of Kyrgyzstan is carbon intensive (three times the World average) and intensive in sulphur dioxide due to use of lignite coal.

Municipal and industrial wastes are not used as sources of energy.

Domestic biomass resources include mainly agricultural animal breeding biomass and straw. Forest biomass has limited potential due to the fact that only 4,32 % are forest cover areas in Kyrgyzstan. Forest biomass is not suitable from the point of view of seasonality and geographical dispersion: most of biomass is available in rarely populated areas with not developed transport infrastructure. Forest areas are obviously in protected natural resources or in high attitude above the sea. There is a small use of biomass for heat generation in the industry. Example of such utilization of biomass by-products is heat generation from wood waste in the wood processing enterprise in Kara-Kol city.

Existing lignite power plants can not use biomass for co-burning with lignite.

There is massive consumption of dried sheep manure for residential space heating in means of inefficient heating /cooking stoves that causes considerable indoor and outdoor pollution. Total consumption of such biomass is assessed of about 730,6 thousands cubic meters is largely unregistered in official statistics. There is a small use of biomass for heat generation in the industry. Example of such utilization of biomass by-products is heat generation from wood waste in the wood processing enterprise in Kara-Kol city.

The most promising uses of biomass are: improved residential biomass stoves, local small district heating served by biomass and bio-gas production in the Kyrgyzstan .

Biomass use for heat generation is of exceptional importance to improve energy supply in remote rural areas, provide employment opportunities and improve economics of agriculture and waste management activities as well as improve overall energy efficiency and reduce pollution.

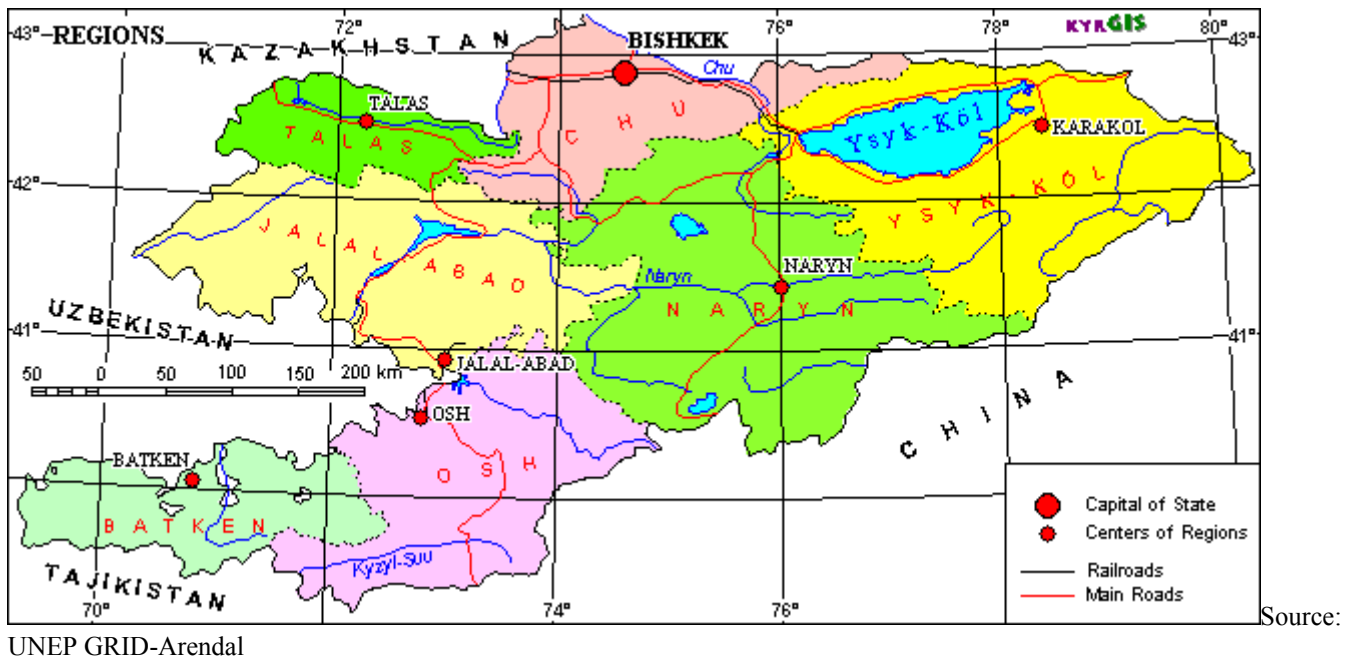
It is to be considered that massive utilization of biomass is precondition for poverty reduction and economic development of agricultural regions of Kyrgyzstan.

There are no national strategies for increase of biomass availability (support programmes, etc) and biomass use in energy production.

Introduction

The Republic of Kyrgyzstan has an area of about 198 500 km², and has a population of 5.07 million (2004). The capital city, Bishkek, is located in the north central part of the country, and has a population of about 800,000. Kyrgyzstan is bordered by Kazakhstan to the north, China to the east, China & Tajikistan to the south, and Tajikistan & Uzbekistan to the west. There are seven administrative divisions (called 'oblast') in Kyrgyzstan, plus the autonomous national capital city of Bishkek; Figure 1 shows a map of Kyrgyzstan's administrative regions. Much of Kyrgyzstan is mountainous, which has led it to be described as "the Switzerland of Asia." Kyrgyzstan's currency is the som, which has an exchange rate of about 40 som per U.S. dollar (as of August 2005).

Figure 1: Administrative Regions of Kyrgyzstan



Economy is predominantly agricultural. Cotton, tobacco, wool, and meat are the main agricultural products, although only tobacco and cotton are exported in any quantity. Industrial exports include gold, mercury, uranium, and electricity, small machinery, textiles, food processing, cement, shoes, sawn logs, refrigerators, furniture, electric motors, rare earth metals. Kyrgyzstan has been fairly progressive in carrying out market reforms, such as an improved regulatory system and land reform. Kyrgyzstan was the first CIS country to be accepted into the World Trade Organization. With fits and starts, inflation has been lowered to an estimated 7% in 2001 and to 2.1% in 2002. Much of the government's stock in enterprises has been sold. Drops in production had been severe after the break-up of the Soviet Union in December 1991, but by mid-1995 production began to recover and exports began to increase. Growth was held down to 2.1% in 1998 largely because of the spill over from Russia's economic difficulties, but moved ahead to 3.6% in 1999, 5% in 2000, and 5% again in 2001. Economy sectors contributes to the national GDP by: *agriculture: 35%, industry: 25%, services: 40%* (2002 est.). Last available economy indicators shows that GDP purchasing power parity is \$13.5 billion (2002), GDP purchasing power parity per capita - \$2,800 (2002).

Energy is one of the most socially and politically sensitive issues in Kyrgyzstan with significant impact on country economy.

Review of the Energy Industry

Under the former Soviet system, energy supply and demand patterns were established on a regional basis for Central Asia. Kazakhstan was responsible for the coal industry, Uzbekistan for natural gas, and Turkmenistan for oil. Though the Kyrgyz Republic has small deposits of all of these resources, due to its remote location these deposits had never been developed to the same extent as in other republics.

The collapse of the Soviet Union forced the Kyrgyz Republic to import all of its demand for natural gas as well as oil products at much higher cost than under the previously subsidised prices. The country depends on foreign suppliers of fossil fuels (Russia and other Central Asian countries) for about 60 % of its primary energy demand. Thus the question of security of energy supply and energy dependence has resolute political and economic priority. On the other hand Kyrgyzstan has overproduction of electricity due to significant hydro power potential and existing production capacities. That allows country to exports electricity to neighbour countries (China, Uzbekistan, Kazakhstan) but also to Russia. The export of electricity for 2004 exceeded 3 000 GWh what is the major export product of Kyrgyzstan.

Nevertheless there is significant overproduction of electricity; there are problems of electricity supply due to overloading and obsolete condition of distribution lines. Communities have significant difficulties with heat supply. Electricity can not be used widely for heating due to low capacity of electrical distribution lines. On the other hand there is not sufficient knowledge and experience how to use and manage existing local renewable heat sources and how to reduce heat losses. Even used (dry animal farming residuals) renewable sources are not used efficiently. There is almost no awareness on how to save energy and what technological solutions are available even among officers engaged on regional and municipal energy planning. That is why promotion activities could be welcome and positively received by general public and municipal authorities in particular.

Table 1: Structure of the primary energy production in 2002 (M TOE) in Kyrgyzstan

	2002
1 Primary energy production	1.204
Coal (including lignite)	0.171
Crude Oil	0.076
Natural Gas	0.025
Hydro potential	0.928
Other (Biomass, Geothermal, Solar, Wind)	0.004

Source: IEA Energy Statistics

Electricity production [8]: The Kyrgyz electricity system forms part of the central Asian electricity system that was developed in the Soviet times.

Upon independence Kyrgyzstan inherited the power stations and lines located on its territory, but still maintain close links with neighboring countries for operational purposes.

On 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%) were issued to the employees and sold via the mass privatisation program. Kyrgyzenergo has recently been unbundled into separate generation, transmission and distribution companies. There have been formed two joint stock companies: Electricity Plants JSC and National Electricity Networks JSC . The former covers major power production capacities of 6 large hydro power plants (Toktogul cascade, Uch-Kurgan, Tash-Kumyr, Shamaldy-Sai, At-Bashi) with total installed capacity of 2 910 MW and two thermal power plants in Bishkek (609 MW) and Osh (22 MW). Two additional large hydro power plants with total installed capacity of 2 160 MW are under construction (Kambarata 1 and 2).

On independence, the Kyrgyz Republic inherited also 8 SHPP. The last are owned and operated by a separate JSC Chakan GES. Hydro power plants form about 90% of the Kyrgyz Republic's generating capacity. This fragmentation of regional electricity and irrigation systems into a number of smaller systems caused problems between neighboring countries. As an independent country, the Kyrgyz Republic would now rather release water from Toktogul reservoir in winter to generate electricity so as to satisfy the high demand for electricity in these months, and store the water in Toktogul reservoir during the summer when demand for electricity is lower. This annual release pattern is almost the opposite of that required satisfying the irrigation needs of neighbouring countries. Recently there have been calls for the government to provide funds for the completion of the Kambarata 2 hydropower station. Kambarata 2 was started in the Soviet era but work stopped due to lack of funds after independence. Kambarata 2 is located upstream from Toktogul reservoir on the Naryn River. Kambarata 2 is a run of runner power station that will have an installed capacity of about 360 MW and produce about 1 000 GWh per annum.

National Electricity Networks JSC takes care for the trans-border and main lines with voltage 110 kV up to 500 kV. The local distribution of electricity to consumers is provided by the regional distribution companies: Severelectro Inc., responsible for the Bishkek and Talas oblasts (sold 43,04 % from all the electricity sold by the local distribution companies for 2002); Vostokelektro Inc., responsible for the Naryn and Issik Kul oblasts (sold 18,33 %, 2002); Oshelectro Inc., responsible for the Osh and Batken oblasts (sold 25,61 %, 2002); Dzalalabadelectro Inc., (sold 13,02 %, 2002).

Table 2: Structure of the primary energy imports in 2002 (M TOE) in Kyrgyzstan

	2002
2 Net Imports* of primary energy	1.343
Coal	0.348
Crude Oil and Petroleum products	0.335
Natural Gas	0.718
Electricity	-0.058

* Taking into account trade balance and stock changes of primary energy carriers (Imports-Export+Stock Changes)

Source: IEA Energy Statistics

Gas sector: The Kyrgyz Republic has few developed gas reserves and what little there are situated in the south of the country around Osh. The Kyrgyz Republic therefore relies on importing gas from neighboring countries, particularly Uzbekistan.

As reported by [8] there are three separate gas networks in the Kyrgyz Republic: Northern system, Osh, and Jalal-Abad. The Northern system, which is by far the largest, is linked to the main gas transmission pipeline from Uzbekistan to Almaty. The Northern gas network supplies gas to Bishkek and other towns in the Chui valley. In addition it supplies gas to Bishkek TPP. The other two systems are very small and are really extensions of the Uzbek gas network in the Fergana valley. The indigenous Kyrgyz gas is supplied into the Jalal-Abad and Osh networks.

JSC Kyrgyzgas, the State owned gas company, owns, operates and maintains the transmission and distribution networks on the Kyrgyz territory. It is also responsible for transmitting gas bound for Almaty through the Kyrgyz gas transmission system. Kyrgyzgas is split into a number of operating units, including transmission, a number of distribution enterprises based on geographical regions, LPG enterprises and various installation and service units. However, large customers and gas traders can pay Kyrgyzgas to transmit and distribute gas to end-users. There are plans to restructure Kyrgyzgas into separate transmission and distribution companies sometime in the future.

Coal sector [9]: Since 1992, when Kyrgyzstan consumed 2.73 million short tons (Mmst) of coal, the country's coal consumption has plummeted. In 1999, Kyrgyz coal consumption was 1.22 Mmst what is a 55% drop that would have been even more dramatic if consumption had not rebounded after it fell to just 0.82 Mmst in 1997. Kyrgyzstan's coal production has dropped even more precipitously since independence

and the end of Soviet subsidies to the Kyrgyz coal industry. From a 1992 level of 2.37 Mmst, Kyrgyz coal production declined to 0.46 Mmst in 1999, making Kyrgyzstan a net coal importer.

A 1999 report for Kyrgyzstan's Ministry of Foreign Trade and Industry suggested that the country could overcome its coal deficit by exploiting the Kara-Keche deposit, one of Kyrgyzstan's 70 coal deposits. The Kara-Keche deposit would yield high-quality coal.

There are 2 larger district heating companies in Kyrgyzstan in the cities of Bishkek and Osh as separate joint stock companies. There are also 4 other regional municipal district heating companies operating electricity, coal, heating oil fueled boiler plants.

The State Forest Service of the Kyrgyz Republic with an independent status was established by the Decree of the President of the Kyrgyz Republic No. 342 dated November 25, 2001 for the state management of forests, development of national strategy and policy on forestry, use and protection of the forest fund and reproduction of forests and flora. On January 1, 2003 the total area of the State Forest Fund amounted to 3321.5 th. hectares, including the forest covered area of 864.9 th. hectares, which is 4.32 % of the total area. The forest fund assigned for management of the State Forest Service amounts to 3275.7 th. hectares including the forest covered area of 834.7 th. hectares.

Energy Demand and Consumption

The severe economic downturn that has followed the country's independence has brought about a dramatic change in the pattern of energy consumption by sector and by products in the Kyrgyz Republic. During 1991-1994, the share of industry in total consumption declined from 42 % to 31 % that of agriculture remained at 13 %, and that of household increased from 27 % to 40 %. If there is counted also public buildings then the sector of buildings exceeds 50 % of the total country final energy consumption.

Table 3: Structure of the primary energy consumption in 2002 (M TOE) in Kyrgyzstan

	2002
3 Total consumption of the primary energy	2.536
Coal	0.519
Crude Oil and Petroleum Products	0.402
Natural Gas	0.748
Electricity	-0.058
Renewable sources (including Hydro)	0.932

Source: IEA Energy Statistics

Kyrgyzstan as one of the NIS' transition economy countries presents the typical decline of economy and energy consumption connected with the transition process. The energy decline is not only due to the decline of economic activity but also to industrial restructuring. The economic revival shown in the recent few years since 1999 is partly connected with an increase of economic activity, and a shift from energy intensive industry, (connected with the production of basic materials, i.e. machinery, heavy chemistry, etc.) to less energy intensive branches, producing goods and commodities according to domestic and international market demand.

Table 4: Structure of the Final energy Consumption in 2002 (M TOE) in Kyrgyzstan

	2002
4 Final Energy consumption	
All sectors	1.936
Industry	0.466
Transport	0.225
Residential, public and communal, agriculture	1.218

Source: IEA Energy Statistics

Table 5: Structure of the final energy consumption per fuels in 2002 (M TOE)		2002
5	All Fuels	1.936
	Solid fuels	0.363
	Liquid Fuels	0.393
	Gaseous Fuels	0.314
	Electricity	0.546
	District heat	0.310
	Combustibles, Renewables and Waste	0.004

Source: IEA Energy Statistics

Institutional Set Up

The supreme government body dealing with the issues of energy sector in Kyrgyz Republic is the “**Fuel and Energy department of The Prime-Minister Office**”. It is responsible within the government for draft of country energy concepts and strategies.

The Ministry of External Trade and Industry is responsible for the administration of the energy sector within the Kyrgyz government. Within the National Assembly “Zhogorku Kenesh” there is a “**Committee on Issues in Fuel and Energy**” responsible for legislative in field of energy.

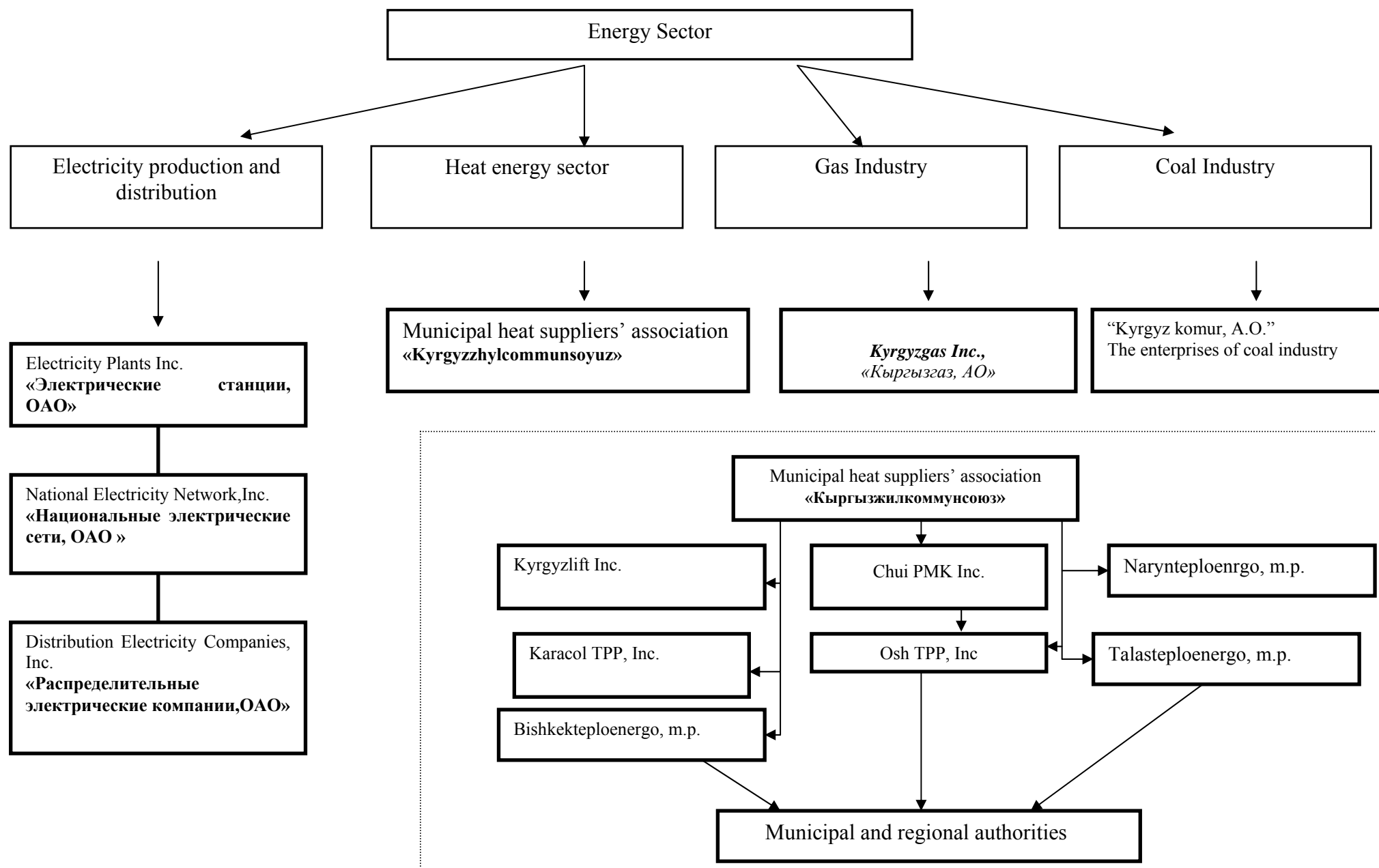
The **Ministry of Ecology and Emergency Situation of the Kyrgyz Republic** is responsible for the implementation of the state policy on environmental protection, including air quality.

The **National State Energy Agency** is the state authority responsible for the implementation of the state energy policy, preparation of the regulations, tariff issues, monitoring and inspection of the energy consumption. It also performs the function of a regulator of energy market.

The **Center of the Problems of Renewable Energy Application „KUN“** is a state supported program on research and development of renewable energy sources.

On Fig. 2. there is the energy sector organization structure with all the main energy enterprises.

Fig. 2. Energy sector institutional structure



Tab. 6. Ownership and responsibilities of the main Kyrgyz energy enterprises

<i>Enterprise</i>	Ownership	Responsibilities
1. Electricity		
Electricity Plants JSC.	<i>Joint Stock Company</i>	Electricity production; management of the power plants; export of electricity.
National Electricity Network JSC.	<i>Joint Stock Company</i>	Transit and distribution of electricity through the 50 kV – 500 kV network; Contract agreement with the eligible foreign and domestic clients; Maintenance and operation of high voltage line; Quality and safety of electricity distribution.
Distribution Electricity Companies JSC. (Severelectro; Vostokelektro; Oshelectro; Dzalalabadelectro)	<i>Joint Stock Company</i>	Distribution of electricity to all the consumers; Operation and maintenance of regional distribution lines up to 50 kV.
2. Heat energy sector		
Municipal heat suppliers' association «Кыргызжилкоммусоюз»	<i>Joint Stock Company</i>	Municipal heat supply for residential and tertiary sectors; Maintenance and service of district heating lines, and municipal heat sources;
3. Gas industry		
Kyrgyzgas	<i>Joint Stock Company</i>	Extraction of natural gas; Transborder transit of gas; Gas distribution and supply to industrial, municipal and residential consumers; Maintenance and service of gas pipe lines.
4. Coal industry		
Kyrgyzkomur	<i>Joint Stock Company</i>	Extraction of coal; Export and distribution of coal; Coal distribution and supply to industrial, municipal and residential consumers;

Environmental Impact of the Energy Cycle

Major Environmental Concerns are water pollution; many people get their water directly from contaminated surface water resources; as a result, water-borne diseases are prevalent; increasing soil salinity from faulty irrigation practices.

Energy sector of Kyrgyzstan generates about 5 million tons of carbon dioxide and over 31 000 tons of sulphur dioxide per year. Taking into consideration relative lack of wind and location of major energy facilities, the environmental impacts of these emissions are focused to major cities in the country: Bishkek and Osh.

Some smaller municipalities (Shopokov, Chui valley) are exposed also to pollution by particles from burning solid fuels in inefficient stoves or coal burning industries throughout the winter. Municipalities where density of households using solid fuels as a main source of space heating per populated area is such that outdoor pollution has to be seriously considered.

Outdoor pollution by burning products correspond with indoor pollution in many poor households that predominantly use solid fuels for space heating and cooking and whose main income is from agriculture. These people are affected both by declining agriculture income, diminished yields and health consequences of environmental pollution as well as lack of employment opportunities in agriculture and forestry. Brief assessment shows that currently about one half of population is affected that way.

Energy Prices and Tariffs

Energy prices in Kyrgyzstan are under tight Government control. The State Energy Agency calculates and issues all the tariffs of electricity, natural gas and district heat. The Kyrgyz Government approves these tariffs and sets the prices of oil products. Import of oil products is subject of quantitative restrictions by the Government. Import permissions are given to the companies selected by the Government. Market is served by both processing of crude oil in domestic refineries and imports from Kazakhstan.

All prices are fixed in local currency – Som that is exposed to annual inflation of 8 to 10 % so the prices could oscillate in real values.

Availability of Biomass Resources

The State Forest Service Report for 2003 describes forest resources as follows: “Forests cover 864 900 hectares, or 4.32 percent of the total area of Kyrgyzstan”. There is counted also the world unique forest of nut-tree on the area of 16.3 hectares. The total area of forest-covered area in 1930, when industrialization in Kyrgyzstan started, has been 6 % of the total area. That is considered to be the natural level of forestation of Kyrgyzstan. In the period 1930 to 1966 the forest covered area decreased by 574.2 th. hectares (3.09 % of the total area) due to degradation of forest resulting from clear cutting. In the period

1966 to 2003 the forest covered area increased by 245.1 th. hectares resulting from termination of clear cuttings, promotion of the natural regeneration and transfer of forest cultures into the forest-covered areas. In 2004, the forest cultures were planted on the total area of 3146.5 th. hectares, while the anti-erosion plantations were installed on the area of 99 hectares. The majority of forests are in a high-altitude interval from 1300 up to 2400 m above a sea level.

The current level of forestation represent about 70 % of optimal forest cover. The standing volume is about 83 030 400 cubic meters. The average standing volume is 96 cubic metres per hectare. The average annual increment is 2.4 cubic metres per hectare and total annual increment 2.08 million cubic meters.

Characteristic kinds for the northern Kyrgyzstan are a fir, poplar, willow, and other. In the southern Kyrgyzstan with drier territories, protected from northern winds, nut, maple, apple forests, almond trees grow. The unique relict nut forests (16.3 ha) have not equal in the world on their area, compactness, and genetic variety of kinds and forms.

The State owns 96.5 % (834.7 th. hectares) of the forests. The remaining 3.5 % is in private ownership.

Today, despite some increase of the areas covered with forest, their quality leaves to wish best. There are several reasons for this:

- a process of growing old of forests outstrips a process of their restoration (old forests occupy 49.9%, or 350.3 thousand ha from general stock) that results in loss of the basic protective functions and strengthened development of the centres of a defeat by vermin and illnesses;
- despite prohibition of industrial felling of forest, 34.9 thousand cu m of wood was felled only in 1994 as sanitary felling. Not smaller amount of wood was felled by population on fuel and construction;
- a cattle herded in forest leads to degradation of all kinds of forest kinds. The erosion parameters reach 10-14 tons on hectare in a year.

Planting material of wood kinds in amount 20 million pieces per year should provide a gain of the wood areas on 10-15 thousand ha. However, infringement of technology of growing, damage by cattle and other factors of anthropogenic influence result only in their insignificant restoration.

Important from point of view of energy use is not the forest biomass but the agricultural biomass. As reported by the EBRD (2002): “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 thousands hectares of irrigated lands giving 90% of plant growing products. Pastures that determined the main branch of agriculture – livestock breeding, occupy more than 50% of agricultural lands. The livestock breeding waste, which could be used after processing in biogas plants, constitutes 2500 thousand ton per year.”

Table 7: Agriculture biomass available for use as a fuel.

Biomass resource type	Total production	Production density
Primary crop production, tonne	(avg. 1999-2001, tonne)	(tonne /1000 Ha)
Total primary crops	8,322,126	434
Top 10 primary crops		
Mixed Grasses, Legumes	3,066,667	160
Wheat	1,154,405	60
Potatoes	1,019,732	53
Maize for Forage & Silage	622,667	32
Sugar Beets	448,490	23
Forage Products (misc)	376,667	20
Maize	281,806	15
Barley	203,353	11
Onions, Dry	151,005	8
Tomatoes	147,999	8
Animal units, number	(number)	(number / 1000 Ha)
Cattle	921,418	48
Poultry	2,854,000	149
Pigs	105,153	5
Horses, camels and yaks	360,000	18
Sheeps and goats	3,800,000	170

Source: FAO Report 2002. The First National Communication on Climate Change, UNFCCC

Agricultural biomass could be used mostly by biogas plants in the larger farms on Chui and Fergana valleys and northern Issik-Kul region or by improved household boilers on burning dried animal residues in all the small farms all over Kyrgyzstan. Brief assessment shows on potential for processing in biogas plants 600 thousands ton of livestock breeding waste with production annually of 300 million m3 of biogas and 600 ton of liquid organic fertilizers that should provide the rural population with fuel. That amount of biogas has an energy equivalent of about 6 690 TJ. Another 168 800 tons of dry sheep manure could be used as fuel for food preparation and space heating in rural areas. That has an energy equivalent of 1426 TJ.

That way all of arable lands in Republic should be provided the organic fertilizers – ecologically clean fertilizers, being free of nitrates and don't create them. About 90 % of rural population should be provided with fuel for preparing food and 60% of families - for heating in wintertime.

A common device for using fuel biomass in households throughout the country is very light cooking stove. The stove achieves energy efficiency of only 20-23%, and has average age of 18 years (UNDP, 2004) while its use for space heating, domestic hot water and cooking is common between households in Kyrgyzstan. More than 70 % of households own at least one of these stoves that also include some households connected to district heating or natural gas networks who keep the stove for energy security.

At the given level of national product and organized collection / disposal Kyrgyzstan produces about 300 million tons of municipal and industrial waste that could be used for

energy purposes. Separation and gasification of organic component could be considered as a suitable technology for energy use of these renewable resources.

At this point of time municipal waste management is organized as simple collection and disposal of waste to local land-fields that are more or less suitable for purpose. However, during several years of neglect, most land-fields in the country are used beyond their designated life. There are neither sewage water treatment plants nor use of biogas byproducts.

Taking into account official figures and restrictive analyses of economical availability (transport, quality, other uses) the following estimation of immediate energy potential of biomass in Kyrgyzstan could be made:

Table 8: Immediately useable annual biomass energy potential in Kyrgyzstan
(Estimation)

	Forests and waste from wood processing industry	Agriculture biomass	Total
Energy Potential (TJ)	2292	9732	12 024
Energy Potential (ToE)	54 689	232 212	286 901

Source: CEF UNISON, 2005

Figures above represent calculation of technically available biomass potential. Anyway that potential highly exceeds demand of the household sector even if consider demographic trends and higher comfort of accommodation. That means biomass including communal waste incineration, agricultural and to smaller extend forest biomass could cover all the heat demand of the rural households. Those way rural communities could shift from partly electrical heating to complete biomass heating. On the other hand technological and market barriers reduce available potential to the level of current use of biomass of 1 676 TJ. That is why national authorities may focus on energy policy supporting penetration of biomass.

Priorities to enhance the use of biomass energy

A national strategy for the use of biomass for energy purposes should be prepared.

Within such development framework following projects could be considered:

1. Replacement of light cooking stoves as a principal biomass burning devices in poor households with down-burning and / or masonry stoves for space heating in order to decrease fuel wood consumption, improve living standards and relax pressures on local fuel wood prices.
2. Introduction of efficient biomass based central heating systems to public buildings in remote areas (switch from electrical and coal boilers to biomass one if the last is locally available).

3. Introduce standardized gasification of municipal waste as a base load cogeneration technology to facilitate distributed electricity generation and support existing district heating systems in Kyrgyzstan ie. Tourist resorts heating needs along Issik-Kul coast.
4. Consider co firing of biomass with lignite in major existing thermal power plants.
5. Promote re forestation and agricultural productivity.
6. To launch extensive information campaign on technologies available on the market for use of biomass;
7. To establish information centers within existing structures of State Energy Agency, where interested individuals and organizations could get sufficient information about the use of biomass;
8. To support pilot and demonstration projects in all the oblast centers of Kyrgyzstan;

Conclusions

Biomass resources are to be considered as important national energy resource in the Kyrgyzstan. They could provide significant contribution to reliability of energy supply in remote rural areas and address poverty. At current level of economic development these resources are to be considered indispensable to foster economic growth, poverty reduction and use of wasted economic resources in infrastructure, agriculture, industry and tourism as well as to facilitate new employment. Utilization of biomass potential will result in reduction of commercial loses of electrical distribution, secure and sustainable energy supply of remote communities and increase export of electricity what will improve national trade balance.

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6. Energy certification of buildings in Kyrgyz Republic, Progress Report No. 1. Civic Environmental Foundation UNISON and Kyrgyz State University of Construction, Transportation and Agriculture, 2005
7. Promotion development of energy service companies (ESCO) in Kyrgyz Republic. Energy Consulting and Civic Environmental Foundation UNISON, Progress Report No. 1. 2004
8. Kyrgyz tariff policy project partnered by DFID and IPA, www.kyrgyztariff.org
9. NIGC - Country Analysis Briefs Asia Kyrgyzstan, www.eia.doe.org
10. CIA World Fact Book, Kyrgyzstan. 2002, 2003.
11. European Bank for Reconstruction and Development, “Renewable Energy Resource Assessment /Renewable Energy country profile: Kyrgyzstan”, 2002.

Annex 1. Selected legislation applicable in the Kyrgyzstan

Energy sector legislation

- The Energy Act, No. 56, adopted by the National Assembly on 17.10.1996;
- The Electricity Energy Act, No. 153, adopted by the National Assembly on 23.01.1997;
- The Act on Oil and Gas, No. 77, adopted by the National Assembly on 8. 06. 1998;
- Energy Savings Law of the Kyrgyz Republic approved by Jogorku Kenesh, June 12, 1998;
- The Regulation on State Energy Agency, No. 198, adopted by the Government on 26. 04. 2001;
- The Regulation on electricity tariffs, No. 191/2002, issued by The Executive Committee of The Kyrgyz Republic on 25.11.2002;
- The Regulation on use of heat energy, issued by The State Energy Agency on 26.01.1999;
- The Regulation on use of electricity energy No. 11-P, issued by The State Energy Agency on 20.08.1989;
- The Regulation on Development Program in Oil and Gas Industries, No. 763, adopted by the Government on 5. 12. 2001;
- The President's Decree on Increase of gas and oil production in Kyrgyz Republic, No. 236, issued on 31. 07. 2001;
- Directive on electricity and heat energy bills and penalties in case of payment delay, No. 483, issued on July 1999 by the Government of The Kyrgyz Republic;
- Directive on communal services, issued on 11.12.2001 by the Government of The Kyrgyz Republic;
- The Administration codex, adopted by The National Assembly on 07. 02. 2002;
- The Act on foreign investments No. 66, adopted by the National Assembly on 22.08.2001 regulation foreign investments including the field of energy;
- Law of the Kyrgyz Republic on Licensing, President of the Kyrgyz Republic on March 3, 1997
- Regulations On Licensing Energy Enterprises In The Kyrgyz Republic, approved by the GOK Resolution of January 1998;
- Kyrgyz Republic Government Decree #187, On Regulation of the Electricity Market in the Kyrgyz Republic, April 6, 2000;
- The Draft National Energy Program of The Kyrgyz Republic up to 2005, No.353 Resolution of The Government of The Kyrgyz Republic on July 16, 2001;

Environmental legal framework:

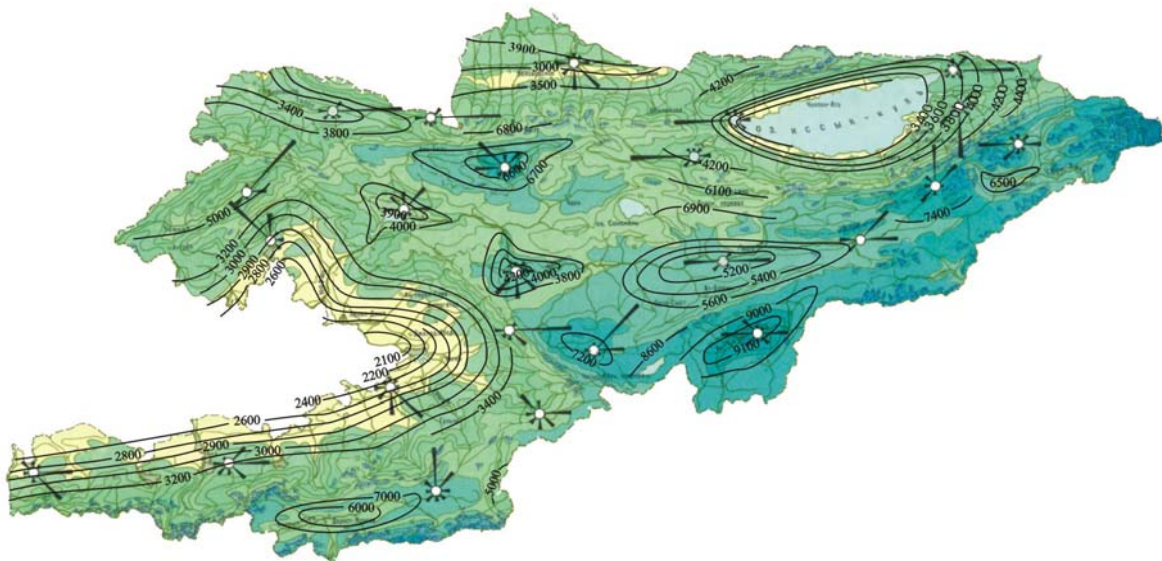
- the Act "On Nature Protection" (alterations are introduced); № 53 16.06.1999;
- the Act "On the Protection of Atmospheric Air"; №51 12.06.1999;
- the Act "On Water"; №1422-XII 14.01.1994;
- the Act "On Environmental Review"; №54 16.06.1999;
- the Act "On the Radiation Safety of the Population". №58 17.06.1999.

Annex 2: Maps

Map of Kyrgyz gas transit network



Climatic map of Kyrgyz Republic with curves of degree-days



Annex 3: Selected energy indicators

IEA Energy Indicators of selected countries compared with the energy indicators of the World and OECD countries

Country	Population	GDP	Energy Production	Net Imports	TPES	Electricity Consumption	CO2 Emissions	TPES / Pop	TPES / GDP	Elec.Cons./ Population	CO2/ TPES	CO2/ Pop	CO2 / GDP
	Million	Billion 95 USD	Mtoe	Mtoe	Mtoe	TWh	Mt	Toe / capita	Toe/ 000 95 USD	KWh / capita	T CO2 / toe	T CO2 / capita	Kg CO2 / 95 USD
World	6195,66	35317,65	10305,74	-	10230,67	14701,24	24101,83	1,65	0,29	2 373,00	2,32	3,89	0,68
OECD	1145,06	28435,02	3847,06	1563,62	5345,72	9212,82	12554,03	4,67	0,19	8 046,00	2,35	10,96	0,44
SEE	54,67	106,74	59,14	31,57	89,19	139,31	228,27	1,63	0,84	2 548,00	2,56	4,18	2,14
Bosnia and Herzegovina	4,11	6,89	3,32	1,18	4,32	7,86	15,22	1,05	0,63	1 912,00	3,52	3,70	2,21
Kyrgyzstan	5,07	2,29	1,2	1,3	2,54	6,82	4,90	0,51	1,11	1362,00	1,93	0,98	2,14
Serbia and Montenegro	10,63	16,87	10,88	5,29	16,17	32,18	48,88	1,52	0,96	3 027,00	3,02	4,60	2,90

TPES= Total primary Energy Supply